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China's National Innovation System

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Synonyms

National system of innovation

Introduction

Innovation capacity is one of the fundamental sources of nation's wealth (Antonelli, 2006). China has made great progress in all fields since the reform and opening-up, especially the accession to the World Trade Organization (WTO). The economy has developed rapidly and GDP per capita increased to more than 5,000 US dollars. The scientific and technological innovation capacity is ranked 30th in the world. Science, technology (briefly, S&T), and innovation now play an increasingly important role in economic and social development. Their supporting and leading roles in sustainable economic and social development are becoming increasingly essential. China has set forward the ambitious objective to be an innovative country in 2020. China's national innovation system still has many deficiencies and problems to overcome, however, before reaching that goal.

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China is the largest developing country in terms of economy and also the largest country with regard to S&T and innovation. China's future development will have an important influence on the world. It is necessary to study the characteristics of China's national innovation system, especially the successes, deficiencies, and problems, and appropriate recommendations are required for its future development. Following is a review of China's national innovation system from participants and sub-systems in a Quintuple Helix model theory, an analysis of problems and challenges faced by China's national innovation system, and some recommendations for reaching the 2020 goal.

Definition of the National Innovation System

Friedrich List (1841) first introduced the concept of a national system and analyzed how it influenced one country's economic development and technological policies. Joseph Schumpeter (1911) first put forward the concept of innovation and defined it to be a procedure introducing a new production function. Christopher Freeman developed the concept of a national innovation system to explain Japan's economic success (Lundvall 2010; Liu 2009). Many researchers have developed the concept of a national innovation system. Lundvall (1992), a well-known researcher of the national innovation system, defined it as the elements and relationships that interact in the production, diffusion, and use of new and economically useful knowledge and that are either located within or rooted inside the borders of a nation state. Nelson (1993) saw it as a set of institutions whose interactions determine the innovative performance of national firms. Patel and Pavitt (1994) defined it as the national institutions, their incentive structures, and their competencies, which determine the rate and direction of technological learning in a country. Freeman (1995) regarded a national innovation system as the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify, and diffuse new technologies. Metcalfe (1995) defined it as a system of interconnected institutions to create, store, and transfer the knowledge, skills, and artifacts that define new technologies.

The national innovation system is considered a comprehensive analysis framework. Edquist (2005) criticized the notion as diffuse and lacking theoretical foundation, but Lundvall et al. (2009) stressed its theoretical elements to evolutionary economics. From the above concepts, many researchers have studied the national innovation system in terms of learning by interacting (Lundvall 1992), technology learning (Patel and Pavitt 1998), innovation policies (Caracostas 2008), and policy instruments (Metcalfe 2008). Although it is sometimes vague in theory, many recognize that the national innovation system has become an important and useful tool for analysis of a country's innovation and development.

Based on models of knowledge production and application and knowledge-based problem-solving, Carayannis and Campbell (2006) put forward the concept and framework of knowledge production system "Mode 3," which is an innovation ecosystem. Mode 3 includes people, culture, and technology and consists of innovation networks and knowledge clusters focusing on and leveraging higher-order learning processes and dynamics that allow for both top-down and bottom-up systems of governments, universities, industry, civil society, and grassroots organizations to interact toward a more intelligent, effective, and efficient synthesis. Etzkowitz and Leydesdorff (2000) put forward the Triple Helix model of the national innovation system, which includes academia/universities, industry, and state/government. Based on it, Carayannis and Campbell (2009) developed a Quadruple Helix model, the fourth helix of which is media-based and culture-based public and the civil society. Furthermore, Carayannis and Campbell (2010) also developed the Quintuple Helix model, bringing in the fifth helix of the natural environments of society, and pointed out that the Quintuple Helix model is adequate for creating and supporting mid- and long-term sustainable development of society.

Some researchers have studied China's national innovation system (Liu and White 2001; OECD 2008). Xielin Liu and White (2001) studied the structure and dynamic of China's national innovation system from R&D, implementation, end-use, education and linkage. Shulin Gu and Lundvall (2006) studied the current characteristics of China's production and innovation system, especially how they have been shaped by history and the major challenges they face in the future. Rowen (2008) found that China's national innovation system originated from an underdeveloped top-down, centralized, and state-run system. Xielin Liu (2001) highlighted the role of government in China's national innovation system transition, noting that China's innovation capability has not increased quickly. Boeing and Sandner (2011) pointed out that China's national innovation system placed the creation of innovation at a lower value, with public research institutes playing a minor role and universities playing a central role; the universities' strong collaborations with the business sector resulted in high volumes of patent applications. Kroll, Comle, and Schuller (2010) noted that the outstanding features of China's innovation system were the continuous importance of public research, the weak position of domestic enterprises in the innovation system, and little investment in research for new products and processes. Chen and Guan (2011) pointed out that the most important problem with China's national innovation system was the weak linkage among the actors. OECD (2008) suggested that China should adopt more bottom-up decision making and help the private sector to play a more important role.

History and Development of China's National Innovation System

After the foundation of the new China, following the development mode of the former Soviet Union, China began to establish many kinds of scientific research institutions, including the Chinese academy of sciences, industrial institutes, and local institutes, and it issued the 12-year national development plan for S&T. The period from 1950 to 1977 was the formation phase of the national innovation system. In 1978, China adopted policies of reform and opening-up and began to explode the development model of the national innovation system. China set forward a series of national plans of S&T, such as the High-tech Research and Development Program (863), the Torch Program, the Spark Program, the Major Achievement Promote Program, the National Natural Science Foundation, and the Climbing Program. China also reformed the funding system, developed technology markets, promoted the commercialization of S&T achievements, and issued many innovation policies. In 1995, China began to deepen enterprise-centric reform. The national technology system of innovation developed quickly. China reformed the enterprise system and the property rights system and emphasized the innovation functions of enterprises. In 1996, China issued the Strategy of Invigorating the Country through S&T and Education. The Department of S&T began to formulate S&T programs jointly with the Department of Economy. The National Engineering Centers, including the National Engineering Research Centers and National Engineering Technology Research Centers, and the Productivity Promotion Centers were established. The Technological Innovation Project was begun to enhance the innovation capacity of enterprises. During that time, many policies were issued to accelerate the commercialization of S&T achievements.

The year 1998 was the formal starting point for China to construct the national innovation system. In December 1997, the Chinese Academy of Sciences put forward a report which name was "welcoming the era of knowledge economy and constructing the national innovation system" to the central government of China. On June 9, 1998, the central government approved the report and required the Chinese Academy of Sciences to implement the knowledge innovation project as a pilot unit for construction of the national innovation system. In 2006, China issued the National Medium and Long Term Plan for Science and Technology Development (2006–2020) and put forward the guiding principles for S&T

undertakings over the next 15 years, which were "indigenous innovation (should be self-dominant innovation), leapfrogging in priority fields, enabling development, and leading the future," and the general objectives in 2020, which were to "noticeably enhance self-dominant innovation capability" and "join the ranks of innovative countries." In this period, China's main tasks are to construct a technological innovation system such that enterprises could be the main player and industries, universities, and institutes could be linked tightly, to construct a knowledge innovation system wherein scientific research and higher education could be combined together, to construct a national defense science and technology innovation system where the military and civilian sectors could combine their work, to construct a regional innovation systems with respective characteristics and advantages, and to construct an innovation intermediary service system with features of socialization and networking. After more than 10 years of development and especially the entrance of the WTO, China's national innovation system developed quickly and became primarily a system with characteristics and five sub-systems, which are the knowledge innovation system, technology innovation system, regional innovation system, national defense innovation system, and innovation intermediate service systems.

Governmental Institutions and Functions for Innovation

Carayannis and Campbell's Quintuple Helix model is a useful tool for analysis of China's national innovation system. The Quadruple Helix model added the fourth helix to the Triple Helix model, which is the media-based and culture-based public as well as civil society; the Quintuple Helix model added the fifth helix, which is the context of environment for society.

In the Quadruple Helix model, the fourth helix is very important, but this helix is not in the same dimension with the other three helices, and this helix ignored another important element, the innovation policy. The innovation policy has been become an essential tool for promoting development of the national innovation system. In recent years, many countries, such as the United States, members of the EU, Japan, South Korea, China, and England, have issued innovation strategies or innovation policies in response to the financial crisis and to revive their economy. This entry will study China's national innovation system, mainly following Carayannis and Campbell's Quadruple Helix model and the Quintuple Helix model and also considering the element of innovation policy.

The Governmental Organizations of China's National Innovation System

At present, China has adopted a unified and separated administration regime of S&T and innovation. Under the leadership of the Leader Group of S&T and Education of the State Council, the National Development and Reform Commission is responsible for the macro plan and management for all S&T and innovation undertakings, especially planning and budgeting for S&T programs and projects and implementation of high-tech industrialization projects, S&T infrastructure projects, basic operation expenses of research institutes, the knowledge innovation project, and so on. The Ministry of Finance handles budgeting for all S&T plans, programs, and projects and the accounting of the implementation. The Ministry of S&T focused on execution of S&T programs such as the Basic Research Program (973), the High-tech Research and Development Program (863), and the S&T Support Program and Programs supporting small and medium enterprises, agriculture, and industrialization according the budgets. The National Natural Science Foundation committee supports science foundation projects via a new mechanism, in particular, expert peer review. The Ministry of Education is primarily in charge of cultivation of human resources and also supports cooperation between universities and business. The Ministry of Industry and Information and the Ministry of Agriculture are mainly in charge of innovation and development of industry and agriculture. The Ministry of Commerce is committed to establishing a sound, unified, open, competitive, and orderly market system to promote fair foreign and domestic trade favoring innovation. It also strives to improve the structure and competitiveness of China's export products through a program of S&T that promotes trade with the Ministry of S&T. The State Administration of Industry and Commerce regulates the market and enforces anti-monopoly policies to create an innovative environment. The State Intellectual Property Office, the Trademark Office of the State Administration of Industry and Commerce, the Plant Variety Office of Ministry of Agriculture and that of the State Forestry Office provide examination services for intellectual property rights such as patents, utility models, industrial design, topographies of integrated circuits, trademarks, and plant varieties to protect and encourage innovation.

Development of China's National Innovation System

The knowledge innovation system of China has made great progress in the twenty-first century. The Chinese Academy of Sciences now is the highest national academic institution for natural science, the highest advisory body for science and technology, and the R&D center for natural sciences and high-tech. The Chinese Academy of Engineering is the highest honor and advisory academic institution in the engineering and technology field. In 2010, the Chinese Academy of Sciences satisfactorily completed two pilot tasks. A number of major innovative achievements have been achieved in strategic high-tech, major public-welfare innovation, and important basic and cutting-edge research fields such as Godson processors, the Shuguang high-performance computer, manned spaceflight, coal-to-oil technology, and so on, effectively lifting the support capability of China's S&T and innovation to economic and social development, and its international competitiveness and influence. In 2011, the Chinese Academy of Sciences began implementing the phase 3 knowledge innovation engineering. The goal is to lead and drive China's national system of innovation into a new stage, encouraging self-dominant innovation, original scientific innovation, and systematic integration of key technologies; upgrading the ability to solve key S&T problems for current and future economic and social development; heightening the ability to provide the knowledge and technical base for implementing the "scientific development concept"; and raising the ability to safeguard national security and respond to the new world revolution in military affairs. Universities are gradually becoming an important player in the implementation of the knowledge innovation engineering project. In 1995, China began to construct 100 key universities for the twenty-first century through the "211 Project." Currently, the number of the key universities has reached 112, and the amount of investment is near 2.8 billion US dollars. In 1998, China began implementing another project to promote Peking University, Tsinghua University, and others to be world-class and high-level universities, and the number of the universities in the "985 Project" has reached 39.

Enterprises have become the main player in the technology innovation system. In 2007, R&D personnel in enterprise accounted for 68.36 % of the entire country's R&D personnel. The R&D fund expenditure from enterprise accounted for 72.28 % of the whole country's R&D fund expenditure. The proportion of the number of enterprises that had science and technology agencies to the total number increased to 58.87 %. The total number of state-certified enterprise technology centers increased to 575, and that of the provincial-certified enterprise technology centers increased to 4,886. The number of service invention patent applications from domestic enterprise accounted for 69.28 % of the total service invention patent applications. The contract amount from enterprises as the seller accounted for 86 % of the national contract amount of the technology market traded.

The regional innovation systems' characteristics and advantages have formed gradually. On the basis of regional development plans of the Yangtze River Delta and Pearl River Delta, China has issued nearly 20 regional development plans to dates, and each plan has emphasized the innovation capacity construction and development of the regional innovation system. China has established 54 national high-tech industrial development zones and many local high-tech industrial zones. Beginning in 2010, the Zhongguancun (Beijing), Zhangjiang (Shanghai), and East Lake (Wuhan) high-tech zones began to transformed into national self-dominant innovation demonstration zones. These three zones and the Hefei, Wuhu, and Bengbu self-dominant innovation comprehensive reform pilot areas were permitted to adopt new policies, such as permitting the service inventor to own a percentage of stock outright and the net profit dividend right of the company implementing the service invention. On January 6, 2010, the National Development and Reform Commission approved 16 cities, Dalian, Qingdao, Xiamen, Shenyang, Xi'an, Guangzhou, Chengdu, Nanjing, Hangzhou, Jinan, Hefei, Zhengzhou, Changsha, Suzhou, Wuxi, and Yantai, as National Innovative Cities. And on January 10, 2010, the Ministry of Science and Technology named Beijing (Haidian District), Tianjin (Binhai New Area), Tangshan, Baotou, Harbin, Shanghai (Yangpu District), Nanjing, Ningbo, Jiaxing, Hefei, Xiamen, Jinan, Luoyang, Wuhan, Changsha, Guangzhou, Chongqing (Shapingba District), Chengdu, Xi'an, and Lanzhou as National Innovative Cities (districts). Both ministries support the regional innovation system by investment in innovation facilities, R&D projects, industrial innovation, and so on.

The civil-military integrated national defense innovation system has made progress. Over nearly 30 years of construction after the foundation, China has established a relatively complete national defense industry system. In 1978, with the reform and opening-up, and later with the national S&T system reform, China actively introduced market mechanisms and promoted the military and civilian cooperation. A large number of national defense enterprises began to produce civil products or were changed to entirely civil enterprises. In 1992, China implemented the strategy of "combining military and civilian, and integrating the armed forces in civilian" efforts and promoted the construction of the national defense innovation system by comprehensive civil-military integration; the scientific and technological strength of the national defense system has thus been lifted significantly. In 1998, the former National Defense Science, Technology and Industry Committee was incorporated into The Ministry of Industry and Information and became the National Defense industrial Development Bureau of Science and Technology, which strongly supports the construction and development of China's national innovation system.

The innovation intermediary service system also developed rapidly. Currently, there are four main kinds of organizations in China's innovation intermediary service system. The first includes productivity promoting centers, engineering and technology research centers, entrepreneurial service centers, including incubators and accelerators, and R&D and design centers. They mainly provide services for production. The second includes information research centers, technology consulting companies, technology transfer centers, technological training centers, and small and medium enterprises (SME) services centers. They provide services for the whole society. The third is service entities, including high-tech zones, science and technology parks, pioneer parks, and economic and technological development zones. The forth provides market services, including technology markets, talent markets, and so on. China has made great efforts to improve the innovation service environment in the last 30 years. All 54 national-level high-tech industrial zones have their own incubators or accelerators. China has established six national technology transfer centers, including those in the Chinese Academy of Sciences, Tsinghua University, and Peking University. The university parks, such as those at Tsinghua University and Peking University, are called National University Science Parks and the number of them reaches to more than 80. In 2010, along with the development of property exchanges of Guangzhou, Shanghai, and Beijing, China established the China Technology Exchange in Beijing and the Tianjin Intellectual Property Right Trading Center. The number of state patent exhibition and trade centers reached 42, the number of patent agencies was more than 1,000, and the number of the practicing patent attorneys was 7,200. The number of entrepreneurial investment enterprises in 2007 reached 464, the investment volume in 2008 was 22.7 billion US dollars, and the cumulative number of investment projects was 6,796; the cumulative investment volume was 12 billion US dollars.

China's Innovation Policies

In 2006, in order to put the National Medium and Long Term Plan guideline for Science and Technology Development into practice, China issued 60 supplemental policies from 10 parts. The supplemental policies were warmly welcomed by enterprises and the whole society. The policies of investment in science and technology mainly include six aspects. The first is to substantially increase investment volume in S&T, both of public and private. The second is to ensure steady growth of the public financial investment in S&T. The annual growth rate of S&T investment volume shall not be less than that of the government financial expenditure. The third is to earnestly safeguard the smooth implementation of 16 Mega S&T Projects. The forth is to optimize the structure of the financial S&T investment. The fifth is to play a leading role in providing financial funds to encourage enterprise's self-dominant innovation. The sixth is to optimize the S&T investment management mechanism.

New tax laws and policies cancel the threshold of annual 10 % growth rate of research and development expenses and allow enterprises to deduct their actual research and development expenses and amortize the intangible assets in corporate taxable income at 150 %. The actual research and development expenses can be carried forward and deducted in the following 5 years if they are shortfall deductable. The employee education and training funds extracted in less than 2.5 % of the total taxable wages can be deducted before the corporate income taxation. Enterprises are allowed to accelerate the depreciation of the instruments and equipment used in R&D activities. High-tech enterprises' corporate income taxation rate was reduced to 15 % from 25 % since they had a profitable year within 2 years after certification by the government.

Investment and financing policies regulate and strengthen the financial support for self-dominant innovation, to lead commercial financial support for self-dominant innovation, to improve the financial services for SMEs' innovation, to accelerate the development of venture capital, to establish a multi-level capital market supportting for self-dominant innovation, and to improve the insurance services and foreign exchange management policies for high-tech enterprises.

Government procurement policies require to establish a self-dominant innovation product certification system and a certified standard and evaluation system, to improve government procurement assessment method, to give preferential treatment to the products of self-dominant innovation, to establish the first government purchase and ordering system to encourage innovation, to establish a certification system for domestic goods and an audit system to purchase foreign products, and to play the role in national defense procurement to support self-dominant innovation. China issued the concept and standard of the self-dominant innovation product in 2010 that it shall has intellectual property right (actually is patent) or using right licensed from abroad in China, and has trademark right registered or using right licensed from abroad in China according to law. But China abandoned the government policies on self-dominant innovation product in 2011 under international pressure.

In addition, China issued other policies to strengthen the import, digestion, absorption and re-innovation, creation and protection of intellectual property right (IPR), cultivating and utilizing innovative talents, strengthening education and science popularization, and promoting construction of S&T innovation bases and infrastructures.

In order to implement the 60 supplemental policies, the relevant departments of China's central government also formulated and issued 78 policy-implementing rules beginning in 2006. The relationship between the 78 rules and the 60 supplemental policies are described in Table 1.

China's National Innovation System, Table 1 Relationship between the 78 implementing rules and the 60 supplemental policies

Supplementary policies	Implementing rules	2006	2007	Supplementary policies	Implementing rules	2006	2007
S&T Investment	6	6	0	Innovative Talent Team	13	6	7
Tax Deduction	8	2	6	Education and Science Popularization	7	5	2
Investment and Finance Support	9	7	2	S&T Innovation Base and Infrastructure	11	5	6
Government Procurement	6	1	5	Co-Ordination	2	0	2
Import, Digestion, and Absorption Re-Innovation	3	2	1	Others	9	2	4
Intellectual Property Right Creation and Protection	4	3	1	Total	78	38	37

Source: The center for innovation and development, Chinese Academy of Sciences

Deficiencies and Problems of China's National Innovation System

Currently, although China has made great progress in construction of a national innovation system, there are still many deficiencies and problems challenging future development, especially innovative country construction. The first is that the allocation of government organizations and government functions has not wholly met the demand of the national innovation system. Scientific research is out of touch with education, and technology innovation is out of touch with the economy. There are many government departments responsible for innovation. Innovation policies come from many departments and many people consider them too complicated. Innovation activity has mainly been dominated by government; the science and technology community has limited impact on innovation activities. Some of the government functions of innovation are overlapping, co-existing, or even missing. For example, many departments have nearly the same function of industrialization, although they are called S&T achievement industrialization, patent industrialization, high-tech industrialization, and industrial stucture optimization and upgrading. The government of innovation management lacks supervision from the public, and the government's innovation service functions are inadequate.

The second is enterprises as the main player in innovation in the national innovation system. Although it can be said that enterprises have been the main player in innovation basing on data such as R&D investment and patent application number, it can be also found that enterprises are not the real main player from views of the decision-making around innovation themselves, major part of government innovation resource allocation and high-end innovative talents including those who has got master or doctor degree. The existence of the lucrative industries, low-cost, rent-seeking behavior, and inadequate implementation of the innovation policies, together with an innovation culture has not been fully formed, infuluencing the enterprises that are not dynamic enough to undertake innovation. The investment policies, trade policies, and intellectual property protection policies are not coordinated enough with the innovation policies. The intellectual property policies place more stress on international rules and increasing application numbers and less stress on quality and utilization. To date, the appropriate mode and effective measures of commercialization of S&T achievements have not been found.

The third is the allocation of innovation resources. Investment in innovation infrastructure such as large scientific or engineering facilities, laboratories, engineering research databases, and data and information databases is inadequate. Innovation resources, whether S&T infrastructure, innovation bases, or R&D funds, are deployed more to the eastern and coastal regions and major cities and less to the medium-size cities and west regions. The Chinese Academy of Sciences is the largest in the world and its staff numbers is more than nearly 60,000. The proportion for basic research of R&D funding has been lower than 10 % of the total R&D expenditure for many years. Because most R&D investment comes from government, many institutes focus more on industrial generic technologies or critical and key technologies and less on new products and technologies needed by enterprises. In the meantime, the government innovation resources are invested more in research institutions and universities and less in enterprises. The division of the national innovation system into five sub-systems is not optimal but is favorable for some departments and institutions to acquire government innovation resources. This method of division limits the ability of enterprises to be the main player in the whole national innovation system.

The fourth is the management of the S&T and innovation funding. The most important problem is lack of openness to the public and transparency. The expenditure of projects funds isn't enough open and fair. A majority of technology projects are required to apply for funding by sub-projects and compete against each other, and it is difficult to form a cohesive force for innovation. The decision-making, management, and supervision of S&T and innovation fund allocation are executed by only one department, affecting the efficiency of the use of the fund. A small number of administrative officials have the final say on the allocation of for S&T and innovation resources, and participation from expert groups and the public is lack.

The fifth is implementation of the innovation policies. To date, there have been no implementing regulations and supporting policies for the Scientific and Technological Progress Law and the Law on Promoting the Transformation of Scientific and Technological Achievement. Thus, there are not detailed regulations for research institutions, technology transfer, S&T fund management, and service and non-service invention. The low technology transfer rate has been a serious unresolved problem for a long time. The implementation of policies like statutory growth of science and technology funding, deduction of R&D expenses before corporate tax at 150 %, and government procurement for self-dominant innovation products still have encountered many difficulties, but there are less effective measures. There are not preferential value-added tax policies or business tax policies for self-dominant innovation and self-dominant intellectual property right products. There are no quick examination policies on intellectual property rights, which are essential to innovation such as small- and medium-sized and high-tech enterprises. The condition and treatment of enterprise talents are poor in household registration, social security, and other aspects. The implementation of innovative talent introduction, cultivation, and utilization planning and police need to be improved.

The sixth is the construction of the innovation culture. Notable progress has not been made in construction of the innovation culture to date. The bureaucratic, counterfeiting, and impetuous cultures suffocate, harm, and restrict innovation culture construction. The scientific community is far from established, the development of scientific ethics lags behind, and the protection of intellectual property rights has a long way to go. Society overall has only a weak awareness of innovation culture. There are large gaps between the current creative talent nurturing model, curriculum design, teacher configuration, and education conditions and the demand of innovative country. Investment and financing, especially venture capital, are also less developed.

Conclusion and Future Directions

Following the Quadruple Helix model and Quintuple Helix model and considering the elements of innovation policy, this entry reviewed the history of China's national innovation system and found that China was gradually being transformed from a technology innovation system to a national innovation system. The entry also examined the roles and relationship among government, industry, and universities/institutes and found that China's national innovation system was still a top-down system, especially in the formulation of innovation policies that were mainly promoted by the government. Enterprises' position as a main innovation player was still low. China's national innovation system was changing from a plan-oriented system to a market-oriented system. But because of departmental interests, it is still not a system that market functions completely. The sub-system method of division is one way to obtain government innovation resources. In construction of an innovative country, in order to achieve the goal of a national innovation system, China not only needs to optimize the three helix relationships of all the players but also to adopt some new innovation policies.

The first is to optimize government organizations and the innovation functions. It is necessary to establish separated and cooperating governmental organizations for decision-making, implementation, and supervision for S&T and innovation. The decision-making function can be undertaken by a commission and the supervision function can be undertaken by an independent third party or even the public. As in other countries, comprehensive departments combining education with basic research, technology with industry, and innovation and economy need to be established. Similar government functions should be integrated into one department. The excessive market behavior of universities and research institutes should be limited, and gathering of innovation resources in enterprises should be encouraged. Supporting development of the scientific community to support innovation through self-regulation is a good choice.

The second is to promote knowledge production. To keep up with cutting-edge science around the world and to meet major national strategic demands, it is necessary to build up a number of high-level national research bases, research universities, and research institutes. Also necessary are coordination in deployment and accelerated construction of the laboratory system and building up a number of large scientific projects and research experimental bases. A sound modern scientific research institute system must be established. In the meantime, it is necessary to accelerate construction of key disciplines and S&T and innovation infrastructures focusing on original innovation in the field of basic research and frontier technology research.

The third is to strengthen enterprises' position as a main player in innovation. This can be achieved by supporting some leading enterprises to establish cutting-edge technology institutes and to promote them to undertake the forefront industrial and key technology research with universities and research institutes as the leader. It is a task for government to guide enterprise with self-dominant intellectual property rights to actively participate in the formulation of international technical standards. The financial and tax policies shall be improved in favor of SMEs' innovation. Another important policy is to promote technology development institutes transformed on specific technology development according to the needs of enterprises.

The fourth is to promote balanced development of the regional innovation systems with distinctive characteristics and advantages. It is necessary to deploy the construction of regional innovation systems, in which universities, research institutes, and leading industries can be combined together geographically. The national or provincial S&T projects, the industrialization projects, high-tech zones, the innovative cities, and the national self-dominant innovation demonstration zones can integrated to support emergence of a number of regional innovation centers. The policies shall encourage the eastern regions and the regional central cities to develop high-end industries and find an innovation-driven development model. They shall lead more innovation resources to flow to the central and western regions through construction of innovation facilities or infrastructures and development of industries with characteristics and advantages than ever. The policies shall also support construction of regional innovation resource sharing networks and promote rational and efficient resource allocation.

The fifth is to promote the development of the military-civilian integrated national defense S&T

innovation system. The policies shall focus on following points: strengthening the integration of military and civilian technology innovation resources; establishing a sound S&T innovation resource sharing and coordination mechanism thus the military and civilians can mutually transfer high technologies easily; encouraging military research institutes to undertake civilian tasks and open the defense R&D projects to civilian research institutes and enterprises; and expanding the military procurement range to products made by civilian enterprises.

The sixth is to accelerate development of the S&T and innovation intermediary service organizations. It is necessary to issue laws or polices to regulate the development of S&T and innovation intermediary services in S&T Progress Law and the Law on Promoting the Transformation of S&T Achievement. It is necessary to transfer state-owned service originations to civilian ones, to establish a vocational qualification and certification system to avoid deceptive and dishonest behaviors, and to decrease the value-added or business tax rate for the innovation intermediary servicers and to enhance their service capabilities. It is necessary to support a number of universities and research institutes to build technology transfer offices and set up venture capital funds to promote technology transfer. A number of high-level innovation intermediary services introduced talents through all kinds of talent plans should be encouraged.

The seventh is to make great efforts to cultivate the innovation culture. One important measure is to reduce the administrative intervention on S&T and innovation, and most decisions shall be made by scientific communities or enterprises themselves. Another measure is to adopt law enforcement accountability for local governments in IPR laws and to crack down on counterfeiting activities. A third measure is to construct innovation culture facilities, especially propaganda facilities such as film, television, websites, newspapers, and others. A fourth is to add the innovation and intellectual property protection idea and method into the national education system of primary and high school. A final measure is to lift the public's scientific and cultural quality through S&T popularization and freely opening universities, research institutes, the S&T museum, and the science bases to the public.

Cross-References

- ▶ Fostering Creativity Through Science Education
- ▶ Innovation Policies (vis-à-vis Practice and Theory)
- ▶ Innovation Systems and Entrepreneurship
- ▶ Institutional Entrepreneurship, Innovation Systems, and Innovation Policy
- ▶ Mode 1, Mode 2, and Innovation
- ▶ Mode 3
- ▶ National Innovation Systems (NIS)
- ▶ Quintuple Innovation Helix and Global Warming: Challenges and Opportunities for Policy and Practice
- ▶ Triple Helix of University-Industry-Government Relations

References

Antonelli C et al. Introduction. In: Antonelli C, Foray D, Hall BH, Steinmueller WE, editors. New frontiers in the economics of innovation and new technology. Cheltenham\Northampton: Edward Elgar; 2006. p.3–20.

Boeing P, Sandner P. The innovative performance of China's national innovation system. Frankfurt School – working paper. Series No. 158; 2010.

Caracostas P. The Policy-Shaper's anxiety at the innovation kick: how far do innovation theories really help in the world of policy? In: Malerba F, Brusoni S, editors. Perspectives on innovation. Cambridge/New York: Cambridge University Press; 2008. p. 464–89.

Carayannis EG, Campbell DFJ. "Mode 3" and "quadruple helix": toward a 21st century fractal innovation ecosystem. Int J Technol Manag. 2009:201–34.

Carayannis EG, Campbell DFJ. Mode3? Meaning and implications from a knowledge systems perspective. In: Carayannis EG, Campbell DFJ, editors. Knowledge creation, diffusion, and use in innovation networks and knowledge clusters a comparative systems approach across the United States, Europe and Asia. Westport: Praeger; 2006. p. 1–25.

Carayannis EG, Campbell DFJ. Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other? A proposed framework for a trans-disciplinary analysis of sustainable development and social ecology. Int J Soc Ecol Sustainable Develop. 2010:41–69.

Carayannis EG, Gonzalez E. Creativity and innovation competitiveness? When, how, and why, Chap 8. In: Shavinina LV, editor. The international handbook on innovation, vol. 1. Amsterdam: Pergamon; 2003. p. 587–606.

Chen KH, Guan JC. Mapping the functionality of China's regional innovation systems: a structural approach. China Econ Rev. 2011:11–27.

Edquist C. Systems of innovation: perspectives and challenges. In: Fagerberg J, Mowery DC, Nelson RR, editors. The Oxford handbook of innovation. Oxford \New York: The Oxford University Press; 2005. p. 181–208.

Etzkowitz H, Leydesdorff L. The dynamics of innovation: from national systems and "mode 2" to atriple helix of university-industry-government relations. Res Pol. 2000:109–23.

Freeman C. The national innovation system in historical perspective. Camb J Econ. 1995;19:5–24.

Gu SL, Lundvall B-A. China's innovation system and the move toward harmonious growth and endogenous innovation. DRUID working paper no 06-7. 2006.

Henry E, Leydesdorff L. The dynamics of innovation: from national systems and "mode 2" to a triple helix of University-industry-government relations. Res Pol. 2000;29:109–23.

Kroll H, Cole M, Schulle M. China: innovation system and innovation policy. In: Friestch R, Schuller M, editors. Competing for global innovation leadership: innovation systems and policies in USA, Europe and Asia. Stuttgart: Die Destche Bibliothek; 2010. p. 241–61.

Liu XL, White S. Comparing innovation systems: a framework and application to China's transitional context. Res Pol. 2001:1091–114.

Liu XL. National system of innovations in developing countries: the Chinese national system of innovation in transition. In: Lundvall B-A, Joseph KJ, Chaminade C, Vang J., editors. Handbook of innovation systems and developing countries: building domestic capabilities in a global setting. Cheltenham\Northampton: Edward Elgar; 2009. p. 119–38.

Lundvall B-A, editor. National systems of innovation. Towards a theory of innovation and interactive learning. London: Pinter; 1992. p. 957.

Lundvall B-A. Innovation in system research – where it came from and where it might go. In: Lundvall B-A, editor. National systems of innovation. London/ NewYork: Anthem Press; 2010. p. 317–51.

Lundvall B-A., et al. Introduction. In: Lundvall B-A, Joseph KJ, Chaminade C, Vang J., editors. Handbook of innovation systems and developing countries: building domestic capabilities in a global setting. Cheltenham\Northampton: Edward Elgar; 2009.p. 1–30.

Metcalfe S. The economic foundations of technology policy: equilibrium and evolutionary perspectives. In: Stoneman P, editor. Handbook of the economics of innovation and technological change. Oxford (UK)/ Cambridge (US): Blackwell; 1995.

Metcalfe S. Innovation systems, innovation policy and restless capitalism. In: Malerba R, Brusoni S, editors. Perspectives on innovation. Cambridge/New York: Cambridge University Press; 2008. p. 441–54.

Nelson R, editor. National systems of innovation: a comparative study. Oxford: Oxford University Press; 1993.

OECD. Innovation in science, technology and industry: OECD reviews of innovation policy: China/Paris: OECD; 2008.

Patel P, Pavitt K. The nature and economic importance of national innovation systems. STI review, NO.14. Paris: OECD; 1994.

Patel P, Pavitt K. Uneven (and divergent) technological accumulation among advanced countries: evidence and a framework of explanation. In: Archibugi D, Michie J, editors. Trade, growth and technical change. Cambridge: Cambridge University Press; 1998.

Rowen H. Introduction. In: Rowen H, Hancock MG, Hall ME, editors. Greater China's quest for innovation. The Brookings Institution; 2008. p. 931–81.

Schumpeter J. Theorie der wirtschaftlichen Entwicklung. Berlin; 1911.

Chronesthesia

► Imagination

Church and Entrepreneurship

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Synonyms

Biblical principles of business; Business of church; Missions and business; Restoration theology and the church

Topic and Definition

The symbiotic relationship between church and entrepreneurship can be viewed from two fundamental perspectives. It is either men's business of religion or God's business on the Earth. The question is, "what is man or God buying?" For example, men can purchase peace of mind (from men) or obtain the peace of God and from God (for free). This entry focuses on how God and men in the church and through the church can become coworkers with God following His principles and guidance. If it is God's business, we need to find out how He runs His business and whether it is a multinational (from every tribe and race) or just a family business. Is God into corporate social responsibility? And how? Is He interested in sustainable business? Entrepreneurs are always looking for gaps or unmet needs they can satisfy with products or services. What is God's unmet need in the business world? Does He have a vision or mission? How does He want to work through the business of the Church and in the Church to achieve His purposes? How does He define value in business terms? To answer this question from His perspective would be immensely valuable to the Christian and non-Christian reader.

The discussion will focus on (1) different concepts regarding entrepreneurship and the Church and on (2) how God reflects His nature through the entrepreneurial talents of His people in and through the Church.

Definitions of Church and Entrepreneurship from a Biblical Perspective

The Church

According to the Biblical perspective, the inventor of the Church, Jesus Christ, gives a simple but profound account about the nature of the Church in the book of Matthew, Chapter 16:13:

> He asked His disciples, Who do people say that the Son of Man is? And they answered, Some say John the Baptist; others Elijah; and others Jeremiah or one of the prophets. He said to them, But who do you say I am? Simon Peter replied, You are the Christ, the Son of the living God. Then Jesus answered him, Blessed are you, Simon Bar-Jonah, For flesh and blood have not revealed this to you, but My Father Who is in heaven. And I tell you, you are Peter, and on this rock I will build My church, and the gates of Hades shall not overpower it.

There are basically three main elements that constitute the nature of the Church. These are essential to understand the activity and mechanisms of the Church:

(a) Jesus reveals His identity as the Christ (anointed One) through the revelation by Simon Peter. Simon Peter received this revelation by the Father. Simon Peter is then also revealed as Peter (his spiritual identity).
(b) This *revelation* of Jesus as the Christ is the foundation (rock) of the Church. The Greek word used here is Petra (huge rock) compared to Petros (rock) that is the name given to Simon.
(c) *Jesus is the builder* and not men. It is a spiritual entity and not a building. And there will be a struggle between gates of Hades and the Church but the latter will be victorious.

We need to note that in this case, the declaration of that revelation by Simon Peter on Jesus' identity brings another revelation of Simon Peter's true identity in Him. This means that the symbol of the rock used to describe Jesus many times, the huge rock (Church), and small rock (Peter) are all one. There is another simple prayer that Jesus taught that receives its true meaning from this passage. Jesus taught the disciples to pray "Father, Your Name be glorified, Your Kingdom come and Your Will be done on earth as it is in heaven." This translated in this context means let the Name of Your Son Jesus Christ be glorified through the work of the Church in the establishment of Your Kingdom (the realization of Your will, power, dominion, and influence on the earth). In short, "let Jesus build His Church."

This entry is all the more important because both God and men have been at work in the Church from two very different perspectives and approaches, and the biggest issue that has been at stake is the *entrepreneurial nature of the Church*. From God's perspective, He is the CEO of a great business and we are His coworkers. God wants to redeem all things and reconcile all things to Him, and one of them is business and entrepreneurship. It is of value to indicate that the first man, Adam, was given a job to take care of a garden and orchard (gardener) and that Jesus also worked as a carpenter and did not consider it shameful. In fact, He called businessmen (fishermen) to enter into His business. From man's perspective, a church has to be a building. It is mainly because a physical building is something that man can build. And this building welcomes many financial transactions: men give tithes (10 % of their income) and offerings and also volunteer their time and effort. In many cases, men go to church to be encouraged, to listen to a message that will give them some comfort, and also attend Bible classes to know more about God. So the church building can be a center of exchange where men buy their peace of mind and some knowledge and help people on occasions. It has the potential to be the center of man's effort and man's achievement through whatever financial contribution they make. It is like a spiritual club where members can receive some self-help lessons about how God is going to bless them through their prayer, giving, and effort. From man's perspective, the activity of the church is constrained to a building but for God's perspective, it is His activity through His people wherever they are.

Entrepreneurship

Four verses encapsulate the plan of God for business:

Deuteronomy 8:18* "But you shall remember the LORD your God: for it is he that gives you power to get wealth, that he may establish his covenant which he swore to your fathers, as it is this day."

Jeremiah 29:11 "For I know the plans I have for you," declares the LORD, "plans to prosper you and not to harm you, plans to give you hope and a future."

1 Corinthians 10:39 "Whatever you do, do it for the glory of God."

Ephesians 2:10 "For we are God's workmanship, created in Christ Jesus to do good works, which God prepared in advance for us to do."

In these four verses, we can understand God's design. He made us with a purpose in mind. He had a plan for us, works for us to do that would *glorify* His Name. God has a redemptive purpose for everyone's activity on earth. And God also provides the power or means to do it. If we look at the promised land promised by God to the people of Israel, we see "land of milk and honey." This can also be translated as prosperous business. Considering the life of Abraham, Isaac, and Jacob, we see in many ways the financial blessing in business that follows the obedience to the word of God. In the book of Genesis, we read how God gave Abraham the wisdom and power to prosper in a dry land. He also gave Isaac the wisdom to sow in a time of famine, to Jacob the wisdom to help the sheep reproduce in a way that was profitable to him, and to Joseph the wisdom to gather grain for a huge sale to the nations. In only one book, we can see how God glorifies His name through the business success He gives to those who follow Him.

However, entrepreneurship in the Church has also been understood in other different ways.

Businessmen are those who provide finances for the church so that it can continue to run. They pay the staff's salaries so that people can be employed to run the church. For many pastors, business is just something else that people do or "a necessary evil" depending on how they perceive business and money.

The Implications of a Business World Run by God

Regarding business and wealth, Jesus made it very clear when He challenged His followers with this question, "what would give a man for his soul? The entire world?" This is essentially the business proposition that Satan had given Him in the dessert, "If you worship me I will give you ALL these Kingdoms (the earth) and their glory thereof." Finally, Jesus got the best deal by paying the *price* through His death and when He proclaimed after His resurrection that "ALL power and authority has been given to Me in heaven and on earth." If this is really true, then the implications are that Jesus is interested in everything that happens in a place (earth) that belongs to Him. These implications for business and entrepreneurship can be summarized as follows:

1. He wants to restore ALL things and redeem ALL things according to His Father's plans including the motivation, purpose, and consequences of entrepreneurship and business.
2. A business that glorifies God is not necessarily a church or a Christian shop but a place where God's work and power is displayed through His people as part of His redeeming plan. Business activity speaks of Him more than the production of Jesus's stickers or Christian music.
3. A business that glorifies God is run by His grace. This grace or divine favor is based on the revelation of His business principles (excellence, integrity, compassion, providing a product or service that edifies according to biblical principles…) and divine enablement for His children to do the work within that framework.
4. A business that glorifies God is run by Christian who can hear His voice and direction for the business, who overcome obstacles by complete faith and trust in His promises, and who display a nature and character that reflects Him who created, shaped, and redeemed them.
5. Christian entrepreneurship is conducted with eternity in mind. Those who engage in it consider how their actions bless or hinder people around them and become a vehicle where the presence of God resides promoting His message of reconciliation.
6. Christian entrepreneurship and business is only a vehicle for Him to do His will on earth as it is in heaven, to establish His Kingdom and see His Name be glorified.

But how do we see the role of the Church in entrepreneurship or the development of the local economy?

Eldred (2005) gives a profile of kingdom business along these lines that helps us understand the type of influence that the Church can have in the entrepreneurial world. He underlines how kingdom business provides a model for sustainable missions; brings technology, expertise, and capital; provides access to many locations; and builds the local economy. These companies not only act as funders of the local church but promote the gospel through their words and deeds by getting involved in local charity and meeting the needs of the poor.

Rundle and Steffen (2003) also give an account of what makes Great Commission Companies (GCC) (companies that do also the work of the Church) in their research with the following findings:

The most effective GCC are managed by professionals including locals who have had experienced in ministry, partner with local churches or ministries, and have an integrated view of work, business, and ministry.

Seebeck and Stoner (2009) go beyond strategies in their analysis of mission companies working in different countries to state three key truths for successful mission businesses. They are interdependence as we realize how much we depend from each other in a global economy as there is no isolated country. The second is reciprocity as each part gives and receives. Finally, there is mutual respect and humility as we do not impose cultural values from developed nations on developing nations.

Conclusions and Future Directions

Entrepreneurship and business has been the battle ground for the church for a long time. The inability to hear God, to know His plans and purposes, and to obey Him has led many people into a man-made and man-centered religion that is void of the presence, purpose, or sanction from God. It is a safe place for man, a place that requires no faith or sacrifice. However, God is building His Church, and this spiritual entity is also interested in doing business that glorifies God. In terms of physical redefinition, the business office or factory is also "the Church" because that name defines God's activity on earth through Christians (His children). We are about to see what God can do through His Church, His Business on earth.

The interaction between the Church and entrepreneurship not only needs more research but also a different perspective that would consider the basic assumptions of Christianity. We are in a world that God wants get involved in and help run through the beneficial influence of the Church.

The Church as representative of a triune God needs to reflect the characteristics of that God in business through righteousness and generosity. Therefore, future directions of research could look into cities and nations that are being transformed by the gospel. For instance, Hughey and Adams (2010) report how small economies in the Fiji Islands have been impacted by the Church and God's presence. These directions could also take into consideration a broad definition of the Church to include businessmen that are trained and anointed to minister in the marketplace through their business. That type of research based on different assumptions will yield drastically different results.

Cross-References

- ▶ Business Creativity
- ▶ Business Emergence
- ▶ Creativity and Church
- ▶ Nature of Creativity
- ▶ Self-Made Man

References

Adams W, Hughey R. Revival: Its present relevance and coming role at the end of the age. 2010. Oasis House.

American King James Bible.

Eldred K. God is at work. In: Transforming people and nations through business. Montrose: Manna Ventures LLC; 2005.

Rundle S, Steffen T. Great commission companies. Downers Grove: Intervarsity Press; 2003.

Seebeck D, Stoner T. My business, my mission. 2009. Partners Worldwide.

Citizen Science in Health Domain

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Synonyms

Open science

What Is Citizen Science?

Democraticization and Openness

In recent years, we have been witnessing increasing evidence that the separation between roles traditionally associated with knowledge production, on the one hand, and roles associated with utilizing and "consuming" knowledge, on the other, have become blurry (see Gibbons et al. 1994; Nowotny et al. 2001). While this is true in many fields of science (Goodchild 2007; Fischer et al. 2012; Nielsen 2011), the health domain is a particularly illustrative example. Patients have started to organize their own medical studies and trials (Wicks et al. 2011); questions that professional scientists have been struggling for years, or even decades, are solved by people playing computer games (e.g., Khatib et al. 2011), and patients facing difficult treatment decisions put their medical information online to invite experts from all over the world to comment (e.g., Albanello 2011). The notion of "crowdsourcing" has been applied by many authors to discuss novel forms of collective knowledge production and collective intelligence.

Although the production of knowledge in the health domain, including the production of scientific knowledge, has always been, to some extent, a collaborative endeavor, the emergence of citizen science as a new paradigm of collective knowledge production has brought the pace and impact of collective knowledge production and innovation to a new level. As the author of this entry has argued elsewhere (Prainsack 2012), the shift we are witnessing goes beyond Ziman's (1996) notion of post-academic science, where knowledge producers were still professional scientists, although their science may serve other than academic purposes primarily. It also goes beyond von Hippel's (2005) diagnosis that users are key drivers of innovation. In contemporary citizen science initiatives, we see nonprofessionally trained people make substantial contributions not only to how scientific findings are applied to "the real world," but they contribute to knowledge production in basic research.

The emergence of citizen science has been partly rendered possible, and definitely catalyzed, by Internet platforms and social media such as Twitter, Facebook, Flickr, and more recently, specific initiatives dedicated to the development of citizen science projects (e.g., http://www.citizensciencealliance.org/). The increasing prominence of citizen science challenges and reconfigures the ways in which knowledge production in the health domain takes place, while at the same time, raising ethical and regulatory questions pertaining, for example, to how contributions from citizens should be attributed in scientific publications; what research ethics procedures should apply to studies that are self-organized by patients; and how new modes of citizen participation in medical and bioscientific knowledge production and decision making can or should be integrated into existing institutional structures (e.g., into existing systems of healthcare delivery). They also raise the question of what can be done to minimize the risk that citizen science initiatives are "hijacked" by actors pursuing primarily commercial interests. Moreover, professional researchers, scientists, and educators are also discussing ways to ensure that the quality and standardization of data are collected, generated, and processed by nonprofessionals (e.g., Cohn 2008; Wiggins et al. 2011; see also the important work led by the Cornell Lab of Ornithology, where the term citizen science seems often seen to have originated: http://www.birds.cornell.edu/citscitoolkit/toolkit/steps). This links to the overarching question of why, and under what circumstances, citizen science works (i.e., it produces "better" results than conventional science; either because the results are produced faster, they are more socially robust, or they solve previously unresolved questions). There are different approaches to answering this question, many of which draw upon the literature on social networks (see also Shirky 2008). James Surowiecki, in his book *The Wisdom of Crowds* (2005), for example, suggested four criteria that need to be met for a crowd to make intelligent decisions: (1) independence of individual opinions from peer or other influences, (2) decentralization of expertise in the crowd, (3) diversity of opinion, and (4) aggregation (i.e., some mechanisms of turning individual opinions into a collective decision). This, of course, leaves open the question of how aggregation should take place in order to maximize the intelligence of the crowd. This is one of the questions that Nielsen starts to unpack in his book on *Reinventing Discovery* (2011). For him, for citizen science to work, initiatives need to provide instant feedback to participants; they need to be modular, and there needs to be some level of coordination. The question of how exactly coordination takes place (e.g., "emerging" from bottom-up or top-down), and how much coordination is too little or too much, will hopefully be answered on the basis of empirical studies of citizen science projects in the coming years.

Citizen science initiatives involve the participation of nonprofessional scientists at any or every stage of the trajectory of scientific knowledge production: at the stage of data collection/generation, data analysis, interpretation, application, dissemination, and evaluation. The following typological grid can help us in the assessment of how coordination and agency is distributed in a particular citizen science project, how "open" it is, and what kind of entrepreneurial and innovative potential it utilizes and/or fosters (see Table 1).

Citizen Science and Open Science

Many practices subsumed under the label of citizen science also fit the definition of open science (e.g., Delfanti 2010). While these two concepts clearly overlap, their focus is different. Open science, as we will see below, focuses on transparency and accessibility of data, results, and often also research infrastructures. Citizen science, in turn, emphasizes the participation of not professionally trained individuals (i.e., at least not in the activity they engage in) within the production of scientific knowledge. In other words, citizen science signifies the production of authoritative knowledge by "amateurs." The term citizen science is rather inclusive with respect to different format and designs of the participation of nonprofessional experts. It is sometimes applied to projects that are conceived, executed, and utilized (also in terms of intellectual property rights) by citizens in a bottom-up way, without

Citizen Science in Health Domain, Table 1 Criteria for the classification of citizen science projects (Source, author)

Coordination: Who has influence in
1. Agenda setting
2. Determining the terms of the execution of the idea/ procedural aspects
3. Deciding what results are (and what "good" results are)
4. Deciding what will be done with results
5. Deciding on intellectual property questions
Participation: Who participates (demographic and social parameters of those who participate)? Why and how do they participate?
6. How much special training or expertise is required to participate in this project?
Evaluation
7. How and by whom is it decided what good outcomes are?
Openness
8. Do participants in the project have access to the core datasets?
9. Can participants in the project edit the core datasets?
10. Is the contribution of participants adequately acknowledged in published materials?
11. Are datasets made publicly accessible (open source/ open access)?
12. Are main findings made publicly accessible (open source/open access)?
Entrepreneurship
13. How is the project funded?
14. What is the role of for-profit entities in this project? Are these small, medium-sized, or large entities, and where are they located?
15. How are for-profit and other interests aligned in this project (and/or do they conflict, and where?)

any involvement of professional scientists; although such projects are rare, they do happen (the example of a group of patients organizing their own study via the platform *Patients Like Me* to explore whether lithium carbonate slows down the progress of motor neuron disease, as suggested by a clinical research study, comes closest to this "pure" citizen model; see also Wicks et al. 2011). Other citizen science projects were either conceived, designed, coordinated, or assessed by professional scientists (see, e.g., the platform for the crowdsourcing of data analysis *Kaggle*; www.kaggle.com) Other projects assign clearly delineated tasks to citizens which do not require any particular experience, training, or familiarity with the subject; an example for this latter type of project would be *Pearl* in China; here, citizens use the infrared device on their mobile phones to record and transfer to a central platform data on human interaction patterns in order to understand better how airborne diseases spread. The project is based on the fact that the range of the infrared device on people's smart phones is the same as the range in which airborne diseases can be caught from an infected person (for more details, see http://bioinfo.ict.ac.cn/pearl/, and Swan et al. 2010). Here, citizens have far less, if any in the designing of the project and the interpretation of the results.

Projects like *Pearl*, where the role of citizens is limited to data collection, have been criticized as using citizens as "brain soldiers," as part of a cognitariat (Toffler 1983); they often volunteer their time to carry out tasks that average human brains happen to do better than computers, namely, the filtering out of "noise." This "bottom-up score" of a citizen science project, which can be assessed on the basis of the criteria listed in Table 1, tells us something about the emancipatory and democratic potential of a citizen science project (e.g., Does the project draw primarily on the creativity of people from outside the academic discipline? Does it empower people who would normally not engage with this field of science and who would normally have no, or very limited, access to datasets?). It does not prejudice, however, how "good" or successful a citizen project is: Some projects in which citizens had very little influence on project design, etc., led to amazing outcomes that had a significant impact on the science in their fields (Khatib et al. 2011). Thus, the overall assessment of the success of a citizen science project will always depend on what the main objective is: the "democratization" of science, the education of citizens (e.g., Bonney et al. 2009), or the solution of a pressing scientific issue.

An additional dimension according to which citizen science projects can be assessed is the degree of their openness. Openness is, as the term suggests, the main focus of the notion of open science. A website devoted to open science (Gezelter 2009) defined open science projects as those meeting four sets of criteria: first, transparency in methodology, observation, and data collection; second, public availability and reusability of scientific data; third, the public accessibility and transparency of scientific communication; and fourth, the availability of Web-based tools to facilitate collaboration. In short, the more publicly accessible every stage of scientific knowledge production process is, the higher the "openness score" (see Table 1) of a project. Whether the project is carried out exclusively by professional scientists, or whether it includes nonprofessional participants, is not a decisive factor in this regard. A project which is carried out by one Nobel Laureate working entirely alone at her lab or at her desk, yet who makes all her data, her lab journals or research notes, and the findings, publicly available, could qualify as an open science project.

The idea of open science is also closely linked to the much older open access (OA) movement in academic publishing. The term OA typically refers to a type of publishing where journals do not charge readers or their institutions for access. In an academic context, OA publishing usually refers to OA journals that are also peer-reviewed and include editorial quality control. In the last decade, OA publishing has become increasingly common in the scientific world. This is partly a result of funding agencies requiring research findings being made publicly available, although they typically allow a period of exclusive use of the data by the researchers who generated them. To date, about 10 % of all peer-reviewed journals wordwide are OA journals (http://www.doaj.org/), and it is estimated that about 30 % of the global research output is available OA (including green OA, or self-archiving; namely, making materials public available which have previously been published in non-OA sources).

Citizen Science: A Mixed Blessing?

Commentators have been both enthusiastic and concerned about the emergence of citizen science. Many authors (e.g., Angrist 2010; Nielsen 2011) welcome citizen science especially also in the health domain as a process of empowerment of patients and citizens. Some people, however, are concerned that the replacing of professionally trained experts, such as clinicians and medical researchers, by "regular" citizens who participate in the production of authoritative knowledge may compromise the quality of both the science and the clinical applications emerging from them. Some authors have also been very skeptical with regard to the political meaning of citizen science. For example, it has been argued that models of participation in citizen science projects – especially those which are "run," or coordinated, by companies, governmental organisations, or other actors which are not primarily acting in their capacity as nonprofessionals and citizens in the first place – bear strong resemblances with many Web 2.0 enterprises. *Google*, for example, famously combined the prioritization of user experience with reliance on user-generated information (*Google*'s algorithms draw on how many times users access particular websites) and now dominates the market (Auletta 2009). Also, the case of the online platform *Napster* (www.napster.com) arguably shows how user "participation," and the reliance on user-generated content, was utilized not only to generate revenue but also to breach copyrights and change an entire industry: *Napster* launched in 1998 to allow users share music files with each other in "real time," and early users played crucial roles as codesigner of the service and shapers of its content. Early adopters thus assumed an important role in challenging the previous dominance of elites – the music industry – as gatekeepers to information (music files; Robinson and Halle 2002). A very similar argument could be made about the ways in which online genetic testing companies involve their consumers in knowledge production facilitated by the company. By creating facts on the ground – namely, by facilitating that thousands of people access genetic information online and allow the company to use their data for the purpose of disease research – the company is in a much stronger bargaining position vis-à-vis regulators who wish for medical professionals to remain gatekeepers to these activities.

According to this more skeptical view of citizen science initiatives, citizens contributing to science in citizen science projects where they will not share the profits engage in value cocreation for the powers to be (Arvidsson 2008; Bonsu and Darmody 2008), whether these are for-profit companies, or traditional academic and scientific institutions who receive the main credit for the discoveries made by citizens.

However, it should not be automatically assumed that all citizens in projects where the influence of participants in project design is very limited are being exploited. For many, being part of something useful, being acknowledged publicly in publications, and/or learning about the scientific area in question is enough of an incentive to participate. While there certainly are initiatives that aim at making profits on the basis of the unpaid labor of people, not every instance of citizens participating in such projects can be automatically read as an instance of "false consciousness."

Conclusion and Future Directions

There is an evident need for systematic empirical and conceptual explorations of the circumstances under which citizen science projects generate good outcomes in the sense that outcomes are academically or scientifically more accurate and better, and more socially robust, than the results of traditional ways of scientific knowledge production in health. Moreover, researchers in the next decade will hopefully also explore according to what parameters the results of citizen science should be evaluated and assessed. Overarching questions include, for example, the following: Is the prominence of citizen science a passing trend, or will it reconfigure the ways in which innovation takes place in a sustainable manner? Is innovation produced by citizens faster, or "better," in any way? And can citizen science be seen as a potential solution for educational needs outside, or both inside and outside, of traditional academic institutions?

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Cross-References

- ▶ Academic Entrepreneurship
- ▶ Creativity and Innovation: What Is the Difference?
- ▶ Healthcare and Innovation
- ▶ Higher Education and Innovation
- ▶ Innovation and Democracy
- ▶ Knowledge Society, Knowledge-Based Economy, and Innovation
- ▶ Social Innovation

References

Albanello L. Lorenzo's brain. 2011. http://lorenzosbrain.blogspot.com/. Accessed 26 Dec 2011.

Angrist M. Here is a human being: at the dawn of personal genomics. New York: Harper Collins Publishers; 2010.

Arvidsson A. The ethical economy of customer coproduction. J Macromark. 2008;28(4):326–38.

Auletta K. Googled. The end of the world as we know it. London: Virgin Books; 2009.

Bonney R, Cooper CB, Dickinson J, Kelling S, Phillips T, Rosenberg KV, et al. Citizen science: a developing tool for expanding science knowledge and scientific literacy. Bioscience. 2009;59(11):977–84.

Bonsu SK, Darmody A. Co-creating second life: market-Consumer cooperation in contemporary economy. J Macromark. 2008;28(4):355–68.

Cohn JP. Citizen science: can volunteers do real research? Bioscience. 2008;58(3):192–7.

Delfanti A. Open science, a complex movement. J Sci Commun. 2010;9(3):1–2.

Fischer DA, Schwamb ME, Schawinski K, Lintott C, Brewer J, Giguere M, et al. Planet hunters: the first two planet candidates identified by the public using the kepler public archive data. Mon Not R Astron Soc. 2012;419:2900–11.

Gezelter D. What, exactly, is open science? 2009. http://www.openscience.org/blog/?p=269. Accessed 26 Dec 2011.

Gibbons M, Limoges C, Nowotny H. The new production of knowledge. London: Sage; 1994.

Goodchild MF. Citizens as sensors: the world of volunteered geography. GeoJ. 2007;69(4):211–21.

Khatib F, DiMaio F, Foldit Contenders Group, et al. Crystal structure of a monomeric retroviral protease solved by protein folding game players. Nat Struct Mol Biol. 2011;18:1175–7.
Nielsen M. Reinventing discovery: the new era of networked science. Princeton: Princeton University Press; 2011.
Nowotny H, Scott P, Gibbons M. Re-thinking science: knowledge and the public in an age of uncertainty. Cambridge, UK: Polity Press; 2001.
Prainsack B. Book review of Elias G. Carayannis and David F. J. Campbell: Mode 3 knowledge production in quadruple helix innovation systems: twenty-first century democracy, innovation, and entrepreneurship for development. New York: Springer, Minerva; In press 2012.
Robinson L, Halle D. Digitization, the Internet, and the Arts: eBay, Napster, SAG, and e-Books. Qual Sociol. 2002;25(3):359–83.
Shirky C. Here comes everybody: the power of organizing without organizations. New York: Penguin; 2008.
Surowiecki J. The wisdom of crowds. New York: Anchor Books; 2005.
Swan M, Hathaway K, Hogg C, McCauley R, Vollrath A. Citizen Science Genomics as a Model for Crowdsourced Preventive Medicine Research. J Particip Med. 2010;2:e20.
Toffler A. Previews and premises. New York: William Morrow; 1983.
von Hippel E. Democratizing innovation. Cambridge, MA: MIT Press; 2005.
Wicks P, Vaughan TE, Massagli MP, Heywood J. Accelerated clinical discovery using self-reported patient data collected online and a patient-matching algorithm. Nat Biotechnol. 2011;29:411–4.
Wiggins GN, Stevenson RD, Crowston K. Mechanisms for data quality and validation in citizen science. IEEE Seventh International Conference on eScience Workshops; Stockholm; 2011. http://citsci.syr.edu/sites/citsci.syr.edu/files/sites/voss.syr.edu/files/Wiggins2011eScience.pdf. Accessed 17 Feb 2012.
Ziman J. 'Postacademic science': constructing knowledge with networks and norms. Sci Stud. 1996;9:67–80.

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▶ Green Business and Entrepreneurship

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▶ Translational Medicine and the Transformation of the Drug Development Process

Clinical Research

▶ Translational Medicine and the Transformation of the Drug Development Process

Clinical Trials

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Clusters, Networks, and Entrepreneurship

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Synonyms

District; Hub; Milieu; National system of innovation; Park; Regional innovation system

Introduction

Innovation processes often depend upon the availability or constitution of a critical mass of knowledge, (multidisciplinary) competences, and (entrepreneurial, managerial, and human) resources that are complex, cumulative, and, for the most, still embryonic or difficult to access. Considerable efforts must be also devoted for the mobilization and training of the manpower, for the acquisition of new knowledge and know-how, and for informing employees about new technologies and services and their market potential. Equally important here is the need for a close coordination among a great number of heterogeneous and geographically dispersed actors. The potential for innovation and the competitive positioning of actors "depend increasingly on their differentiated abilities to collaborate with a wide range of partners – those with key complementary competences and significant specific resources, and/or those enjoying competitive advantages in terms of localization" (Depret and Hamdouch 2011, pp. 249–250). Hence there is a need for intense, more collective coordination between many heterogeneous and geographically dispersed actors. These collaborations are increasingly structured in the form of coalitions and networks of a very varied nature, which transcend geographical borders. This coordination often goes through the formation of interest coalitions, vertical and horizontal partnerships, inter-organizational networks (as well as entrepreneurial/social/political/cultural networks), clusters, etc. Only the geographical concentration of activities (spatial proximity) combined with the belonging to the same community (organizational proximity) and the adoption of a shared "cognitive space" (cognitive proximity, either scientific or technological) allow entrepreneurs to amortize the high R&D, production, and commercialization costs they often have to engage in. It is also at this condition that entrepreneurs could eventually overcome the various entry and mobility barriers that can block or slow the growth of their business. Finally, these combined forms of proximity are the conditional "gate" that allows entrepreneurs to preempt and control the knowledge, competences, and strategic resources that are needed in the achievement of increasingly complex, uncertain, and costly projects (Depret and Hamdouch 2009).

These innovation clusters and networks and the role that entrepreneurs play in their dynamics have given rise to a wide range of theoretical and empirical studies in a variety of disciplines (economics, sociology, geography, management). The core idea underlying these studies is that it is the combination of agglomeration and proximity logics that finds nowadays competitive, innovative, and entrepreneurial dynamics in most (if not all) industries. More precisely, the available literature converge around the idea that the geography of innovation and entrepreneurship is being fundamentally structured (or embedded) within the clusters (broadly speaking) and networks that encompass the collaborative, learning and knowledge spillover dynamics that are specific to certain territories and to the innovation actors (notably the entrepreneurs) they involve (Depret and Hamdouch 2009).

The literature (especially the empirical one) offers a highly diversified range of approaches in terms of research aims and methodologies and of countries or regions or industries studied. They are also highly varied as regarding the hypotheses tested and the results yielded. Hence, the aim here is not to provide a comprehensive survey of these studies. It is rather to draw a first (tentative) typology of the most visible pieces in the literature according to the approaches privileged and to their specific focus (for more detailed surveys, see Hamdouch 2008, 2010; Depret and Hamdouch 2009, 2011; Hamdouch and Depret 2009). In this perspective, the remainder of the entry is organized as follows: The first section defines the notions of clusters and innovation networks (grasped here, in a broad sense, under the generic term of *territorial innovation and entrepreneurial systems, or TIES*); the second section shows that there exists at least eight differentiated views of TIES depending on the hypotheses founding the approaches privileged by the researchers, and therefore that there exists also at least eight ways in defining the goals and the contents of policies (whatever their spatial scope) that are aimed at promoting or supporting or accompanying entrepreneurial and innovation dynamics in a given territory and/or sector.

Key Concepts and Definition of Terms

The common point of these different studies is to consider *entrepreneurship as a territorial innovation and entrepreneurial system (TIES)* that is characterized by Hamdouch and Moulaert (2006): (1) the fundamental role of territorial proximity and clustering dynamics; (2) the multiplicity and diversity of the actors (large companies, SME, entrepreneurs, business angels, venture capital, and private equity firms, layers, etc.); (3) the complex articulations between the multiple institutional, spatial, temporal, and cognitive frameworks; (4) the crucial importance of the historical, social, cultural, and geographical dynamics in structuring these frameworks; (5) the diversity of the forms taken by this system.

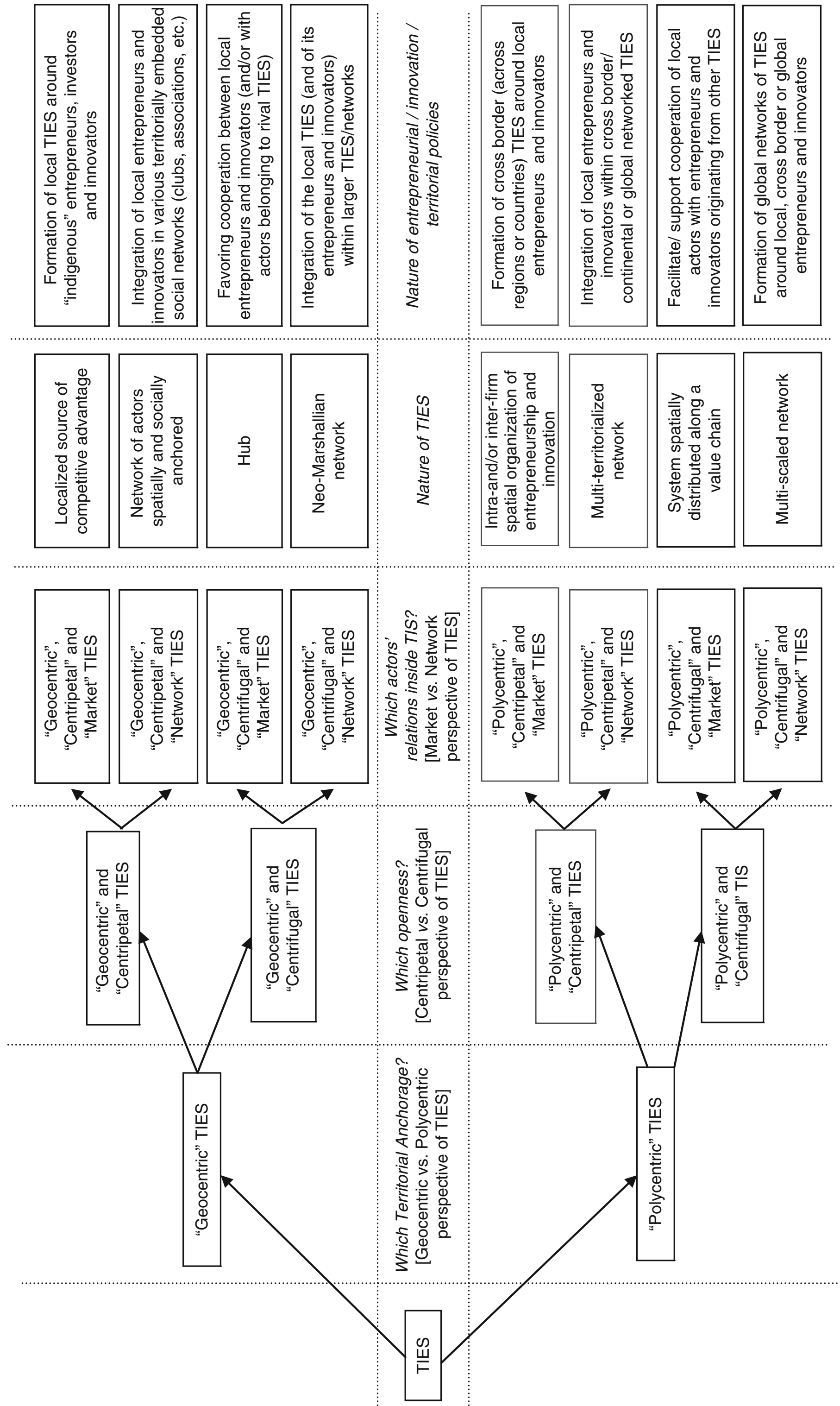
In this context, the TIES (as a cluster) is a spatial mode for the organization of entrepreneurship, innovation, and related activities (Depret and Hamdouch 2011). It "comprises an ensemble of various organizations and institutions (a) that are defined by respective geographic localizations occurring at varied spatial scales and within specific institutional environments, (b) that interact formally and/or informally through inter-organizational and/or interpersonal regular or more occasional relationships and networks, (c) and that contribute collectively to the achievement of all kind of innovations within a given industry or domain of activity, i.e., within a domain defined by specific fields of knowledge, competences and technologies. This definition is rather flexible, as it entails only that the three sets of conditions are being simultaneously verified. It could then correspond to a large variety of spatial, institutional and organizational concrete configurations of innovative dynamics. Moreover, it does not prejudge of the spatial topography of the interacting actors, nor does it impose any constraint on the way they may interact (i.e., cooperate or compete)" (Hamdouch 2010, p. 43).

At the same time, a network is a specific modality for the structuring or coordination of inter-organizational relationships among various legally independent actors (firms, entrepreneurs, institutions, etc.) "aiming at achieving a common project in a specific domain through the control, exchange or sharing of information, know-how, knowledge, as well as products and/or capital (. . .). The actors participating to a network may be co-located within the same cluster or belong to different clusters" (Depret and Hamdouch 2011, p. 232).

Unfortunately, the "understanding of the mechanisms at work within the dynamics of the emergence, structuring, coordination and development of the phenomena of the clustering and networking of [entrepreneurship and] innovation processes remains incomplete, dispersed and (let's admit it) fairly flimsy" (Depret and Hamdouch 2011, p. 231). Almost all the different approaches of TIES relate to realities (semantic, topographical, and contextual) which differ depending on the authors, for different reasons (Hamdouch and Depret 2009).

Clusters and Networks in the Entrepreneurship (and Innovation) Literature

In fact, it is believed here that the TIES literature is mainly organized around three major structuring dimensions, which partly overlap (Fig. 1). These dimensions refer respectively to the cultural and political territorial anchorage ("geocentric" or "polycentric") of TIES, to the degree to which they are open to "the outside," and to the nature of the inter-dependences ("competitive" or "reticular") between the actors. The combination of these three dimensions results in eight possible approaches of the notion of TIES that can be related to two bundles of works: The first group gathers the traditional approaches which build on the triple hypothesis of a strong territorial anchorage of the actors, of a strict impermeability of the territory vis-à-vis other territories, and of relationships among the actors mainly based on transactions or contracts; the second bundle relates to "evolutionary" approaches which postulate a spatially multiscalar, open, and networked view of the territory.



Clusters, Networks, and Entrepreneurship, Fig. 1 Drawing the "tree" of TIES approaches: a suggested 3-dimensional typology

The Traditional Approaches of Clusters and Networks

To analyze clusters and networks, it is then necessary to open "the 'black box' of the TIES approach" (Depret and Hamdouch 2009). In order to progress toward a better understanding of what "TIES" are or might actually be, it is necessary to change the analytical framework, and the manner in which TIES are traditionally studied (Hamdouch and Depret 2009). Indeed, within this framework the TIES appear to be at the same time (see Fig. 1):

"Geocentered" (i.e., Localized or Regionalized)

In this case, most TIES are generally defined as being very strongly (spatially) embedded in a territory (a district, a city, a region, a country) that is more or less extensive but which is still relatively well (spatially) defined (clusters, districts, parks, areas, *milieux*, cities, agglomerations, regional or national innovation system, etc.) (Hamdouch and Depret 2009).

In this perspective, the emphasis is placed, on the one hand, on the decisive role played by co-location, geographical proximity (preemptive access to knowledge, skills, resources, and strategic technologies, localized collective learning effects, access to new outlets, etc.) and spatial clustering effects (technological externalities of agglomeration), and on the other hand, on the formative importance of territorialized (technological, institutional, and economic) dynamics (Depret and Hamdouch 2011). This is why entrepreneurs, in this theoretical framework, should start and develop their businesses within the TIES where R&D centers of excellence, large companies, funding institutions, specialized business services, and other entrepreneurs are located.

"Centripetal" (i.e., Territorially Closed or Anchored or "Autarkic")

In this approach, the territorial bounding of the TIES is relatively strict, insofar as the other spatial scales have a relatively secondary or marginal role in this (Gordon and McCann 2000), although they are sometimes taken into account (Hamdouch and Depret 2009).

From this perspective, the authors focus on only one territorial scale and therefore mainly (even exclusively) on the only actors of innovation that are to be found there. The TIES therefore appear here to be "closed" systems (Bell and Albu 1999), relatively closed to the outside (even autarkic) (Hamdouch and Depret 2009). However, this doesn't seem to be detrimental to the territory's competitiveness, in view of the fact that, from this "centripetal" perspective, knowledge and resources are mainly distributed within the territory (and in all cases are distributed better than between the territories) (Jaffe et al. 1993).

The emphasis is therefore placed on the presence, within the TIES, of "pulling" or central actors socially embedded: star scientists, critical interfaces, intermediate actors or gatekeepers, entrepreneurial investors, business leaders (or anchors) or pioneer entrepreneurs, dense social networks, etc. (Hamdouch and Depret 2009; Depret and Hamdouch 2011).

From this perspective, extra-territorial relationships are an exception or a "second best" (Audretsch and Stephan 1996) because the extra-local level "comes as a supplement to relationships and properties pertaining to the local level" (Lagendijk 2002, p. 84).

And/or "Market-Dominated" (i.e., Exclusively Targeting Economic Competitiveness)

In this case, competition and the externalities of knowledge represent the two engines of competitiveness of the TIES (Hamdouch and Depret 2009). They therefore contribute toward "organizing" relations between actors within the TIES, by favoring the entrepreneurship and the distribution of knowledge and by encouraging actors to invest in R&D.

This approach thus presents the TIES as a specific spatial industrial organization based on two main dimensions: the links between actors in terms of geographical proximity, of complementarities, and of trustworthy relationship building, and the existence of both competitive and cooperative interactions among the co-localized entrepreneurs and firms (Hamdouch and Depret 2009; Hamdouch 2010). In other words, they "represent a kind of new organizational form in between arm's length markets on the one hand, and hierarchies, or vertical integration, on the other" (Porter 1998, p. 79). In this way, the inter-organizational and inter-individual relationships formed within TIES are generally seen from a contractual or transactional (market-oriented) perspective (Cooke 2005). Cooperation between the actors is only considered in logic of "coopetition" (Gordon and McCann 2000). In this perspective, the performance of the TIES will depend on the "right balance" between the intensity of competition and the heterogeneity (of actors) within the TIES (Bathelt and Taylor 2002). On the one hand, the probability of survival for the entrepreneurs will be weak if the competitive pressure is too strong. On the other hand, a too strong heterogeneity will translate into a greater number of surviving entrepreneurs but that are likely to be in average less creative/innovative and of smaller size.

In this approach, the relationships formed within TIES are generally seen from a purely transactional, contractual, or market-oriented perspective (Cooke 2005; Depret and Hamdouch 2011). Networks are often presented as fairly informal (Grabher 2006), sometimes decontextualized (Dicken and Malmberg 2001) – that is, without any real (social, informational, or cognitive) considerations – and sometimes even seen from a static (Garretsen and Martin 2010) or a-historical (Bathelt and Taylor 2002; Boschma and Frenken 2006) viewpoint (Depret and Hamdouch 2011). In this context, "nonmarket relationships" (entrepreneurial, institutional, cultural, jurisdictional, etc.) appear to be, in the TIES, as mere pecuniary positive externalities that can feed the economic growth and create jobs within the territory.

The emphasis is therefore placed on the (apparently necessary) "critical size" of TIES (Porter 1998; Orsenigo 2001; Folta et al. 2006; Trippl and Tödtling 2007). The performance of TIES is usually measured by the number of entrepreneurs, firms, and institutions of innovation that are present (or created) in the territory and by their R&D expenditure, the number of patents (or scientific articles), the number of employees, etc. (Audretsch and Stephan 1996; Suarez-Villa and Walrod 1997; Orsenigo 2001; Prevezer 2001; Trippl and Tödling 2007; Zucker and Darby 2007; Aharonson et al. 2008). The TIS therefore compete to attract (or to retain) the most competitive actors in their territory (Hamdouch and Depret 2009). Within this framework, the increasing integration of innovation actors fosters interaction and new connections; creates new investment, entrepreneurial, and recruitment opportunities; helps to develop supporting infrastructures; and, in fine, creates a "climate" that is a priori relatively favorable to entrepreneurship and innovation (Baptista and Swann 1998). Cumulatively, spatial integration also heightens the attractiveness (Bathelt 2005) of the territory and the performance of its members through "increasing agglomeration and proximity returns" (Depret and Hamdouch 2011) and the mimetic effects of a self-fulfilling and self-strengthening reputation (Appold 2005).

Other studies (Audretsch and Stephan 1996; Dicken and Malmberg 2001; Kaiser and Prange 2004; Wolfe and Gertler 2004; Casper and Murray 2005; Jong 2006; Trippl and Tödling 2007; Waxell and Malmberg 2007) focus on the central role played by the existence of a wide and diverse (local) labor market because it fosters the dissemination of knowledge and facilitates interaction (Hamdouch and Depret 2009; Depret and Hamdouch 2011). Most of the contributions also emphasize the major role of financial markets, investors, and business angels (Kaiser and Prange 2004; Zucker and Darby 2007).

Finally, they highlight the importance of a certain number of key actors, who, by their sufficient presence within a TIES, will play a critical role as coordinators, go-betweens, advisors, scrutinizers, and proselytes (Prevezer 2001; Wolfe and Gertler 2004; Hamdouch and Moulaert 2006; Trippl and Tödling 2007; Waxell and Malmberg 2007; Champenois 2008). This is why various "support stakeholders" (local institutions, business service organizations, technology transfer institutions, business incubators, think tanks, etc.), infrastructures (property, transport, etc.), venture capital, consulting and law firms have an important position in the TIES

(Hamdouch and Depret 2009; Depret and Hamdouch 2011).

The Evolutionary Approaches of Clusters and Networks

When these three hypotheses (i.e., local anchorage, weak openness, and market-dominated logics) are jointly (or, at least, by pairs) postulated, like it is often the case, TIES appear to be strongly anchored within the territory, with little room for openness toward the "outside" and based essentially on market-like relationships. This is the rationale explaining why various authors have attempted during the last few years to go beyond this restrictive vision of TIES by adopting an alternative approach (see Fig. 1) that is at the same time:

More "Polycentric" (or Multi-Territorialized or Scattered or Nested)

This approach places the emphasis more on the logics of organizational or cognitive proximity than on spatial proximity (Carrincazeaux et al. 2001; Boschma 2005). They consider that it is no longer so much the co-localization of actors which matters but more the nature and intensity of their "connectivity" (Amin and Cohendet 2005; Depret and Hamdouch 2011).

From this polycentric perspective, the TIES have an anchorage that is either transversal or multi-territorialized (Hamdouch and Depret 2009). In the first case, TIES is part of a (sectoral or technological) system, community, world or mode of production, or value chain. This "system" transcends geographical boundaries (Depret and Hamdouch 2011). In the second case, TIES are very clearly seen as being multi-anchored to several territories (more or less distant geographically) (Coenen et al. 2004). In some cases, TIES are multi-spatialized when a network-firm serves as a *node* (Amin and Thrift 1992; Gertler and Levitte 2005) between different spatial locations or scales (Hamdouch and Depret 2009).

More Centrifugal (or Openness-Based)

From this perspective, agglomeration dynamics are generally deployed under a constant tension between, on the one hand, the need to develop strong, cohesive relationships between the local innovative actors, and, on the other hand, the need to preserve a certain "permeability" (Bathelt and Taylor 2002) *vis-à-vis* outside actors (including sometimes geographically distant actors) in order to benefit from complementary cognitive or financial inputs (Lagendijk 2002; Wolfe and Gertler 2004; Depret and Hamdouch 2009). The different spatial scales therefore fit together (Depret and Hamdouch 2011), one inside the other, while impacting on each other (Dicken et al. 2001; Wolfe and Gertler 2004; Moodysson et al. 2008). In this way, exchanges outside the TIS are often more favorable to the transfer of knowledge than exchanges within these TIES. In fact, "local exchanges are often based on weak or routine links that only rarely (Bathelt et al. 2004) or insufficiently (Asheim 2002) foster learning, knowledge transfer, and synergetic effects and, therefore, major innovations" (Depret and Hamdouch 2011, p. 246). Actually, relatively distant actors at the geographical level can perfectly build and sustain over the long run "strong ties," interact (physically and/or virtually) on a recurrent basis, and exchange among them even tacit pieces of knowledge and competences (Breschi and Lissoni 2001; Gertler 2003; Bathelt et al. 2004; Bresnahan et al. 2004; Amin and Cohendet 2005; Niosi and Zhegu 2005; Torre 2006; Glückler 2007). Equally, several researches show that, beyond a certain degree (even intrinsically), spatial proximity does not impact (or insufficiently) on knowledge creation or dissemination and on innovativeness within the territory (Grotz and Braun 1997; Suarez-Villa and Walrod 1997; Wever and Stam 1999). Lastly, several researchers point out the fact that spatial proximity may well generate negative agglomeration externalities that can be higher than the expected positive externalities of agglomeration and closeness (Nooteboom 2000; Boschma 2005; Torre 2006).

As a matter of fact, most of the entrepreneurs and other actors of innovation processes within the TIES have often more (or stronger) ties with external than with internal actors of the TIES (Depret and Hamdouch 2009). This is particularly the case when local entrepreneurs must look "elsewhere" for the knowledge, competences, or resources they need but cannot find "locally" (Hussler and Rondé 2005). In this way, the probability of innovating is greater for firms benefiting from a favorable "local *milieu*" but also from close links with global networks of knowledge, capital, and people (Gertler and Levitte 2005; Depret and Hamdouch 2011). The dynamism of TIES also "depends on the capacity of their members to absorb knowledge outside the territory and to subsequently disseminate this within their own territory in order to 'hybridize' them with the knowledge or innovations" (Depret and Hamdouch 2011, p. 250) developed locally (Bathelt and Taylor 2002). Consequently, the entrepreneurship and innovation process can be seen as "a result of a 'combinaison' of close and distant interactions" (Oinas 1999, p. 365). Some authors (Lagendijk 2002; Powell et al. 2002; Nachum and Keeble 2003; Saxenian and Li 2003) even show that the openness of the TIS "does not necessarily translate into a reduction of the intensity and density of local links" (Depret and Hamdouch 2011, p. 247). In contrast, this openness may represent a factor in making (inter-organizational) relationships more viable and stronger (Powell et al. 2002; Owen-Smith and Powell 2004). This appears to be the case including for entrepreneurs and small-medium enterprises that can tap in "external" sources of knowledge, competences, or funding they cannot find (or not anymore) within their TIES. By a matter of fact, these enterprises are usually more developed (in terms of size), more mature (in terms of organizational and strategic experience), and positioned more downstream in R&D processes (i.e., more "close to the market") than the average of innovating enterprises (Powell et al. 2002).

Some authors stress the risk, for local stakeholders, of a progressive and often irreversible cognitive lock-in within TIES (Granovetter 1985; Uzzi 1997; Bathelt 2005), which is sometimes fatal (Camagni 1995). Worse, certain TIES "contain the seeds of their own destruction and may potentially disappear or die (. . .) if they [don't] develop ways to access external markets, adjust power relations in a fluid way and reproduce [their] structures through 'powerful' institutions" (Bathelt and Taylor 2002, p. 106, authors' square brackets).

And More Reticular

From this perspective, TIES and networks are inseparable from the logics of the spatial and strategic organization of innovation (Dicken et al. 2001; Cooke 2005; Grabher 2006). Relationships among actors within (and sometimes between) the TIES are usually based on formal *and* informal ties that refer to a "coopetitive" or non-strictly market-oriented logic (i.e., a mix of competition and cooperation) rather than on formal (i.e., through legal contracts or agreements) market-oriented rationales (Moulaert and Mehmood 2010).

Within this alternative framework, networks (and particularly inter-individual "social networks," in the original sense of local and physical or concrete interplay among co-located people or connections thanks to acquaintances or "go in between" people or whatever "bridge" role that some individuals, sometimes unforeseen, can occasionally play) are the core explanation of the co-location of innovation actors in some specific places, starting with "entrepreneurs," that is, researchers, potential innovators, and business-project's oriented actors. Hence, the articulation of networks within *and* across TIES appears to be a central component or conditional building block for a territorial (open) clustering dynamics.

This articulation of TIES and networks vary however, depending on the authors (for a detailed analysis, see, e.g., Hamdouch and Depret 2009; Depret and Hamdouch 2011). *A minima*, TIES can be considered as simple networks of actors, more or less co-localized in one territory (and sometimes in several territories). As a result, many approaches in the literature mostly come under the "market-oriented perspective" (see above). Indeed, in such approaches, networks are, roughly speaking, supposed to yield positive effects on entrepreneurs' performance (Baum et al. 2000). Entrepreneurs' relationships with large companies, research institutions, or universities are supposed to attenuate the inherent uncertainties related to their "youth in business." Accordingly, their initial performance increases along with their more or less size of "alliance networks" with "institutionalized partners" (Baum et al. 2000) but also with the "diversity" of such networks and partners (Owen-Smith and Powell 2004). The "age" of the network is also decisive. Indeed, Stuart (2003) shows how entrepreneurs have a greater probability to be funded further by a potential investor if they have already formed alliances (trustworthiness effect) with previous funders/investors and if the time run since their first alliance has been enough long to set a "good reputation." However, alliance networks are also "risky games": They can be a source of vulnerability for "candidate entrepreneurs," given the risks of opportunistic behavior from the "partners." This being said, some researchers rest on the conviction that "reputation effects" (both related to entrepreneurs and potential funders or "allies") play, in most situations, a greater role than short-sighted opportunistic behavior (Owen-Smith and Powell 2004; Hamdouch 2008).

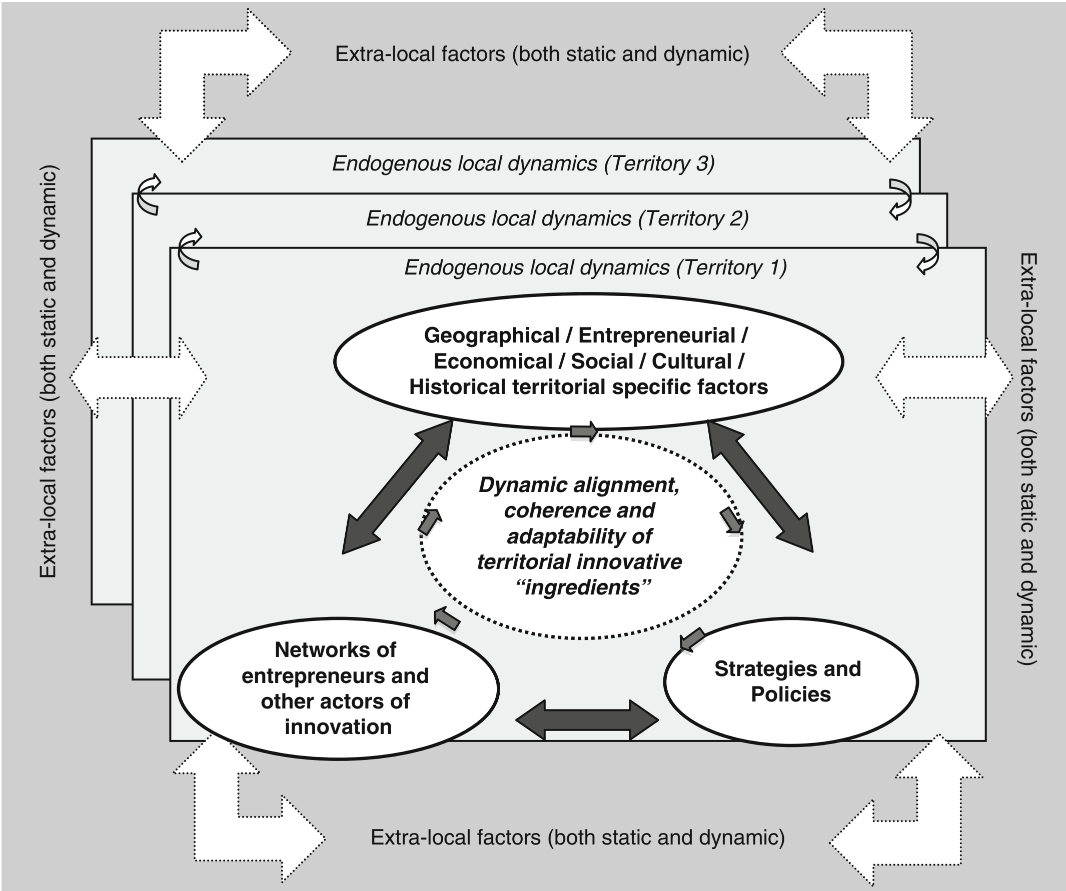
Moving further, other researches tends to show the importance of social networks and relationships, and of trust, reputation, altruism, friendship, leniency, forbearance, kindliness, integrity, social capital, *habitus*, culture, rules, conventions, routines, rites, symbols, taboos, beliefs, myths, or, more broadly, "extra-market" relationships (Castilla et al. 2000; Moulaert and Sekia 2003; Ter Wal and Boschma 2009).

For some, however, this approach seems to be locked into an overterritorialized view about the embeddedness of TIES (Coe et al. 2004). This is why some advocate a more integrated (even coevolutionary) vision of TIS and networks. In this network governance approach (Grabher 2006), TIES are no longer (only) considered as geographically "anchored" networks, within which actors are grouped together more or less on a co-localization basis (Depret and Hamdouch 2011). They appear more as combinations of "multi-scaled networks," in terms of both location and the variety of actors' modes of interaction (Hamdouch 2010). From this viewpoint, TIES and networks are intimately connected (Amin and Thrift 1992; Dicken et al. 2001; Nachum and Keeble 2003; Coe et al. 2004; Phlippen and van der Knaap 2007). TIES are seen as being juxtaposed and coevolving with each other (see Fig. 2). The different spatial scales fit into this, one into the other, each having an impact on the other (Wolfe and Gertler 2004). Following this line of thought, one can say that, "while networks are embedded within territories, territories are, at the same time, embedded into networks" (Dicken et al. 2001, p. 97), so that "the global economy is constituted by 'spaces of networks relations" (Dicken et al. 2001.) or, to put it differently, it builds on "multi-scaled networks of networks" (Hamdouch 2010).

The TIES, as a cluster, is also "a complex-networked entity that is systemic, structured (around stakeholders with highly varied organizational or institutional profiles), polymorphic, dynamic (that is, it evolves over time and in space) and relatively open to the outside world (that is, 'centrifugal') or even 'multiscalar' (or polycentric)" (Depret and Hamdouch 2011, p. 230). In this way, TIES is a web of social networks comprising a potentially large variety of entrepreneurial and innovation stakeholders who interact (or coevolve) within the framework of occasional or regular relationships, both inter- and intraorganizational, and who contribute to the performance of activities in a particular area (Depret and Hamdouch 2011, p. 232).

Finally, more often than advanced in the literature, the co-location of innovation actors within TIES is neither motivated by market-oriented purposes nor, intentionally, structured around networks.

As highlighted by Markusen (1996) and Torre (2006), it can sometimes be the result of diverse other factors (e.g., attractive property prices, tax breaks, the quality of the local employment market, the "critical size" of the outlets offered by the local market, the reputation of the TIES). It can even, in certain cases, be the result either of a "historical accident" or a "non-choice" (Champenois 2008) of purely subjective individual factors (Autant-Bernard et al. 2007), or even of a "copycat effect" (Appold 2005; Gertler and



Clusters, Networks, and Entrepreneurship, Fig. 2 A schematic representation of TIES time-space evolution dynamics (Source: Authors, inspired by Hamdouch and d'Ovidio 2009)

Levitte 2005) of "chain location" (Caplin and Leahy 1998). Certain works, some of which are quite "old," have equally shown that culture, well-being, diversity, "social glue," learning, social movements and "bottom-up" socially creative initiatives, governance modes, social conventions, ethical shared values or norms of behavior, "solidarity" among the actors, etc., can highly contribute (as much as economic and scientific, technological, business or financial networking processes) to the long-term territorial dynamics and therefore to TIES development trajectories and socioeconomic "achievements" (see Moulaert and Mehmood 2010).

Building on this three-dimensional analysis (see Fig. 1), it comes that at least eight "manners" for conceiving TIES can be envisaged. It comes also that there are as much varied ways to design policies aiming at promoting/supporting the development of entrepreneurship initiatives and successful outcomes.

Clusters, Networks, and Entrepreneurship Policies

During the last three decades, geographical borders have tended to become more permeable (through the influence of external factors) and, as a result, they subject national and regional spaces to developments (entrepreneurial, scientific, technological, institutional, economic, strategic, and organizational) that are in part influenced by dynamics that are external to the territories, e.g., strategies of multinational firms, monetary and economic developments at the global level, regional integration policies and their effects, free trade agreements, etc. (see Hamdouch and Moulaert 2006; Depret and Hamdouch 2011).

At the same time, the growing spatial interdependencies between actors of innovation – exacerbated on the one hand by interregional integration processes, globalization of economies, internationalization, and "networking" of firms, on the other by policies of devolution and regionalization at the infra-national level – tend to redefine the space and the modalities of expression of their respective rationalities and of their modes of interaction and, as a result, to link different spatial levels in the determination and evolution of institutional frameworks within which the processes of territorial entrepreneurship and innovation take place (cf. Hamdouch and Moulaert 2006; Depret and Hamdouch 2011).

It is in this context that the idea has been developed that it is within TIES (see above) that added entrepreneurial opportunities, value, growth, and, ultimately, jobs are created today. In the same time, the comparative advantage of TIES is not longer exclusively depends on the simple mobilization of the resources with which they have been provided by "nature," history, geography, institutions, or contingency. Competitiveness in markets, which have become global, requires the access to a wide range of (entrepreneurial, financial, and cognitive) resources and technological skills. "Hence the emphasis placed on greater proximity and closer coordination between the various 'holders' of resources and skills. In an environment characterized by a redistribution of spatial and sectoral 'cards' between" the different innovation "players" and entrepreneurs, the "comparative advantage lies in the ability of rival yet complementary actors(. . .) to manage increasingly close and structural" including extra-market interdependencies within an extremely wide range of clusters [TIES] and networks (Depret and Hamdouch 2011, p. 228, authors' square brackets).

Indeed, the governments (at all levels of territorial organization) are now multiplying the (TIES's) politics which aim to place entrepreneurship and innovation at the heart of their economic development strategies (Hamdouch and Depret 2009). These policies are differentiated across territories depending on the way public authorities conceive the TIES that exists or that they want to promote and develop (see Fig. 1).

Conclusion and Future Directions

Entrepreneurship and innovation dynamics, as related to specific territorial and institutional settings and evolution paths, appear to multifaceted phenomena. As illustrated by the literature reviewed and the analytical typology presented, it is rather clear that there are very contrasted approaches to TIES, though the reality offers concrete territorial dynamics that are probably lying along a continuum of configurations rather than matching "discrete" models of TIES. Equally important is the intertwining of clustering and networking phenomena in the shaping, deployment, and evolution of TIES. And it is this dynamic articulation between the two phenomena that constitutes a robust argument for conceiving TIES as multiscalar and rather "open" territorial settings that can best favor viable entrepreneurship and innovation processes over the long range. Finally, public policies appear to be capable of influencing the shape and evolution of the TIES they can influence, under the condition, however, that these policies are dynamically aligned with the strategies and networks deployed by local innovation and entrepreneurship actors, both inside and outside the TIES.

As regards future directions for research efforts, two axes should be privileged. The first one, mostly theoretical, is related to the effort that is still to be engaged for a better characterization of TIES and the configurations they may underlie. The second axis is essentially methodological and empirical. It relates both to the selection of efficient criteria and empirical methods (converging or complementary ones if possible) and to the realization of in-depth case studies on a comparative basis.

Cross-References

- ▶ Business Emergence
- ▶ Business Start-Up: From Emergence to Development
- ▶ Entrepreneur
- ▶ Entrepreneurial Opportunities
- ▶ Entrepreneurial Organizations
- ▶ Entrepreneurship and Financial Markets
- ▶ Entrepreneurship Policies
- ▶ Entrepreneurship Policy
- ▶ Innovation and Entrepreneurship
- ▶ Innovative Milieu as a Driving Force of Innovative Entrepreneurship
- ▶ Innovative Milieux and Entrepreneurship (Volume Entrepreneurship)
- ▶ Innovator
- ▶ Multilevel Innovation Systems
- ▶ Network and Entrepreneurship
- ▶ Networking Entrepreneurship
- ▶ Partnerships and Entrepreneurship (Vol Entrepreneurship)
- ▶ Social Networks and Entrepreneurship
- ▶ Territory and Entrepreneurship

References

Aharonson BS, Baum JAC, Plunket A. Inventive and uninventive clusters: the case of Canadian biotechnology. Res Policy. 2008;37:1108–31.

Amin A, Cohendet P. Geographies of knowledge formation in firms. Ind Innov. 2005;12:465–86.

Amin A, Thrift N. Neo-Marshallian nodes in global networks. Int J Urban Reg Res. 1992;16:571–87.

Appold S. Location patterns of US industrial research: mimetic isomorphism and the emergence of geographic charisma. Reg Stud. 2005;39:17–39.

Asheim BT. Temporary organisations and spatial embeddedness of learning and knowledge creation. Geogr Ann. 2002;B84(2):111–24.

Audretsch DB, Stephan P. Company-scientist locational linkages: the case of biotechnology. Am Econ Rev. 1996;86:641–52.

Autant-Bernard C, Billand P, Frachisse D, Massard N. Social distance versus spatial distance in R&D cooperation: empirical evidence from European collaborations choices in micro and nanotechnologies. Pap Reg Sci. 2007;86:495–519.

Baptista R, Swann P. Do firms in clusters innovate more? Res Policy. 1998;27:525–40.

Bathelt H. Cluster Relations in the media industry: exploring the "distanced neighbour" paradox in Leipzig. Reg Stud. 2005;39:105–27.

Bathelt H, Taylor M. Clusters, power and place: inequality and local growth in time-space. Geogr Ann. 2002; B84:93–109.

Bathelt H, Malmberg A, Maskell P. Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. Prog Hum Geogr. 2004;28(1):31–56.

Baum JAC, Calabrese T, Silverman BS. Don't go it alone: alliance networks composition and startups' performance in Canadian biotechnology. Strat Manag J. 2000;21(3):267–94.

Bell M, Albu M. Knowledge systems and technological dynamism in industrial clusters in developing countries. World Dev. 1999;27(9):1715–34.

Boschma RA. Proximity and innovation: a critical assessment. Reg Stud. 2005;39:61–74.

Boschma RA, Frenken K. Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. J Econ Geogr. 2006;6:273–302.

Breschi S, Lissoni F. Knowledge spillovers and innovation systems: a critical survey. Indust Corp Change. 2001;10(4):975–1005.

Bresnahan T, Gambardella A, Saxenian A. "Old economy" inputs for "new economy" outcomes: cluster formation in the new silicon valleys. Indust Corp Change. 2004;10(4):835–60.

Camagni R. Global network and local Milieu: towards a theory of economic space. In: Conti S, Malecki EJ, Oinas P, editors. The industrial enterprise and its environment. Aldershot: Avebury; 1995. p. 195–214.

Caplin A, Leahy J. Miracle on sixth avenue: information externalities and search. Econ J. 1998;108:60–74.

Carrincazeaux C, Lung Y, Rallet A. Proximity and localisation of corporate R&D activities. Res Policy. 2001;30:777–89.

Casper S, Murray F. Careers and clusters: analyzing the career network dynamic of biotechnology clusters. J Engin Technol Manag. 2005;22:51–74.

Castilla E, Hwang H, Granovetter E, Granovetter M. Social networks in silicon valley. In: Moon-Lee C, Miller WF, Cong Hancock M, Rowen HS, editors. The silicon valley edge. Stanford: Stanford University Press; 2000. p. 218–47.

Champenois C. La co-localisation d'entreprises innovantes comme non-choix: L'exemple de l'industrie allemande des biotechnologies. Géographie Economie Société. 2008;10:61–86.

Coe NM, Hess M, Yeung HWC, Dicken P, Henderson J. "Globalizing" regional development: a global production networks perspective. Trans Inst Br Geogr. 2004;29:468–84.

Coenen L, Moodyson J, Asheim BT. Nodes, networks and proximities: on the knowledge dynamics of the medicon valley biotech cluster. Euro Plann Stud. 2004;12:1003–18.

Cooke P. Regionally asymmetric knowledge capabilities and open innovation exploring “Globalization 2”: A new model of industry organisation. Res Policy. 2005;34:1128–49.

Depret M-H, Hamdouch A. Clusters, réseaux d’innovation et dynamiques de proximité dans les secteurs high-tech: une revue critique de la littérature récente. Revue d’Economie Industrielle. 2009;128:21–52.

Depret M-H, Hamdouch A. Multiscalar clusters and networks as the foundations of innovation dynamics in the biopharmaceutical industry. Région et Développement. 2011;33–2011:227–68.

Dicken P, Malmberg A. Firms in territories: a relational perspective. Econ Geogr. 2001;77:345–63.

Dicken P, Kelly PF, Olds K, Yeung HW-C. Chains and networks, territories and scales: towards a relational framework for analyzing the global economy. Glob Netw. 2001;1:89–112.

Folta TB, Cooper AC, Baik Y-S. Geographic cluster size and firm performance. J Bus Venturing. 2006;21:217–42.

Garretsen H, Martin R. Rethinking (New) economic geography models: taking geography and history more seriously. Spat Econ Anal. 2010;5:127–60.

Gertler MS. Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there). J Econ Geogr. 2003;3(1):75–99.

Gertler MS, Levitte YM. Local nodes in global networks: the geography of knowledge flows in biotechnology innovation. Ind Innov. 2005;12:487–507.

Glückler J. Economic geography and the evolution of networks. J Econ Geogr. 2007;7(5):619–34.

Gordon IR, McCann P. Industrial clusters: complexes, agglomeration and/or social networks? Urban Stud. 2000;37:513–32.

Grabher G. Trading routes, bypasses and risky intersections: mapping the travels of “networks” between economic sociology and economic geography. Prog Hum Geogr. 2006;30:163–89.

Granovetter M. Economic action and social structure: the problem of embeddedness. Am J Sociol. 1985;91(3):481–510.

Grotz R, Braun B. Territorial or trans-national networking: spatial aspects of technology-oriented Co-operation within the German mechanical engineering industry. Reg Stud. 1997;31(6):545–57.

Hamdouch A. Start-up biotechnologiques et dynamique des clusters et réseaux d’innovation dans la biopharmacie: une revue de la littérature empirique. Journal des Entreprises Familiales. 2008;1(3):8–43.

Hamdouch A. Conceptualizing innovation clusters and networks. In: Laperche B, Sommers P, Uzunidis D, editors. Innovation clusters and networks. Brussels: Peter Lang; 2010.

Hamdouch A, Moulaert F. Knowledge infrastructure, innovation dynamics and knowledge creation/diffusion/accumulation processes: a comparative institutional perspective. Innov Euro J Soc Sci Res. 2006;19:25–50.

Hamdouch A, d’Ovidio M. Expected and unexpected creative cities. Is there an “Alchemy” of territorial creative dynamics? ESDP conference, Aveiro, 21–22 June; 2009.

Hamdouch A, Depret M-H. Surveying the literature on territorial innovation systems: a suggested interpretation framework. SSRN Working Papers Series, 22 p; 2009.

Hussler C, Rondé P. Les réseaux d’innovation des chercheurs universitaires sont-ils géographiquement circonscrits ? Revue d’Economie Industrielle. 2005;109:69–90.

Jaffe AB, Trajtenberg M, Henderson R. Geographic localisation of knowledge spillovers as evidenced by patent citations. Quart J Econ. 1993;108:577–98.

Jong S. How organizational structures in science shape spin-off firms: the biochemistry departments of Berkeley, Stanford, and UCSF and the Birth of the biotech industry. Indust Corp Change. 2006;15: 251–83.

Kaiser R, Prange H. The reconfiguration of national innovation systems: the example of German biotechnology. Res Policy. 2004;33:95–408.

Lagendijk A. Beyond the regional lifeworld against the global systemworld: towards a relational-scalar perspective on spatial-economic development. Geogr Ann. 2002;B84(2):77–92.

Markusen A. Sticky places in slippery space: a typology of industrial districts. Econ Geogr. 1996;72: 293–313.

Moodysson J, Coenen L, Asheim BT. Explaining spatial patterns of innovation: analytical and synthetic modes of knowledge creation in the medicon valley life science cluster. Environ Plann. 2008;A40: 1040–56.

Moulaert F, Mehmood A. Analysing regional development and policy: a structural-realist approach. Reg Stud. 2010;44:103–18.

Moulaert F, Sekia F. Territorial innovation models: a critical survey. Reg Stud. 2003;37:289–302.

Nachum L, Keeble D. Neo-marshallian clusters and global networks: the linkages of media firms in central London. Long Range Plann. 2003;36:459–80.

Niosi J, Zhegu M. Aerospace clusters: local or global knowledge spillovers? Ind Innov. 2005;12(1): 5–29.

Nooteboom B. Learning by interaction: absorptive capacity, cognitive distance and governance. J Manage Govern. 2000;4(1–2):69–92.

Oinas P. Activity-specificity in organizational learning: implications for analyzing the role of proximity. GeoJournal. 1999;49:363–72.

Orsenigo L. The (Failed) development of a biotechnology cluster: the case of Lombardy. Small Bus Econ. 2001;17:77–92.

Owen-Smith J, Powell WW. Knowledge networks as channels and conduits: the effects of spillovers in the Boston biotechnology community. Organ Sci. 2004;15:5–21.

Phlippen S, van der Knaap B. When clusters become networks. Tinbergen Institute Discussion Papers, TI 2007-100/3 (2007).
Porter ME. Clusters and the new economics of competition. Harv Bus Rev. 1998;76:77–90.
Powell WW, Koput KW, Bowie JI, Smith-Doerr L. The spatial clustering of science capital: accounting for biotech firm-venture capital relationships. Reg Stud. 2002;36:291–305.
Prevezer M. Ingredients in the early development of the U.S. biotechnology industry. Small Bus Econ. 2001;17:17–29.
Saxenian A, Li W. Bay-to-Bay strategic alliances: network linkages between Taiwan and U.S. venture capital industries. Int J Technol Manag. 2003;25: 136–50.
Stuart TE. Governing strategic alliances. In: Buskens V, Raun W, Snidjers C, editors. Research in the sociology of organizations. 20th ed. Greenwich: JAI Press; 2003. p. 189–208.
Suarez-Villa S, Walrod W. Operational strategy, R&D and Intra-metropolitan clustering in a polycentric structure: the advanced electronics industries of Los Angeles. Urban Studies. 1997;34:1343–80.
Ter Wal ALJ, Boschma RA. Applying social network analysis in economic geography: framing some key analytic issues. Ann Reg Sci. 2009;43: 739–56.
Torre A. Clusters et systèmes locaux d'innovation: retour critique sur les hypothèses naturalistes de transmission des connaissances à l'aide des catégories de l'économie de la proximité. Région et Développement. 2006;24:15–44.
Trippl M, Tödtling F. Developing biotechnology clusters in non-high technology regions: the case of Austria. Ind Innov. 2007;14:47–67.
Uzzi B. Social structure and competition in interfirm network: the paradox of embeddedness. Adm Sci Q. 1997;42:35–67.
Waxell A, Malmberg A. What is global and what is local in knowledge-generating interaction? The case of the biotech cluster in Uppsala, Sweden. Entrepreneurship Reg Dev. 2007;19:137–59.
Wever E, Stam E. Clusters of high technology SMEs: the Dutch case. Reg Stud. 1999;33(4):391–400.
Wolfe D, Gertler MS. Clusters from the inside and out: local dynamics and global linkages. Urban Stud. 2004;41:1071–93.
Zucker LG, Darby MR. Virtuous circles in science and commerce. Pap Reg Sci. 2007;86:445–70.

Co-citation

▶ Networks and Scientific Innovation

Co-Conception and Entrepreneurial Strategies

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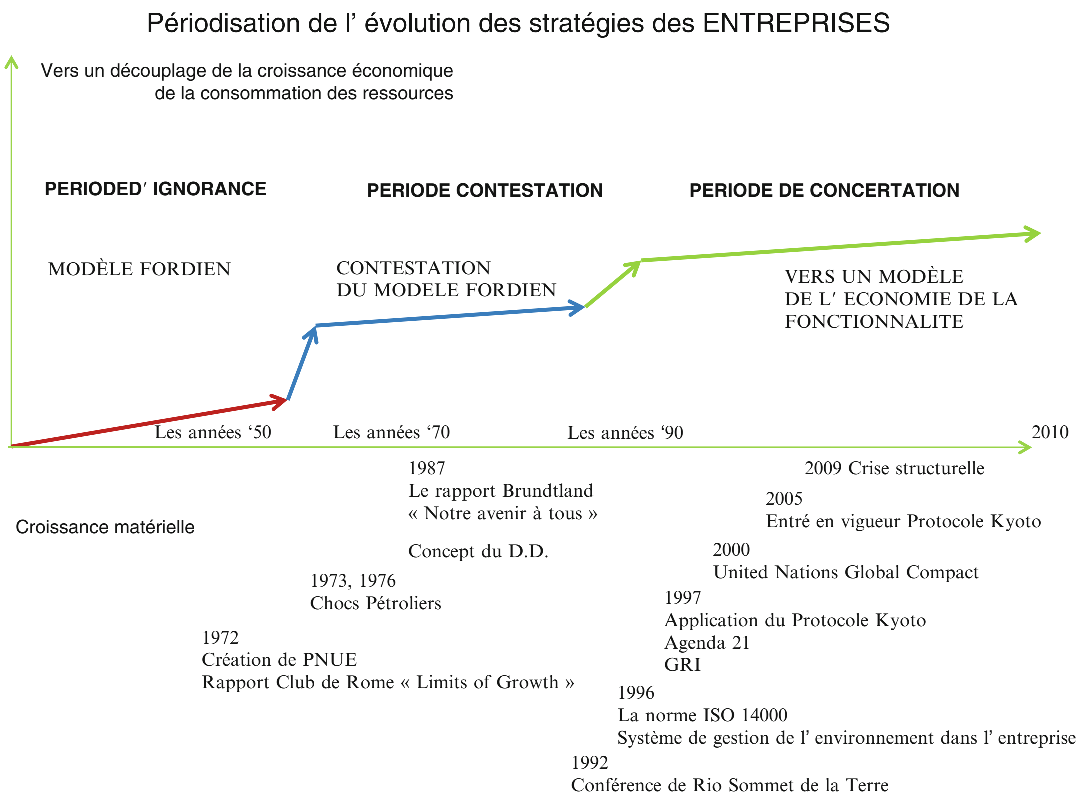
Synonyms

BtoBtoU; Collaborative work; Co-innovation; Marketing

Co-conception will be defined here in the context of the recent evolution in entrepreneurial strategies that value creation in compatibility with sustainable development and that have also lead to important changes in relations with clients (B to B) and with customers (B to C). The place of the client (and customer) in the economic process has changed in the last 60 years, depending on the economic model that has been adopted in different countries. For instance, the Fordism social-economic model from the period of the Thirty Glorious Years imposed a simple transactional relation (Moati and Corcos 2009), with the client meeting the offer of the product exclusively on the market. The "service economy" (Tertre 2006), which developed in the 1970s, relies on the co-conception of the solution with the client in the earlier stages of the economic process, during the conception and the production either of a product, a service, or a Product-Service System (PSS) (Stahel 1997) as solutions to specific needs. This collaboration relation with the client and the stakeholders, rather than a simple transaction relation, assumes organizational changes in terms of corporate management, contractual tools, and new forms of competition. Statistics from the OECD countries show the growth of the service economy (OCDE 2007) based on "service relation" (Gadrey 1996; du Tertre 2006), which brought clients and other stakeholders into the creation of the solution at the point of its conception, especially in the case of entrepreneurial strategies, and even made them a source of creation of new, innovative small and medium enterprises (SMEs).



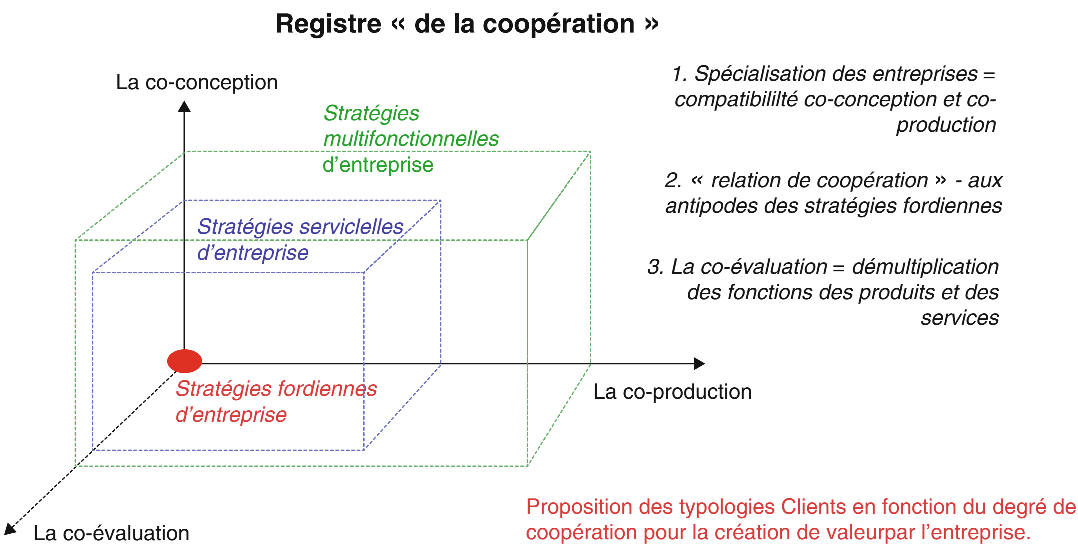
Co-Conception and Entrepreneurial Strategies, Fig. 1 Time line of the evolution of firms' strategies in the context of the increased demand for compatibility with sustainable development (Source: Vaileanu Paun 2010)

The perception of value by the client during the co-conception process resides in exclusive experiences while using the products or experiencing the service that was co-conceived together with the entrepreneur rather than in a transactional relationship. The role of the client will be discussed in the context of the evolution (Boutillier et al. 2010) of the role of the entrepreneur from the exclusive role of profit-maker to a role of shared-value co-creator with client and stakeholders.

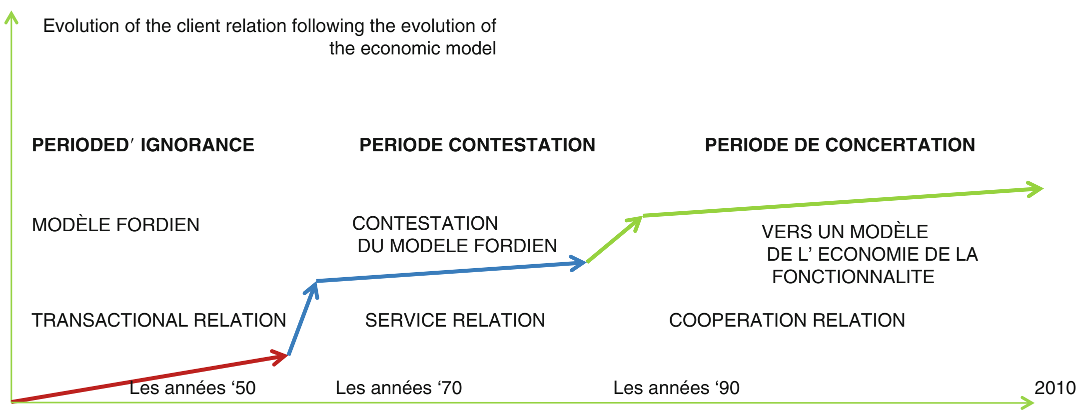
Definition and Process Description

The Co-Conception as a Consequence of the Evolution of the Economic Model: Context of the Concept Development

The context of the emergence and development of co-conception entrepreneurial strategies is important, as the place of the client in the economic process has changed in the last 60 years, following the evolution (Figs. 1–4) of business models in modern societies towards compatibility of economic growth with sustainable development solutions. For instance, the Fordism socio-economic model during the period of the Glorious Thirty Years corresponds to a period that saw social injustices and the destruction of resources, with multinational corporations pushed to achieve productivity gains via product standardization and low production costs, in spite of the social and environmental impacts. This model imposes a "simple transactional relation," with the client meeting the offer of the product exclusively on the market and ignoring the whole product life cycle (maintenance, repair, recycling). The "service economy," developed in the 1970s, relies, in exchange, on the co-conception of the solution with the client in



Co-Conception and Entrepreneurial Strategies, Fig. 2 Evolution of client relations toward collaborative work (Source: Vaileanu Paun 2009)

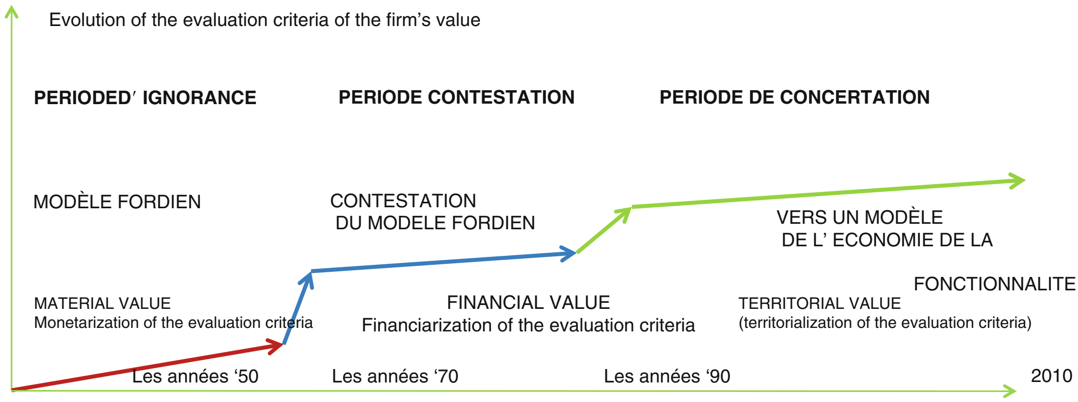


Co-Conception and Entrepreneurial Strategies, Fig. 3 Evolution of the client relation (Source: Vaileanu Paun 2009)

the earlier stages of the economic process, during the conception and the production of a product, a service, or a PSS (Mont 2002). Solutions of this type improve the performance of the result by adapting it to specific multiple needs of the client.

Actors of the Co-Conception

The actors in co-conception strategies are often SMEs, which are capable of investing more resources in adapting offers to their clients, as their economic model is not yet ready for mass production, which is the case with multinationals that are nevertheless experienced with the benefits of co-conception strategies, for instance, in the case of software innovations such as the "lead-user method" (Hippel 1988). The co-conception strategy offers opportunities for entrepreneurial developments, as the client's and stakeholders' contributions represent free resources and capabilities supporting



Co-Conception and Entrepreneurial Strategies, Fig. 4 Evolution of the evaluation criteria of a firm's value (Source: Vaileanu Paun 2009)

ex ante the business development of a SME lacking the financial resources to invest ex post in marketing and promotion but also in compliance with environmental and social constraints. The input of clients and stakeholders, the consumer work (Dujarier, 2008) at an earlier stage of the economic process (Fig. 2) of a SME could spare entrepreneurial investments and thus contribute to sustainable development by adapted use of resources and by integrating negative and positive externalities within a sustainable entrepreneurial business model (Vaileanu Paun 2010).

Impacts and Implications of Co-Conception

The service economy approach brought the client closer to the entrepreneur and encouraged the creation of new SMEs based on this new, virtuous circle of performance-related sales of solutions. Thanks to the co-conception dynamic, entrepreneurs embraced a new position in society, not just as a simple production point but as a "system" (Vaileanu Paun 2009) of related stakeholders with different interests influencing its strategy towards the co-conception of offers capable of providing a coherence between economic, social, and environmental performance. The co-conception collaborative work induces an évolution in the management strategies efficiency évaluation from the dichotomic approaches, either BtoB (Business to Business) or BtoC (Business to Consumer), towards an extended evaluation approach of whole system actors of BtoBtoC (Business to Business to Consumer) or even BtoBtoU (Business to Business to User) (Vaileanu Paun 2009), according to the functional economy concepts. Statistics in the OECD countries show the increase of the service economy (OCDE 2007) based on "service relation" (Gadrey 1996; du Tertre 2006), leading clients (Fig. 3) and other stakeholders to contribute to the creation of the solution in the phase of its conception, especially in the case of entrepreneurial strategies, and even to be the source of creation of new, innovative SMEs.

This collaboration relation with the client and the stakeholders rather than a simple transaction relation assumes organizational changes in terms of corporate management, contractual tools, and new competition forms. The co-conception strategy supposes the capacity and the decision to evolve in collaboration relations during the R&D process, which is more likely to be accepted in SME and entrepreneurial business environments (due to financial constraints and lack of capabilities) than in multinational corporations that are reluctant to share their knowledge with clients and stakeholders. Co-conception also implies a strategy of evaluating the contribution of each of the actors involved in the co-conception as well as the capacity to "reduce or compensate the different asymmetries" (Paun 2011) of the actors to favor co-innovation by entrepreneurs.

The impacts on the evaluation strategies are potentially important, considering the new organizational structure of the economic process and especially the new boundaries of action for the actors involved in this collaborative relation.

The evolution of evaluation criteria (Fig. 4) of a firm's value from an evaluation of the material value during Fordism was followed by the introduction of evaluation of the financial value during the period of contestation of the Fordism. Today, there is a need to integrate the extra-financial value (social and environmental impacts) of the firm. The evaluation methodology tends toward co-evaluation.

Co-evaluation has been perceived by different researchers as a collaborative process involving at least two evaluators in direct contact with the subject of the evaluation, representing more than just an evaluation by peers and possibly in the context of the changes of the post-modern revolution (top–bottom), legitimizing the multiple perspectives.

Co-evaluation, part of the territorialization tendency (Vaileanu Paun & Boutillier 2012) of the evolution criteria involving the stakeholders, is collaborative work and is a dimension of the collaboration relation that allows the actors in the value creation to find, through the co-conception process, a new, virtuous circle by constantly improving the solutions for better performance in terms of better response to needs that are in a dynamic evolution, heterogenic, and non-sectorized.

Structural institutional changes are necessary to encourage value creation based on co-conception. New, shared-value contracts and other contractualization forms of loyalty between the actors in the co-conception process should be specifically guaranteed in today's economic model while also retaining financial evaluation criteria. The issue of property rights to the results of the co-conception process are still to be addressed as the strategy proves its pertinence and gains recognition. An increasing number of SMEs are closer to the clients via adapted co-conceived solutions, whereas their value creation and sharing within society is still subordinate to capitalistic evaluation (Rifkin 2000; Stiglitz et al. 2008), which takes into consideration only the monetary value-driven evaluation system of economic growth today.

Conclusion and Challenges Related to Co-Conception

Entrepreneurial strategy, based on the service economy approach, could provide through the l co-conception strategy new evaluation criteria for value creation and sharing with clients and stakeholders. This new approach is considered pertinent in the context of the evolution of the economic model toward greater socio-economic performance of the firms as a complement to the multinational business model stemming from the Fordism model but potentially generating spin-offs and an entrepreneurial hybridization of market pull and technology push approaches (Paun 2011) for value creation through innovations.

Cross-References

- ▶ Externalities
- ▶ Innovation

References

Boutillier S, et Matagne P. Théories économiques, écologie et histoire, Forum IV Environment, Innovation and Sustainable development, Marseille, 7–8 octobre; 2010.

Du Tertre C. Economie de la fonctionnalité, performance et Développement Durable, colloque de Cerisy des 15–19 juin 2006.

Dujarier, MA. Le travail du consommateur. Comment nous coproduisons ce que nous achetons, Editions La Découverte, p 246; 2008.

Gadrey J. Economie des services, Repères, La découverte (2e édition), Paris; 1996.

Hippel E. (von), The sources of innovation, New York, Oxford University Press; 1988.

Moati P, Corcos A. Des marchés transactionnels aux marchés relationnels une approche théorique pour repenser l'impact des politiques de rétention de la clientèle, Cahiers du CREDOC, NC. Paris: CRÉDO; 2009.

Mont O. Clarifying the concept of product-service system. Journal of Cleaner Production. 2002;10(3):237–45. http://www.iiiee.lu.se/Publication.nsf/$webAll/0E4B621AEE907184C1256CD8003C2115/$FILE/PSS-JCP.pdf.
OCDE. Synthèse de l'étude sur la mondialisation et l'innovation dans le secteur des services aux entreprises, OCDE, Paris; 2007.
Paun F. From managing informational asymmetries towards a systemic asymmetries approach in technology transfer and innovation strategies: An economic analysis of the SME strategy at ONERA – The French Aerospace LabTM, in the IUP Journal of Knowledge Management, p. 27–52, Vol. IX, No. 4; October 2011.
Rifkin J. L'âge de l'accès. La nouvelle culture du capitalisme. Paris: La découverte; 2000.
Stahel W. The functional economy: Cultural and organizational change, in Richards D. J. (Ed.), The industrial green game: Implications for environmental design and management, Washington DC: National Academy Press, p. 91–100; 1997.
Stahel W. The performance economy. Basingstoke [England]/New York: Palgrave Macmillan; 2006.
Stiglitz J, Sen A, Fitoussi JP. Report by the commission on the measurement of economic performance and social progress. Paris: OECD; 2008.
Vaileanu Paun I. Entreprises et territoires dans l'économie de la fonctionnalité. Le cas de EDF, travaux de la première thèse en économie de la fonctionnalité en France, convention CIFRE chez EDF, Université Paris 7 Denis Diderot; 2009.
Vaileanu Paun I. Economie de la fonctionnalité et Smart Grids. DGALN/PUCA: Atelier Bepos et Smart Grids; 2010.
Vaileanu Paun I, Boutillier S. Économie de la fonctionnalité. Une nouvelle synergie entre le territoire, la firme et le consommateur ?, Innovations, 2012/1 n° 37, p. 95–125. doi:10.3917/inno.037.0095; 2012.

Coevolution

▶ Mode 3 Knowledge Production in Quadruple Helix Innovation Systems: Quintuple Helix and Social Ecology
▶ Quality of Democracy and Innovation

Cognition

▶ Cognition of Creativity

Cognition of Creativity

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Synonyms

Cognition; Cognitive science; Divergent thinking; Information processing; Novelty; Originality

Key Concepts and Definition of Terms

Trying to understand creativity has produced a vast literature spanning psychology, anthropology, biology, archaeology, sociology, business, literature, the arts, architecture, design, and several other disciplines. Here is one definition from a recent compendium on creativity: *Creativity may . . . be . . . thought of as the entire system by which processes* [conceptual combination, conceptual expansion, metaphor, analogy, mental model construction, etc.] *operate on* [psychological, social, and cultural] *structures to produce outcomes that are novel but, nevertheless, rooted in existing knowledge* (Ward et al. 1997, p. 18). This brief review of the information available will concentrate on a psychological perspective, but all vantage points add important dimensions to the concept. Psychologists primarily study topics from an individual's point of view, but recent work has begun to appreciate the larger contexts in which creativity occurs and their role in its manifestation (Boden 1994). Nevertheless, irrespective of the definitional and evaluative context chosen to explore creativity, it ultimately depends on the mental experience of individual minds – both for its manifestation and appreciation (Gardner 1993).

From the current evidence, it appears that creativity rarely if ever involves completely new or original concepts or ideas. Instead, most creative work efficiently integrates the existing information into unusual syntheses or juxtapositions, together with only incremental novelty. The notion of an isolated genius with special powers who consistently stuns the world with great insights, inventions, or ideas – as if by magic – has likewise not enjoyed much empirical support. The bulk of the evidence points instead to the many influences that together produce the ability to build on past accomplishments; approach problems in novel ways; and entertain multiple, ambiguous, and even conflicting alternatives. In this regard, Sir Isaac Newton once remarked, "If I have seen farther than other men [sic], it is because I have stood on the shoulders of giants."

Although creativity can be incremental in relation to its historical context or involve great leaps of imagination, it seems most often to be incremental. In fact, original ideas that jump too far beyond currently available conceptual frameworks are typically ignored or even vilified. There is some controversy over whether popularity alone can indicate evidence of creativity, or whether expert knowledge and information must also be considered. At least it appears safe to say that for something to be truly creative, it must have both a source and an audience. Analogous to the oft noted mystery regarding sound without anyone present to hear it, creativity must be appreciated by someone to be considered creative. Otherwise, it might be merely original or novel from its producer's perspective.

However, novelty and originality figure prominently in many investigations of creativity. In fact, some studies have evaluated "degree" of creativeness specifically in terms of statistical or actuarial rarity. Something being new or original certainly fits with most people's conception of creativity, but a little more thought reveals that it is an inadequate definition. For example, just because there are more yellow cars than purple ones does not mean that purple is thus a more creative color for cars. No doubt there are more "stick" or stone/brick houses than trailers in most countries, but few architects would argue that modular homes are more creative due to their scarcity. Nonetheless, novelty enjoys a time-honored distinction within most acts of creativity.

Theoretical Background and Open-Ended Issues

In general, two different perspectives broadly characterize the various methods used to investigate creativity. Researchers distinguish between "mundane" and "exceptional" creativity. The former is often studied under controlled laboratory conditions, while the latter necessarily involves studying individual examples of creativity within their historical or contemporary contexts (e.g., Gardner 1993). Studies of "mundane" creativity seek to understand the cognitive structures and processes involved when anyone behaves in creative ways (e.g., Zabelina and Robinson 2010), while studies of "exceptional" creativity try to determine if any unique features or attributes characterize outstanding, usually historical examples of creativity. Thankfully, the results from these two approaches yield many areas of conceptual agreement.

First, analogy and metaphor appear to play an important role in creative behavior. Analogies and metaphors relate things that on the surface do not appear to be similar, but understanding their use typically requires comparisons at higher levels of abstraction, thus allowing the similarities to be appreciated. For example, the observation, "When Carl stepped to the lectern, he confronted a sea of faces," implies a comparison between crowds of people and large bodies of water. From the simple definitions of "crowd" and "sea" no immediate similarities exist. However, the analogy creates similarity at the level of "large, undifferentiated or unitary expanses" and can then be easily understood. Both the use and deciphering of analogy and metaphor may depend on searching through associative networks underlying long-term semantic memory (cf. Zabelina and Robinson 2010).

Studies have demonstrated that problem solving in general can be improved by the use of relevant analogies, similes, and metaphors. In addition, much of the research evaluating outstanding historical instances of creative genius (e.g., Kepler, Galileo, Newton, Picasso, Leonardo da Vinci, Einstein, Michelangelo) has found that the comparison processes underlying metaphors and analogies figure prominently in the accomplishments of these luminaries (cf. Gardner 1993).

Second, the cognitive processes underlying "mundane" and "exceptional" creativity appear to differ more in terms of quantity than quality. This is good news, because it means that everyone can learn to be more creative. These underlying processes include (1) Conceptual Combination; (2) Conceptual Expansion; (3) Metaphor; and (4) Analogy and Mental Modeling. There are obvious similarities among these creative behaviors as already noted, but exploring examples of each separately will aid discussion (Ward et al. 1997).

Conceptual Combination

This involves the combining of concepts (usually words) to form a completely new concept. For example, Darwin's term "natural selection" built on the prevailing knowledge of artificial selection as used by breeders to influence subsequent generations of animals or plants. His creative new concept suggested that such an apparently intentional process might also occur without design interference, hence "natural selection." Popular culture often employs this approach as well, as in "asphalt jungle," "quiet riot," "quantum leap," etc. An important implication from findings in this area involves the salience of diversity in experiences and abilities within and across individuals in providing the fertile conditions necessary for the occurrence of useful combinations.

Conceptual Expansion

Children's growing understanding of the world and language through development provides the most obvious example of conceptual expansion. However, anyone involved in learning something new also participates in conceptual expansion. Interestingly, research evidence suggests severe limitations on most people's ability to jump very far beyond their current knowledge framework. For example, when children were asked to draw or describe imaginary animals, their attempts reflected many of the fundamental properties of species known to them. Essentially the same results have been reproduced in studies of adult subjects as well. An interesting implication from this research is that in order to be creative in an influential way, new ideas must relate to existing knowledge structures and familiar concepts, or they may not be recognized or accepted as useful (Zabelina and Robinson 2010).

Metaphor

The use of metaphor not only requires creativity on the part of the originator; it also can increase the creative experience of those comprehending the metaphor. Metaphors can, thus, at the same time be an example of creativity and also act as catalysts to spur further creative language. Metaphors, like analogies, usually demand that a comparison between the related entities be made at a higher conceptual level of abstraction for the implied similarity to be constructed. "You must accept the thorns with the roses" suggests a comparison between life's experiences and a rose bush. While easily understood by most adults, young children can get distracted by the surface definitions of the terms involved.

Interestingly, the myth that children tend naturally to be more creative than adults and are subsequently stifled by the rigid structure of the educational system has not survived close scrutiny. Both children and adults tend to be influenced by their current conceptual knowledge structures and reach beyond these constraints only with difficulty. Again, the implication for business leaders is that diverse, extensive prior experience among one's employees can foster creativity within the organization. Much like the acquisition of expertise, it would appear there is no substitute for accumulating vast amounts of knowledge in fostering creative breakthroughs (Winner 2000).

Analogy and Mental Modeling

Lord Ernest Rutherford's comparison of a hydrogen atom to a planetary system (the nucleus as the "Sun" surrounded by orbiting electrons) made use of analogy; many other examples of the creative use of analogy could be given. Investigators of creativity have distinguished between "near" and "far" analogies. An example of a "near" analogy might be comparing Romeo and Juliet with West Side Story, while an example of a "far" analogy could be Kepler's comparisons between light from the Sun and the vis motrix (motive force; gravity was unknown at the time). Some investigators have argued that "far" analogies – those comparing categories that are highly conceptually distinct – are more important in creativity than "near" analogies, but recent evidence suggests this view may be too simplistic.

Mental models could enhance creativity by providing a rich context in which novel words, terms, ideas, and concepts can be explored. More elaborate cognitive frameworks in which novel ideas or objects could be embedded allow many more alternatives for their potential development or enhancement to be explored and compared. There is recent evidence that groups of people, who share a mental model of their task, outperform groups whose members do not. Again, a variety of experiences and responsibilities seem to promote more extensive, detailed mental models, resulting in richer conceptual structures stored in memory.

Implications for Theory, Policy, and Practice

Creativity usually comes from extensive, diverse knowledge rather than from eccentric or inherently gifted individuals with a bent toward bizarre imagery. Increasing the diversity of employees' cultural and ethnic backgrounds, their areas of expertise, and using interdisciplinary, cross-functional teams should enhance creativity wherever needed. To fully leverage their diversity and the opportunity for creative combinations and synergies, such teams need a shared vision, mission, and goals. Other important factors to promote group syntheses include training the group as a unit and explicitly sharing information about each group member's particular area(s) of expertise (cf. Ford and Gioia 1995).

Creativity depends both on its production and its appreciation. Context can be just as important as content. Thus, being very familiar with trends in the larger society can improve creativity by ensuring its relevance to an audience. Being creative can involve new insights about the recipients of ideas as well as the ideas themselves being original or novel. Pursue sensitivity to the sociocultural milieu, providing this broader organizational or institutional context for internal tasks, activities, and functions (cf. Ward et al. 1997).

Metaphors and analogies appear to be important in the creative process. Their usefulness depends not only on their novelty and originality, but also on how cleverly they integrate with existing knowledge structures and available information. Thus, creativity involves incremental progress as much as surprising leaps of logic. Exploring combinations of ideas as well as ideas in isolation can be a useful strategy (cf. Casakin and Shulamith 2011).

Creativity may be related to physical activity and bodily experience; thus, a variety of behavioral pursuits and opportunities contribute to being creative. This suggestion holds implications for education at all levels (e.g., the continuing importance and usefulness of recess – unstructured play time – during the school day), but may also improve the creative performance of individuals, groups, and teams within different institutions and organizations, public or private.

Creativity may depend on group interaction, particularly to prevent less useful ideas from being pursued. Individuals working alone quickly manifest a vested interest in their ideas and a bias toward confirming information. Collective contributions to creativity seem particularly important when tasks are well-known and participants have a high degree of expertise. Explanations of creativity tend more and more to rely on the importance of the broader social context in which it occurs. Diverse, autonomous, motivated, cohesive groups with a collective purpose can result in creative production in any organization (Sternberg 1999).

Conscious access to the process of creating appears to be lost soon after the realization of a creative outcome or problem resolution. It might, thus, be important to provide high-quality tools to support collective cognition and collaboration within schools, institutions, or corporate enterprises, thereby improving the quality of group/team interactions and capturing them while they are occurring.

Creativity may thrive on noticing how unlike things might be related. Only experienced individuals have an adequate understanding of multiple organizational or institutional levels and processes to leverage opportunities for creative synergy. Recruitment and retention of students, faculty members, executives or employees with an extensive, diverse knowledge base – both inside and outside of the relevant enterprise(s) – can increase the likelihood of creativity.

Although creativity may be modestly correlated with intelligence up to IQs around 120 or 125, extreme intelligence does not guarantee creative ability – nor vice versa. However, creativity does seem to be related to certain personality characteristics. Some of these include independence, nonconformity, being unconventional (even Bohemian), being open to new experiences, having wide interests, having both cognitive and behavioral flexibility (particularly, comfort with paradox), and a disposition toward risk-taking. These findings have important implications for the tendency among corporate executives to hire and promote individuals who reflect those executives' opinions, preferences, and lifestyles. Diversity – not conformity – is the watchword of creativity (Simonton 2000).

Creativity depends critically on the initiation and maintenance of effort – usually over extended periods of time. It is, thus, important for government and corporate leaders to analyze carefully both the implicit and explicit incentive systems currently operating within their institutions or organizations. Do the intrinsic and extrinsic reward structures encourage creative, innovative behaviors and taking risks? Or do they instead exert pressure toward the status quo, toward safe havens of normal, ordinary conduct? Do these functional incentives adequately reward useful creativity while at the same time effectively pruning bizarreness for its own sake? (Amabile and Kramer 2011; Hennessey and Amabile 2010).

Since creativity often involves unusual associations or novel integrations across conceptual boundaries, open sharing of knowledge and information across institutional or corporate entities may be very important. While competition for limited resources in some cases can be motivating, it also tends to promote the hoarding of ideas and lessons learned. Encouraging the wide sharing of best practices as well as mistakes within universities, government entities, or companies can help to eliminate redundancies of effort and prevent the repetition of unproductive pursuits, while providing an atmosphere for synergy, remote reference, and the fertile interaction of ideas. Recent evidence suggests that for speeding up the creative process, cycling between divergent (broad) and convergent (narrow) thinking may be very important; the exact timing and number of sequences for these activities depend on contextual factors, such as organizational/group culture, type of problem/topic (creative problem solving [CPS] represents an entire subspecialty in creativity research), team diversity (ethnic/nationality and disciplinary), team competencies, and motivational circumstances (Amabile and Kramer 2011; Ford and Gioia 1995; Sternberg 1999).

Initiating and maintaining creativity as an explicit corporate or institutional goal actually involves an inherent conundrum: The origin of "command and control" organizational structures hails from the industrial revolution when Frederick Taylor – among others – conceived of social organizations that could be arranged so that individual workers would mindlessly contribute to abstract goals defined by executive management and thus, collectively operate just like a grand, glorious machine. Some evidence indicates that true genius and creativity may depend as much on superior innate abilities as on characteristics acquired through diligent effort, and so to encourage creativity, corporations or institutions must intentionally identify, recruit, retain, and reward creative individuals and teams; creativity cannot be process-engineered (Sternberg 1999).

Some evidence suggests that daydreaming and fantasy may be related to creativity. Whether creative people daydream more or daydreaming can make ordinary people more creative has not yet been determined; however, it seems reasonable that to encourage creativity, some freedom from tight schedules and deadlines may be important. To increase the likelihood of creativity, the effectiveness and efficiency of repetition and "standard operating procedures" must be balanced with the time and flexibility to explore and innovate for its own sake (Amabile and Kramer 2011; Hennessey and Amabile 2010).

Conclusions and Future Directions

An important remaining controversy pertains to the degree of independence from concrete, physical experience that human conceptual behavior actually enjoys. B. F. Skinner and other behaviorists have argued that language and thought are simply behaviors grounded in the evolutionary and personal past of individual people. In this view, concepts and the words that came to symbolize them should reflect actual, bodily interactions with the environment. However, early work in cognitive psychology treated language in general and the formation of concepts in particular as convenient abstractions in the mind, only arbitrarily related to perceptual and behavioral interaction with the world. Language concepts that seem to lump arbitrary, dissimilar items together provide evidence for this perspective. For example, in one Australian aboriginal language, one category word includes women, fire, and dangerous things. In-laws aside, most people would not immediately apprehend the perceptual similarities defining this classification. Such illustrations seem to argue that conceptual language can have derivative meaning in the abstract – independent of any actual similarities among the objects symbolized (cf. Ward et al. 1997).

However, many other researchers insist that such extreme examples constitute the exception rather than the rule, and that the majority of concepts do simply reflect distinctions inherently present in the world of experience. Indeed, more contemporary work has begun to resurrect and enlarge on the behaviorists' views. According to some current accounts of the usefulness of analogies, metaphors, and similar comparison processes in creative thought, the meanings of words and concepts depend in important ways on a historical foundation of actual bodily experience.

For example, the term "comprehend," a virtual synonym for "understand," comes from the Latin *comprehendere*, which literally means "to seize" or "to grasp." Recent theoretical and empirical work suggests that many analogies and metaphors create meaning by ultimately being grounded in actual bodily experience in this way. Consider the statement, "I stand for affirmative action." Although most people readily accept an abstract meaning for the term "stand" in this instance, such meaning may ultimately derive from situations where people indicate their preferences by literally standing. The meanings of metaphors and other creative expressions may in important respects be similarly embodied. If bodily experience relates to producing or understanding creative expressions, then it might be useful to encourage workers entrusted with acting creatively to behave in a variety of ways while at work other than sitting down all day.

An additional attribute of creative endeavors involves their multifaceted and sometimes serendipitous nature. Lucky juxtapositions sometimes contribute to creative invention, but this usually occurs in an environment that systematically fosters rigorous exploration, thorough investigation, and broad knowledge acquisition. In addition to the role of accident in creation, research has not yet delineated each of the relevant structuring forces on the creative process, nor exactly how these may interact. Other remaining questions include, Can the process of creativity be usefully studied separately from its consequences? How can the effort, persistence, and motivation necessary for maintaining creativity best be initiated and sustained? Exactly how are completely new ideas produced and comprehended? How can society optimally understand and overcome individual and collective conceptual inertias? (cf. Casakin and Shulamith 2011).

For the future, what roles do emergence (chaos theory) and change play in creativity? These areas may indeed prove to be the most fruitful for future inquiry since the explosive variety of creativity in the natural world appears to reflect fundamentally emergent phenomena – the unpredictable outcomes from complex, adaptive systems. If complexity theory proves to be applicable to organizational behavior and other human creative endeavors, some of the influences on creativity may involve higher levels of abstraction and determination above the level of individuals and perhaps even groups of workers. How to characterize – much less predict – these possible coalescing eddies of conceptual convergence and divergence in the psychosocial fabric of an organization remains a mystery at present (cf. Ford and Gioia 1995; Ward et al. 1997).

Finally, some intriguing "detective" work has revealed that some of the most celebrated historical instances of creativity, such as Kekulé's analogy to a snake swallowing its tail for the structure of the benzene molecule – may have involved unintentional reconstructions after the fact. In other words, creators may fabricate analogies after arriving at their productive conclusions, and then unwittingly remember the analogy as formative of their ideas, when in fact it served primarily as a useful illustration a posteriori to help others understand their discovery. Likewise for groups involved in the creative process: The conceptual scaffolding so necessary and important during group interaction only serves as a temporary support structure for producing useful analogies. Most of the details of this process are subsequently lost after the creative outcome is obtained.

Cross-References

▶ Creative Mind: Myths and Facts
▶ Divergent Thinking
▶ Divergent Versus Convergent Thinking
▶ In Search of Cognitive Foundations of Creativity
▶ Mental Models and Creative Invention
▶ Metaphorical Reasoning and Design Creativity: Consequences for Practice and Education
▶ Psychology of Creativity

References

Amabile T, Kramer S. The progress principle: using small wins to ignite joy, engagement, and creativity at work. Boston: Harvard Business Review Press; 2011.

Boden M, editor. Dimensions of creativity. Cambridge, MA: MIT Press; 1994.

Casakin H, Shulamith K. The cognitive profile of creativity in design. Think Skills Creat. 2011;6(3):159–68.

Ford CM, Gioia DA, editors. Creative action in organizations: ivory tower visions & real world voices. Thousand Oaks: Sage; 1995.

Gardner H. Creating minds: an anatomy of creativity seen through the lives of Freud, Einstein, Picasso, Stavinsky, Eliot, Graham, and Gandhi. New York: BasicBooks; 1993.

Hennessey BA, Amabile TM. Creativity. Annu Rev Psychol. 2010;61:569–98.

Simonton DK. Creativity: cognitive, personal, developmental, and social aspects. Am Psychol. 2000;55:151–8.

Sternberg RJ, editor. Handbook of creativity. New York: Cambridge University Press; 1999.

Ward TB, Smith SM, Vaid J, editors. Creative thought: an investigation of conceptual structures and processes. Washington, DC: American Psychological Association; 1997.

Winner E. The origins and ends of giftedness. Am Psychol. 2000;55:159–69.

Zabelina D, Robinson M. Creativity as flexible cognitive control. Psychol Aesthet Creat Arts. 2010;4(3):136–43.

Cognitive Competencies

▶ Knowledge Society, Knowledge-Based Economy, and Innovation

Cognitive Computing

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▶ Model of Dialectical Learning

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Collaborative Economy

► Entrepreneurship in Creative Economy

Collaborative Innovation and Open Innovation

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Synonyms

Cooperations to innovate; Coopetition; Distributed innovation process; External relationships; Networks

Introduction

Consumers' demand for products has moved, since the eighties, toward products customized to personal needs. This change has incited firms to work closely with other organizations and especially customers, in order to anticipate better the future needs, inducing a growth in external relationships of firms. This trend is still at work in most of industries in which lead users impulse evolution in products. In consequence, the collaborative process continues to increase. At the same time, the efficiency of the production by in-house R&D of firms' decreases to such an extent that following Chesbrough (2003), many scholars advise firms to access knowledge externally and to develop innovation with an open process of development: the open innovation model. They incite firms to use all the external sources which are available to be the first to introduce a new product or process in the market.

Collaborative and open innovation seems quite similar at a first glance, but open innovation is a broader conception than collaborative innovation and includes this notion.

Various Process of Development of Innovation in a Collective Way

Collaborative Innovation

Collaborative innovation is the fact that an organization cooperates with other firms (suppliers, customers, competitors, and consultants) or other organizations (such as universities or public research organism) to develop or commercialize a new innovation. The organizations agree to pool their resources or to share information and knowledge to develop one project, at the end of the project, they keep independent from the legal point of view. The main goal of such collaborative innovation is to gain access to the partner's knowledge and competences especially to tacit knowledge. Indeed, tacit knowledge is by definition nonarticulable and generally inscribed into the routine and know-how of a firm. It can be transferred to external third parties only by the demonstration of its owner by face to face interactions. So, this kind of knowledge needs physical proximity between the owner and the receptor, even if any means allow reducing this need of proximity by using only temporary geographic proximity for interactions. For instance, firms can send their staff to the plant of the organization participating to the project.

The collaboration can be formal: the participants sign a contract of cooperation, or informal (that is the most common situation). The agreement can imply the creation of a common structure, known as a research joint venture, but in most of the cases, there are no such creation and organizations only pool their resources to solve technical problems or reduce risks of the project or share the costs of the development. This kind of collaboration is known as joint R&D. So, in practice a collaborative project can take many aspects from the more informal to the more formal. Collaboration can take place in all the stages of the development of the innovation from the R&D to commercialization of the artifact. Start-ups tend to cooperate for production and commercialization because they lack internal competences on these two fields whereas incumbent firms tend to cooperate in R&D because they need new ideas from start-ups to develop novelty (Colombo et al. 2006).

The size of the firm, industry, and belonging to a group are the most common factors that influence the propensity to cooperate. The size of the firm influences the propensity to cooperate to innovate. Larger firms tend to cooperate more than smaller firms. Industries differ for the use of cooperation, in sectors as biotechnology, informatics, or new materials most of the firms cooperate whereas in mature industry (such as textile or food sector), firms tend to cooperate less. Firms that belong to a group cooperate more than independent structure and especially with another unit of the group.

Collaborative innovation has grown since the eighties, but since the beginning of the year 2000, a new kind of collaborative project became of great importance for firms. In fact, the need for customization continued to grow, and in many industries, firms developed collaboration with their customers to be more in line with the future trends of the market. Recognizing that the customers play an important part in the innovation process is the real novelty of the years 2000 in the literature (Greer and Lei 2012). Firms realized the importance of customers with the development of numeric economy. As customers could become their own producers of contents and transmit these contents to other users, firms had to rethink their business models. In many industries, such as footwear, video games, or surgical equipment, users became an important source of new products (Greer and Lei 2012).

Collective Invention

Collective invention knew a renewal in the literature also in the years 2000, but it differs from collaborative innovation.

Collective invention is an old process in the industry, as Allen (1983) identified its existence in the blast furnace industry in the nineteenth century. In that industry, competitors shared information about all the improvement than one of them implemented in his plant. Doing so, competitors overcame technical problems of the industry. So, collective innovation is a process of exchange of information mainly between competitors. Then, Powell and Gianella (2010) defined collective invention as "a technical advance driven by knowledge sharing among a community of inventors who are often employed by organizations with competing intellectual property interests." Collective invention knew a new development with the development of open source software developments. In such process, developers belonging to various firms and even individuals share source code and make improvements that they diffuse to the "community of practices." All the participants of the community get access to the improvements, and the technical problems are solved with the collective intelligence. In such industry, participants regularly increase the stock of knowledge available for all and contribute to generate incremental improvements.

In the collective invention process, inventors freely reveal their invention to the participants of a community, so firms could not appropriate privately the invention coproduced by the community. To be able to capture private value of invention, firms must use the collective invention and integrate it to its own innovation process or must develop innovation on the rest of the value chain.

Collective invention is an invention, is as to say only an idea that inventors have not yet converted into a technical artifact introduced into the market. That point differentiates collective invention from collaborative innovation.

Open Innovation

The open innovation model (Chesbrough 2003, 2011) incites firms to open up their innovation process, giving up the model of the internal process. In the internal process of innovation, firms lean upon their own R&D laboratory and develop the entire projects alone, from initial research to industrialization, because firms used to consider R&D as a strategic asset and thought innovation requires control so they generated the new idea, industrialize, and commercialize by themselves. Companies such as Bell, IBM, or DuPont have succeeded in such strategy for almost all the twentieth century. If, more recently, companies failed to pursue such strategy, it is because knowledge became much more difficult to control. Knowledge became an essential asset in the innovation process, but as this asset grew it became more difficult to fix in a single company or country. Both internal as open innovation process help firms to scan the environment and to detect potential innovation. But open innovation is superior because it let the possibility to detect what Chesbrough qualifies as "false negative." These projects lack promises at one moment of the process, but if they turn out to be profitable, open innovation will be a way to access this technology. Companies which are focused too internally risk lack these opportunities.

Firms that have noticed the loss of efficiency of their process of development of innovation tend to open it by specializing in one part of the process and then using external partners to develop the innovation or acquiring license for the use of the technology. Procter & Gamble, for instance, is a company that turned its strategy from internal exploitation of idea to open innovation. This company now incites his staff to exploit better ideas by using an organizational rule: If an idea has not been exploited from 3 years, the company will sell it outside, even to competitors.

The end of the internal process gave birth to four kinds of firms specialized in the innovation process: innovation explorers, innovation merchants, innovation architects, and missionary organizations, and two kinds specialized in the commercialization stage: innovation marketers and one-stop centers (Chesbrough 2011).

Innovation explorers specialize in generating innovation, performing the R&D discovery function. Many of these firms are spin-off of the previous internal R&D lab of large firms. Any of these explorers are departments of public university that developed commercial function in the eighties.

Innovation merchants focus on property rights, they innovate by purchasing innovation developed by other firms or by combining this innovation with their internal resources to sell the technology outside. These companies use their IP portfolio and sell IP to get fund to finance R&D on their core competency.

Innovation architects act as brokers between various companies selling a specialized set of services to connect actors in the same field.

Innovation missionaries innovate to attain a goal and no to reap profits, for instance the community of practices in open software development as Linux model.

Two types of organizations specialize in bringing innovation to the market: innovation marketers and one-stop centers. Innovation marketers specialize in detecting the needs of customers and bring in-house the idea that will allow them to answer these needs. One-stop centers identify the needs and furnish a new extensive service to customers.

Collaborative Innovation and Open Innovation

Dahlander and Gann (2010) built a typology of open innovation defined by two criteria (Table 1). They oppose "inbound" innovation to "outbound" innovation for the first criterion. The second criterion is the fact of providing pecuniary compensation or, not, for the innovation. The typology produces four kinds of process of open innovation. Firms should use them jointly to improve their ability to introduce innovation onto the market more regularly.

Case 1: "inbound innovation" with a pecuniary compensation, firms can buy or acquire a patent license to be allowed to use an innovation developed by another firm. IP's strategy, here, leads to the question of how to exchange technology on the market. To be allowed to participate in the market of technology, firms should own property rights, such as patents or trademarks. As a consequence, Chesbrough incites firms to file patents to be able to exchange technology.

Case 2: "outbound" innovation, the firm develops an innovation, but it cannot exploit it by itself, so it sells a patent license to another firm. Case 2 is symmetric to 1 from the IP point of view. IP is only used to increase firm's revenue.

Case 3: "outbound" innovation without pecuniary compensation. This case has been studied a lot because it is the newest behavior of open innovation. Scholars named it the "free-revealing" process. It characterizes, above all, software development in open source models (Dahlander and Gann 2010). This type of openness can include many degrees from a closed process to collective invention (such as the one described by Allen) to newer behavior of crowd sourcing (von Hippel and von Krogh 2006). This case does not include pecuniary compensation because inventors voluntarily give up their rights on innovation, and they cannot appropriate privately the innovation. Besides, it is the entire

Collaborative Innovation and Open Innovation, Table 1 Process of open innovation and the links with collective invention and collaborative innovation

	"Inbound innovation"	"Outbound innovation"
Pecuniary compensation	Case1: acquire technology. Buy IP (patent license)	Case2: sell technology. Sell IP (patent license)
	Use marker for technology	Use marker for technology
Non pecuniary compensation	Case4: cooperation. Use external source of knowledge and projects in cooperation with external partners	Case3: free revealing into community of practices
		Business model of the open source software
	Collaborative innovation	Collective invention

Source: Dahlander and Gann (2010) and author

revealing of innovation that forms the basis of the firms "performance." Scholars suppose that free revealing brought competitors, in an industry, to a positive circle of information and technical knowledge exchange allowing firms to develop regularly incremental innovation. Free revealing leads firms to capture the innovative's rent by developing complementary goods.

Case 4: "inbound" innovation without pecuniary compensation. This process is well known, because it characterizes the development of innovation in cooperation with other firms or organizations such as public research organizations. Chesbrough (2003) underlines that cooperation is the basis of openness because firms have externalized some parts of their process of production. He even builds a typology of different kinds of organization. However, thereafter he does not describe this process of cooperation.

Case 4 corresponds to collaborative innovation. Case 1 and case 2 are symmetric and correspond to the acquisition of technology by using the market for technology. In Case 3 and 4, firms produce technology whereas in case 1 and 2 they only acquire an existing technology developed by other organizations. So, open innovation is broader than collaborative innovation because it does not focus on the same problem. Open innovation concerns all the means that can be used by a firm to gain access to technology whereas collaborative innovation focuses on a way for firms to create a new technology and artifact.

The development of open innovation by collaborative innovation leads to any open-ended issues: (1) the risks that collaborators become further competitors (Greer and Lei 2012), (2) the risk that the growth of opening of the process of innovation undermines the internal creativity of the firm, and (3) the issue of property rights.

1. Suppliers and customers can potentially become further competitors in defining standards, setting products expectation, and even capturing the rents generated by more open process of innovation.
2. Greer and Lei (2012) underline that collaborative process, especially with customers, could undermine the in-house R&D of the firms because technology-driven ideas would be neglected to the use of customers' ideas. Indeed, it is clear that the opening of the innovation process will cause a modification of the function of the internal R&D team. The R&D staff should evolve toward function of gatekeepers and serve of links between the external sources of innovation and the internal capabilities of the firm.
3. The property rights issue is the most important brake, at the moment, toward an evolution to more open process of innovation. Chesbrough focuses on the possibility for firms to participate on the market of technology (case 1 and 2) and on the case of free revealing. One of the open-ended issues of the model is the problem of intellectual property of the innovation produced by open innovation. Indeed, Chesbrough underestimates that problem (Gallaud and Nayaradou 2012). In the case 1 and 2, there is only one producer of the innovation: the firm and property rights are clearly defined. Then, the firm can acquire or sell its own rights to third parties. In case 3, of free revealing, innovators voluntarily give up their property rights to diffuse the invention to their community. As Chesbrough recognizes the importance of cooperation but focuses less on this kind of process of open innovation, he deals very little with the fact that many producers can own the property rights on an innovation. However, such cases have grown quickly since the eighties, with the development of co-patenting or patents pools. Co-patenting is the fact that many inventors can file a patent jointly. Patent pool is a consortium of at least 2 companies agreeing to cross-license patents relating to a particular technology. The creation of a patent pool can save patentees and licensees time and money; in case of blocking patents, it may also be the only method for making the invention available to the public. At last, the problem of property rights is a major cause of failure or negative judgment of the participants in collaborative projects of innovation.

Conclusion and Future Direction

The main message of open innovation model is to incite firm to increase their search of innovation opportunities. Even if such message is not new, this behavior of search is still a characteristic of the largest firms. Indeed, Chesbrough's model leans on case studies of large firms (the case study of Procter & Gamble for instance). Many SMEs have not yet developed such a search behavior and are still constrained by their lack of innovative capabilities. The main obstacles they declare for not innovating are the lack of information about market or the fact that they do not need to innovate. It seems that the incitation to increase the innovation capabilities is still a good recommendation. However, at the same time, public policy should take into account the difficulties to innovate for SMEs and incite them to develop more incremental innovation than radical projects to encourage them to overcome the difficulties of the innovation project.

Cross-References

▶ Business Creativity
▶ Decrease in Creativity
▶ Intellectual Property, Creative Industries, and Entrepreneurial Strategies

References

Allen RC. Collective invention. Journal of economic behaviour and orgnaization. 1983;4(12):1–24.
Chesbrough H. Open innovation. Cambridge, MA: Harvard University Press; 2003.
Chesbrough H. Top ten lessons on the new business of innovation. *MIT Sloan Manag Rev*. 2011;35–42.
Colombo M, Grilli L, Pili E. In search of complementary assets: the determinants of alliance formation of high-tech start-ups. Res Policy. 2006;35(8):1166–99.
Dahlander L, Gann D. How open is innovation? Res Policy. 2010;39:699–709.
Gallaud D, Nayaradou M. Open Innovation and co-operation: which choice of means of protection for innovation. J Innov Econ. 2012;10(2):167–90.
Greer CR, Lei D. Collaborative innovation with customers: a review of the literature and suggestion for further research. Int J Manag Rev. 2012;14:63–84.
Powell WB, Giannella E. Collective invention and inventors networks. In Hall BH, Rosenberg N, editors. Handbook of economics of invention, vol 1, California: Stanford University; 2010, pp 575–605.
Von Hippel E, von Krogh G. Free revealing and the private collective model for innovation incentives. R&D Manag. 2006;36(3,2):95–306.

Collaborative Process

► Technology Push and Market Pull Entrepreneurship

Collaborative Work

► Co-Conception and Entrepreneurial Strategies

Collective Creativity

► Creative Collaboration

Commercial Firm

► Academic Firm

Communication

► Speaking Pictures: Innovation in Fine Arts

Comparative Word Analysis

► Two Hs from Harvard to Habsburg or Creative Semantics About Creativity: A Prelude to Creativity

Competitive Dynamics

► Technology Life Cycles

Competitive Intelligence

► Information Monitoring and Business Creation

Competitiveness

► Technology Push and Market Pull Entrepreneurship

Complex Dynamics

► N-Tuple of Helices

Complex Thinking

► Dialogical Critical Thinking in Children, Developmental Process

Composition

► Creativity in Music Teaching and Learning

Computational Intelligence

► In Search of Cognitive Foundations of Creativity

Concept Development, Trends

► Creativity Definitions, Approaches

Conceptualization of Democracy

► Quality of Democracy and Innovation

Conflict and Creativity

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Synonyms

Adaptation; Asynchrony; Brainstorming teams; Cost of expertise; Marginality; Mindfulness; Originality; Preference for complexity

There are quite a few parallels between the evolution of *Homo Sapiens* and the development of individuals. The theory that ontogeny recapitulates phylogeny was not used to describe the entire lifespan, but only prenatal development, and in any case it did not hold up. Yet there are parallels between evolution and development, especially if you take the lifespan perspective. The most obvious may be that, just as adaptation allows a species to evolve and survive, so too do learning and coping allow an individual to live an effective life.

It is also true that creative behavior helps to lead an effective life. In fact, creative talent may facilitate adaptability. This is especially likely given the implication of the first paragraph that life is fraught with challenges. There are various ways to describe the benefits of creativity – it adds to the quality of life, helps us to stay healthy, and contributes to progress – and the most important benefit may be that it does allow us to adapt and cope. Life can be challenging, but creative behavior makes it easy to keep up.

Much of this reasoning is theoretical, but there are data showing that creativity is the result of challenges, conflict, and tension. These data can be found in case studies and experimental research. This entry will briefly review each. It covers all perspectives on the relationship of tension and creativity. Some of the data about the tension-creativity relationship are found in developmental psychology, while others are in the social.

Asynchrony

What makes a good parent? Is a good parent someone who comforts his or her child and satisfies all needs? Actually, a good parent will allow the child to experience tension and conflict. Otherwise, the child will not develop the capacity to tolerate tension nor learn the skills that will allow life-long adaption. A good parent does not even provide an environment that is perfectly aligned with a child's abilities. Instead the parent creates a slight mismatch and then scaffolds. The parent may speak to a child with a sentence that has eight words, and seven of them are in the child's current receptive vocabulary. But the meaning of that eighth word must be inferred. The child must work, just a bit, to grasp the meaning of the sentence. And as the child grows, so too do the mismatches. A good parent will keep just ahead of a child's current abilities. That is scaffolding.

But challenges are varied. They are not just in the parent-child communication. Many do occur during childhood and seem to contribute to the development of mindfulness and adaptability, and case studies of creative individuals suggest that many of them had huge challenges or all sorts (Runco 1994) Although these are retrospective reports, the implication is that the challenges contributed to the capacity for creativity. This makes sense if creative ability is a kind of adaptability.

Tension may result when there is an asynchrony or mismatch between the needs and capacities of the individual and what is available and supported by the environment. Some asynchronies occur within the family. They may be the result of a loss of a parent when the child is still quite young, or the loss of a sibling, both of which are remarkably common among famous creators. Yet other tensions result from mismatches and asynchronies outside of the family.

One kind of asynchrony occurs when an individual moves from one culture to another. This may put the person in a position where they feel that they should process information mindfully rather than make assumptions. It is almost as if they are forced to use the "question assumptions" tactic that is so often recommended in programs designed to enhance creative thinking. Another kind of asynchrony occurs when an individual moves from one profession to another. Again, the individual is forced to think in a mindful fashion. He or she also has the benefit of using concepts or methods from the original profession in the new profession, which of course means that they may do or see something that experts in the second field do not see. That kind of thing happens fairly regularly and has been labeled "the cost of expertise." The benefits of moving from one field to another are implied by the insights of Darwin (geology to evolutionary biology), Jean Piaget (biology to cognitive developmental psychology), and Sigmund Freud (physiology to psychiatry). Admittedly, it is possible that the same benefit occurs when an individual is on the periphery of a field for some reason other than moving from one field to another. Indeed, there is research suggesting that marginality, like asynchrony, has similar benefits. Note that these can often be explained by the fact that being marginal or asynchronous challenges the individual to think in a mindful, and often original, fashion.

Conflict that may lead to creative thinking sometimes involves different modes of thought. Convergent processes may lead to a solution to a problem, while, at the same time, divergent thinking suggests alternatives. This situation may lead to what Arieti (1976) called the magic synthesis. For Arieti, creativity results from a blend, or synthesis, of different ideas and feelings. Interestingly, he felt that these might come together in the corpus callosum, which is the neural bridge between the two hemispheres. A variety of other theories also view creativity as the blend of opposites. These create a tension which the individual resolves using creative processes. The tension is not necessarily only between cognitive modes of thought; it may also be between thinking and emotion.

Interestingly, there is a personality trait found in many highly creative individuals that may both result from but also in turn lead to these tensions between modes of thought. Sometimes called the *preference for complexity* (Eisenman 1997), this trait not only allows the individual to tolerate situations fraught with tension, but in fact the individual may have learned that from tension comes the satisfaction of creative insight. The individual learns to prefer complexity, even if there is a tension felt because of it. They know that the tension is indicative of the creative process.

Tension in Organizations and Teams

Tension is probably unavoidable in large organizations. It is also no doubt common in teams and brainstorming groups. Some of the time, this works to the advantage of the group. In fact, tension is one of the factors included in descriptions of optimal teams and workgroups (Rubenson and Runco 1995). In one of the most detailed theories of optimal groups, a team should be composed of six to eight people. If there are more, there is too great a cost for any one individual to take a risk and share a wild, and potentially original, idea. In fact, the least risk is in so-called nominal groups – someone working alone! The problem there is that creativity is not synonymous with originality. Creativity requires effectiveness as well as originality. This is especially true in organizations, which very likely are interested in innovation. That means that an idea must not be simply original; it must also work. It must be practical. It should lead to implementation. It would be good if it could sell. So although smaller groups are good for the risk taking that allows originality, creativity requires more than that. Hence, a team should be involved, with not too many (risk increases, originality drops) nor too few (high originality but lacking the diverse perspectives and experience that will insure that some ideas are practical as well as original).

In addition to an optimal size, a team should be diverse. This is where the tension comes in. It is probably best to have two to three highly experienced individuals. They are the ones that will bring information and huge knowledge bases to the problem at hand. They will evaluate and criticize and insure that only practical ideas move forward, from the team to the larger organization. Since assumptions are to be avoided and diverse perspectives on problems are useful, the experts in the groups should represent different points of view. If they were scientists, one could be an engineer, one a humanistic psychologist. The key is diversity. This will insure that assumptions (within any one field) are avoided, but it will probably lead to some tension and conflict. The experts may very well argue and debate. That is a good thing for creativity. It will allow ideas to be tested and evaluated and all relevant information to be brought to bear.

It is quite possible that the experts will not have the most creative insight. They will bring information and question assumptions, but the creative insight is actually most likely to be found by an inexperienced member of the team! This is because, with experience comes rigidity, or in the vernacular of creativity theory, inflexibility. Experts have so much invested in their own fields and theories and points of view that they tend to defend them and become increasingly rigid. This again is the "cost of expertise." But if the team is optimally composed, there will be novices as well as experts, and just as the experts are inflexible, so are the novices flexible. They will hear the conflict, the debate, and the exchange of information, and they are the ones that are most likely to benefit from the conflict and team work and have a useful insight.

Very importantly, this optimal team may find a creative idea. Then again, there is no guarantee. What the theory of an optimal group defines is a way of finding the conditions which should allow the creative process to occur. You could say that the optimal work group has the *potential* to be creative (see "► Four Ps of Creativity", this volume). As a matter of fact, much the same must be said about all of the different kinds of tensions and conflicts and asynchronies that are summarized in this entry. None of them guarantees creativity. Conflict sometimes supports mindful thinking and interactions that can lead to original and useful ideation. But conflict can go different ways. It can be used productively, or it can become an issue in and of itself, a distraction, a block to creativity. It is much like putting a deadline on a person. Many people are challenged by the deadline and do good work. But others are frozen by deadlines. The condition – the deadline – is the same, but interpretations of it differ. The impact varies from person to person. This is the same with conflict and tension. It works for some people, some of the time, but not everyone all of the time.

Conclusions and Future Directions

These last comments on conflict within teams apply most obviously to industry and organizations. But then again, schools sometimes use brainstorming, and diversity could be captured in student groups. Additionally, a beneficial tension was suggested by Dean Keith Simonton when he described how the best mentor-student relationship is not one of complete compatibility and camaraderie. The ideal mentor-student relationship is instead one where there is some discrepancy. Certainly there must be enough compatibility for good communication; but some distance and dissimilarity is also good. Otherwise, the student may merely imitate the mentor, and original insights are unlikely.

It is possible that creative insights sometimes occur when there is no conflict, no tension. Indeed, this is the humanistic view, proposed by Carl Rogers. Creativity is inextricable from the epitome of psychological health, namely, self-actualization, and individuals self-actualize when they are in environments which provide unconditional positive regard. Yet at the same time, there are logic and numerous examples of tension leading to shifts of perspective and creative insight. These two perspectives are not really at odds with one another if you keep in mind that much depends on the interpretation of the individual.

At least as important is the caution that must be taken whenever an attempt is made to enhance creativity by structuring experience or context. Simply put, even if conflict was the most likely route to the development of creative thinking skills (and more accurately, it is simply one route that sometimes works for some people), it would be unethical to impose conflict on individuals! There is probably no need to impose conflict anyway. Life throws challenges at us; we do not have to go looking for them.

This brings us to our last point. Much of the thinking in this entry implies that creativity can be stimulated by tension and conflict. That in turn may imply that creativity is a form of adaptation. This view can be refuted, however, since some creative behaviors are maladaptive. Creativity is sometimes associated with psychopathology, for example, and sometimes leads to such radical thinking that the individual creator can be alienated. Perhaps more convincing is that creative thinking is sometimes proactive, while adaptations are by definition reactive. In the evolution of a species, for example, adaptations are not selected unless they correspond with environmental pressures. This is not to say that they are directed or teleological. But creative behavior is often self-expressive and independent of environmental demand. Further, many of the most creative insights are not solutions to a problem (solutions would be reactions) but are instead a reflection of problem identification or problem finding. The point is that sometimes creative insight is the result of self-expression, and there is no problem. Other times there is a problem and perhaps tension. There are different routes to creative insight. Given the importance of creativity, future research should be directed to determine exactly what kinds of conflict and tension are beneficial, for whom, in what settings.

Cross-References

▶ Freedom and Constraints in Creativity
▶ Ideas and Ideation
▶ Risk

References

Arieti S. The magic synthesis. New York: Norton; 1976.

Eisenman R. Creativity, preference for complexity, and physical and mental health. In: Runco MA, Richards R, editors. Eminent creativity, everyday creativity, and health. Norwood: Ablex; 1997. p. 99–106.

Rubenson DL, Runco MA. The psychoeconomic view of creative work in groups and organizations. Creative Innov Manag. 1995;4:232–41.

Runco MA. Creativity and its discontents. In: Runco MA, Shaw M, editors. Creativity and affect. Norwood: Ablex; 1994. p. 102–23.

Contextual Determinants

▶ Environmental Determinants of Entrepreneurship

Continuity

▶ Idea-Marathon System (IMS)

Convergent Versus Divergent Thinking

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Definitions

Convergent and divergent thinking are two poles on a spectrum of cognitive approaches to problems and questions (Duck 1981). On the divergent end, thinking seeks multiple perspectives and multiple possible answers to questions and problems. On the other end of the spectrum, convergent thinking assumes that a question has one right answer and that a problem has a single solution (Kneller 1971). Divergent thinking generally resists the accepted ways of doing things and seeks alternatives. Convergent thinking, the bias of which is to assume that there is a *correct* way to do things, is inherently conservative; it begins by assuming that the way things have been done is the right way. Divergent thinkers are better at finding additional ideas, whereas convergent thinkers have a more difficult time finding additional ideas. Convergent thinkers run out of ideas before divergent thinkers. However, convergent thinking strengthens the ability to bring closure and to conclude problems.

Creative Process

In the creative process, the relationship between thinking for divergence and thinking for convergence is not simplistic. Convergent thinking and divergent thinking are both necessary for creativity but in different relative amounts, depending on the creative domain. Because divergent thinking considers problems from multiple perspectives and often discovers and develops original solutions, it plays a crucial role in most creative processes. Divergent thinking is central to innovative type creativity, the creation or development of new products, processes, services, technologies, or ideas that society accepts. Convergent thinking also plays a role in innovative creativity, though the role is often more subtle than divergent thinking. Convergent thinking, at the higher-order level, brings facts and data together from various sources and applies logic and knowledge to find solutions. Higher-order convergent thinking involves evaluation and is often crucial to maintaining viability of a paradigm or product.

Situations do not always require innovatively creative solutions. Sometimes, the creative process involves *adaptive* creativity: retaining the core elements of an existing paradigm or product and improving, revising, or adapting it to suit new circumstances. In product marketing, for example, many creative changes are merely adaptations of existing products to extend their product life cycles. So, for adaptive type of creativity, convergent thinking is more often used than divergent thinking is.

Because any creative act ultimately involves a decision, both divergent and convergent thinking are necessary for creativity to operationalize. In the process of creativity, divergent thinking is prevalent in the initial stages of finding novel ideas, but convergent thinking is needed later for analysis and evaluation of the ideas to arrive at a useful product. Initially, complex problems or questions should be approached divergently, that is, by looking at the problem from multiple perspectives and imagining different solutions. Then, at some point, the problem solver must converge or decide on one answer or solution. Thus, creativity requires both of these thinking processes, and creativity occurs when these two processes complement each other: divergent thinking to generate many novel ideas and convergent thinking to evaluate these ideas and select one of them to solve a particular problem.

Relationship of Convergent and Divergent Thinking to Intelligence

Convergent thinking is included in both intelligence, which is measured by IQ, and creativity, which is substantially independent of intelligence and not measured by IQ. Intelligence can support creativity because of the role convergent thinking plays in creativity, but extremely intelligent people are not necessarily creative: their knowledge can act as a blinder, forcing a degree of convergent thinking that limits their creative insights. In his analysis of scientific revolutions, Kuhn (1962) concluded that most scientists, who are generally considered highly intelligent, are fundamentally conservative and work to strengthen existing scientific paradigms. Only rare creative scientists have the creative capacity to think outside existing paradigms, including Copernicus, Galileo, Newton, and Einstein.

Although intelligence can support creativity, very creative people do not need to be very intelligent. Creative people need only enough domain-specific intelligence to be able to generate multiple possibilities or solutions. Divergent thinking is part of the creative personality and attitude, which must exist for a creative product to result. Divergent thinking requires intellectual curiosity and open-mindedness. Divergent thinking connects seemingly irrelevant ideas together and tends to approach problems from different perspectives. Divergent thinking will exhibit various other traits common among creative personalities, and these traits may encourage or result in their innovative problem-solving style.

Education systems, because they typically encourage convergent thinking, have generally favored development and measurement of IQ rather than of creativity. Most traditional forms of education focus on the transmission of knowledge, skills, and values of existing society. Teachers and professors impart knowledge to their students, whose acquisition of that knowledge is measured. The philosophy of education supporting this approach is known as Essentialism, which rests on a number of assumptions, above all that students' brains are blank slates, that the teachers possess correct answers (knowledge), and that the purpose of education is preparation for the future (Duck 1971). Because preparation for the future is unquestionably a significant purpose of education for many, perhaps most, middle-class families, Essentialist philosophy dominates most systems of schooling and education. Because educational systems often function within society to sort students into vocations or to determine who can advance, systems of assessment capture the degree to which students have successfully acquired the knowledge and skills of the existing social order.

John Dewey reacted to this situation and developed his own approach to education, which today is referred to as Constructivism. Constructivism rests on different assumptions: that students have innate ideas, that teachers and professors function as experienced co-learners with their students, and that education serves to enhance students' lives now. Educators in the tradition of Dewey foster divergent thinking by posing questions to which there are many possible answers and to which the teachers themselves do not possess any one *correct* answer. Students must inquire and develop their own solutions, ideally evaluating which is the best answer. Thus, although most schools have not excelled at fostering creativity, an educational philosophy and instructional approaches exist that can.

Extreme Convergent and Extreme Divergent Thinking

Just as innovation and adaptation overlap, divergent and convergent thinking are not fully distinct categories. Divergent thinking, for example, could consider as many perspectives as there are people or cultures, or customers; it could also consider just several perspectives, for examples, perspectives of two or three or four market segments. Convergent thinking can in a doctrinaire fashion imagine that there is one possible answer and refuse to consider any others. Or, in a less extreme form, a convergent thinking process could anchor itself in a few nonnegotiable presumptions and then synthesize new information in the context of these basic accepted facts. The most productive thinking does not occur at the extreme ends of the spectrum of convergence or divergence, but rather where the two types of thinking complement each other to produce creatively meaningful outcomes.

Just as a combination of divergent and convergent thinking is the most productive, extreme convergent or divergent thinking may be harmful. Extreme forms of either convergent or divergent thinking are unlikely to produce useful products. At the extreme edge of convergent thinking are high-functioning autism and Asperger's syndrome (Andersen and Kim in press). Individuals with high-functioning autism and Asperger's syndrome have a cognitive style that focuses on under-inclusion instead of over-inclusion. Under-inclusive thinking can result in excellent attention to detail and extraordinary memory, and children with Asperger's syndrome are prone to spend countless hours and devote a great deal of effort to minutiae of interest to them. This cognitive style associated with under-inclusion is more suitable to reality-based creativity or scientific creativity. Gifted mathematicians and engineers tend to share these traits. Less extreme but more common is the type of convergent thinking that, despite reflecting intelligence, lacks intellectual flexibility. In a classroom, a student with overly convergent thinking is the type who struggles with ambiguity and uncertainty or who is uncomfortable learning in a fashion outside their preferred learning style.

Extreme varieties of divergent thinking also exist. Schizophrenia is beyond extreme divergent thinking because the condition results in thoughts and behaviors that do not lead to creative thought or creativity (Andersen and Kim in press). However, artists and writers, who often reflect traits common to divergent thinking, sometimes exhibit schizo-type behaviors. Any of the common traits of creative people could be exhibited too frequently, or too strongly, and in doing so prevent creative output and product. Divergent thinking ranges into greater over-inclusion. Eminent artists and writers, for example, focus on over-inclusion and show elevated levels of unusual experiences and impulsive nonconformity. Less extreme but more common forms of strongly divergent thinking include an inability to come to closure or to make a decision because too many possibilities are under review. Extreme divergence can lead to irrelevance through thinking processes not anchored in socially meaningful points of reference. Extremely divergent thinking manifests as an unproductive variety of nominalism, preventing meaningful categorization and other cognitive tasks that are intellectually useful and lead to constructive and useful outcomes.

Education systems can work to mitigate extreme varieties of either convergent or divergent thinking. An ideal educational system would strike a better balance between Essentialism and Constructivism than currently occurs in most schools. Students do need to be prepared for a future, which includes acquisition of knowledge and values of the existing social order, an outcome achieved through convergent thinking. On the other hand, because the world changes faster and faster, students need the capacity to think divergently to see multiple possibilities and to consider multiple perspectives. Finally, students need to know how to combine the two forms of thinking in complementary fashion to know when to bring closure to an inquiry process to produce a good solution.

Role of Mentorship

Creative ideas spring from creative personalities plus enough intelligence to acquire an expertise in a specific domain. Without the creative personality and attitude, creative ideas cannot take place. Every child is born with a creative personality and attitude, and society and circumstances usually act to dim that spark. For creativity to thrive, therefore, it is important to understand what creative personalities are and how to encourage them.

As noted above, most school systems today, despite their best intentions, dampen creativity. Teachers ask their students questions with only one right answer or, worse, the teacher judges students' responses on the basis of one right answer. An obvious place of mentorship in the creative process can begin with parents and teachers, with whom most young people spend the majority of their day. Parents can learn the basics of fostering creativity and try to raise their children with those objectives in mind. Teachers can do the same. Some contemporary trends in education, especially the standards movement, challenge teachers to find ways to be creative and to foster creativity, but the impact in schools is reduced when teachers are grounded in the assumptions of other educational philosophies. Under those conditions, teachers can be aware when their instruction fosters convergent thinking and when it fosters divergent thinking.

Divergent Thinking and Invention and Innovation

Combining adaptive creativity and innovative creativity is best for invention and innovation, and both can give rise to entrepreneurship. Eminent creative invention or innovation arises generally through leading with thinking for divergence and complemented near the end of the process with thinking for convergence. The result often is the production of creative products (Kim and Pierce 2012).

In examination of the etymologies, both the terms invention and innovation highlight the role of divergent thinking in innovation. The roots of invention are "in" plus a form of the Latin word for "to come" (*venire*). Ideas need to come in, to come together. A similar stress on divergence underpins innovation, which stems from "in" plus the Latin word for "new" (*novus*). Both words rest innately on the concept of new ideas and possibilities other than those currently known. Virtually all groundbreaking innovations or inventions rest on this basis. Johannes Gutenberg, for example, combined ideas from his work as blacksmith and a goldsmith, to create (a form of convergence) mechanical movable-type printing, one of the most revolutionary inventions of the last 1,000 years. Other great inventions rest on similar foundations. From an economic perspective, new ideas or products are only innovations if they have socially meaningful applications. In Gutenberg's case, his invention of movable-type printing had immediate and powerful implications. Growing cities were producing an increase in literate populations, and strengthening central monarchies were in greater need of more literate people to serve in bureaucratic functions. This was all in a context where the basic instrument for teaching reading and writing were expensive manuscripted texts. By using metallurgical skills, the relatively simple Western phonetic alphabet, and basic types of presses available for use in other commercial contexts, Gutenberg devised a mechanical device that could produce numerous copies of sought-after texts at a far lower cost than before. With the decline in costs of books, demand increased significantly. Printing allowed for the diffusion and amplification of knowledge, which then brought about social and economic revolutions.

Today, many economists view innovation as central to economic growth. Schumpeter (1942), whose expression "creative destruction" today is much quoted and misquoted, asserted that innovation is central to economic growth and has led to the field known as "innovation economics." In earlier periods of human history, much of the basis of economic growth rested on natural resources and environment. As obvious sources of natural resources are tapped or depleted, the ability to innovate is viewed as the principle resource central to competitiveness and to maintenance of vibrant economies. Society and its institutions, including businesses, governments, and schools, should foster and pursue innovation, which can be achieved by understanding and fostering complementary divergent and convergent thinking.

Conclusions and Future Direction

Divergent and convergent thinking are two poles on a spectrum. Both types of thinking play a role in the creative process, although in their extreme forms, neither is particularly helpful and may indicate certain problems. Convergent thinking is closely related to intelligence, whereas divergent thinking is not. Schools generally privilege and seek to foster convergent thinking, though some educators, such as Dewey, have tried to foster varieties of divergent thinking. Toward that end, he was on the right track. Mentors, including teachers, can play a crucial role in fostering creative thinking. In light of the ever more competitive world economically and the place of innovation in economic growth, educators need to place greater emphasis on divergent thinking in their curriculum, assessment, and instruction.

Cross-References

▶ Business Creativity
▶ Cognition of Creativity
▶ Convergent Versus Divergent Thinking
▶ Creative Destruction
▶ In Search of Cognitive Foundations of Creativity
▶ Innovation and Entrepreneurship

References

Andersen L, Kim KH Are creatively gifted students different from academically gifted students. in press.

Duck L. Teaching with charisma. Burke: Chatelaine Press; 1981.

Kim KH. The creativity crisis: the decrease in creative thinking scores on the torrance tests of creative thinking. Creat Res J. 2011;23(4):1–11.

Kim KH, Pierce RA. Torrance's innovator meter and the decline of creativity in America. In: Shavinina LV, editor. The international handbook of innovation education. New York: Taylor & Francis/Routledge; 2012.

Kneller GF. Introduction to the philosophy of education. 2 ed., rev. New York: Wiley; 1971.

Kuhn T. The structures of scientific revolutions. Chicago: University of Chicago Press; 1962.

Schumpeter JA. Capitalism, socialism, and democracy. New York/London: Harper & Brothers; 1942.

Cooperations to Innovate

▶ Collaborative Innovation and Open Innovation

Coopetition

▶ Collaborative Innovation and Open Innovation

Co-publication

▶ Networks and Scientific Innovation

Corporate Creativity

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Introduction

When describing creativity at Pixar Animation Studios, cofounder and CEO Ed Catmull (2008) wrote, "A movie contains literally tens of thousands of ideas. They're in the form of every sentence; in the performance of each line; in the design of characters, sets and backgrounds; in the locations of the camera; in the colors, the lighting, the pacing. The director and the other creative leaders of a production do not come up with all the ideas on their own; rather, every single member of the 200–250 person production group makes suggestions. Creativity must be present at every level of every artistic and technical part of the organization" (p. 66).

Creativity in a corporate setting, whether in the private or public sector, a large or small organization, and manufacturing or service industry, is much more like Pixar than not. Creative ideas can and actually do need to come from everyone in the organization. Nobody can predict *who* will be involved in them, *what* they will be, *when* they will occur, or *how* they will happen. But rather than mean that nothing can be done, the very unpredictability of creativity leads to a greater understanding of how organizations can increase their creative performance. The unpredictability of creativity is the reason why more individually targeted strategies, such as attempts to hire especially creative people or training current employees to be creative, have not been particularly successful. As Curtis Carlson (2006), president and CEO of SRI International, put it, “top-down innovation is orderly but dumb, while bottom-up innovation is chaotic but smart.”

Corporate creativity differs from more individual perspectives on creativity in that it recognizes the collective and distributed nature of work in a corporate setting and the organization as the basis for determining usefulness. As Cameron Ford (1995) observed in his review of research on creativity, most definitions of creativity involve newness and usefulness but differ on the focus or reference point for the definition. This reflects the early and substantial involvement of psychologists, many of whom have defined creativity in terms of a person and their characteristics, or have focused on processes associated with creativity.

In contrast with more individually based definitions of creativity, Robinson and Stern (1997) defined ***corporate creativity*** so as to emphasize the company’s role as the reference point for both newness and usefulness:

> A company is creative when its employees do something new and potentially useful without being directly shown or taught. (Robinson and Stern 1997, p. 10)

This definition builds on the work of Paul Torrance who, very early in his career, conducted a multiyear research study with the US Air Force to determine how it could prepare pilots and crews to survive the brutal experiences they would be likely to face as prisoners of war in North Korea. In the end, what he found surprised him: The thing that had proved most critical for survival was something that no training program taught – *creativity*. Torrance found that no matter how much training people had received, when faced with the real thing, they almost invariably had to cope with *unexpected* situations. Those who survived had combined elements of their training and life experiences to create a completely new survival technique, one they had not been taught (Torrance 1959). This discovery fascinated Torrance and led him on to a distinguished research career in creativity, one that spanned more than 40 years.

Today, in an increasingly mobile, socially interconnected, and competitive world, the very survival of companies depends on their creativity. To survive and prosper, they must succeed not only at what they plan to do but also in ways they never expected. This is where creativity, both incremental improvement and breakthrough innovation, happens. Since both the situation and the actions are unexpected, the greatest leverage for increasing the capacity for creativity is in creating an environment that is friendly to this type of bottom-up creativity.

Through research on creative acts in different types of organizations in different countries, Robinson and Stern (1997) have identified six characteristics of an environment that increase the probability of creativity in a corporate setting. Although no one can predict the specific creative acts that will follow, the likelihood of their happening will significantly increase when these six elements are in place. “Managing” creativity is about raising probabilities, and in this respect it is similar to operating a casino. Even though casinos do not know how individual gamblers will fare at any given table, they know very well that if enough customers come and play for long enough against the house odds, the casino will make a very predictable and stable profit. In much the same way, although companies cannot know where specific creative acts will come from or what they will be, they can take action to increase the frequency with which creative acts occur. The specific six environmental characteristics that advance corporate creativity are alignment, self-initiated activity, unofficial activity, serendipity, diverse stimuli, and within-company communication (Robinson and Stern 1997).

The first characteristic, ***alignment***, is about ensuring that the interests and actions of all employees are directed toward a company’s key goals, so that any employee is more likely to suggest and respond positively to an idea with potential value for the company. On a hit-or-miss basis, creative acts can happen in any company, but they cannot occur consistently over time unless a company is well aligned. Companies can function with relatively poor alignment, but they cannot be consistently creative unless they are strongly aligned. Alignment is often overlooked; it is intangible and elusive, and as far as corporate creativity is concerned, its effects are readily visible only when a company is either extraordinarily well aligned or misaligned. In *Built to Last*, James Collins and Jerry Porras (1994) identified alignment as the key difference between their study's "visionary" companies (those select few that had steadily grown, survived, and prospered over a 100-year period) and the "also-ran" companies which had not.

The second characteristic is ***self-initiated activity***, and no unplanned act of creativity can happen without it. While companies can plan for new and useful things, these take an organization in only directions it has already anticipated. People have a natural drive to explore and create, a drive that leads them to initiate new activity. One reason why self-initiated activity figures so prominently in corporate creativity is that it allows employees to pick a problem that they are interested in and feel able to solve, for *whatever* reason. This means that their intrinsic motivation is much higher than would be the case if the project had been planned or picked for them by someone else.

Unofficial activity, the third characteristic, occurs in the absence of direct official support but with the intent of doing something new and useful for the organization. So many instances of corporate creativity, including the bar code, post-it notes, and ink-jet printer, all began as unofficial work by one person or a small group of people. When an idea is new to an organization, it is often resisted and opposed. Unofficial activity gives ideas a safe haven where they have the chance to develop until they are strong enough to overcome that resistance. Unless an organization makes some space for such activity, it leaves itself little room to be consistently creative – to bring along a stream of new and useful things without being shown or taught.

The fourth characteristic, ***serendipity***, is a widely used word, but few people are familiar with its history and original meaning. When this meaning is restored, the relationship to corporate creativity and specific actions that companies can take become clear. A serendipitous discovery is one made by *fortunate accident* in the presence of *sagacity* (keenness of insight). Creativity often involves recombining or making connections between things that may seem unconnected. The more abstruse the connection, the greater the intellectual distance that must be traversed to make it, and the greater role for the unexpected.

The fifth characteristic of corporate creativity is ***diverse stimuli***. A stimulus may provide fresh insight into something a person has already set out to do, or it may bump that person into something different. One reason why no one can predict who will be involved in a creative act, what it will be, or when or how it will happen is that it is impossible to know in advance what sort of stimulus will lead a particular person to initiate one. It could be anything from a casual conversation to a formal presentation or a seemingly unrelated activity. And what serves as a powerful stimulus for one person may not even be noticed by someone else. This unpredictability means that efforts to expose people to prescribed stimuli will necessarily have a low success rate. The real leverage lies in helping employees to get the stimuli and in creating opportunities to bring these stimuli back into the organization where then can be put to use.

The sixth characteristic is ***within-company communication***. Every organization carries out planned activities and should establish the necessary lines of communication to support them. But these official channels are of limited usefulness for corporate creativity, which goes beyond what is already done and planned for. Unanticipated within-company communication seems to happen more naturally at smaller companies but not so naturally at larger ones. The larger the company, the more likely it is that the components of creative acts are already present somewhere in the company, but the less likely it is that they will be brought together without some help. A company's creative potential increases with its size, but without systems in place to promote unanticipated exchanges of information, this potential is unlikely to be realized.

Conclusion and Future Directions

Given the unpredictability of corporate creativity, the greatest leverage for assuring ongoing creativity is in nurturing an environment that increases the probability that creativity, both small and large, will occur with regularity. However, the "borders" of any organization's environment are becoming increasingly blurred by globalization, social networking, and greater mobility and flexibility in the workforce. Increasing capacity for corporate creativity will relate to the development of strategies that successfully engage ideas and actions of people inside the organization as well as all those stakeholders who interact with it.

Cross-References

▶ Business Creativity
▶ Corporate Entrepreneurship
▶ Creative Leadership
▶ Organizational Creativity

References

Amabile TM. The social psychology of creativity. New York: Springer; 1983.

Carlson CR, Wilmot WW. Innovation: the five disciplines for creating what customers want. New York: Crown Business; 2006.

Catmull E. How Pixar fosters collective creativity. Harv Bus Rev. 2008;86(9):64–72.

Collins JC, Porras JI. Built to last: successful habits of visionary companies. New York: Harper Business; 1994.

Ford CM. Creativity is a mystery. In: Ford CM, Gioia DA, editors. Creative actions in organizations. Thousand Oaks: Sage; 1995. p. 12–49.

Pirola-Merlo A, Mann L. The relationship between individual creativity and team creativity: aggregating across people and time. J Organ Behav. 2004; 25(2):235–57.

Robinson AG, Stern S. Corporate creativity: how innovation and improvement actually happen. San Francisco: Berrett-Koehler; 1997.

Torrance PE. Surviving emergencies and extreme conditions: a summary of six years of research (Unpublished manuscript prepared for the survival training unit of the Air Force Personnel and Training Research Center). Washington DC: U.S. Air Force; 1959.

Corporate Entrepreneurship

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Synonyms

Corporate entrepreneurship, internal; Corporate venturing, internal; Independent entrepreneurship; Internal innovation; Internal venturing; Intrapreneurship; Redefinition; Reorganization; Revival; Strategic change; Strategic departure; Strategic renewal; Transformation

Introduction

Many innovative companies have progressively lost their creativity over time due to increases in size, bureaucracy, and hierarchy associated with their growth. To regain the entrepreneurial dynamic they once had, some companies are choosing to invest in employee-generated innovative projects linked to their core or closely related competencies. These types of initiatives can arise spontaneously from within the company or, in cases when the organization does not possess the internal entrepreneurial talent, they can be implemented through a top-down approach as managers instill an innovative work culture to modify employee behaviors. These entrepreneurial initiatives are typically facilitated by the main organization and are managed from within the firm or through an external entity.

Definitions: A Concept with Imprecise Semantic Boundaries

This brief summary explores several phenomena that fall under the notion of corporate entrepreneurship. Literature often classifies the different variations of this concept into four categories: *corporate venturing, strategic renewal,* *intrapreneurship, and corporate entrepreneurship* (Sharma and Chrisman 1999). Of this terminology, *corporate entrepreneurship* encompasses the widest range of definitions and will be used as the keyword in this entry.

Corporate Venturing

The first set of definitions refers to the phenomenon of *(internal) corporate venturing*, the creation of new activities (or business) within an existing firm.

> Block and Mac Millan "*consider a project a venture when it: Involves an activity new to the organization; Is initiated or conducted internally; Involves significantly higher risk of failure or large losses than the organization's base business; Is characterized by greater uncertainty than the base business; Will be managed separately at some time during its life; Is undertaken for the purpose of increasing sales, profit, productivity, or quality*" (1993, p. 14).

A corporate venture is typically characterized by the launch of a new (often risky) project, the relative autonomy of the project, and the fact that the project is being developed internally.

This type of undertaking requires the company to develop new skills, knowledge, or processes, but such new skills are generally never far from the firm's original core competencies. The resulting new initiatives or products have a significant and lasting impact on the organization.

Internal corporate entrepreneurship, internal innovation, internal venturing, and sometimes *intrapreneurship* all refer to the same phenomenon.

Strategic Renewal

The second group of definitions refers to the transformation or "renewal" of organizations.

We call this category "*strategic renewal*," but the terms "*organizational renewal*," "*strategic change*," "*revival*," "*transformation*," "*strategic departure*," "*reorganization*," and "*redefinition*" are also used to explain the same phenomenon. It is important to note that strategic renewal should not be confused with financial restructuring.

According to Zahra (1995, p. 227) "*Renewal means revitalizing a company's business through innovation and changing its competitive profile*."

This definition highlights the fact that the companies themselves are subject to business reorganization or innovation. Many authors use Schumpeter's broad definition to illustrate the broad range of potential changes stemming from entrepreneurial behaviors. These changes do not necessarily have innovation as the end goal; strategic renewal can also result from cost cutting or a reallocation of resources, which may bring about new business opportunities or innovation.

This category encompasses what is sometimes called "*Frame-breaking changes*," whereby changes focus on the rules of competitive engagement (e.g., creating new business models) (Stopford and Baden-Fuller 1994).

Intrapreneurship

A third perspective of corporate entrepreneurship is represented by the term *intrapreneurship*. Firms have genuine entrepreneurs among their personnel. "Intrapreneurs" are creative and often autonomous employees who try to implement innovative projects to improve the firm's performance. Overseeing intrapreneurs' projects is a way to generate increased profits. Intrapreneurs detect opportunities, build ad hoc internal and external networks, and shorten the duration of the innovation process (Bouchard 2009).

Many companies try to encourage their staff to adopt an "intrapreneur-like" mind-set and behavior. This model, therefore, analyzes the institutionalization of routines and the adoption of entrepreneurial behaviors within existing organizations.

The term "intrapreneurship," a neologism created by combining "entrepreneurship" and "internal," was popularized by Pinchot (1985) in the 1980s. In this school of thought, authors often cite the entrepreneurship literature since it is there that the entrepreneurial behavior is seen as a driving force.

The authors differentiate "*intrapreneurs*" from "*entrepreneurs*" (Pinchot 1985) and "*independent entrepreneurship*" from "*corporate entrepreneurship*" (Collins and Moore 1970; Sharma and Chrisman 1999). According to Pinchot, an intrapreneur is "*Any of the 'dreamers who do.' Those* *who take hands-on responsibility for creating innovation of any kind within an organization. The intrapreneur may be the creator or inventor but is always the dreamer who figures out how to turn an idea into a profitable reality*" (Pinchot 1985, p. iX). On the other hand, an entrepreneur is "*someone who fills the role of an intrapreneur outside the organization*" (Pinchot 1985, p. iX). The key distinguishing characteristic between entrepreneurship and intrapreneurship, therefore, lies in whether the entrepreneurial activity has been developed internally or externally.

Corporate Entrepreneurship

Guth and Ginsberg's definition combines the first two categories through the meaning of *corporate entrepreneurship*, the final category of definitions for discussion. "*The topic of corporate entrepreneurship encompasses two types of phenomena and the processes surrounding them: (1) the birth of new businesses within existing organizations, i.e., internal innovation or venturing; and (2) the transformation of organizations through renewal of the key ideas on which they are built, i.e., strategic renewal*" (Guth and Ginsberg 1990, p. 5). This interpretation is widely accepted because it encompasses many other definitions (Sharma and Chrisman 1999).

While Guth and Ginsberg's definition (1990) emphasizes the fact that corporate entrepreneurship can involve new businesses or initiate major changes within the organization, other definitions for this category also highlight the qualities of intrapreneurship (and consequently, encompass the three previous categories of definitions). According to Sharma and Chrisman, "*Corporate entrepreneurship is the process whereby an individual or a group of individuals, in association with an existing organization, create a new organization or instigate renewal or innovation within that organization*" (1999, p. 18). In this case, the individual or collective dimensions of entrepreneurship, as well as the partnership with the organization, are the key to defining the concept of corporate entrepreneurship.

Still other definitions stress the process and resources required to foster corporate entrepreneurship. "*Corporate entrepreneurship* [...] *refers to the process whereby firms engage in diversification through internal development. Such diversification requires new resource combinations to extend the firm's activities in areas unrelated, or marginally related, to its current domain of competence and corresponding opportunity set.*" (Burgelsman 1983, p. 1349).

Theoritical Origins, Corporate Entrepreneurship Practices, Innovation, and Intrapreneurs

The Field of Corporate Entrepreneurship Has Two Theoritical Origins

First, management researchers have been interested in the concept of *corporate entrepreneurship* or *corporate venturing* since the end of the 1960s. According to Bouchard (2009), the first article dealing with this issue dates back to the year 1969 (Wesfall 1969). Venturing is similar to traditional entrepreneurship, but it occurs exclusively within the bounds of the corporate organization. The practice is undertaken to improve sales, profits, productivity, or quality. Corporate entrepreneurship also consists of fostering a venturesome environment to help the firm's continuous development of new business opportunities or activities.

Second, the concept of corporate entrepreneurship has also been covered in various studies on entrepreneurship. Corporate entrepreneurship was originally analyzed as a particular form of entrepreneurship. Over time and especially with the emergence of "intrapreneurship" (Pinchot 1985) as an established concept, it eventually evolved as an independent field of study.

Management researchers are especially interested in intrapreneur behaviors, but also in the entrepreneurial practices implemented by firms.

Corporate Entrepreneurship and Innovation

The flexibilization and debureaucratization of the workplace since the 1970s has led to the increased popularity of corporate entrepreneurial practices. Most innovation models have come to be based on planned and systematic innovations with well-established procedures. These models became too expensive and rigid because they were often integrated within everyday operational routines. Such models did not bring about increased efficiency and only led to incremental innovations. While traditional innovation processes, such as R&D, stem from organizational continuity, intrapreneurship focuses on the role of human continuity in the innovation process (Blanchot-Courtois and Ferrary 2009). According to this interpretation, intrapreneurship leads to increased employee motivation and development.

The place of corporate entrepreneurship within firm's innovation process changes over time depending on the firm's strategic policy and its cultural perception of innovation in the workplace. While some firms develop corporate entrepreneurship externally, others integrate it within the company's organizational processes.

In the current climate of uncertainty, the adoption of innovative projects entails increased risk, so companies tend to view entrepreneurship as a secondary activity or may simply choose to abandon these types of projects.

The Intrapreneur: Status, Motivations, and Characteristics

Intrapreneurial projects may be generated spontaneously by employees. The intrapreneur may develop an independent project linked to the firm's core competencies or to peripheral activities. Initially, the employee may need to conceal the project from the management team until the project has reached an acceptable level of development. Then, he or she will have to get approval from the leadership to obtain financial support, human capital, or logistical resources and be allowed time to continue working on the project. The management may dismiss the project if it does not fit within the strategic goals of the company. This type of corporate entrepreneurship is called "spontaneous intrapreneurship" as employees launch projects – often in spite of limited or nonexistent corporate support – that they consider important for the firm's development.

To complete the project successfully, the intrapreneur must possess numerous technical competencies and motivational skills and also has to build the project's legitimacy within the firm. The intrapreneur must possess the political know-how of identifying stakeholders and mobilizing corporate networks to protect the project's autonomy and convince the senior management to support the initiative (Bouchard 2009). In that sense, an intrapreneur must possess strong managerial and entrepreneurial skills.

According to Bouchard (2009), intrapreneurial motivations have two origins. On the one hand, the altruist intrapreneur is persuaded to bring a major project to the firm and is not directly concerned with the potential financial rewards and promotion that may come with the success of the idea.

On the other hand, the ambitious intrapreneur has a strong desire to reach his or her full potential. The ambitious intrapreneur ultimately seeks to improve his or her intellectual capabilities, develop transversal skills, and frequently tries to free his or herself from the limitations of the firm's routines. Intrapreneurship can almost be seen as a second career path for an employee to improve social and professional status without following the traditional stages of professional development (Pinchot 1985).

To provide an example of spontaneous intrapreneurship, we can look to the case of Ian Telford, an employee who worked at Dow Chemical Company, and developed a project of e-commerce named "e-epoxy.com" (Chakravarthy and Huber 2003). The goal of his project was to reach small businesses and occasional customers who are not typically reached through traditional commercial visits. This project was progressively accepted by the company, and Ian Telford managed it at each stage (from the project's original conception to implementation) and chose his partners (Bouchard 2009).

While employee drive plays a key role in the success of a project, corporate entrepreneurship also depends on a company's organizational context. Burgelsman (1983) explains that spontaneous entrepreneurship occurs when the employee's proposed project matches the firm's opportunities and when the firm possesses a wealth of financial and human resources.

Projects may fail due to a weak intrapreneurial culture within the firm, especially during periods of economic uncertainty.

Corporate Entrepreneurial Practices

Various forms of corporate entrepreneurial practices exist. In addition to spontaneous intrapreneurship, three types of "induced intrapreneurship" practices have been identified: intrapreneurial units, intrapreneurial platform, and intrapreneurial division (Bouchard 2009).

- Induced intrapreneurship has led to the development of "intrapreneurial units" (called "task forces," "project teams," or "entrepreneurship cells"). Many companies evaluate their managers on their implementation of projects and push them to take on intrapreneurial behaviors.

  To control spontaneous intrapreneurship or to develop induced intrapreneurship, many firms develop a special task force devoted to project innovation to isolate high-risk projects from the rest of the organization. This business model reduces costs and allows the company to have the flexibility of stopping the operations of these special units when a particular project is completed. In large companies, many innovative projects have been developed with this type of intrapreneurial process.

  An example of induced intrapreneurship can be found in the case of the French Postal Service and its development of a new technology called Vigik – a nationwide access control system for residential buildings. The manager who spearheaded Vigik had his own independent team and resources throughout the development of the project. Today, Vigik has become a registered trademark for products that match specifications initially developed by an entrepreneurial unit of the French Postal Service (Merlin-Brogniart 2011).
- Other companies choose to implement significant intrapreneurship procedures. Two types of intrapreneurship dynamics are identified: The intrapreneurial platform, which fits within the firm's operational routines, and the intrapreneurial division, which is separate from the organization. Both reflect the most extensive entrepreneurial culture. Google, Procter & Gamble, Apple, and Xerox Corporation are all companies that encourage this type of corporate entrepreneurship. For example, Google launched the idea of "*a license to pursue your dream*" as part of their human resources program. The company's engineers have the ability to use up to 20% of their time to develop their own projects without having to receive approval from upper levels of management. Many of Google's most significant innovations, such as Google News, have come from this entrepreneurial culture.
- The goal of the intrapreneurial platform is to help intrapreneurs during the early stages of their projects. The activities can be very diverse, but have to enhance the company's growth and profits by reducing costs, improving quality or developing new products, combining existing skills in new ways, or creating new activities. Within this formula, intrapreneurs can keep their job, which helps to reduce the risk they are taking. Employees who want to develop projects are supervised by a small team of experts who can provide the necessary competencies and networks. This method contributes to decompartmentalizing the organization. To illustrate the intrapreneurial platform, we can look to Ohio Bell and the program "Enter-Prize" (Kanter and Richardson 1991). Employees could submit project in order to improve the firm's growth. Managers are leading the platform and have developed a network of experts (ex: innovation consultancy). If the project is selected, a time budget is granted to elaborate the project (Bouchard 2009).
- The intrapreneurial division is generally separate in order to avoid disturbing the company's overall organization. It possesses its own financial and human resources which enables it to dynamize the innovation process. Autonomy, transversal skills, and risk-taking are promoted. This type of intrapreneurship is usually developed to solve a malfunction in the existing organization (inadequate innovation promotion, loss of innovation dynamic). It increases the number of challenging projects

(finding new venture, developing new generations of products or new technologies, and opening new markets).

Employees's projects are evaluated at each stage in order to keep the costs down, reduce risks, and bring the innovations to market more quickly. In that form of corporate entrepreneurship, intrapreneurs may be allowed to return to their previous position or may have to leave it altogether.

For example, Procter & Gamble implemented "Corporate New Ventures" (CNV) to stimulate radical innovations (Amabile and Whitney 1997). This entrepreneurial structure is small, independent, and flexible so that it can set up good practices and make better use of the company's technologies. A team representing the various functional departments of the company was established. The team meets once a week at the start of new projects. Project implementation is subsequently transferred to operational divisions.

The Role of Managers

In the three kinds of corporate entrepreneurship structures, managers play a key role in driving innovation or corporate ventures. The involvement of middle level managers is crucial from an early stage. They support independent strategic initiatives and bring together various capabilities dispersed throughout the firm's operating system (Burgelsman 1983). Intrapreneurial structures can be run by a manager, a small team of venture managers, or by a venture-group operating within the corporation.

Top managers ensure that new business ideas are generated and play an important role in strategic recognition. They try to match entrepreneurial activities with their strategic vision, often retroactively. They balance diversity and order over time.

Corporate Entrepreneurship: An Interesting but Risky Process

The implementation of corporate entrepreneurship practices involves many risks.

First, as corporate entrepreneurship units are often complementary to the organization, they may conflict with the routines and units of the existing structure. These conflicts are a major source of project failure, which is why "Corporate" and "entrepreneurship" are sometimes seen as an oxymoron: The introduction of entrepreneurship behaviors involving creativity, flexibility, and reactivity may be incompatible with the structure, routines, and planning that companies have built so carefully over the years.

Second, support for spontaneous intrapreneurship also raises problems within companies.

While they can be an asset for the growth of the firm, intrapreneurs may generate mixed feelings among the other employees and managers. On one hand, intrapreneurs help the company find competitive advantages, and on the other, employees and managers do not always appreciate intrapreneurs who are given autonomy and extra financial or human resources. Tensions build up all the more as the success of the project is never assured.

Third, the process entails risk for the intrapreneurs: They bear the full responsibility if the project fails, and they can be rejected by the other employees and isolated. Even in case of success, their previous position is not necessarily guaranteed and their chances for promotion might be jeopardized because an intrapreneur is no longer part of the traditional system.

The company has to carefully balance the benefits of corporate entrepreneurship and its drawbacks before implementing it.

Conclusion and Future Directions

"Corporate entrepreneurship" is still a fairly new concept, and the different definitions and terms used to explain this phenomenon can be confusing. Particularly since the lines between the various definitions of *corporate entrepreneurship* are frequently blurred, the theoretical and practical mastery of this concept is not yet established and demands further examination.

Cross-References

- ▶ Academic Entrepreneurship
- ▶ Entrepreneurial Opportunity
- ▶ Entrepreneur's "Resource Potential," Innovation and Networks
- ▶ Environmental Determinants of Entrepreneurship
- ▶ Innovation Opportunities and Business Start-up
- ▶ Innovation Systems and Entrepreneurship
- ▶ Innovations of and in Organizations
- ▶ Venture Capital and Small Business

References

Amabile T, Whitney D. Corporate new ventures at procter & gamble. Boston: Harvard Business School; 1997. case 9-897-088.
Blanchot-Courtois V, Ferrary M. Valoriser la R&D par des communautés de pratique d'intrapreneurs. Revue française de gestion. 2009;35(195):93–110.
Block Z, Mac Millan IC. Corporate venturing: creating new businesses within the firm. Boston: Harvard Business School Press; 1993.
Bouchard V. Intrapreneuriat, innovation et croissance. Entreprendre dans l'entreprise. Paris: Dunod; 2009.
Burgelsman RA. Corporate entrepreneurship and strategic management: insights from a process study. Manag Sci. 1983;29:1349–64.
Chakravarthy B, Huber H. Internal entrepreneurship at the Dow Chemical Company. 2003. International, ref. IMD-3-1117, 29.07.2003
Collins O, Moore DG. The organization makers. New York: Appleton; 1970.
Guth WD, Ginsberg A. Guest editor's introduction: Corporate entrepreneurship. Strateg Manag J. 1990;11(5–15):5–15.
http://google24x7.blogspot.com/2008/03/9-rules-of-innovation-from-google.html
Kanter M, Richardson L. Engines of progress: designing and running entrepreneurial vehicles in established companies; the enter-prize program at Ohio Bell, 1985–1990. J Bus Ventur. 1991;6(3):209–29.
Merlin-Brogniart C. Intrapreneuriat et services publics marchands en réseau: Le cas de La Poste. In: Hamdouch A, Reboud S, Tanguy C, editors. PME, dynamiques entrepreneuriales et innovation. Bruxelles: Peter Lang, coll. Business and Entrepreneurship; 2011.
Pinchot G. Intrapreneuring, why you don't have to leave the corporation or become an entrepreneur. New York: Harper & Row; 1985.
Sharma P, Chrisman JJ. Toward a reconciliation of the definitional issues in the field of corporate entrepreneurship. Entrep Theory Pract. 1999;23(3):11–27. Blackwell, Spring.
Stopford JM, Baden-Fuller CWF. Creating corporate entrepreneurship. Strateg Manag J. 1994;15:521–36.
Wesfall SL. Stimulating corporate entrepreneurship in US industry. Acad Manage J. 1969;12(2):235–57.
Zahra SA. Corporate entrepreneurship and financial performance: the case of management leveraged buyouts. J Bus Ventur. 1995;10:225–47.

Corporate Entrepreneurship, Internal

▶ Corporate Entrepreneurship

Corporate Finance

▶ Financing Innovation

Corporate Management

▶ Cyberentrepreneurship and Proximity Relationships

Corporate Spin-Off

▶ Extrapreneurship

Corporate Venture

▶ Extrapreneurship

Corporate Venture, Internal

▶ Business Project

Corporate Venturing, Internal

▶ Corporate Entrepreneurship

Cost of Expertise

▶ Conflict and Creativity

Craft Companies

▶ Craftsman

Craft Industry

▶ Craftsman

Craft Trade

▶ Microfirms

Craftsman

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Synonyms

Craft companies; Craft industry; Manual worker

Key Concepts and Definition of Terms

The most widespread meaning of the word "craft" is the one that covers the economic sector of producing decorative objects, often manually, by a local labor force using traditional tools and materials.

As such, the definition adopted by UNESCO (United Nations Educational, Scientific and Cultural Organization) is as follows: "Artisanal products are those produced by artisans, either completely by hand, or with the help of hand tools or even mechanical means, as long as the direct manual contribution of the artisan remains the most substantial component of the finished product. These are produced without restriction in terms of quantity and using raw materials from sustainable resources. The special nature of artisanal products derives from their distinctive features, which can be utilitarian, aesthetic, artistic, creative, culturally attached, decorative, functional, traditional, religiously and socially symbolic and significant" (Symposium Manila, October 1997).

However, is this a true picture or a stereotype found in every country's touristic representation? Is it not the visible but economically and socially least important side of the craft industry? In some countries, builders and electricians are legally recognized as craftsmen.

In fact, there are as many variations, definitions (if they exist that is), and ways of treating this type of economical sector through companies and people who work for them as there are countries!

Within the scope of this entry, different approaches used by different countries in different continents will be seen in order to show this diversity. A look to the common roots will then explain what the craft industry is in a modern economy and what is expected from artisans. Finally, one will approach, as per Europe's example, why it is worth evolving toward a united status of the craft industry.

Multiple Approaches to the Craft Industry and Craft Businesses

In Africa, more than anywhere else, the most widely used definition of craft is referring to the production of traditional decorative arts despite the fact that manufacturing of miscellaneous goods and service offerings are developing alongside the legal documents required to structure this sector of the economy. For example, the "Organisation for the Harmonization of Business Law in Africa" (OHADA) is made up today of 16 African states: Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Republic of the Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Niger, Senegal, Togo, Democratic Republic of Congo. This organization is a system of business laws and implementing institutions adopted by these nations. The laws promulgated by OHADA are exclusively business related. The OHADA treaty, Uniform Act relating to General Commercial Law, amended on 15 December 2010 in Lomé, ensures uniformity and consistent legal interpretations across the member countries. Article 2 shows the difference between the trader, "whose regular occupation is to carry out commercial transactions" and entrepreneur: "physical person who carries out a professional activity which can be civil, commercial, artisanal or agricultural," in line with the current Uniform Act. This entrepreneur status aimed at developing individual initiatives is not linked with the number of employees (as it is in other countries such as Algeria) but with the turnover generated over two consecutive accounting periods. This entry allows the harmonization of all different approaches and gives recognition to this type of business.

Each country executes its own classification by activity. For example in Niger, member of OHADA, Article 5 of Ordinance No. 92–026 of 7 July 1992 sets out the main lines of the national policy for the crafts industry. It can be divided into two groups: craft production (mining industry, processing of goods, including utilitarian use of craft as well as building trade and civil engineering) and craft services (transport, services to households and businesses, small restaurants and catering businesses). With regard to the craft industry, one is talking of a micro or small business (Article 6) or even a few craftsmen grouped in a cooperative. There could be three different types of businesses (Article 7): craft companies with storefront, craft companies with inadequate premises and taking their trade to local markets, and the one with neither of these, which are therefore very difficult to identify.

In Algeria, who is not a member of OHADA, the definition of the craft industry is widely inspired of the French system. Since 10 January 1996, the crafts of the art and traditional handicraft are regulated by the 96/01 of 19 Chaâbane 1416 law, which sets the conditions and rules for exercising handicraft activities in Algeria. The term "handicraft" covers any production, creation, restoration, or maintenance activity as well as mainly manual service delivery carried on in the following areas: decorative art, handicraft, "functional" craft (i.e., maintenance, repair, or restoration work). An artisan is a manual worker who makes items that require some particular kind of skilled work and is applied toward people occupied in production of goods, including the running and management of the whole process. The artisan worker is an employee who holds a professional qualification. With regard to companies, the decree 96–01 makes a distinction between "handicraft businesses" and "businesses producing goods and services." The legal status of both is free within the scope of the commercial code. In the first case, there can be an unlimited number of employees, when in the second case, the number is limited to ten. In both cases, the person in charge of the business does not necessarily need to hold a qualification relevant to the business, as long as there is at least one qualified person in charge of the technical side of things. The economic sector is structured around chamber of trades who act as consultative bodies between public authorities and craftsmen. These also manage the craft and the outline of the craft trades register. An index managed by the national trade chamber includes all this data.

These examples show the wide legal status diversity between countries: some have detailed legislations, other have legislatives tools under way, like in Morocco where the craft industry is a strong element of social inclusion, particularly with regard to women where craftwork is not supported by any law but by economical development programs, and targeted block actions. Both of these examples show the importance of the political significance granted to this economical sector, which is either already identified or part of the "informal economy," that is people's daily activities and quite often their way of surviving and therefore directly about the political stability of the state.

In America, there is not any law specific to the craft industry, whereas in Canada they are using the term "handicraft business" or "handicraft goods" whose parameters are described in detail in official documents such as memorandum D10-15-13. These are generally work of art or objects typical to the region or country from which they originate (fabric, pottery, jewelry). In Mexico, the same thing applies (Boutillier et al. 2011. The USA does not have a particular definition of handicraft businesses but, as early as 1953, they have set up a specific law for small businesses through the "Small Business Act." The legislative initiatives in Asia are the same. In China, for example, the craft business relies on its know-how, manual labor, and traditional processes; however, there is not any specific law like in Africa or Europe to define the craft industry.

Europe's case is quite unique as the handicraft business is defined in ten countries (Germany, Austria, Belgium, Denmark, France, Spain, Luxembourg, Poland, Portugal, and Slovenia) but in a different way in each (APCM, Assemblée Permanente des Chambres de Métiers). In Germany, for example, there is the "Crafts Code," which defines 125 craft trades and establishes the list in seven categories for jobs in this sector (Kari Embarek 2003; Sénat 1995): construction and installation (i.e., builder, painter); electricity and metal (i.e., mechanic, electrician); wood (i.e., carpenter); textile, clothing, and leather (i.e., upholsterer, tailor); food trade (i.e., baker, butcher); health and dry-cleaning (i.e., hairdresser, optician, dry-cleaners); glass, paper, ceramic, and other occupations (i.e., printer, postman, instrument maker). Business activities in the regulated skilled trades and crafts professions principally require that the providing company is managed by a master craftsperson or equivalently qualified individual. There is no size criterion involved. The business concerned is entered in a register kept by the relevant Regional Chamber of Trade and Craft. Luxembourg and Austria also have this type of definition based on the activity rather than the size of the business (APCM 2007). In Luxembourg, for example, the Law of 28 December 1988 (regulating the access to the professions of craftsman, salesman, as well as to some liberal professions), impose a principle of prior authorization by providing relevant qualification documents for all activities covered by this law. In Spain, the handicraft businesses are defined in the royal decree 1520/82, which limits the number of employees to ten on top of potential apprentices and family members. The artisanal sector covers the manufacture, production, and repair of goods or service delivery achieved "through a process where personal intervention is a dominant factor. . .." There are also lists of the concerned guilds. The business also has to be registered with the "craftsman register."

In Italy, the Law n. 443 dated 8 August 1985, on artisanal business, regulates artisanal work in the same spirit as in Spain but in a more restrictive approach. The entrepreneur "must carry out prevalently his personal manual labour in the manufacturing process and retain the greater part of the capital and of the deliberative powers." One of the downsides of this definition is that some legal status is prohibited (such as Limited Liability Company (LLC) and Limited Company (SA)). The number of employees is limited depending on the trade – 18 as a rule, including apprentices whose number should never exceed 9.

In France, according to the law of 5 July 1996 relating to the development and promotion of trade and handicrafts, craft businesses are defined irrespective of the craftsman who is himself defined in the decree 98–247 dated 2 April 1998 (Boutillier et al. 2009). A craft business should not have more than ten employees (however, under certain conditions, companies that so desire may remain registered on the register of trades beyond the threshold of ten employees – this is called "droit de suite") and exercise an independent professional activity involving the "production, transformation, repair of handicrafts or handicraft service provisions appearing on a list established by decree in Council of State." Only those persons having the required qualification can claim to their customers to be a craftsman or a master craftsman. Since 1969, various governments have developed supporting policies in this economic sector (Fournier 2006). In contrast, in the UK, there is not any status, regulation, or specific register to define the craft business.

Theoretical Background and Open-Ended Issues

The Craft Businesses Role in Different Types of Economy

This brief entry shows the diversity existing between the underlying social and economic reality of the craft business. However, if the legal side of the craft industry (and its definition alone) is already problematic, these various schools of thoughts are no better.

In the "Treatise on the craft industry and SME" ("Traité de l'artisanat et de la petite entreprise," Boutillier et al. 2009), S. Boutiller studies in detail the role played by the craft industry in the development of economic thinking from the eighteenth century until present. Some of her most interesting examples will be used before investigating the craft business research and development, especially in France. According to all eighteenth century economists (such as Smith, Quesnay), labor is a way of adding value – but which "labor" where they referring to? Smith advocated industrialization and division of labor... for the Physiocrats such as Quesnay, agricultural labor is the only productive labor; all other services and other labors than those of agriculture, including the craft, were sterile. Turgot considers that the cultivator produces not only his own wages, but, in addition, "the revenue which serves to pay the whole class of artisans and other stipendiaries..." (Turgot 1997, page 166 as quoted by Boutillier). The rest is history: industrialization, quest for profit, speculation, etc., have all led us to consider, for numerous years, the craft industry as a relic of the past. In the nineteenth century, Marx also considered that economic progress was synonymous with large companies and that unlike the proletariat which was revolutionary by nature, the craft industry was reactionary, for it was trying to "make the wheels of history turn backwards." He specifies however that a craftsman does not exploit the labor of other people but sells his work for his own profit.

Labor being a source of value creation, its organization became a major issue, which explains why companies, and especially big ones, became the focus of economists. During the whole period there will be a dichotomy between the worker who owns only his labor and is paid in wages for the exercise of that labor; he does not own the products of his labor, and has no right to any of the money from the sale of these products. One will have to wait until the 70s with Schumacher (Small is beautiful) for the SMEs to regain their popularity in terms of economic consideration. In France between 1980 and 1990, work from Julien in Canada and Marchesnay in France describe the SMEs like a "man-made invention enabling them to adapt to the complexity of changing environment." In 1982, Jaeger dealt directly with the craft industry in her publication "Artisanat et Capitalisme, l'envers de la roue de l'histoire" (craft. business and capitalism: turning back the wheels of history). In parallel to the main considerations regarding businesses, theories regarding entrepreneurs carry on evolving.

Implications for Theory, Policy, and Practice

During the 2000/2010 decade, theories and studies were developed with regard to the craft business and the craftsman as company leaders. A network of specialist researchers was also created (Fournier 2007) and produced perspective and insights about the economic and social specificity of craftsmen and craft businesses. The theoretical approach can be categorized through the "resource potential" concept developed by Boutillier and Uzunidis (Boutillier 2006; Boutillier and Uzinidis 2006) whose building blocks are as follows: knowledge, financial resources, and social relationships. From the beginning of the twenty-first century, craftsman and craft businesses have become very popular among scientific and social areas of research. The role played by the craftsman in the innovation process and in the strengthening of social cohesion is beginning to gain exposure and recognition (see section in the "Treatise on the craft industry and SME" – "Traité de l'artisanat et de la petite entreprise").

A definition rather different from the "official ones" touched upon in the first part of this entry is starting to emerge from all these different publications. Modern vision of a human society is now as far from backward-looking as the one described by economical speculators and specialists for who, to exaggerate a bit, companies are first and foremost a number which one can fiddle with in order to increase business profit. The modern craftsman is more and more a well-educated man or a woman who is perfectly integrated in the local community, well aware of innovation and able to picture his business' growth not solely through the number of employees. He is aiming to control his business and to live in an environment where he feels, rightly or not, free and independent. Practically, the craftsman manages, consciously or not, his areas of development depending on his resources, his trade, and his profession and puts forward its characteristics and institutional and normative setup. These three factors of development explain the limits of the craftsman's "freedom" and the wide range of diversities encountered in the field.

Conclusion and Future Directions

Toward a Unified Characterization of the Craft Industry

As seen previously, there is no definition of the craft industry: there are as many definitions, as there are countries, including within Europe. However, looking at various studies about the craft industry, it transpires that all these industries, men, and women share common characteristics and vision. For example, in Europe, the craft industry has now set up a European structure of representation, the "Union Européenne de l'Artisanat et des Petites et Moyennes Entreprises" – UEAPME (European Association of Craft, Small and Medium Sized Enterprises), which represents 12 million companies and 50 million people. This structure created a working group devoted to the culture of "craft enterprises" (Entreprise à caractère Artisanal, ECA) whose purpose is to define identification criterion for this type of business throughout Europe in order to establish a background for policy proposals and notably the EEC Commission. The consensus would be based on four ECA characteristics: production and processing of goods and services by outstanding craftsmanship at the head of the company, fundamental role of the head of the company who assumes responsibility and supervises the whole production process, acquisition, value building and knowledge capitalization, especially via a learning plan and integration of the company into its territory through its social responsibility.

The ECA's ambition is to show that a new business model is possible and would favor social stability. This new model must gain support of relevant public authorities by setting up appropriate flanking policies (like the Small Business Act in the USA).

Another factor, not frequently highlighted, characterizes the craft business: it is both the large number of businesses and their geographical dispersion. This largely contributes to the role of the craft industry in the community as well as its buffering role during an economic crisis: when a business employing hundreds or thousands of employees shuts down, it creates devastating economic and social effects in the area for numerous years to come. When a small craft business shuts down, unfortunately quite often nobody notices!

At the beginning of the twenty-first century, when the virtual economy has shown its limits, the craft industry by contrast could be assuring the well-being of future generations, by using a "real" economy as a way of moving the community forward through taking better account of the people and the environment. The craft industry is no longer then a "relic of the past" but one of the cornerstones underpinning our society and its evolution (Boutiller and Fournier 2006). That, combined with heads of companies' higher level of education (see above, as per OHADA use of the term "entreprenant"), should position the craft industry as a key player in any innovation process. That way, the professional representation' renewal could also move forward and politicians would be able to give a new meaning to craft industry policies which was well and universally expressed in Article 1 of the French law known as "Royer" (Fournier 2006 p.116): "They (trade and craft industries) must contribute to improvement of the quality of life, awakening of the urban life as well as increase competitiveness of national economy."

Vast programs which leave entreprenants a huge scope, should they be craftsmen, researchers, or elected representatives.

Cross-References

- ▶ Business Emergence
- ▶ Business Model
- ▶ Entrepreneur
- ▶ Entrepreneurial Opportunities
- ▶ Entrepreneurial Organizations
- ▶ Entrepreneurship and Business Growth

References

APCM. Quatrième conférence européenne sur l'artisanat et les petites entreprises. Stuttgart 16 et 17 avril 2007. www.artisanat.fr/portals/0/presse/dossiers_2007/2007_04_06_Conference_europeenne.pdf

Boutillier S, Castilla Ramos B. Les petites entreprises au Mexique, "Capitalisme aménagé" et réseaux sociaux, dans Boutillier S., 2011dir, *L'artisanat et la dynamique de réseaux*, Coll. L'esprit économique, L'Harmattan: Paris;2011. pp. 119–140.

Boutillier S, David M, Fournier C. (dir), Traité de l'artisanat et de la petite entreprise. Barcelona ES: Ed. Educaweb;2009.

Boutillier S. Du capital social au potentiel de ressources, Cahier du Lab. RII. 2006;115.

Boutillier S, Fournier C. Connaissance, finance, lien social: artisanat et innovation. Humanisme et Entreprise. 2006;280.

Boutillier S, Uzunidis D. Le potentiel de ressources de l'entrepreneur artisan dans le système territorial de production. Cahier du Lab. RII. 2006;127.

Fournier C. Artisanat et politique économique. In: Boutillier S, Fournier C (dir). Artisanat la modernité réinventée, coll. Marché et organisations. Paris: Ed. L'Harmattan;2006.

Fournier C. Une communauté de pratiques singulière: Le club des dirigeants du réseau Artisant-Université. In: Arnaud M (dir). Pédagogie en ligne, méthodes et outils. Barcelona ES: Ed. Educaweb;2007.

Kari Embarek. Le concept international de l'artisanat. Séminaire APCM/UIAPME Budapest 4 et 6 octobre 2003.

Sénat. Le statut de l'artisan;1995. www.senat.fr/lc/lc5/lc50.html

Symposium. Crafts and the international market: trade and customs codification;1997 October; Manila.

Turgot ARJ. Formation et distribution des richesses. Paris: GF-Flammarion (première édition 1766);1997.

Craftsmanship

▶ Microfirms

Create

▶ Invention Versus Discovery

Creation

▶ Business Start-Up: From Emergence to Development
▶ In Search of Cognitive Foundations of Creativity

Creation of Activities

▶ Entrepreneur and Economists

Creative Act

▶ Creative Behavior

Creative Behavior

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Synonyms

Creative act; Creative being; Creative expression

What Is Creative Behavior?

Definitions and Perspectives

Creative behavior has been viewed as the creative act, or a set of acts, which is made explicit through behavior. Creative behavior is not submissive; it is action, which leads to a creative output or a solution to a challenge. Creative behavior is not confined solely to the domain of cognition and thought but rather it is action that yields output that is deemed original and useful (Puccio and Cabra 2011). It is a behavior that permits one to act unobstructed from self or externally imposed constraints in pursuit of self-expression, invention, discovery, design, and problem solving.

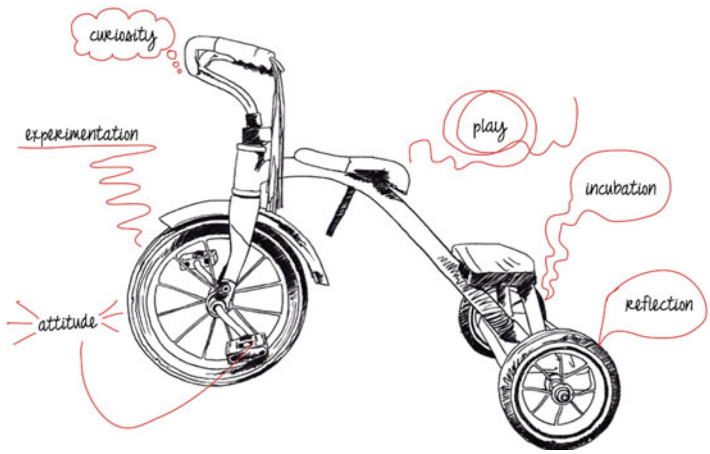
The actions most often associated with creative behavior can be drawn from Guilford's explanation and description of divergent thinking. Guilford (1977) constructed a three-dimensional model that he referred to as the Structure of Intellect (SOI) theory. In other words, intellectual abilities are described as a type of operation (e.g., divergent thinking, convergent thinking, memory, evaluation, cognition), which is set in motion by a kind of content stimuli (e.g., visual, auditory, semantic, symbolic, behavioral) for the purpose of organizing information into meaningful products (e.g., units, classes, relations, systems, transformations, implications).

Torrance (1966), who was influenced by Guilford's work, conceptualized measures of divergent thinking called the Torrance Tests of Creative Thinking (TTCT). These measures introduce individuals with a number of open-ended situations for which they are asked to provide either written or visual responses. The four primary cognitive skills assessed through respondents' answers are fluency (the total number of germane responses), flexibility (the number of categories associated with the germane responses), originality (the number of uncommon responses), and elaboration (the elaboration or extension of responses) (Millar 1995; Runco 1999; Torrance 1966). It is these four cognitive abilities that are most often associated with creative behavior. To the original four cognitive abilities, Torrance (2000) included 14 indicators of creative behavior, namely, abstractedness of titles, resistance to premature closure, emotional expressiveness, story articulateness, movement, expressiveness of titles, synthesis of ideas, unusual visualization, internal visualization, extending or breaking boundaries, fantasy, humor, colorfulness of imagery, and richness of imagery.

Creative behavior has also been described as incorporating spontaneity, which at its core is a reflection of freedom and incorporating sensitivity, which also involves a greater sensory perception to one's surroundings and to one's own feelings and thoughts (Klein 1972). Creative behavior also incorporates persistence and resilience.

What is most striking about these descriptions of creative behavior is its pattern. There is no single definition of creative behavior (Klein 1972). Instead, several words are used in concert to describe behavior. For example, Torrance's fluency, flexibility, and originality are pooled to identify a behavioral pattern. Resilience, persistence, and intra- and interpersonal awareness are used to describe a pattern that is demonstrated in everyday life. And, uniqueness, divergence, and spontaneity are used to identify characteristics of a normal behavioral pattern. These aforementioned qualifiers look at creative behavior as an essential life skill (Puccio et al. 2011). It is also worth noting that most of these descriptors speak to the cognitive abilities related to creative thought rather than to a more holistic concept of

Creative Behavior, Fig. 1 "TRYCycle" model of creative behavior (From (Uribe-Larach and Cabra 2012)



exercising creative behavior. As elusive as the constructs for creativity and creative thinking are to the layperson, the construct for creative behavior is even less developed, researched, and understood.

Creative Behavior Versus Creativity

Creative behavior in its most primitive form is a subset of play behavior (Brown 2009). From a biological perspective, play behavior is regarded as a form of exploration and adaptation. Conversely, creative behavior is also a form of exploration and adaption for the purpose of producing novel and useful outcomes. Creative behavior allows us to explore ways to rearrange features of an experience into something that is joyfully meaningful and novel (Uribe-Larach and Cabra 2011) – though creative behavior and creativity are intimately related, there is a distinction; while creativity is commonly understood as the production of novel and useful ideas (outcome centric), creative behavior relates to what we do to achieve such outcomes (attitude/behavior centric). First, an individual engaged in creative behavior scans a field for stimuli that is either external, internal, or both. Then out of curiosity, the individual explores the stimuli to gain understanding, insight, and a point of view. From this point of view, the individual experiments with new combinations or engages in sense making by generating analogies and metaphors. Responses can vary ranging from incubation, reflection, or more experiments that lead to discovery.

Using a "TRYCycle" Metaphor to Synthesize Attributes of Creative Behavior

The term "creative behavior" comprises a host of terms that are applied collectively to describe behavior. How then to organize and give physical form to a working definition of creative behavior? Toward a model to synthesize attributes most germane to creative behavior, a metaphor was identified, namely, the tricycle (see 1). The tricycle is an iconic toy and a symbol of childhood play and adventure. This metaphor has a strong emphasis on trying things and experimenting as a means to discover and learn; therefore, the word tricycle is adapted to include the word *TRY*. Additionally, this metaphor rests on three core behaviors (tri → try) that fuel creative behavior and they are experimenting (an iterative and hands-on approach to exploration), reflecting (a process to make meaning of past experiences), and incubating (a break from the energetic pursuit of a solution to a challenge or an experience) (Puccio et al. 2011). These three core behaviors occur in ongoing cycles until one's curiosity is fulfilled. The creative person then proceeds to the next thing that peaks his curiosity; curiosity's thirst is quenched and then off to the next adventure, which in turn reignites the ongoing *Cycle*. The TRYCycle's three wheels represent these three core behaviors.

Creative behavior is a form of play and, as such, makes up an early and natural way of discovering and making meaning of the world. Play is a state of mind that revolves around an absorbing, apparently purposeless activity, which provides enjoyment, and suspension of self-consciousness and time. Findings indicate that as in childhood, playfulness serves as a robust adaptive operation in adulthood (Magnuson 2011). Play also provides individuals with more cognitive resources from which they can manifest effective coping mechanisms while confronting stressful situations (Magnuson 2011). The tricycle seat therefore represents play since the seats serve as a mechanism for a child to fuss about and wiggle. In addition, sitting on a seat is the first behavior/action that is demonstrated, which parallels an early and natural way of discovering and making meaning of the world. Building on this metaphor, play sets the stage for creative behavior (experimenting, reflecting, and incubating).

The pedals represent the attitude of a child as shown through the child's vigorous peddling and metaphorically represent a sense of adventure, risk taking, passion, and openness to experience. The handlebars signal curiosity as the child scans for an attention-grabbing target and then manipulates the handlebars toward the target that captures the child's imagination. The child exhibits a focused attention, then questions what is observed, wanting to know more about what caught the eye's attention, then seeks to explore the object. Finally, the frame symbolizes a creative mindset essential to overcoming the constraints that get in the way of creative performance much like the frame keeps the tricycle together as it navigates bumps in the road. Specifically, the creative mindset operates three affective skills that permits exploration, such as openness to novelty (the ability to entertain ideas that at first seem outlandish and risky), tolerance for ambiguity (the ability to deal with uncertainty and avoid leaping to conclusions), and tolerance for complexity (the ability to stay open and persevere without being overwhelmed by large amounts of information, complex issues, and competing perspectives) (Puccio et al. 2011).

The TRYCycle metaphor serves as an organizing framework to visualize a simple, holistic, and coherent picture of what is involved in the complex phenomenon of creative behavior. This metaphor brings about an understanding of the interplay between the core behaviors of curiosity, play, experimentation, reflection, and incubation and the attitudes needed to sustain creative behavior.

Role of Creative Behavior in Creativity and Innovation

Typically, groups do not personalize creativity models to the fullest extent because they have too many steps and too much language for the models to be remembered. Despite the excitement creativity models can bring, the groups can appear enabled not necessarily empowered to want to internalize creative behavior. Many models are results oriented. Instead, if creativity and innovation models were behavior centric, then the model would serve as more effective prods to creative behavior. A behavior centric model offers easy access to organizational members because it prompts individuals to do more of what comes natural. Thus, the role that creative behavior can play is one of a sustained catalyst to creativity and innovation. If innovation is viewed as products, concepts, theories, and/or processes that are novel, useful, and successful (meaning that there is a high level of acceptance of the innovative qualities by a given domain), then creative behavior is essential to building innovation capabilities for any given social system (e.g., company/organization, community, country). That is, the more that creative behavior is seen within a social system, the greater the probability of producing novel and useful outcomes and, conversely, the greater the probability that one or more of these outcomes can result in successful innovations in their respective domains.

From a person-centered perspective, Ackoff and Vergara (1988) asserted that creativity is the ability to overcome self-imposed constraints. Therefore, creative behavior, when made explicit and is applied, can overcome perceptual, affective, and implementation blocks that get in the way of creativity and innovation (Klein 1972).

Perceptual blocks comprise inabilities to read people, circumstances, and even oneself. Without these reads, one is denied access to a host of data and knowledge useful for creative output. Instead, creative behavior sharpens one's ability to observe, hear, feel, smell, discriminate, touch, and access tacit knowledge. It is the perceptive person who can feel shades and degrees of meaning based on what is being observed. It is the perceptive person who broadens their scanning field. For example, one day, someone is seen placing a small amount of baking soda in a refrigerator and notices that it absorbed odors.

Affective blocks comprise inabilities to demonstrate empathy, formulate feelings based on observations, control emotions and one's relationship with others. The creative person, who is free of these blocks, can both anticipate and plan emotional reactions. They can see the point of view of others. They can build relationship with others and are not necessarily affected by societal judgments that hinder freedom of action (e.g., Who would have thought that a cup of coffee could be sold for $4.00? Yet, Starbucks did not permit the fallacy of a mature market, and the reaction it may have against the $4.00 coffee, to stop it from revolutionizing the take-out coffee business).

Implementation blocks comprise the inability to act upon emotions and the data that is garnered via perceptions. In other words, implementation blocks preclude the generation of new ideas and connections based on the insights that stem from increased perceptions, knowledge, and sensitivity. Instead the creative person can see new ways to use an object beyond its traditional use (e.g., Seeing other uses for baking soda such as baking-soda deodorant, baking-soda toothpaste, and, recently, baking-soda diapers). It is important to note here that implementation also requires overcoming further self-imposed constraints that might inhibit people from moving their organizations toward an innovative output.

Some people may have a fear of vulnerability that is attributed to change, which is an inevitable collateral of pursuing creative results and innovation. As a result, they may be inclined to go back to past ways of doing things. In other circumstances, other people are unable to flex. People may associate pain with new experiences, and as a consequence, they simply avoid them. Others may subscribe to a belief that their span of control is limited. This relates to people who do not go after new ideas because they believe they do not have the influence, the resources, or the political power to make things happen. Here they play it safe because they are overly concerned with the negative consequences that might come about if they try something new and fail.

In summary, creative behavior shifts or removes behavioral boundaries and, as such, aids in over coming self-imposed blocks, thus enhancing the probability of producing creative outcomes and innovation. A person who behaves creatively takes full advantage of options. They know they have a broad range of options and by itself can overcome cognitive paralysis or emotional hijackings. They realize that all things are possible, and all are worth knowing, worth exploring, and experiencing. Creative behavior searches for freedom. People who exhibit creative behavior feel comfortable and are free to define themselves not through the eyes of others but rather through their individual preferences. Creative behavior involves deferment of judgment, taking responsibility for creativity, taking risks, and being open to new experiences.

Future Directions and Conclusions

Given the importance of creative behavior as an essential life skill for thriving in a complex world, future research and practice should focus on the following lines of inquiry:

(a) *Behavioral components and skills*: The metaphor described above offers a holistic understanding of core behaviors that contribute to creative behavior. However, the metaphor is short of offering a developmental framework that nurtures the core behaviors and skills as described in the model. How can individuals be trained for curiosity, exploration, and play in a manner that adopts a more experimental hands-on approach to inquiry? In the same way in which thinking skills have been made explicit for optimizing creative thinking processes (Puccio et al. 2011), a deeper understanding of core behaviors and their embedded skills are needed to develop methods to assist individuals, teams, and organizations.

(b) *Environmental conditions for creative behavior*: While there has been an abundance of research to identify psychological climate dimensions supportive of organizational creativity (Ekvall 1996; Amabile et al. 1996), only loose connections can be drawn between these dimensions and the creative behaviors represented in the tricycle, namely, curiosity, play, experimentation, reflection, and incubation. For example, Ekvall's (1996) dimension of play and humor can be directly connected to the behavior of play, yet there is no climate dimension that can be connected in such way to experimentation, incubation, and curiosity. It can be asserted that the stronger the climate dimension of *risk taking*, as measured by the SOQ assessment instrument (Isaksen et al. 2001), the greater the volume and degree of experimentation expected from individuals and teams in an organization. Although the above correlation is rational and logical, such a relationship has not been established empirically. In other words, the dimensions identified in the literature for nurturing a creative climate connect to the outcome of creativity and not specifically to the behaviors involved in producing such outcomes. Moreover, it has been hardly established that these dimensions have predictive validity in nurturing conditions that foster creative behavior. Therefore, more and new research is needed to refine and unveil climate dimensions that correlate directly to creative behavior. Such a climate model that is linked to creative behavior would permit academics and practitioners to design effective intervention plans for building environments that trigger creative behavior in teams and organizations.

T. S. Eliot once asserted that we must not cease from exploration and at the end of all of our exploring will be to arrive where we begin and to know the place for the first time. Understandably, behavioral psychologists paid little attention to Eliot's prose as creativity was deemed an elusive construct and as such they avoided studying it. There are good reasons of course to explain their reticence. Myths and other misunderstandings have served as cognitive and cultural blocks to its study. Creativity suggested that only a few had it. And of those who had it, their creativity could not be studied, as it would unveil its magic. If only a few possessed this gift, then it would suggest that creativity was an endowment bestowed by the gods to those special few (Puccio et al. 2011). Although these myths have been largely marginalized by today's contemporary research efforts to explore these multifaceted phenomena, the layperson continues to believe that creativity cannot be trained. It is precisely these kinds of constraints that lead scholars to assert that a crucial ingredient to creative behavior is acting freely from the many restraints society puts around people and the self-imposed constraints people place on themselves.

Creative behavior is an essential function of the human experience. It is not something you turn on and off like a water faucet. Instead, it is an ongoing process of behaving in society, of engaging in the vicissitudes of life. Creative behavior is a way of viewing the world in the moment. Read how Hallmark poignantly described the experience outside its tricycle keepsake box.

> What could be more thrilling than your first set of wheels? From its finger-grip handlebars to the ride-along platform, the little red tricycle inspires almost universal nostalgia. It's easy to imagine the expression of surprise and joy on the face of its new owner. Not long afterward, with a rush of independence, the rider pedals off down the sidewalk and the adventure of a lifetime begins.

It is through creative behavior that adventure is experienced in the same manner in which a tricycle ride translates into self-expression, discovery, invention, design, and problem solving.

Creative behavior is about manifesting full potential in a mad world of complexity, volatility, uncertainty, and ambiguity. At its core, creative behavior prompts us to take a dynamic hands-on role in shaping a life as free and determined as possible – if only we would invest half as much childlike effort attempting to capitalize on our choices for behavior as we invest adult-like effort in restricting them (Klein 1972).

Cross-References

- ▶ Creative Mind: Myths and Facts
- ▶ Creative Personality
- ▶ Creative Styles
- ▶ Creativity and Emotion
- ▶ Decrease in Creativity
- ▶ Divergent Thinking
- ▶ Freedom and Constraints in Creativity

References

Ackoff RL, Vergara E. Creativity in problem solving and planning. In: Kuhn RL, editor. Handbook for creative and innovative managers. New York: McGraw-Hill Book; 1988. p. 77–89.

Amabile TM, Conti R, Coon H, Herron M, Lazenby J. Assessing the work environment for creativity. Acad Manage J. 1996;39(5):1154–84.

Brown S. Play: how it shapes the brain, opens the imagination, and invigorates the soul. New York: Avery; 2009.

Ekvall G. Organizational climate for creativity and innovation. Eur J Work Organ Psychol. 1996;5(1):105–23.

Guilford JP. Way beyond the IQ: guide to improving intelligence. Buffalo: Creative Education Foundation; 1977.

Isaksen SG, Lauer KJ, Ekvall G, Britz A. Perceptions of the best and worst climates for creativity: preliminary validation evidence for the Situational Outlook Questionnaire. Creat Res J. 2001;13:171–84.

Klein RD. Evolving creative behavior. An unpublished doctoral thesis. Amherst, MA: The University of Massachusetts; 1972.

Magnuson CD. The playful advantage: How playfulness enhances coping with stress. An unpublished master's thesis. Urbana-Champaign: Graduate College of the University of Illinois; 2011.

Millar GW. E. Paul Torrance: the creativity man. Norwood: Ablex; 1995.

Puccio GJ, Cabra JF. Idea generation and idea evaluation: cognitive skills and deliberate practice. In: Mumford's MD, editor. Handbook for organizational creativity. New York: Elsevier; 2011. p. 187–213.

Puccio GJ, Mance M, Murdock MC. Creative leadership: skills that drive change. 2nd ed. Thousand Oaks: Sage; 2011.

Runco M. Divergent thinking. In: Runco MA, Pritzker S, editors. Encyclopedia of creativity, vol. I. San Diego: Academic; 1999. p. 577–82.

Torrance EP. Torrance tests of creative thinking. Bensenville: Scholastic Testing; 1966.

Torrance EP. Research review for the Torrance tests of creative thinking: verbal and figural forms A and B. Bensenville: Scholastic Testing Service; 2000.

Uribe-Larach D, Cabra JF. The opportunities and challenges of technology driven collaborations. In: Mesquita A, editor. Technology for creativity and innovation: tools, techniques and applications. Hershey: IGI; 2011. p. 325–42.

Uribe-Larach D, Cabra JF. TRYCycle: Comportamiento creativo [Creative behavior]. Santiago, Chile: Idemax; 2012.

Creative Behaviors

▶ Model for Managing Intangibility of Organizational Creativity: Management Innovation Index

Creative Being

▶ Creative Behavior

Creative Brain

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Synonyms

Creative insight; Creativity in neuroscience, studies; Creative process in brain

Key Concepts and Definition of Terms

The concept of "creativity" includes different aspects, such as a human ability of a creative insight, the product created by such a creative insight, and the appreciation of this product as something new and valuable by people. The term “creative insight” implies a process occurring in a flash but which brings something very substantial and completely new, it differs from conscious production, it can happen during sleep or in a dreamlike state, and this process seems to be inspired (Andreasen 2006). If a creative insight is a topic of interest, the human brain and human psychology are studied. However, the psychological reaction and brain work are inseparable from sociocultural context. To enhance creativity, there must be knowledgeable experts to assess the product of creation, universities to teach top-level science, and the field which wants a created product. Thus, creativity can be considered as a kind of interaction between a person’s thoughts and sociocultural context (Csikszentmihalyi 1997).

Theoretical Background and Open-Ended Issues

Contesting Views on Creativity and Challenges

There has been a long-lasting discussion in science concerning creativity and the interaction of “nature” (genes) and “nurture” (good education, the accessibility of the domain for a researcher, and societal encouragement).

As a rule, neuroscience does not include the wider social aspect of creativity and limits itself to the study of neurophysiological processes in the brain. But this narrower field has its own challenges: what is consciousness and what is the exact mechanism of transformation of neural firing into an abstract thought? Only after answering these questions, we can reliably define what a creative insight is and how to enhance human creativity.

The creative insight is difficult to study with the help of scanning in the laboratory conditions, because the owner of such an insight never knows when it will come to him/her. So neuroscientists have to restrict themselves to the studies of neurophysiological characteristics of creative people and to scanning the brain during various tests on creativity.

The tests on creativity are usually on divergent thinking and consist mostly of verbal tasks. However, the creative people, who are tested, work in different spheres (literature, music, science) and can see an image or hear sounds as a creative solution without any words or conscious thinking. It means that, perhaps, their neuronal activation patterns in the creative process will differ and they are not what the test-designers suppose. And, perhaps, a highly creative person might be unwilling to answer such irrelevant to his work a question as: “How many uses can you think of for a brick?”

In other words, how do we know that the existing tests on creativity identify the creativity, indeed? And what kind of level of a creative person is studied by a neuroscientist: a clever original conversationalist, a creative person whose creativity is directed at himself, or a person who has changed the public culture and science (Csikszentmihalyi 1997)? Everyone is mainly interested in the third phenomenon, but neuroscientists never discriminate between these three categories of creative people, though it is clear that their brains will work differently.

There are also some technical and data assessing challenges in neuroscience. The creative activity of the brain is scanned and usually compared with a baseline, when the brain is considered to be in a passive state. But the brain is never passive at all, and it is, perhaps, when the person is not thinking consciously about the solution of the problem that a creative insight takes place due to the formation of uncontrollable unconscious associations in the mind (Andreasen 2006).

The attention of neuroscientists has been focused on the following questions in the study of creativity:

– What are the properties of a creative brain?
– What goes on in the brain during a creative process?
– How does a creative process influence the brain itself?
– How can we help the brain to be more creative?
– How can we use the process of creativity (e.g., in art therapy) for curing disease?

Various research methods have been used for answering these questions, and various hypotheses have been put forward:

– Anatomical importance of some brain structures with unusual characteristics (the phenomenon of synesthesia) and, perhaps, the thickness/thinness of the brain cortex at certain places
– Inborn or acquired specific neurochemistry of the brain
– Genetic predisposition (rather close to the characteristics of schizophrenia)
– Specific functioning of neural circuits in the brain under certain circumstances (tiredness, dream, beautiful landscape, a pleasant shock, etc.), i.e., the controlling neural circuits stop controlling or control less, new neural circuits start working, and creative associations are formed
– Neurophysiological importance of specific brain waves at specific brain areas for a creative state

Many neuroscientists also emphasize special traits of character of a highly creative person and a specific behavior: the courage of insisting on the nonconventional way of solving a problem, obstinacy and "doggish pursuit" of the task, and the elimination of all irrelevant aspects of life which distract the attention from a creative process.

Implications for Theory, Policy, and Practice

Creativity: Studies and Hypotheses in Neuroscience

What Goes on in the Brain During a Creative Process?

There are four basic types of creative thinking with distinctive neural circuits depending on the knowledge domain (emotional or cognitive) and the processing mode (deliberate or spontaneous) (Dietrich 2004). The first type operates in an emotional field and has the deliberate processing (e.g., writing and rewriting a novel). The second type is based on the spontaneous processing in an emotional field (e.g., writing a poem). A cognitive field with the deliberate processing (e.g., working, planning, and experimenting in science) is the third type. A cognitive field with the spontaneous processing is the fourth type (e.g., the solution of the problem comes quite on a sudden when the person is doing something else and stops thinking about the work). For this classification, it is important to distinguish the function of the frontal lobe from three posterior cortices – the temporal, the occipital, and the parietal (TOP) (Dietrich 2004). The frontal lobe does not get direct sensory information and does not have long-term memory unlike the TOP, but the frontal lobe is important for working memory and responsible for the deliberate focusing of attention, critical assessment, and flexibility of thinking that allows new combinations. In the TOP, there are mainly neurons engaged in perception, because there are primary sensory areas and associative areas. The representation of the information received by the TOP goes to the frontal lobe and is present in the working memory. The deliberate mode in the cognitive domain is supported by the prefrontal cortex, which gets the necessary information from the TOP and other cognitive structures of the brain. The deliberate mode in the emotional domain is supported by the frontal attentional neural network and the structures of the brain responsible for emotions. The spontaneous mode in the emotional domain recruits the structures which process emotional information spontaneously, and this information gets into the working memory. The spontaneous mode in the cognitive domain starts in the TOP areas during the unconscious thinking full of free associations. The more brain structures are involved in the integrative brain process, the more new combinations are formed. Such a classification is an attempt to combine knowledge, emotions, and deliberate and spontaneous modes involved in creative thinking. A creative person uses mostly one type of creating thinking out of four, but it does not mean that he cannot use another type.

Bekhtereva considers that creativity is a natural process and any brain needs creativity for normal functioning because customary actions gradually become partly automatic reducing the activity of neural networks engaged in novelty and the brain stops working in the optimal regime (Bekhtereva 2007). Creative thinking, according to Bekhtereva, is connected with the reorganization of neural activity in the brain. There are fixed links and flexible links between some neural areas. The fixed links work constantly, but flexible links have a tendency of disappearing, with other ones appearing. The brain fights monotonous work done by a researcher with the help of the formation of new flexible links which, nevertheless, are engaged in the general task performed by a researcher. Both fixed and flexible links continue working for the solution of the task. The appearance of new flexible links depends on both the monotonous work (inner cause) and the signals from the surrounding (outer cause). The more flexible links are involved, the more original and creative the solutions are.

Damasio emphasizes some requirements for creativity, for example, the strong generation of representative diversity (i.e., the ability to generate a lot of novel combinations of entities or parts of entities as images and bring these images to the conscious mind) (Damasio 2001). The images demand the work of sensory cortices, but they are conducted and ordered from the prefrontal cortex. Creativity demands also a large capacity of working memory which permits to retrieve and generate representations internally, to hold these representations ready, and operate on them. The term "working memory" means not only the retention of some information but also the manipulation on it. Creativity needs the prefrontal cortex to recognize novel representations and to choose the best. The signals from the perceived surrounding first go to the primary cortices responsible for auditory and visual perception. At this stage, the map of activated neurons is created. The areas of brain responsible for sensory perception are surrounded with associative areas where neurons are polyfunctional. Here, the new representations are created out of the mapped information from sensory cortices. Damasio calls such representations in the associative areas of the brain as dispositional representations (Damasio 2001). Such dispositional representations preserve all mapped recordings of neural activities. From here, the representations can go back to the sensory areas, and the person can see in his mind, for example, the features of his friend's face without seeing him. It is in this backward process that the modification usually takes place and novelty appears. If such memory, for example, of a friend's face brings about some emotions, it means that the prefrontal area participates in the process and the representations are important for the whole organism/body of the person. These above-mentioned dispositional representations correlate with the first state of the body when the event or object was first mapped and produced an effect on the human body. Neurochemical responses in the brain change the functioning of neural circuits and influence the emotional state and creative abilities. For example, the level of creativity due to the changed neurochemicals in the brain caused by depression is much lower; the hippocampus of the brain, which is important for remembering, shrinks; and working memory becomes worse.

What Are the Properties of a Creative Brain?

The relation between knowledge and creativity has always been of great interest for scientists. It has been found that the ability for creative thinking does not depend so much on the level of intelligence. If the IQ is higher than 120, it does not correlate with creative abilities anymore (Andreasen 2006). The person can have a higher level than 120, but he/she can be less creative than the other one who has a lower IQ. Neuroscientists conducted scans of people to measure levels of N-acetylaspartic acid (NAA) to define the correlation between creativity and intelligence and made measurement of the thickness of the cortex at certain places in the brain where they thought a creative process took place (Jung et al. 2009a, b). The decrease of the level of NAA indicates the dysfunction or the death of neurons. Jung and colleagues arrived at the conclusion that their NAA tests confirmed the psychological studies that for creativity it is not necessary to have a high IQ and that after 120, the level of intelligence is not important for creativity (Jung et al. 2009a). As for the thickness of the cortex, the thickness at some places had a positive correlation with the level of creativity, but at other places, there was a negative correlation (Jung et al. 2009b). For example, the thicker the cingulate cortex is, the better it is for creativity (a cingulate gyrus is responsible for detecting a mistake), and the thinner the cortex is in the area of a cuneus (Brodmann area 18, left hemisphere) or in the fusiform gyrus (Brodmann area 19, left hemisphere), the more creative a person is. If to speak about the cortex of the brain, on the whole, the thinner the cortex is, the more creativity its owner shows. Jung explains it by an easier and quicker possibility of forming associative connections by neurons, which is necessary for creative thinking.

There is also a hypothesis that creativity is connected with synesthesia because synesthesia promotes metaphoric thinking, helpful for creativity (Ramachandran and Hubbard 2001). Synesthesia is a neurological phenomenon. The stimulation of one neural network (sensory perception or cognitive thinking) is accompanied automatically by the activation of another network at the same time and which under the normal conditions is not activated. For example, when a man is looking at figures, he sees them in color, or when he listens to music, he sees it in color. Sometimes color, sound, and smell are combined.

The concept of creativity has always been connected with the term “genius.” The behavior of a genius, as it is generally noticed, is different from an ordinary person. The hypothesis of the connection between high creativity and mental disorder (especially mild forms of schizophrenia) was put forward long ago. According to this hypothesis, creativity has a genetic basis.

Andreasen agrees with the hypothesis on the whole but remarks that mental illness is not a necessary requirement for creativity, besides she insists that one should discern extraordinary abilities for creativity from normal abilities for creativity because different neural circuits are engaged (Andreasen 2006). If we deal with extraordinary abilities, a subconscious mental process prevails. The brain of a genius works differently. Andreasen finds similarity of the state of the brain in meditation (or the altered states described by the great mystics) with the state of the brain of a creating person (intense focus, dissociative state as though being in some transcendent and remote place) (Andreasen 2006).

How Can We Help the Brain to Be More Creative?

To answer this question, the hypothesis of the enhanced creativity due to a hypnagogical effect on the brain was proposed. Hypnagogia is the transient state which happens when waking becomes sleeping. In such a state, a person often has fragmentary thoughts and visual imagery. The hypnagogical state starts when the theta band (6–7 Hz) amplitude becomes more pronounced than that of alpha (8–11 Hz) (Gruzelier and Egner 2004). With the help of electroencephalogram (EEG) and neurofeedback training, it is possible to enhance creativity in live performance. After alpha-theta training, for example, conservatoire musicians demonstrated a higher level of performance and musicality by 12% on average and some of them even by 50% (Gruzelier and Egner 2004).

Conclusion and Future Directions

Conclusion

However elusive a creative process may be for studying with the help of brain scanning, what makes things much worse is an unsolved mind-brain problem. The ontological position on the nature of consciousness and hence on creativity makes a neuroscientist choose a matching epistemological approach for his research. For example, having chosen a materialist ontological position on brain and mind, Rex Jung studies the thickness of the cortex as a physical property of creative thinking. The thinner (or thicker) the cortex is at certain places, the more creative ideas one will produce. Meanwhile a non-materialist neuroscientist would draw our attention to the neuroscientific fact that the brain changes physically under the pressure of non-material thoughts (Beauregard and O’Leary 2007). So the thickness of the cortex can develop after practicing creative activities for a certain period of time (if thickness/thinness is important for creativity at all). A non-materialist neuroscientist would also say that such an epistemological approach is wrong and it cannot show the true nature of creativity, however well and thoroughly Rex Jung might study the thickness of the cortex. The thickness/thinness does not cause creativity, it follows it. A materialist neuroscientist, on the contrary, would claim that any thought arises after and on the basis of neural firing, and so does creativity. However, none of them has yet discovered the exact working mechanism of interaction between a non-material abstract thought and a material biological neuron.

Science comes into our life and its conclusions influence social policy. Is it the brain whose neurophysiology should be changed for better creativity? Must there be the change of sociocultural climate for the better interaction between a person's thought and sociocultural context? Is creativity similar to a mystic state when a human mind freely travels to get the information from the Universal Mind? Should meditation be introduced into schools and universities to train a student to bring about a creative trance at will?

Though the source of creative insight has always been one of the most interesting for people, neuroscience is not ready yet for giving a definite answer to all these questions.

Cross-References

▶ Creative Behavior
▶ Creative Personality
▶ Creativity, Experiential Theories
▶ Four Ps of Creativity
▶ Genius
▶ Measurement of Creativity
▶ Nature of Creativity
▶ Research on Creativity
▶ Role of Intuition in Creativity
▶ Science of Creativity

References

Andreasen NC. The creative brain, the science of genius. New York: A Plume Book; 2006.

Beauregard M, O'Leary D. The spiritual brain. A neuroscientist's case for the existence of the soul. New York: HarperOne; 2007.

Bekhtereva NP. The magic of the brain and labyrinths of life. Moscow/St. Petersburg: Sova; 2007.

Csikszentmihalyi M. Creativity. Flow and the psychology of discovery and invention. New York: Harper Perennial; 1997.

Damasio A. Some notes on brain, imagination, and creativity. In: Pfenninger K, Shubik V, editors. The origin of creativity. New York: Oxford University Press; 2001. p. 59–68.

Dietrich A. The cognitive neuroscience of creativity. Psychonomic Bull Rev Psychonomic Soc. 2004; 11(6):1011–26.

Gruzelier J, Egner T. Physiological self-regulation: biofeedback and neurofeedback. In: Williamon A, editor. Musical excellence: strategies and techniques to enhance performance. New York: Oxford University Press; 2004. p. 197–219.

Jung RE, Gasparovic C, Chavez RS, Flores RA, Smith SM, Caprihan A, Yeo RA. Biochemical support for the "threshold" theory of creativity: a magnetic resonance spectroscopy study. J Neurosci. 2009a;29:5319–25.

Jung RE, Segall JM, Bockholt HJ, Flores RA, Smith SM, Chavez RS, Haier RJ. Neuroanatomy of creativity. Hum Brain Mapp. 2009b;31:398–409.

Ramachandran VS, Hubbard EM. Psychophysical investigations into the neural basis of synesthesia. Proc R Soc Lond B. 2001;268:979–83.

Creative Business

▶ Creative Management

Creative Climate

▶ Measuring Organizational Climate for Creativity and Innovation

Creative Collaboration

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Synonyms

Collective creativity; Great groups; Group creativity; Interdisciplinary groups; Open creativity

Introduction

Creative collaboration refers to two or more individuals, teams, entities, or organizations coming together to work on a project or challenge of common concern typically that is too challenging to be undertaken alone; the creative process of the collaboration would produce novel and useful work. Members can collaborate either physically or remotely through electronic or other means at all or different phases of the project.

This entry explores the various conditions for creative collaboration to thrive. In social science research, instead of relying on generalizations, the more useful approach is to study the conditions upon which a desired outcome (in this case, creative collaboration) would likely happen.

There have been debates surrounding the question on whether creative individuals or groups are more optimal for generating creativity. Judging from historical outputs or successful outcomes, the creative tasks that lend well to being undertaken by individuals include tasks that require organizing and expressing ideas that are partially formed in one's mind or those that involve the ideas from deep in the unconscious such as writing novels, poetry, art, or symphonic score.

For more significant projects, including those that arise from issues in our increasingly complex world and hypercompetitive business environments, the creative ideas and execution would demand a pool of talented people. The notion of the lone genius, such as Steve Jobs or Thomas Edison, is partly a myth because creative geniuses depend on many other people in the team or external organizations to bring their visions into fruition. Many significant discoveries that won Nobel Prizes increasingly have been the result of collaboration or sharing of information among two or more individuals. A case in point is the discovery of the DNA – this is the result of a creative collaboration between a physicist Francis Crick and a biochemist James Watson; they relied on data from Rosalind Franklin and the considered the ideas of Maurice Wilkins and Linus Pauling.

A Northwestern University team of researchers, after having analyzed millions of academic papers and patents from the past five decades, found that the average team size has increased by 20 % each decade, and levels of teamwork have increased in over 95 % of scientific subfields (Wuchty et al. 2007). "Home-run papers" – publications with over one hundred citations – are six times more likely to be the result of creative collaboration of teams of scientists than the solo author. As research questions become increasingly more complex, and researchers and experts become more specialized due to the limit a mind can handle, this leads to a natural need for collaboration – and more cross-disciplinary explorations.

The Process of Creative Collaboration

The process of group creativity can be categorized into four stages:

1. *Identifying and clarifying the project/problem.* This involves scanning the external and internal environment for problems and opportunities. The leadership needs to set the desired results clear for the group.
2. *Creating the ideas (ideation)*, which involves generating and assessing the different ways to circumvent the problems and exploit the opportunities. This is typically perceived to be the diverging phase of the entire process where the members search for or contribute many ideas. Two-time Nobel Prize winner Linus Pauling was quoted: "The best way to have a good idea is to have lots of ideas."
3. *Developing the selected ideas*. This stage is the converging phase where the best possible options are selected and further elaborated upon.
4. *Implementing the solution(s)*. This is the stage where the detailed ideas are put into fruition.

In terms of the assessment of creative outputs, a commonly used criterion is the Torrance framework, which forms the basis for the Torrance Creative Thinking tests. The four criteria include fluency (number of ideas), flexibility (ideas from different categories), originality, and elaboration.

Fluency and flexibility during the ideation phase is desirable; hence, the psychological conditions of the team (team diversity) described below is helpful toward this aim.

The second stage (ideation) is often associated with group brainstorming, and quantity and variety of ideas are useful. The term "brainstorming" was created in the late 1940s by Alex Osborne, a partner in the advertisement firm BBDO. Among the rules were the members of the team are not allowed to criticize other people's ideas. There has been research findings on brainstorming that suggest that this aspect of non-critical group ideation may not be very effective. Charles Nemeth, at the University of California (Berkeley), found that groups given brainstorming guidelines created more ideas than groups that were not given any brainstorming guidelines; however, the most creative groups are the ones who debated and criticized each other's ideas. Nemeth postulates that dissent forces team members to understand other team members' ideas more fully and makes each team member reassess his/her viewpoints, thereby stimulating more ideas (fluency).

The exposure to unfamiliar perspectives and discussions around initially disjointed ideas can lead to idea flexibility. This phenomenon is termed "breaking set" – instead of going down familiar cognitive pathways to generate the most obvious connections, the team members instead go off tangentially to explore novel idea connections. A related idea is Janusian thinking or the concept of paradox. Janus, in Greek mythology, is a god with two faces looking in opposite directions, one eastward, the other westward. In Janusian thinking, the thinker holds opposing views or images concurrently; this is the process of holding antithetical ideas and then trying to resolve them. In a group setting, this can be achieved when different team members come up with the opposing ideas (debate) and then collectively iron out the plausible solution(s).

The team members involved would typically have preferences in one or more of the stages. A good way to parcel out the tasks is to identify the stage or stages that each member has clear preferences in. The creative collaboration would then have a clear path from problem identification to successful implementation.

Besides consideration on the stages, there are social, psychological, and physical conditions that affect the outcome of the creative collaboration.

Social and Organizational Conditions

There are many group norms and organizational conditions that favor very successful creative collaborations (Bennis and Biederman 1998; Edmundson 1999):

(a) People: Strong leader(s) and superb team members who have a symbiotic relationship. The leaders love talented people and know where to find them. The right person is assigned the right job.
(b) Mission: They think they have a divine mission and are able to remove distractions. The leaders provide them what they need and free them from other commitments. They are like an island but still bridged to the mainland. The intrinsic motivation of delivering the great work or product in itself is the reward (Amabile 1996).
(c) Optimism and risk taking: They are not realistic, they are optimistic. They identify for themselves an enemy target and also see themselves as winning underdogs. The culture of risk taking should be one where there is psychological safety. This is defined as the "characterized by a shared belief that well-intentioned action will not lead to punishment and rejection." The risk-taking culture that leads to improved performance is the responsibility of good team leadership.

Certain forms of collaborations lend themselves better for scalability and are therefore more powerful (Hagel et al. 2009):

- Relational versus transactional collaboration: Relational collaboration, the seekers and solvers build relational capital for longer period of time, supports the creation and exchange of tacit knowledge – hence, is more likely to be scalable. Transactional collaboration relies on companies putting forward specific problems and asking groups of people to propose potential solutions such as the case of InnoCentive – this is an example of crowd sourcing.

- Dynamic versus static collaboration: In static collaboration, participants contribute existing knowledge. For dynamic collaboration, new knowledge and capabilities are formed continually.
- Loosely coupled versus tightly coupled collaboration: Tightly coupled collaboration is a more hardwired approach in which the activities or connections between the collaborating parties need to be renegotiated each time there is a change in the activity or connection. More loosely coupled collaborations tend to be more flexible; hence, this form of collaboration scales better.

Brian Uzzi and Jarrett Spiro (2005), who studied Broadway musicals from 1945 to 1989 in their quest to find the ideal model of group creativity, proposed a five-point scaled called the Small World Quotient (or Q, in short), which is a measure that quantifies the density of social connections from low to high connectivity or familiarity from past collaborations. He found that musicals that were commercial successes were three times more likely to be produced by teams with a Q score within the range of 2.4–2.6 than teams with scores above 3.2 or below 1.4. The best creative outcomes come from networks of people with an intermediate level of social intimacy (between a), i.e., a mixture of old friends and newbies or strangers – which can be an injection of unknown talent in an otherwise overly comfortable team that reverts to its former ideas.

For research-type roles, a moderate flowthrough of new members joining the collaboration is helpful as they bring along with them fresh ideas and perspectives which the original group would not have otherwise been exposed (Allen et al. 1988).

Psychological Conditions

For collaboration to yield creative outcomes, the selection of team members can comprise people with substantial knowledge of the field, different cultures, and thinking styles. Thinking or cognitive styles refer to the left-brain, right-brain dichotomy. Although this is a simplified view of the brain structure and function, it is a quick classification that can be easily implemented through questionnaires. The left-brain thinking is characterized by an analytical, sequential, and logical approach to problem solving, while the right-brain thinking approach is more intuitive and nonlinear (Leonard and Strauss 1997). Interactions among people with different thinking styles and preferences for the process stages described above may result in creative abrasion - this term, coined by Jerry Hirshberg at Nissan Design International, is defined by Xerox Parc leader John Seely Brown as "ideas that really rub against each other productively as opposed to destructively." The team members with differing thinking styles are deliberately chosen to maximize the diversity of the team. This diversity can be helpful particularly during the ideating stage of the collaboration.

Successful collaborations tend to exhibit substantive conflict (i.e., conflict arising from differences in views regarding the ideas or substance of the project) instead of interpersonal conflict that are more personal in nature (Eisenhardt et. al 1997). Diverse groups that can get over the initial challenging periods where team members learn to adjust with each other would end up with ideas or products that are more creative than those generated by homogeneous teams that have smoother interactions from the start (McLeod et al. 1996).

Physical Conditions

The collaboration space should allow for interaction and movement as teams move around to group and regroup. Smaller tables that accommodate several people are preferable to large conference style tables. Psychologist Ivan Steiner found that actual productivity increases for a while as the size increases, then reaches a plateau, and then decreases as the group gets too large; the optimal number is between four to five people.

A study of geographically dispersed teams (Leonard et al. 1998) found that, for complex tasks, the teams prefer face-to-face interactions for optimal creative process. Face-to-face meetings afford the richest multichannel medium of communication, including body language. Researchers from Harvard Medical School found from their study of 35,000 peer-reviewed papers, concurred the above findings. The best research papers, i.e., those with high number of citations, were coauthored by people working within 10 m of each other. Papers written by coauthors working more than 1 km apart were the least cited (Brownstein et al. 2010). This suggests the need for the optimal design of architectural spaces that support spontaneous, regular, and face-to-face interactions.

Future Directions

The process of globalization has resulted in an increasing trend of global collaborative creativity resulting in cross-border patents. Although the number of inventors collaborating on cross-border projects has increased exponentially, the number of cross-border patents has only grown linearly. Although the nature of collaborative creativity has become more globalized, this form of collaboration has so far mainly concentrated in countries such as the USA, the UK, France, Germany, and Canada (Huang et al. 2012).

Another trend is the Creative Commons licensing framework or Public Domain Mark, started by a nonprofit company by the same name (web: creativecommons.org). Content owners can choose to grant limited permission (licenses) for their work to be used for noncommercial purposes or to be further built upon by others to create derivative works, including by people unrelated to the original content. Through this sharing framework, this new concept of creative collaboration can result in a derivative work taking on a new life of its own, unrestricted by the boundaries of an intact team.

Cross-References

▶ Brainstorming and Invention
▶ Convergent Versus Divergent Thinking
▶ Corporate Creativity
▶ Creative Behavior
▶ Creative Personality
▶ Ideas and Ideation
▶ Interaction, Simulation, and Invention

References

Allen T, Katz R, Grady JJ, Slavin N. Project team aging and performance: the roles of project and functional managers. R&D Manag. 1988;18(4):295–308.

Amabile T. Creativity in context: the social psychology of creativity. Boulder: Westview Press; 1996.

Bennis WG, Biederman PW. Organizing genius: the secrets of creative collaboration. Reading: Nicholas Brealey Publishing; 1998.

Edmondson A. Psychological safety and learning behavior in work teams. Adm Sci Q. 1999;44:350–83.

Eisenhardt K et al. How management teams can have a good fight. Harvard Bus Rev. 1997.

Hagel III, J, Brown JS, Davison L. Introducing the collaboration curve. HBR Blog Netw. 2009.

Huang M-H, Dong H-R, Chen D-Z. Globalization of collaborative creativity through cross-border patent activities. J Informetr. 2012;6(2):226–36.

Lee K, Brownstein JS, Mills RG, Kohane IS. Does collocation inform the impact of collaboration? PLoS One. 2010;5(12):e14279.

Leonard D, Strauss S. Putting your whole company's whole brain to work. Harvard Bus Rev. 1997.

Leonard DA, Brand PA, Edmonson A, Fenwick J. Virtual teams: using communications technology to manage geographically dispersed development groups. In: Bradley SP, Nolan RL, editors. Sense and respond: capturing value in the network era. Boston: Harvard Business School Press; 1998. p. 285–98.

McLeod P, Lobel S, Cox T. Ethnic diversity and creativity in small groups. Small Group Res. 1996;2(27):248–64.

Uzzi B, Spiro J. Collaboration and creativity – the small world problem. Am J Sociol. 2005;111(2):447–504.

Wuchty S, Jones BF, Uzzi B. The Increased Dominance of Teams in Production of Knowledge. Science. 2007;316:1036.

Creative Conditions

▶ Creative Knowledge Environments

Creative Contexts

▶ Creative Knowledge Environments

Creative Destruction

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Synonyms

Economic dynamics; Entrepreneurial economy; Entrepreneurship financing; Innovation

Intellectual Roots of the Concept

Creative destruction refers to the phenomenon of economic change through the creation of new ways of doing things that endogenously destroy and replace the old ways. It is assumed that new products and new processes are the main source of the capitalist economy's development. The term "creative destruction" is usually used to emphasize the dynamic nature of the modern economic system and is more readily thought as a positive evolutionary process.

Creative destruction is originally derived from Marxist economic theory (*The Communist Manifesto* of Marx and Engels, 1848, *Grundrisse* of Marx, 1857 and *Das Capital*, 1863), which put to the fore the capitalist processes of destroying and reconfiguring previous economic structures. This approach argued that the capitalist evolution must ceaselessly devalue existing wealth (through war economic crises) in order to prepare the environment for the creation of new wealth. In its most common sense, this process points out the way in which capitalist economic development goes through the destruction of the prior economic order to create some new structures. But the intellectual roots of the term "creative destruction" can also be found in Nietzsche's *Zarathustra* (1883–1892) and in the *Krieg und Kapitalismus* (War and Capitalism, 1913) of German Marxist sociologist Werner Sombart (see Reinert and Reinert 2010).

Creative Destruction as an Evolutionary Process of Economic Change

Economic Change

After World War II, creative destruction has become identified with Joseph Schumpeter (1883–1950) who used and popularized it as a theory of economic change due to innovations framed and implemented by a specific class of economic agents in a capitalist society, called entrepreneurs. This approach gained analytical and political ground within neoliberal models of free-market economics as a description of market dynamics resulting in the increase of the efficiency of the economy through decentralized and self-interested private agents' behavior.

In Chap. 7 (*The Process of Creative Destruction*) of his book *Capitalism, Socialism and Democracy* (2000 [1942]), Schumpeter states that "The essential point to grasp is that in dealing with capitalism we are dealing with an evolutionary process." Then he adds that: "Capitalism, then, is by nature a form or method of economic change and not only never is but never can be stationary." This evolutionary character of the capitalist process is due to the fundamental impulse "that sets and keeps the capitalist engine in motion which comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates" (p. 83). The opening up of new markets or the creation of new production processes and organization incessantly revolutionizes the economic structure *from within*, "incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in" (p. 83). Therefore, Schumpeter argues that the relevant problem is how capitalism creates and destroys existing structures.

This incessant change process is led by entrepreneurs who are at the heart of the economic system. The entrepreneurs also called by Schumpeter the "wild spirits" (*Unternehmergeist*, German for *entrepreneur-spirit*, English for *entrepreneurship*, and French for *enterprise*) drive capitalist dynamics and obtain market power to create temporary monopolies. In his early work, Schumpeter argued that the innovation and technological change are due to individual entrepreneurs who make things work in the economy through. From World-War II, at Harvard, he changed his interpretation of the roots of economic dynamics and he asserted that the major changes in the economy stem from big companies which have the resources and capital to invest in research and development. Then, in a capitalist economy, the entrepreneur or the enterprise, whatever its size, is *the actor* of the endogenous change, the process of industrial mutation, which should replace the invisible hand-competitive price theory of classical and new classical economics.

Entrepreneurs' Innovations as the Source of Creative Destruction

In his *Theory of Economic Development* (1961 [1934]), Schumpeter maintains that the creative destruction process is mainly due to entrepreneurs' innovations that create an endogenous motion which revolutionizes the economic structure. New combinations "appear discontinuously in groups or swarms." As this process does not only sweep old structures but also calls for new horizons to be widened, it is called creative. Such a creative motion comes from novelty about goods and services, new methods of production and all related activities, new process of implementing projects, new ways of organization, new combinations of factors of production, and so on. The field is large, limitless, depending on the imagination of Schumpeterian entrepreneurs. The Schumpeterian entrepreneur is not a single physical person and not a well-defined group of people. The entrepreneur may be the capitalist, a corporate manager, or a visionary who tries to change the established economic structure in order to create novelty. He or she is a novelty lover who is like an adventurer, a pioneer who is incessantly searching for changes in his existence. In this picture, the competition is a source of change through innovations that are destroying and remaking the existing structures so positions of agents cannot rest on a pillow of previous situation. Therefore, such an incessant change must be studied as a vehicle for uncertainty which allows economic actors to adopt leapfrogging strategies in order to reshape market structures following their expectations and own interests.

This approach offers a specific way of apprehending economic development through the introduction of innovations onto the market that would disturb the existing economic environment and trigger overall structural change.

Schumpeter identified entrepreneurial innovations as the major source of economic change. He argued that economies revolve around entrepreneurial innovations that often create temporary monopolies, allowing high profits that would soon be competed away by rivals and imitators. Then he remarks that the creative destruction dynamics stand out most clearly in the case of sectors which at any time happen to embody the impact of new things and methods on the existing industrial structure. In this vein, he argues that "The best way of getting a vivid and realistic idea of industrial strategy is indeed to visualize the behavior of new concerns or industries that introduce new commodities or processes or else reorganize a part or the whole of an industry" (2000 [1942], p. 89). Such concerns are assumed to be aggressors by nature and wield the effective weapon of competition. The meaning of the competition is therefore related to that kind of competition which comes from new commodity, new technology, new source of supply, and new type of organization that command a decisive cost or quality advantage and "strike not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives" (2000 [1942], p. 84).

In the same vein, but considering a global and continuously changing world of the twenty-first century, David Audretsch (2007) argues that in modern economies, there is a shift from the (old) managed economy to the emergence of an entrepreneurial society where individuals and firms as well as groups and communities try to proactively use the opportunities of the time. The connections between entrepreneurship and growth, founded on the creative destruction schema, can be narrowed also to entrepreneurship's stimulation of developing economies as entrepreneurs can serve, according to Audretsch, as a conduit for knowledge spillovers, improving competition for new ideas and methods and increasing diversity.

Innovation and Invention

There is no commonly accepted definition of innovation within a business context. However, in the literature, invention and innovation are distinguished.

In the *Theory of Economic Development*, Schumpeter distinguished between the invention and innovation. The invention is the discovery of a new technical knowledge and the innovation is its application to industry. The innovation, in its broader sense, is the introduction of new technical methods, new products, and new sources of supply and new forms of organization.

Invention is used in order to define a fundamental technological change, the apparition of which is usually depending on scientific changes which would affect our way of life.

Innovation expresses the way that aims to derive anticipated benefits from change and concerns new commercial uses that the decision-making unit perceives to be profitable in economic terms. The innovation can be a new idea, new practice, method, or process, product, or market opportunity.

So the term "innovation" is a generic term of all strategic economic and financial changes which may mean the developing of new services (allowing to the product differentiation), new products (diversification and penetration of new markets with new products and creating new needs and demand), new manufacturing processes (reducing production costs or supplying better products), and new business processes.

Research and Development as the Source of Modern Entrepreneurial Innovation

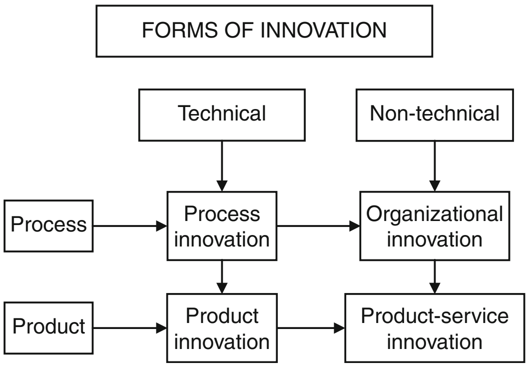
Therefore, it is obvious that the innovative process is related to the research and development (R&D). The fundamental research produces new knowledge (scientific-invention level of the process of change) while the applied research aims to lead to the acquisition of new knowledge for specific purposes as the launch of new products and processes including design, prototyping, testing, construction of pilot plants, etc. It is usually assumed that, given the financial and scientific requisites of the R&D activities, the process must be found on public and private structures cooperation.

Forms of Innovation

Innovations can take an incremental or radical form as regards their effects on existing economic structures:

Incremental innovation	Minor change at the industry level
Radical innovation	Major change at the industry level
Change in technological system	New industry and/or change at the intersectoral level
Change in techno-economic paradigm	New industry and/or change at the intersectoral level with heavy socioeconomic consequences

There is also a distinction between technical and nontechnical innovations. While product or process innovations represent technical innovations, product-service and organizational innovations are assumed to be nontechnical innovations. From this point of view, the second type of innovation can be classed as commercial innovations because they concern the methods of commercialization, advertising and market searching, etc. Then the main types of innovation, following Schumpeter, can be classified into three main categories: product innovation, process innovation, and commercial innovation. However, the following schema can be used to present different forms of innovation summarizing various conceptual and observational factors intervening in the design and implementation process of innovative activities:



In the technical category, product innovation is defined as the development of new products or technologies supported by research and development activities of firms. Process innovation aims at finding new process technologies in order to reduce costs of production and time costs and/or to increase quality.

In the commercial category, service-product innovation consists in offering the customers new services such as maintenance or operating services. Organizational innovation comprises the development and implementation of new organizational structures and processes in order to offer customers more flexibility and efficiency.

One can find in this category just-in-time concepts as applied by the Japanese firms in the 1970s. Organizational innovations are differentiated into two types of innovation:

– Procedural organizational innovations which affect the routines and operations of a firm. They are aimed at increasing the speed and flexibility of production.
– Structural organizational innovations change responsibilities, accountability, and information flows and affect therefore the divisional structure of functions within the firm's hierarchical framework.

Organizational innovations can occur within a firm. Then, they are called intraorganizational innovations and affect the overall strategy of the company as a whole. When they include new organizational procedures beyond a firm's border, they affect the firm's environment throughout R&D cooperation with customers or other firms, and they are called interorganizational innovations.

Relevant Examples and Issues

Innovation at the Roots of Modern Economies' Change

To date, innovation is at the top of the strategic agenda of corporations (Tzeng 2009). One can argue without exaggeration that in the wake of numerous technological and organizational changes that modern economies' dynamics provoke through new products, processes, and services on industrial as well as on financial markets, the late twentieth and the early twenty-first centuries' capitalism is certainly the age of Schumpeter.

In modern economics, creative destruction is a relevant way to study the stability concerns as it can explain most of the dynamics of industrial change and the evolution of market structures from competition to oligopolistic/monopolistic markets. It constitutes also the main reference for endogenous growth theories (Speight 2001) and evolutionary economics.

New Industrial Economics

In the new industrial economics (or the theory of organizations), the Schumpeterian model of creative destruction is used as one of the main references. This approach consists in considering the behavior of new organizational forms which introduce new process or products. This model allows economists and market analysts to consider new organizational forms which introduce new process or products in a dynamic setting. The issue of innovation in firms' market strategies for which the first initiative comes from firms themselves and not only due to given market structure constitutes a relevant analytical purpose in order to apprehend different market structures (imperfectly competitive markets, monopolistic or oligopolistic markets with dominant firms which determine the market's conditions in the aim of dominating evolution of markets and preventing the entry of new rival firms).

Innovations, Merger, and Acquisition

In *Capitalism, Socialism, and Democracy*, putting the emphasis on the *routinization* of technical innovation and the obsolescence of entrepreneurs' creative activities, Schumpeter presents a pessimistic view of the future of capitalistic economies. If R&D becomes centered in large corporations (financial needs of R&D activities may prevent little firms from undertaking innovative strategies), by exercising their market power, the large oligopolies would be able to use their market power to blockade Schumpeter's entrepreneurs' dynamics. Therefore, large corporations will come to dominate innovation; new entry and creative destruction would decline. In this perspective, Edgar Norton (1992) studies evidence of creative destruction in the US economy to deal with this issue thorough the examination of the role of merger and acquisition in the process of creative destruction, firm growth, and firm decline. He shows that mergers and acquisitions were also major forces behind the exit of firms from the top 500 during the 1970s–1980s. He states that the net impact of merger and acquisition activity on creative destruction and wealth concentration is an empirical and a public policy question needing further study.

Innovations and Factors Affecting R&D Activities

Various factors affect the R&D activities of firms then the creative destruction process in an economy:

– The "technology push" factor: According to the available level and state of technology in a market, firms may try to use different opportunities to develop new technologies. For example, there seems to be more technological opportunity today in the biotechnology than in the cloth manufacturing industries.
– The "demand pull" factor: It is the evolution of the demand in a given market that gives firms the effective orientation of their market strategies. For example, when the thinness is fashionable, some firms develop new technologies and slimming products.
– Profitability factor: Can firms appropriate the monetary returns to R&D? If the patent rights are strong, firms should be able to capture the profits that could come from inventions and innovations created during the R&D. If not, either (1) other firms copy the invention or innovation, (2) other firms develop minor variations of the new technology and capture parts of the market demand, or (3) large firms with strong investments in the technology can maintain dominance by having large numbers of patents and copyrights, and by defending them legally, so that new firms are kept out of the market.
– Ability of firms to use the new technologies developed in other firms or by academic researches. That is the extent to which a firm has the relevant R&D personnel and other resources needed to use efficiently the new technologies.
– Scale and scope factor: This is related to the possibility for the firm to realize scale or scope economies. When the firm is small, the scale of production is usually low and then profitability of the innovative activity (costs of development, of market analysis, of advertisement, etc.) may take more time than the case of larger firms, which may spread the costs of R&D over the numbers of units produced and distributed.
– Financing factor: Availability of the internal finance and conditions of the external finance (borrowing conditions in the financial markets) for the R&D activities usually give more advantages larger firms and can prevent the little firms' innovative activities.

Innovations and the Size of Firms

Some critical questions then arise: How does the structure of an industry (the numerous characteristics of firms in a given market) affect R&D in the sector? Why might the bigger or the smaller tend to do more R&D?

Acs and Audretsch (1988) show that the possibility of innovations from small firms, especially from new start-ups, is related to sector-specific conditions. If the industry is capital-intensive and highly unionized, small firms have no access to innovative activities.

Larger firms tend to have more capabilities than smaller firms to improve and streamline existing technologies. Hence, large firms often pursue large numbers of minor improvements to products and manufacturing processes. It is also observed that in capital intensive sectors, large firms can innovate more than small firms which have no sufficient access to capital markets while in new sectors, with low barriers to entry and less capital-intensive, small firms can follow aggressive and innovative strategies and can change the path of sector's evolution. However, it is also obvious that if an innovation comes from smaller firms, commercialization still takes a lot of effort for young firms which do not have expanded distribution networks or enough advertisement structures.

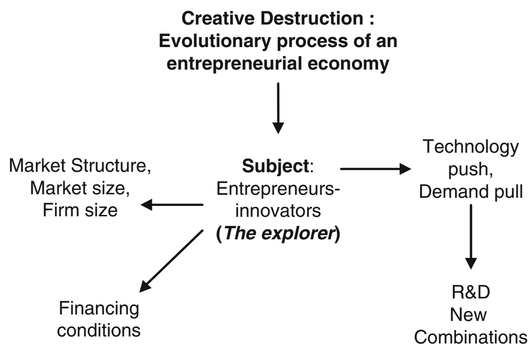
Financing of Innovations

In the Schumpeterian economic development model, dynamics enter the picture with the innovation decisions of entrepreneurs. Innovation is the driving force of accumulation. Innovation means to change deeply the economic status quo. The subject of the innovation is the entrepreneur who tries to execute new combinations. But the sole presence of entrepreneurs is not sufficient to guarantee the system's evolution. In order to innovate, to found a new firm, and to construct a new plant and order new equipment from existing firms, entrepreneurs need means of financing. As the creation of novelty requires new ways of doing things, the entrepreneur-explorer needs new ways of financing. If one presents the entrepreneur as the source of the creative destruction process and the innovations-new combinations as his objective, the way to reach the objective is related to the access of entrepreneurs to monetary means required to fund new plans and strategies. The result of such an adventure will also determine the final performance of entrepreneurs.

Consequently, the financing conditions of innovations are a real concern in the creative destruction process of an economy but also regarding its stability (Ülgen 2001).

Schumpeter argues in *The Theory of Economic Development* that the access to money (credit) is the power to command and to determine the level of economic change. Credit money becomes the critical variable which authorizes an economic separation between entrepreneurs-innovators and other agents. The financing of enterprise has been assigned logical priority in the process of economic development since innovations have to be supported by new funds beyond the existing ones. Therefore, the financing conditions of innovative activities and the evolution of banks and financial markets play a crucial role in the creative destruction process.

Therefore, the creative destruction process becomes a global issue in the analysis of economic evolution:



Conclusion and Future Directions

The creative destruction is used to describe the evolution of a capitalist economy through its endogenous dynamics assumed to be mainly founded on entrepreneurs' decisions and strategies. These strategies aim at strengthening dominant positions on markets in order to give firms more profit and higher control on market's development.

Such a (anti)competitive aim does improve, according to some economists, the functioning of market economies while other economists believe that the creation can finally result in some destructive processes.

Whatever the theoretical position that one can adopt in the analysis of economic change, it is obvious that the creative destruction process depends on innovative behavior of market actors. Therefore, the relevant question is related to the issue of creating, improving, and, maybe, framing entrepreneurial dynamics to let them reinforce positive changes which would be able to raise the welfare of the society. Then the size of firms, measures, and mechanisms to give entrepreneurs incentives to innovate more and the adequate market structures and financing rules and tools to accompany firms' evolution gain importance in economic change. The design and implementation of relevant and consistent industrial policies become then a crucial issue in the development of an entrepreneurial economy.

Cross-References

▶ Angel Investors
▶ Epidemiology of Innovation: Concepts and Constructs
▶ Financing Entrepreneurship
▶ Informal Venture Capital
▶ Innovation
▶ Joseph A. Schumpeter and Innovation
▶ Love Money
▶ R&D

References

Acs ZJ, Audretsch DB. Innovation in large and small firms: an empirical analysis. Am Econ Rev. 1988;78:678–90.
Audretsch DB. The entrepreneurial society. Oxford: Oxford University Press; 2007.
Norton E. Evidence of creative destruction in the U.S. economy. Small Bus Econ. 1992;4:113–23.
Reinert H, Reinert ES. Creative destruction in economics. In: Backhaus JG, Drechsler W, editors. Friedrich Nietzsche (1844–1900). Economy and society. New York: Springer; 2010. p. 55–86.
Schumpeter JA. The theory of economic development. Cambridge, MA: Harvard University Press; 1961 [1934].
Schumpeter JA. Capitalism, socialism, and democracy. London: Routledge; 2000 [1942]. With a new introduction by Richard Swedberg.
Speight AEH. Innovation, creative destruction, and endogenous growth: contemporary economic theory and the Schumpeterian legacy. In: Orati V, Dahiya SB, editors. Economic theory in the light of Schumpeter's scientific heritage, vol. I. Rohtak: Spellbound Publications; 2001. p. 171–86.
Tzeng C-H. A review of contemporary innovation literature: a Schumpeterian perspective. Innovat Manage Pol Pract. 2009;11:373–94.
Ülgen F. The monetary dynamics of growth: credit economy and stability. In: Orati V, Dahiya SB, editors. Economic theory in the light of Schumpeter's scientific heritage, vol. I. Rohtak: Spellbound Publications; 2001. p. 119–34.

Creative Ecology

▶ Model for Managing Intangibility of Organizational Creativity: Management Innovation Index

Creative Entrepreneurship

▶ Entrepreneurship in Creative Economy

Creative Environments

▶ Creative Knowledge Environments

Creative Expression

▶ Creative Behavior

Creative Insight

▶ Creative Brain

Creative Knowledge Environments

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Synonyms

Creative conditions; Creative contexts; Creative environments; Systems of innovation

Definition

> Creative Knowledge Environments (CKEs) are those environments, contexts and surroundings, the characteristics of which are such that they exert a positive influence on human beings engaged in creative work aiming to produce new knowledge or innovations, whether they work individually or in teams, within a single organization or in collaboration with others (Hemlin et al. 2004, p. 1).

CKEs promote the production of new creative knowledge and can best be understood by taking a holistic multi-perspective, interdisciplinary approach. One important aspect following from the definition of CKEs is that they need to be understood at different micro-, meso-, and macro-levels, from the environment surrounding the individual knowledge worker to the more global level surrounding organizations. Indeed, CKEs can be viewed as nested layers of environmental factors influencing the unit undertaking the knowledge and innovation-producing activities. Examples of important dimensions and aspects of creative knowledge environments (with brief explanations and more specific examples in parentheses) include *task characteristics* (simple/complex, routine/novel), *discipline* (type of disciplinary field), *individuals* (e.g., knowledge profile, skill profile, abilities, cognitive style, motivation, career plans), *group characteristics* (size, degree of integration, inward/outward looking, degree of heterogeneity, degree of group tension, knowledge mix, skill mix, ability mix, common/contested beliefs), *general work situation for individuals* (work tasks, time available for research, degree of freedom in goal setting, quality of IT available), *physical environment* (facilities, architecture, location, equipment), *organization* (economic situation, organizational structure, reward profile, managerial style, degree of organizational harmony), and *extra-organizational environment* (size of economy and whether expanding/declining, degree of market openness and outreach, reward profile, information access, job opportunities and mobility, cultural features).

The unit undertaking the knowledge and innovation-producing activities can be conceptualized at different levels from individuals to groups, to a research laboratory or institution, and to whole nations or associations of nations. In order to understand the factors that help produce CKEs, one needs to have a clear conception of what is meant by creativity; otherwise, the degree of creativity of the resulting knowledge product cannot be evaluated. Traditionally, a creative product is defined as a product that is new, useful, and of good quality. A well-known problem in this context is to find robust criteria for judging the quality of a product, be it knowledge or an innovation. Quality criteria are likely to change over time and to have a relational character, and an important issue is when in the product's life cycle, the quality evaluation should be made – i.e., early, middle, or late in the cycle.

Examples of features that hinder the efficient functioning of CKEs are low individual competence levels, unclear objectives and badly coordinated team workers, lack of a genuine research-promoting culture, poor group/organizational climate, hierarchical and formal organizational structure, inability of group members to influence the direction of group work, poor internal and external communication, lack of encouragement and basic resources for staff, homogeneous groups with respect to disciplinary/subdisciplinary background and skills, externally and weakly motivated members, poorly managed staff selection, poor leadership lacking vision and useful external contacts, and excessive or intrusive quality control.

Cross-References

- ▶ Creative Leadership
- ▶ Creativity and Innovation: What Is the Difference?
- ▶ Creativity from Design and Innovation Perspectives
- ▶ Creativity in Invention, Theories
- ▶ Organizational Creativity
- ▶ Psychology of Creativity

References

Hemlin S, Allwood CM, Martin BR. What is a creative knowledge environment? In: Hemlin S, Allwood CM, Martin BR, editors. Creative knowledge environments. Cheltenham: Edward Elgar; 2004. p. 1–28.

Creative Leadership

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Synonyms

Absolute leadership; Idea leadership; Ideal leadership

Definition

Creative leadership is the process of accelerated advancing organization.

Introduction: New Type of Leadership

Creative leadership, as a type of leadership, is rarely understood properly, but it is so fundamental that its ultimate form can be called ideal leadership or absolute leadership.

In traditional terms, "good" leadership (and good leadership is always creative leadership) means having the "right ideas" and "doing the right thing" which includes having the "right behavior," knowing when and how to ask the "right questions," then taking the "right action," and producing the "right results." A good leader communicates, that is, creates and sends positive messages (nonverbal and verbal) that clearly depict the vision (new organization of the future world) and inspire people to do their best to achieve the vision. A good leader can use these processes in multiple situations to lead people or organizations successfully, effectively, and with efficiency. A good leader can solve complex problems – and the more creative the solutions are, the more successful the organization, civilian, or military will be. Moreover, any good leader (a creative leader) projects creativity to subordinates, and their collective (united, combined) creativity becomes unbeatable.

Creative leadership (ideal leadership, absolute leadership), as a fundamental form of leadership, reveals itself in other types of leadership. Thus, it is useful to review the well-known styles of leadership.

Traditional Types of Leadership

Most people would agree that a good general definition of leadership is "the process of influencing others toward a common goal" (see other definitions in Bennis 1985; Burns 1978; Yukl 1981; etc.).

For the majority of researchers, leadership is personified by great people and is carried out in historically great events. Thus, the leadership typically analyzed and discussed in literature is based on either traits or behaviors. The well-known classifications include:

- Autocratic versus charismatic (Avollo and Bass 1988; Kuhnert and Lewis 1987)

- Formal (leadership of position) versus informal (a leader controls the group without being in a leadership position)
- Transactional versus transformational (the leader changes the circumstances of events) (Bass 1998)
- Exclusive versus inclusive (the leader embraces the opinions of the group and includes the group in the process of decision making)
- Authoritarian versus servant (the leader accepts the goal of serving the group and its interests) (Greenleaf 2002)

Characteristics (Traits) of a Leader

Since the main emphasis in leadership research is placed on the behavioral characteristics, the majority of researchers go straight to the basic characteristics of a leader. In numerous resources, you will find from 3 to 50 basic traits that successful leaders must have (see, e.g., Maxwell 2007; Smith 1986; Taylor and Rosenbach 1984). These key qualities of a leader include strong character, charisma, commitment, communication, competence, courage, focus, vision, etc. However, even the authors who identify the 21 qualities of a leader do not mention creativity. They mention problem-solving ability, but not creativity.

The Leadership of Idea (Empirical Proof)

As a counterexample of all "trait theories," there are instances when a person *does not* have all of these traits, *does not* say anything to the group, but functions as a leader nonetheless:

Case 1. During a raging flood, a group of people became trapped on the roof of a house. The water was rising rapidly, and there was no way to escape. As the waters rose, inflated tires from a nearby garage began to wash up onto the roof. One woman saw the tires, grabbed one, sat in the middle of it, and jumped into the river, using it as an inner tube. The floodwaters carried her to a nearby hill where she jumped off to safety. The other people trapped on the roof watched her do this and followed her example. As a result, all of the people were saved.

In this case, without saying a word, simply by acting correctly and achieving the desired result, the woman was able to lead the people to safety. That is leadership by example, some researchers would state, but notice that the woman's leadership began with an idea ("right idea"), went through to the action stage ("right action"), and finished also with an idea ("right idea") in the minds of the other people. There was no coordination, no communication, and no charisma. The woman created an idea – a connection between earlier non-connected entities (situation: danger of drowning; goal: safety; means: inflated, floating tires) that led to saving her life and the lives of other people. This was certainly an act of creative leadership: (a) a creative act – she generated a creative idea and (b) a leadership act – by her example, she led people out of danger. It was also "ideal leadership": (a) idea-based and (b) the best in the situation (ideal) – it required no radio, no helicopters, no rescue workers, no explanations, and no instructions. It was simply **ideal**. The concept of ideal is used here as it is understood and explained in the works of Altshuller, the author (see TRIZ, ► Inventive Problem Solving (TRIZ), Theory) who introduced the so-called ideal final result (IFR) as achieving a goal with minimal effort and minimal material expenses (Altshuller 1986).

Another life example that required no other traits of leadership except creativity is given below:

Case 2. During WWII, airplanes were built and repaired in hangars. Imagine winter time in Russia. Working on airplanes in the open air was impossible. There was frost, snow, winds, and blizzards. So the obvious question was how to put more aircraft into one hangar so as to do the repairing faster. People were not a problem: there were lots of mechanics. Space was a problem. All the specialists from the Constructor General to the entry-level engineers were thinking of the problem. The Constructor General visited the hangars and talked to workers. A stunningly simple idea came from an older mechanic. He suggested lowering the pressure in all the left (or all the right) tires of the chassis. The airplanes would lean to one side, and their wings would not interfere with those of other airplanes. The same hangar could accommodate nearly twice as many airplanes. Here was a creative idea–creative solution to the problem. The Constructor General was happy with the idea; he called Stalin; Stalin gave an order to the aviation industry, and all airplane production plants and maintenance facilities followed the suggested idea. As a result, literally overnight, the air force repair industry nearly doubled its production (adapted from Altshuller 1986).

In this specific case, an older mechanic was the creative idea generator or idea leader. It was his idea that the Constructor General, then Stalin, then ministers, then plant directors, and finally engineers, followed. This is a clear case where no other traits of traditional leadership come into play, only creativity. Moreover, this case is an example of "ideal leadership": no construction of new hangars, no cutting of wings, no special platforms, and no lifting mechanisms were needed. Minimal energy was exerted to reach the goal. Thus, this case is very close to an ideal leadership solution.

These cases illustrate one aspect that has been missed by most leadership theories: it is not the person who is leading. It is the idea(s) that this person generates or perceives and then makes available to people. The existing theories of leadership either did not see this kind of leadership, or they were unable to explain it. A new theory was needed.

New Concept and New Vision of Creative (Ideal, Absolute) Leadership

The concept of creative leadership can have both a narrow and a broad meaning. If creative leadership is understood as leadership in a creative area, then its meaning is narrow. If creative leadership is understood as training leaders to solve problems creatively, then its meaning is also narrow. However, if creative leadership is understood as leadership by creative ideas, then this is a broad meaning.

When creative leadership is understood as leadership by idea (no matter who the author of this idea is), the scope of the leadership concept is widened and the volume of the concept is increased.

For example, from the religious point of view, God leads people by ideas (absolute leadership), so God's leadership is included in the concept of creative leadership. In secular life, a genius who develops a breakthrough idea and is then led by this idea is encompassed by the new concept as well. A great explorer led by the dream to conquer the North Pole is included. Any person following an idea is led. As Lord Byron stated, "And when we think we lead, we are most led."

Ideas, however, are immaterial. They cannot be touched, seen, or heard until they are manifested. They may be articulated in speech (utterances, monologues, dialogs, presentations, etc.) or in writing (notes, letters, reports, articles, books, or even covenants carved in stone). In any case, the process of manifestation of ideas is present.

Emotions and feelings may exist without language. Ideas (thoughts, concepts, conclusions) need language in order to exist. People think in words. Leadership, therefore, is communication, verbal or nonverbal.

Theoretical Analysis: Paradigm Shift

Language is the main tool whereby ideas are manifested. Language communication is the domain where people exchange ideas coded in words, sentences, or statements. That is why linguistics – the science of speech and language – has to be taken into account in order to deal with the manifestation (expression) of ideas. As a response to the need, creative linguistics, introduced in 1988, developed the tools for analyzing the creative aspects of speech and proved that any speech act is a creative act (see ► Creative Linguistics, Aleinikov 1988, 1992). This development led to the explanation of creative leadership and eventually to a new science of leadership – agogics.

As shown in cases 1 and 2, an idea (a correct, useful, and problem-solving new idea) can lead the positional and even the autocratic leader. A creative idea can advance the group (society) to a better (more efficient) organization of its activities and resources.

In any communicative act, whether at work or at home, people listen to each other in search of new ideas. In contrast, imagine that some individual mumbles one and the same thing all the time. This person will be of no interest to anyone. But a person with lots of new ideas is listened to. People listen to those individuals who have ideas. In any problem situation, people listen to a person for at least a short period of time and then decide whether or not to use this person's idea as a part of the common solution. If they decide yes, they continue to follow the idea (so the idea is still "leading"). If not, they listen to someone else with a more creative idea or offer their own idea. Obviously, the person who offers the best (most creative) idea becomes an idea leader without any additional or special effort. This is creative leadership (ideal leadership) at its best.

From the theoretical point of view, this creative leadership can be viewed as the best possible version of leadership or as "ideal." To combine these two meanings (*ideal*$_1$ because it stems from an *idea* and *ideal*$_2$ because it is the best), a special spelling of the term IdeaLeadership© was introduced (Aleinikov 1999b).

In contrast to the traditional view that a leader is required to have certain characteristics of a leader (often described in a lengthy list), the broad vision of creative leadership includes the possibility that *any* person who produces an idea – a useful idea – becomes a leader in a given situation. Such an individual can be in the lowest possible position in an organizational or social hierarchy. Such an individual may have no traditional leadership traits at all. This does not matter. The idea producer becomes an instant leader because the idea leads other people. The life episodes described in the cases above are examples of a useful idea leading. Such situations happen in the family life when a useful idea comes from a child, at work, school, etc.

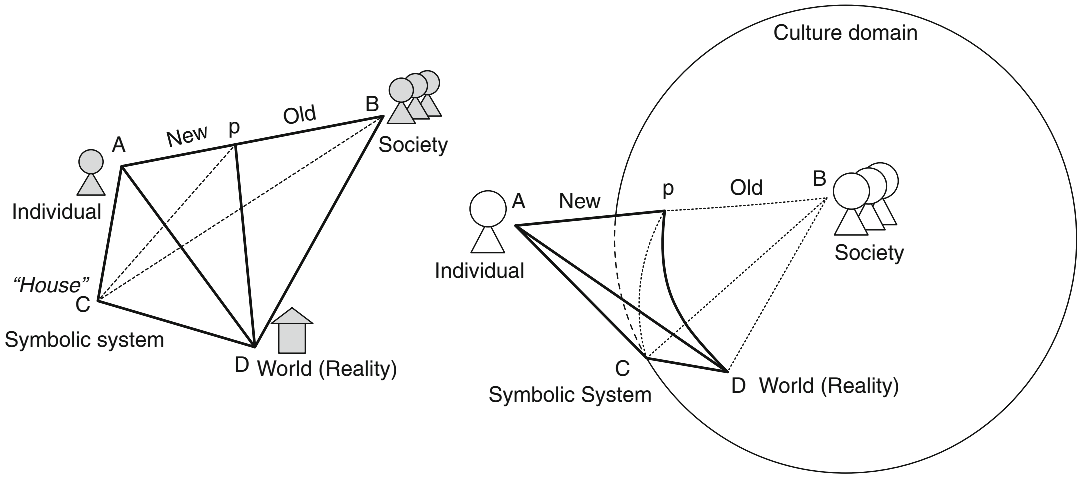
Now, it is easy to see how creative leadership shapes the basis for all other types of leadership.

- Even the most autocratic leaders (despots, dictators) rule mostly with words, and words merely manifest their ideas.
- The charismatic leaders also lead or rule by communicating ideas. Even those with the sweetest of personalities have to have ideas to wrap them up into charismatically delivered verbal or nonverbal message.
- Transformational, inclusive, and servant leaders have to have ideas in order to lead. They themselves may be very intelligent and creative generating ideas on their own or they may solicit and use the ideas of the others (as inclusive leaders do), but *having* ideas is a must. Good leaders both generate ideas and are open to the ideas from the followers.

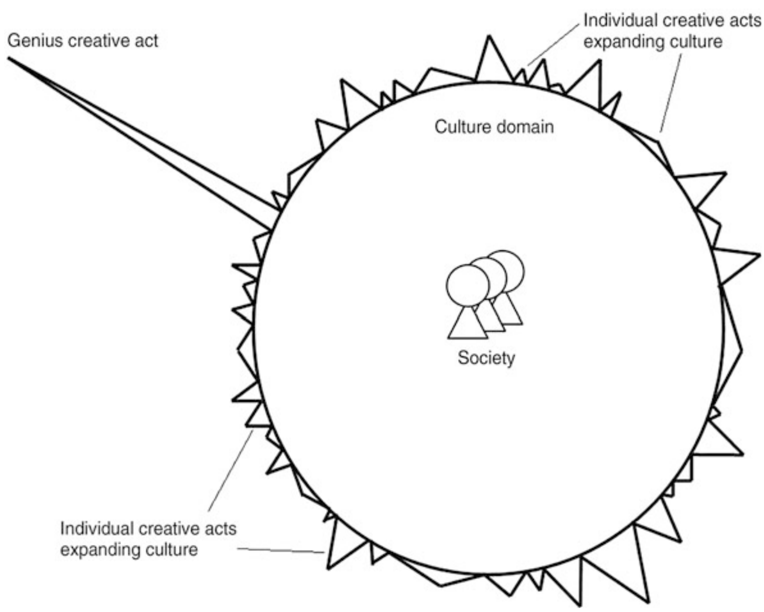
A person in charge – in a leadership or management position at any level – has to generate (create) an idea before that idea can be communicated to followers, subordinates, employees, etc. The idea must come first; communication and the manner of communication come second.

A new theoretical approach states that if creativity, in traditional terms, is a new combination of known elements, then people who speak engage in creativity all the time. In every statement, people take the known elements of language and combine them in a unique manner – suitable in this particular moment for solving this particular communication problem. The degree (rate) of creativity in a statement may vary: one statement with a low degree of creativity will be forgotten in a second, while another – with high degree of creativity – will be remembered for centuries, like Shakespeare's "to be or not to be" speech. In leadership terms, one statement "leads" people's minds (and behavior) for a very short period of time, and another "leads" people's minds (and behavior) for hundreds of years. Nevertheless, any statement is a result of **creative** thinking, and any **created** utterance in turn **creates** a new communicative situation and causes other people to **create** their responses too.

To illustrate this understanding, creative linguistics offers the theoretical model of sign, language, language consciousness, and speech act that also reflects a heuristic act (the act of discovery, invention, or art creation – all *leading* by ideas). That is why the model is called universal. This three-dimensional model allowed



Creative Leadership, Fig. 1 Universal model of sign, language, speech act, and heuristic act (*left*) and how it expands the culture domain (*right*)



Creative Leadership, Fig. 2 Genius creative leadership (*leading* into the future)

researchers to represent the creative act graphically in relation to the society (Aleinikov 1999a).

This vision (Fig. 1) of speech act and creative (heuristic) act shows an individual (A) as creating ideas about the world (D), coding them into language tools (C) and communicating them to the society (B), thus expanding the available domain of culture that includes knowledge, traditions, etc.

Such a graphic representation allows researchers to make the next step (Fig. 2) and to visualize the creativity of a genius whose creative acts (breakthrough discoveries or art masterpieces) expand the domain of culture in the most accelerated manner and *lead* the society for a long time (see ▶ Genius).

Geniuses are the most powerful leaders. Their ideas lead all of the humanity (not simply one country) for centuries. Moreover, their leadership does not need armed forces, police, or any other enforcement. Their leadership needs no other means except learning about their ideas. People read their books, learn their ideas, and follow their explanations. Geniuses are the most prominent representatives of IdeaLeadership: they are IdeaLeaders that people follow.

For example, since early in our human history, people have been using the game-changing invention, the wheel. People have been using calculation since somebody created it. People have been using logic since Aristotle described it. People have been using x-ray technology in various forms after Röntgen discovered this type of short-wave rays. People use thousands of things and processes, including language that is renewed and recreated in every statement. Somewhere back in our history, there was a discoverer, an inventor, a creator, an author of an idea. For more examples of creative leadership, see Modern Applications below.

With this new concept of creative leadership that spans from a single speech act to the books that attract thousands of researchers and millions of comments, such as the Bible, and movies that attract millions of viewers in a matter of months, the general concept of leadership expands as well. In addition to traditionally construed political, military, business, and education leadership, leadership now includes scientific, technological, artistic, cultural, athletic, and media leadership, as well as leadership in all other spheres of social life. This is leadership by creativity, leadership by creative act.

A society that leads other societies into the future (e.g., a democracy) safeguards intellectual property in scientific research (certificates of discoveries), technological development (patents), literature (copyright), and other forms of protection, which allows people to create freely and to implement their creative solutions rapidly. This is acceleration in development, and this **accelerated advancing organization** is the creation of the new world organization by creative leadership.

With this rapid advancement, such fields as creative education (Creative Education Foundation, Buffalo, NY), the search for creativity-enhancing techniques and the most powerful idea-generation methodologies as well as teaching innovations - all become a priority. The reason is obvious: the more efficient the process of generating new ideas, the more successful the society (group) that employs it will be. Even this encyclopedia is an example of attention to the sphere of creativity and innovation. The first *Encyclopedia of Creativity* was published in 1999, and this *Encyclopedia of Creativity, Innovation, Invention, and Entrepreneurship* is another powerful step to popularizing the field of creativity and innovation, which is now being examined on the scientific level.

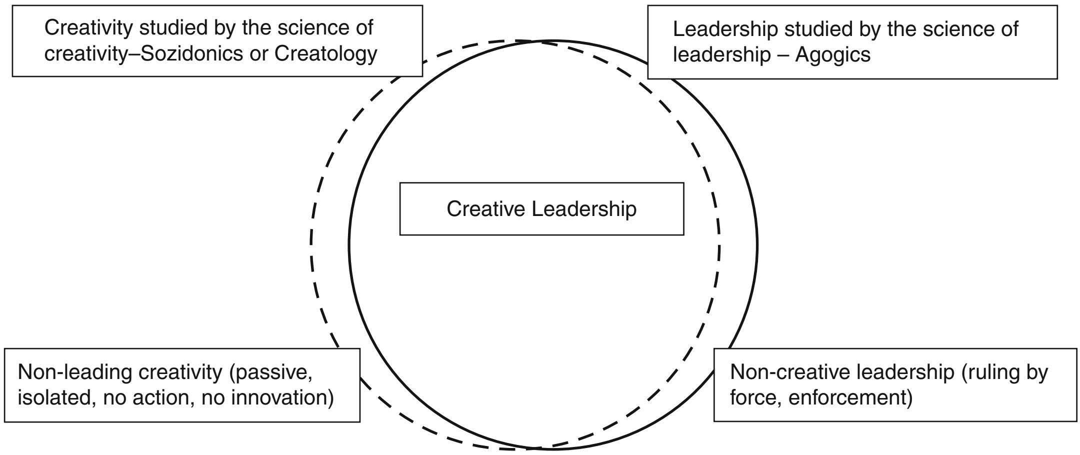
Limits of the Concept

Where are the limits of the creative leadership concept? Below is a graphic representation of two fields – creativity and leadership – as well as the two sciences that reflect them and overlap (Fig. 3).

As the model shows, the bulk of leadership is creative leadership, but there are two domains that border the limits of the concept: non-leading creativity and noncreative leadership.

- Non-leading creativity occurs when someone creates alone and never shows the works to public. In such a case, the works do not "lead" (attract, entertain, fascinate, enthuse, inspire) anybody, so there is no leadership at all. The person might be a founder of a new style of art or a discoverer of new scientific laws, but since no one even knows about these works, no one is led by them.
- Noncreative leadership happens when destructive methods are used to rule, govern, or control somebody's behavior (as in slavery). Such a leadership style does not create anything and actually destroys the subordinates. The final result is that a leader who practices such leadership style (a despot, a dictator) is usually destroyed as well.

Creative leadership, as opposed to both "trait" and "event" leadership, does not have time and space limitations and is much more enduring. For instance, past military or political leaders are still remembered, honored, studied, and followed. It means creative leadership as a concept is broader than an individual leader's life, features, and behaviors. If events, such as wars, battles,



Creative Leadership, Fig. 3 Creative leadership domain

revolutions, as well as the victors of these encounters, are still studied by students, then creative leadership as a concept is broader than the event leadership.

People are led by ideas – ideas from the past (people study history), ideas from the present (people watch TV, listen to the radio, read newspapers), and ideas from the future (people dream and have goals). Education and training as a whole is nothing more than learning about the ideas developed in history for solving problems.

For example, Socrates became a great intellectual leader not because of his ability to motivate groups of people to do something but because of his ideas. Socrates continues to lead centuries after his death because his ideas remained valuable. He is still remembered and considered a genius. The Socratic method of teaching (an educational idea) is a viable methodology.

Genius ideas is exactly what John F. Kennedy meant when he said, "A person may die, nations may rise and fall, but an idea lives on. Ideas have endurance without death."

New Science of Leadership

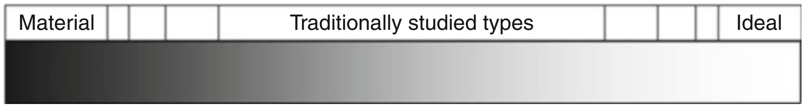
Despite numerous attempts to develop some scientific theories of leadership, "...leadership theories are, at this point, sets of empirical generalizations and have not developed into scientifically testable theories" (Johnson 1990). Such situations are typical in the history of science – it takes time to move from recognizing and describing the phenomena to distilling the essence.

The research into creative leadership and finding the ultimate forms of leadership (ideal leadership, absolute leadership) helps shape a new science of leadership that is growing out of descriptions and stand-alone theories. The research is moving from phenomena to the essence, from separate theories to science.

This science of leadership is called agogics. This name is coined from the Greek *agogos*, which means "leader." This root is seen in the second part of modern terms like ped*agogy* and andr*agogy* which are translated as *leading child* and *leading adults*. The traditional suffix -*ics* is added to follow the model of the names of other sciences: physics, mathematics, linguistics, etc. This new science, agogics, explains both the material and ideal worlds of leadership while dealing exactly with its essence – advancing organization.

New Definition of Leadership

The concept of leadership in general should include all types and styles of leadership. As we have seen in the earlier example, the woman in the flood managed to find the right **organization** of materials, means, and movements that



Creative Leadership, Fig. 4 Leadership types spectrum

advanced her and the other people to the "right" solution – survival and safety. Political, scientific, and social leaders do it all the time. They shape the future – they lead the society to a new **organization** of the world. This new organization of the world created by the leader, expressed in language and called vision, attracts followers, and they begin to help leaders to achieve this new organization.

The new definition of leadership that takes into account all types of leadership is as follows: "**Leadership is the process of advancing organization.**"

New Classification of Leadership

Clearly, there are two polar types of leadership:

- Material leadership (coercion/physically pushing/pulling – the most primitive)
- Ideal leadership (communicating/transferring an idea/inspiring/motivating by idea/convincing that the idea is "right")

The scale below graphically depicts the types of leadership, with the darkest shading representing material leadership and the lightest representing ideal leadership.

Ideal leadership, on one side of the spectrum, is the most powerful. It is the first to start and the longest to live, instant and eternal (at least as long as there is one follower). Creative leadership would be the closest to the ideal depicted on the chart (Fig. 4).

Note that all types of leadership can be classified according to the degree of ideality. The less effort and enforcement a type of leadership needs, the higher the level of leadership. The more effort and enforcement a type of leadership needs, the lower the level. This is a scientific, energy-based criterion of leadership. It is objective and measurable.

From this point of view, the dictator type of leadership (dark on Fig. 4), which requires police, military, terror, prisons, and other enforcement activities, turns out to be at a much lower level than a democratic type of leadership where "majority rules" and ideas are freely discussed or, for instance, a charismatic type of leadership that works by inspiration.

What Is an Idea?

An idea, whether it takes the form of thought, notion, concept, conception, image, decision, or association, is the product of mental activity, the creation of the human mind. It can be a reflection of the material world (an image), but it can also be the reflection of reflection (an idea about the image, a concept of the concept). Ideas are capable of multiplying without regard to the material world.

Such is the power of ideation. Ideation can bring the images of the future world, and the current material world can be reorganized to fit this image. Architects and inventors engage in this kind of imaginative activity all the time.

It is certainly better for humanity if our scientific ideas reflect the world realistically with minimal fantasy, but when it comes to technology, literature, arts, theater, and movies, there are no limits to ideation.

In any case, since an idea is the **creation** of the mind, it is already **created** and it is **creative**. The question is *how* creative an idea is?

What Is a Creative Idea?

An idea is often understood as a very new idea, but sometimes, an idea is a known pattern applied to a new situation. In this case, the amount of newness is different. A world chess champion, for example, recognizes moves and strategies that have been used by others and has a store of winning tricks and combinations. The champion may apply an existing idea or a combination of ideas to a particular chess game. However, true champions may also create new ideas even under the pressure of a world championship match.

There are thousands of attempts to define creativity (see details in Aleinikov et al. 2000). For example, Stanley Gryskiewicz, Center for

Creative Leadership, defines creativity as novelty that is useful (Gryskiewicz 1999). More often, creativity is understood as the ability and the process of generating new ideas, an ability to find not previously seen combinations of existing concepts.

The scientific definition of creativity states that creativity is the process of accelerating organization (see ► Creativity Definitions, Approaches). Since creativity is the process of accelerating organization and leadership is the process of advancing organization, then **creative leadership is the process of accelerated advancing organization.**

Born or Made?

There are debates on whether leaders are born or made. In the same manner, people debate whether creativity is innate or can be taught and whether genius is born or nurtured. The right answer to this debate is to delete "or" and use "and" instead. Creativity characteristics, genius features, as well as leader traits are both genetic **and** nurtured. If in the natural world survival of the fittest occurs, then in the human world, the strongest and the most creative will have advantages as well. The strongest individuals may become champions and leaders in sports. The most creative individuals find solutions, survive, and endure. Strength, creativity, and leadership are trainable and teachable. Thus, a trained person can be stronger, more creative, and a better leader.

No wonder that organizations like Center for Creative Leadership (Greensboro, NC) are in demand and so successful – they adequately reflect the essence of the issue: **leadership must be creative, and creativity (by generating winning ideas) leads to success**! Creative leadership (idea leadership, IdeaLeadership) is more powerful and definitely much more spread than non-creative leadership.

Applications to the History and Modern World of Leadership

The world's religions – Judaism, Christianity, Islam, Buddhism, and Hinduism – all are the ideas that have led masses of people throughout history. In the best cases, no enforcement was needed. On the other hand, under political doctrines like Marxism, Leninism, or fascism, the enforcement was horrific and led to enormous loss of human lives. The wars of ideas often led to actual wars between the countries and coalitions (WWI and WWII) as well as between the groups of people within single countries (civil wars). Wars of ideas are the fight for the dominance of a particular idea in the world of the future. Ideas (through people they lead) are fighting for the future organization of the world (Hamel and Prahalad 1996). Creative ideas are accelerating this advancement.

Some examples of this advancement are as follows:

- Creators of religions are next to geniuses in creative leadership power. Their ideas lead masses of the world's population and have succeeded in doing so over the centuries and across the borders of numerous countries.
- Creators of new technologies, such as Apple, Microsoft, and World Wide Web, are vivid examples of creative leadership. They create the ubiquitous technologies, thus leading to free communication among human populations.
- Movie makers and movie industries are among the leaders in the creative leadership domain. Their products move masses to the desired organization of the world by creating images and phrases that indelibly influence the minds of viewers.

Implementation of Creative Leadership Ideas

Many countries promote creative leadership principles through organizations and educational institutions.

For example, the Creative Education Foundation (Amherst, Massachusetts, USA), one of the first in the world, since its inception in 1954 in Buffalo, NY, has offered creativity education to all sectors of the population, including military and business leaders. Their unique programs, such as Creative Problem Solving Institute (CPSI), offer week-long conferences where creativity specialists from around the world get together to share their ideas and teaching methodologies. They also teach children – future leaders – to think creatively.

The Center for Creative Leadership (Greensboro, NC) since 1970 has led the trend in creativity by teaching leaders in the United States and now globally in the Americas, Europe, the Middle East, Africa, the Asia-Pacific region, Russia, and other countries. Creativity-oriented and customized programs are geared to all levels of leadership, from the entry level to the top executives in business, education, healthcare, law, the nonprofit sector, pharmaceuticals, and government.

The American Creativity Association has for over 20 years supported global creativity and innovation initiatives through local chapters in the United States and with international affiliates in Australia, Canada, Chile, China, Singapore, and Taiwan.

Creative leadership organizations and individual companies for training leaders exist in Europe, Africa, Asia, and Australia. They train leaders via conferences, live programs, and consulting.

One of the strongest and most consistent organizations promoting creative leadership principles and innovation initiatives is located in South Africa. The South African Creativity Foundation, founded and headed by Dr. Kobus Neethling, has been advancing the country and region for about two decades. In addition to publishing research papers and literature on creativity and creative education, the foundation organizes unique conferences and teaches political, business, and educational leaders to lead creatively. The South African Creativity Foundation produces a TV show on creativity and sponsors TV contests for the most creative man in Africa. Its leader, Dr. Kobus Neethling, together with the author of this entry, holds the Guinness World Record in publishing for the fastest written, printed, and published book in 2001.

Some forward-looking universities and colleges have begun to introduce new programs on creativity. For example, Buffalo State College, State University of New York, pioneered a Master's Degree in Creativity Studies in the 1940s. The International Center for Studies in Creativity (1967), established in the college, also educates researchers and creative education practitioners from all over the world.

At present, there are some attempts to create Ph.D. Programs for Studies in Creativity (e.g., Saybrook University, San Francisco, California, and other universities). These institutions are the places where the new concepts of creative leadership will be researched and developed further.

Conclusions and Future Directions

Leadership is a phenomenon that is not and must not be limited by behaviors, traits, events, or material activity. Leadership by ideas, creative leadership, forms the foundation of any human leadership. Creative leadership, therefore, must be included in the concept of leadership, thus expanding the traditional view. Now that the volume of the concept of leadership is defined precisely, this concept has become a subject of study for the new science of leadership, agogics. The new science offers a new definition of leadership, a new classification of leadership, and puts forward new models for studying leadership.

The ultimate versions of creative leadership are ideal leadership (IdeaLeadership©) and absolute leadership, where leading occurs without enforcement, without extra effort or without resources and where the idea is so good that the manifestation (communication or demonstration) of the idea is sufficient to motivate people to follow it.

The struggle of ideas (creative or destructive) is as old as ideation itself. The winners in this struggle are people with the better ideas or a better ability to produce (generate, create) winning ideas. The power of ideas created by individuals determines the power of the social entity because they shape the future. If leadership in general is defined as **advancing organization**, then creative leadership is defined as **accelerated advancing organization**.

If there is value in ideas, then any forward-looking society should be in search of the best (fastest) methods and techniques to generate innovative ideas. Moreover, the more efficiently these methods work, the faster they lead to creative ideas and so the higher is the probability that the subject (person, group, organization) will become a leader. This is where the efficiency of idea generation comes into play and methodologies leading to top-level creative efficiency, like MegaCreativity (see ▶ Science of Creativity), become necessary for succeeding in the future. These are the directions of future research and development as well as broad implementation to industrial, educational (see ▶ Creative Pedagogy), social, and political life.

Cross-References

- ▶ Creative Linguistics
- ▶ Creative Pedagogy
- ▶ Creativity Definitions, Approaches
- ▶ Genius
- ▶ Innovation in Business: Six Honest Questions
- ▶ Inventive Problem Solving (TRIZ), Theory
- ▶ Model for Managing Intangibility of Organizational Creativity: Management Innovation Index
- ▶ Political Leadership and Innovation
- ▶ Science of Creativity

References

Aleinikov AG. Creative linguistics (foundations, problems and perspectives). In: Language awareness: stereotypes and creativity. Institute of Linguistics, USSR Academy of Sciences, Moscow (russ. Креативная лингвистика (обоснование, проблемы, перспективы). Языковое сознание: стереотипы и творчество. Институт языкознания, Академии Наук СССР, Москва, 1988).

Aleinikov AG. Theoretical foundations of creative linguistics. (russ. Теоретические основания креативной лингвистики). Unpublished Doctor of Sciences dissertation. Military University, Moscow, 1992.

Aleinikov A. Humane creativity. In: Runco MA, Pritzker SR, editors. The encyclopedia of creativity, vol. 1. San Diego/London/Boston/New York/Sydney/Tokyo/Toronto: Academic; 1999a. p. 837–44.

Aleinikov AG. Mega-creator: from creativity to mega-, giga-, and infi-creativity. Montgomery: MIMII; 1999b.

Aleinikov A. MegaCreativity: five steps to thinking like a genius. Cincinnati: Walking Stick Press; 2002.

Aleinikov A, Kackmeister S, Koenig R, editors. Creating creativity: 101 definitions (what Webster never told you). Midland: Alden B. Dow Creativity Center Press; 2000.

Altshuller GS. To find an idea. Novosibirsk: Nauka; 1986.

Avollo BJ, Bass BM. Transformational leadership: charisma and beyond. In: Hunt J, Baliga B, Dachler H, Shriesheim C, editors. Emerging leadership vistas. Toronto: Lexington Books; 1988.

Bass BM. Transformational leadership: industrial, military and educational impact. Mahwah: L. Erlbaum Associates; 1998.

Bennis SW. Leaders. New York: Harper and Row; 1985.

Burns JM. Leadership. New York: Harper and Row; 1978.

Greenleaf RK. Servant leadership: a journey into the nature of legitimate power and greatness. 25th Anniversary ed, New York: Paulist Press; 2002.

Gryskiewicz SS. Positive turbulence. San Francisco: Jossey-Bass; 1999.

Hamel G, Prahalad CK. Competing for the future. Boston: Harvard Business School Press; 1996.

Johnson DE. Leadership: some thoughts after twenty years. In: Concepts for air force leadership. Maxwell AFB: Air University; 1990. p. 352–7.

Kuhnert KW, Lewis P. Transactional and transformational leadership: a constructive/developmental analysis. Acad Manage J. 1987;12:648–57.

Maxwell JC. The 21 indispensable qualities of a leader: becoming the person others will want to follow. 2nd ed. Nashville: Thomas Nelson Publishing; 2007.

Smith PM. Taking charge. A practical guide for leaders. Washington, DC: National Defense University Press; 1986.

Taylor RL, Rosenbach WE, editors. Contemporary issues in leadership. Boulder: Westview Press; 1984.

Yukl GA. Leadership in organizations. Englewood Cliffs: Prentice Hall; 1981.

Creative Linguistics

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Synonyms

Sozidolinguistics

Definition

Creative linguistics is a subscience of linguistics that studies creative aspects of language/speech and language aspects of creativity.

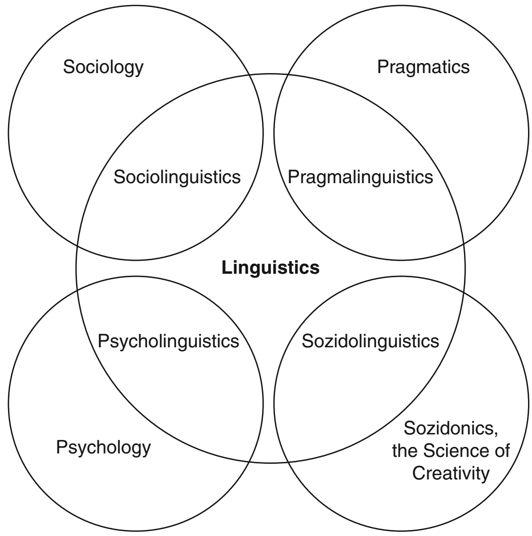
Introduction

Creative linguistics (sozidolinguistics) is a study of the domain common for language/speech and creativity (Aleinikov 1988a; 1992b; 1994). Sozidolinguistics selects in any communication event only those factors that deal with the generation of newness, that is, with the creative aspect of language and speech. On the other hand, both creative thinking and creative behavior, as it is well known, are based on and/or are wrapped into the language (including music and visual arts), and thus sozidonics, as the science of creativity (see ► Science of Creativity), just cannot ignore the language as a colossal machine generating more and more of the new products. Neither linguistics nor sozidonics separately can understand and explain how language and creativity coexist and interact. That is why there grew a need for creative linguistics as a combined field of research. That is why it appeared, just as one day in the past there appeared mathematical linguistics, pragmalinguistics, psycholinguistics, sociolinguistics, etc.

Definition and Differentiation from Psycholinguistics, Sociolinguistics, and Pragmalinguistics

Creative linguistics, as a field of linguistics that studies creativity in language and language in creativity, emerged at the cross section of two sciences.

Graphically speaking, if two circles, representing two domains, partially overlay each other and make a cross section, then this section belongs to both domains. Here is how the cross sections of fields mentioned above look on the graph.



Creative Linguistics, Fig. 1 Subsciences at the cross sections of sciences

As Fig. 1 illustrates, there are subsciences or emerging fields of research on the cross sections of sciences, and creative linguistics (sozidolinguistics) is one of them. Just as objectively there is creativity in language and there is language in creativity, the science of creativity and linguistics create a cross section to reflect this interaction. Certainly, in life, for example, sociolinguistics phenomena are interrelated with pragmalinguistics phenomena (Labov 2001), as well as psycholinguistics phenomena are interrelated with sozidolinguistics phenomena, so the corresponding circles could be overlapping, but this simplified graph is used just to visualize the basic relationship with other sciences when they emerge as subsciences.

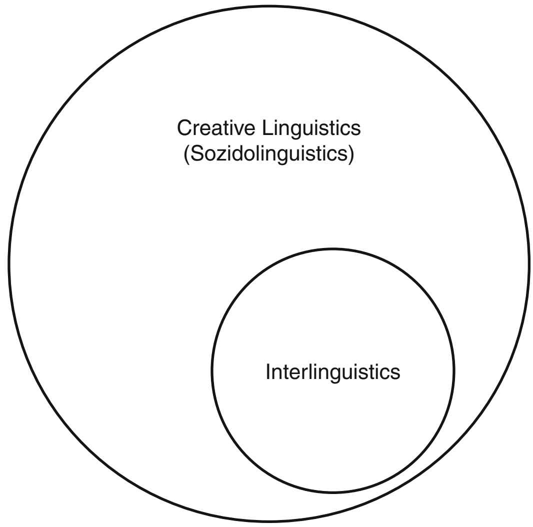
There are some other fields like the ones depicted in Fig. 1, for example, mathematical linguistics, computational linguistics, neurolinguistics, a cross-section of neuroscience and brain research with language research (Luria 1975), etc.

The main difference in the process of developing creative linguistics was the fact that there was *no* established science of creativity at that time. It was a growing field of research, but not a science yet. So the founder of creative linguistics (sozidolinguistics) had to either foresee (predict) the formation of the new science or to create it. That is why sozidonics, the science of creativity (see ► Science of Creativity), was being developed at the same time, and both sciences benefited from this symbiosis.

On its way to recognition, creative linguistics had some differentiation problems. Some authors, probably far from the field of linguistics, made an attempt to apply this term to the field of constructing artificial languages. In addition to the website on creative linguistics that dealt with artificial languages, there were some articles that associated creative linguistics with constructed languages (Spencer 2012). Moreover, there was even an unsuccessful attempt to create a Wikipedia page named "Creative Linguistics" for describing constructed languages. The latter was absolutely correctly redirected by Wiki editors to the article "Constructed Languages" because creative linguistics is different. It should be differentiated (disambiguated) from the field of constructed languages. As a field of research that deals with creativity and creative acts in the language domain, sozidolinguistics certainly includes the acts of creating new languages, such as Esperanto and over 1,000 other projects, but it is not limited to such acts and cannot be attached to them exclusively. There is a special field that deals with constructed languages. It is called interlinguistics (Kuznetsov 1987; Schubert 1989). It studies the international auxiliary languages, also called "constructed" and "planned" languages as opposed to the natural languages developing spontaneously. The term interlinguistics itself goes back to 1911 and was greatly popularized by the famous Danish linguist Otto Jespersen (Jespersen 1931).

Creative linguistics, as opposed to interlinguistics, is 77 years younger (1988 vs. 1911) but much broader in its subject of study (see New Subject of Research: All Language Innovations below). If depicted graphically, interlinguistics may be seen as a part of creative linguistics.

As Fig. 2 illustrates, the field of interlinguistics is only a part of creative linguistics, and, therefore, it should not be confused with it, as any part cannot be confused with the whole.



Creative Linguistics, Fig. 2 Creative linguistics (sozidolinguistics) and interlinguistics

The second difference between creative linguistics and the other fields is the fact that creative linguistics was designed consciously and published first in a series of articles and then described in a doctor of sciences dissertation. That is why creative linguistics has its own name, sozidolinguistics, its own well-defined subject of study, as well as its own methods, models, and research results (achievements). For comparison, shaping psycholinguistics took about 60 years and the efforts of many outstanding researchers such as Wilhelm Wundt, Noam Chomsky, Dan Slobin, Judith Greene in the West, and Aleksey A. Leontyev, the "father of the Soviet school of psycholinguistics," with his followers in the East.

Theoretical Foundations: Cross Section of Creativity Research and Language Research (Linguistics)

As a new field of research, designed scientifically, creative linguistics had formidable tasks to accomplish. The outline of research included:

1. The ontological and gnosiological foundations of Creative Linguistics

- 1.1. Ontological (empirical) level of research. Facts of interaction between creativity and language. Domain of study.
  - 1.1.1. Creativity in general and communicative component in it
  - 1.1.2. Creativity in communication (language and speech)
  - 1.1.3. Field of study
- 1.2. Gnosiological level of research
  - 1.2.1. Mentioning of the language in the creativity research
  - 1.2.2. Mentioning of creativity in the linguistic research
  - 1.2.3. Subject of study
- 1.3. Hypothesis, stages and projected results of research

2. Designing the basic models of research
   - 2.1. Modeling. Creative Modeling
   - 2.2. Main concepts, theories, and models of creativity. Approaches to research in creativity. The suggested concept and model.
     - 2.2.1. Main concepts and theories of creativity. Available definitions and approaches to its study
       - 2.2.1.1. Creativity phenomenon limits (volume of the concept)
       - 2.2.1.2. Essence of creativity (contents of the concept). Paradoxes of being undefinable
     - 2.2.2. Solving the paradoxes. Offered concept of creativity. New approach to the study of creativity phenomenon
     - 2.2.3. Models of creativity and the suggested new model
   - 2.3. Main concepts, theories, and models of linguistics (semiotic) objects. The suggested concept and model
     - 2.3.1. Sign. Four-side essence. Universal creativity model
     - 2.3.2. Language awareness and its modeling. Models of consciousness as functional organ and the place of language consciousness in it
3. The basic concepts and methods of Creative Linguistics (Sozidolinguistics)
   - 3.1. Modern speech innovations and the need for special tool for their research
   - 3.2. Gnosiology of newness–the sub-language of creativity
   - 3.3. Sozidonics and Novology
     - 3.3.1. Newness. Explication of the concept
     - 3.3.2. Units and methods of Novology
     - 3.3.3. Units and methods of Sozidonics
   - 3.4. The model of Sozidonics’ act as the act of speech and languages creation. Heuristic capabilities of the model in the research of language structures generation
     - 3.4.1. Generation of language consciousness
     - 3.4.2. Forming of Sozidolinguistics units
   - 3.5. Analytical power of the model. Classification experience
   - 3.6. The main techniques and methods of generating newness by linguistic means. Lingua-heuristics and Lingua-design.
4. Applications of research
   - 4.1. Application of Creative Linguistics to education (Creative Pedagogy)
     - 4.1.1. Designing theoretical discipline programs with creative orientation
     - 4.1.2. Designing foreign language acquisition programs with creative orientation
     - 4.1.3. Designing faculty development programs (Creative MetaPedagogy)
   - 4.2. Application of Creative Linguistics to translation and interpretation
     - 4.2.1. Creative translation: Fundamentals of creative theory of translation
     - 4.2.2. Methodologies of teaching interpreters with the Creative Linguistics model
   - 4.3. Application of Creative Linguistics ideas to management, positioning, and media
     - 4.3.1. Creative Linguistics in creative management
     - 4.3.2. Creative Linguistics in positioning
     - 4.3.3. Creative Linguistics in media

5. The perspectives of further theoretic development and practical testing of the theory (List includes 18 types of practical applications).

The dissertation (Aleinikov 1992b), completed and approved for defense, due to dramatic changes in the life of the author, has never been published. Some compressed data from this research appeared in various publications and can be viewed below.

Sociocultural Background (Need)

By the eighteenth/nineteenth century, it became obvious that languages change faster and faster. Wilhelm von Humboldt mentioned that language is *energeia* (Greek *ενεργεια*), which means the language is creating and recreating itself in everyday speech act (Humboldt 1987). Historical and comparative linguistics described thousands of lexical, grammatical, and phonetic changes in the history of any language. When F. de Saussure differentiated chronological (historical) and synchronic research, the latter was understood as a contemporary cut, but even a contemporary cut has some duration. In abstract, it can be a momentous cut, but any real research takes time; therefore, it is *not* really a moment. So the question is what happens if during that interval, called "cut," something new appears in the language. How to research this newness? Also, within the historical trend, the question is not only which sounds, words, and constructions change but also why there appeared new forms and new words and how they appear. Thus, both chronological and synchronic linguistics have to deal with the issue of newness – the issue of constantly flowing language innovations.

Globalization brought so much international and intercultural interaction that borrowing words, concepts, and even grammar patterns became the norm. English vocabulary grew to over 1,000,000 words. Neologisms… after neologisms… after neologisms. Some examples can illustrate the issue:

- Coined words, like *nylon, Coca-Cola, Pepsi-Cola*, *iPhone, iPad*, appeared in the language, thanks to new products on the market: new products had to have new names.
- Words with slightly changed spelling, like *Kwik Printshop* (for *quick*) or *Kollege* (for *college*), became a traditional marketing trick.
- Contracted words or word combinations, like *StoRoom, BlanKids*, *SteriCycle* or even *Toys Я Us* (with the reversed letter *R* that stands for *are* in *Toys "R" Us*), created by the marketers to attract customers' minds and multiplied by the advertising, movies, and media, added to this avalanche of verbal newness.
- Slang stepped out of the "thieves' cant," out of the suburbs, onto the movie screens and then to ordinary life.
- Jargon in any professional field, like *megabyte, gigabyte,* and *thumb-drive,* filled the world of communication, business, and everyday speech.
- Dialectal pronunciation and grammar, like *y'all* or *I ain't got n'ting* – ridiculed but still multiplied by media – spread far beyond the geographical location of the dialects.
- Finally, the Internet and global connectivity completed the breakthrough to totally unlimited language creativity. New domain names, new programs, new acronyms, and abbreviations are being added constantly. Now, anything goes. If a phrase or abbreviation, accidentally or intentionally misspelled word brings a giggle, if it shortens the message, if it shocks somebody, it is cool. Lol. Authors of successful phrases even copyright them.

Language purists, who have been fighting for the clear, grammatically and phonetically correct language, had to give up. Language changes are so massive that they may seem overwhelming to some people. Newness, verbal newness, is ubiquitous. General research in classical linguistics could not explain this process.

On the other hand, researchers of creativity saw the language as a powerful mechanism generating more and more of the new products in literature, science, patents, and even in music and visual arts, but they did not have the tools to analyze and describe these language innovations. For example, synectics (Gordon 1961) offers a set of methods united by the name "symbolic analogy." One of the methods is called "book title" where participants of the group have to imagine they are writing a book about some subject and then make up new titles for the book that have to consist of two contradictory words. Obviously, participants work with the language, and creative ideas are coming from the language source. The results of these and other language-based creativity boosting methodologies had to be evaluated. . .and perhaps, even better, they had to be scientifically evaluated. There was no such a thing.

A special field of research that could explain how and why it is done was needed.

That is why creative linguistics came into being.

Origin and History of Development (Historical Sketch)

Creative linguistics researched the history of creativity (see ▶ Science of Creativity) to find out that the concept of creativity changed dramatically in volume and contents. First, at the dawn of civilization, it was applied only to God the Creator and the only true creation was "creation from nothing." Then, much later, poetry and poets were considered creative (they seemingly create their poems from nothing). Then slowly, creativity concept grew to its contemporary understanding which states that every human is creative.

Note that the second step after God was poetry, that is, a language activity. As opposed to poets, fine artists were considered just imitators of the nature, and the concept of creativity did not apply to them. Thus, poetry, the creativity in the language forms and the creativity of the language, was the first human activity recognized as creative. Poets were the most prolific newness producers. Shakespeare, for example, introduced 1,700 new words. It makes about 10% of the 17,000 words that he used in all his works. It means he "made up" every tenth word he used.

When creativity studies appeared (see the list of outstanding researchers in ▶ Science of Creativity), the knowledge of creativity processes could be applied to language studies and language training, thus leading to the birth of a new field of research – creative linguistics (sozidolinguistics) and then creatively oriented education (see ▶ Creative Pedagogy).

New Subject of Research: All Language Innovations

Just as traditional linguistics, creative linguistics studies all levels and aspects of the language starting from nonverbal communication and paralanguage factors and ending with phonetics, lexicology, grammar (traditional, structural grammar, functional grammar), stylistics, and even translation, however, only from one point of view – the point of view of generating (and generated) newness.

The volume of study, therefore, includes every act from the smallest (the creation of the meaningful speech sound by a baby) to the largest (like the creation of greatest literature masterpieces or the creation of an artificial language, human, or machine). Creative linguistics certainly studies the creation of new sounds, new words (neologisms) and word combinations (logos, symbols), new grammar patterns, new figures of speech, new styles, etc. Thus, creative linguistics studies all the traditional language/speech units from a new perspective. It also gives linguists new tools to see the creative aspect of each unit functioning in the flow of language communication.

Simply put, all language innovations make for a subject of study for sozidolinguistics: any newness in the form, meaning, or use of the language units, any newness the language brings to the society, as well as any newness caused by societal or individual changes make subjects of study for sozidolinguistics. The field of research is vast, and, therefore, it opens new horizons for the new researchers to explore.

Creation of the artificial international languages is only a little part of it, no matter how visible and romantic it is.

Here is the array of units that the subject of study includes.

Entity	Example
New artificial (constructed) languages for human communication	Like Esperanto, Ido, Volapuk...
New fictional languages	Like Tolken...
New programming languages (machine communication)	Like Java, HTML...
New special languages	Like Braille for the blind or sign language for the deaf
New Creole languages (mix of developed language like English and local languages)	Like Chinese Pidgin English, Swenglish...
New dialects	Like Ebonics...
New sociolects	Like gender or age group dialect...
New professionalisms (jargon)	Like *RAM*, *bit*, *byte*, *CPU*, *thumb-drive*, *flash-drive*
New colloquialisms	Like *y'all*, *gonna*, *wanna*, *raining cats and dogs*
New slang	Like *Cool! G to G (Good to go)...*
New alphabets, new letters	Like transition from Cyrillic to Latin for some languages. Also, letter ё was introduced to the Russian Cyrillic alphabet in 1797 to reflect the sound [yo] as opposed to letter *e* [ye] on the one hand and letter *o* [o] on the other hand.
New texts	New poetic forms, new prose forms...
New syntax structures (sentences configurations, phrases)	As *Toys are us*, *Toys "R" Us* (*Toys Я Us*) instead of *We are toys*, *We sell toys*.
New words (neologisms)	Like *nylon*, *quark*, *cyberspace*, *blog*, *webinar...*
New meanings	Like the meaning of *green* in *green movement...*
New morphemes	
New phonemes	
New abbreviations and acronyms (abbreviations pronounced as words)	Like *LOL* (Laughing out loud) or *ROFL* (Rolling on the floor laughing) in chatting...
New intonations	As in robot-like speech...
New sounds (new pronunciation)	Like in personal speech, in second language communication...
New signs	Like road signs, logos...
New symbols	Like in *Toys Я us* (with the reversed letter *R* that stands for *are*), as well as Wingdings and Webdings on the computer...
New...	

Universal Model of Sign, Speech Act, Language Consciousness, and Heuristic Act

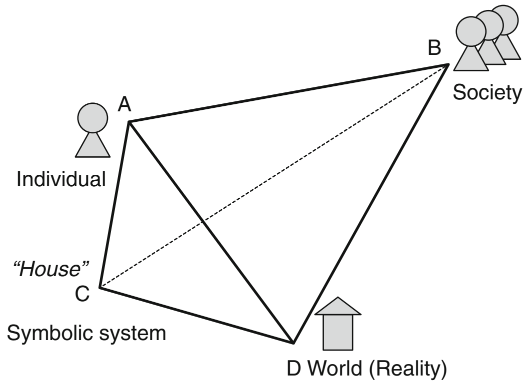
The new model of sign was developed in 1977 in Baku, Azerbaijan. It was first presented at the conference and mentioned in publishing in 1979. In 1988, it was published by the Institute of Linguistics, Soviet Academy of Sciences, Moscow, Russia (Aleinikov 1988c), and then by the *Journal of Creative Behavior* and *Encyclopedia of Creativity* in the USA (Aleinikov 1994, 1999).

The most well-known models of that time included:

- One-side sign model: the sign is the sound or letter (Solntsev 1977)
- Two-side sign model (an oval divided in two): the signifier and the signified (Saussure 1916, 1977)
- Three-side sign model (a triangle of reference): symbol, referent (object), and thought or reference (Ogden and Richards 1923; Frege 1892)
- Four-side sign model (a square): world or referent, writer's thought, symbol or word, and reader's thought (Searle 1975)

Despite the fact that the introduction of each of these models was a big step forward and the discussion of their pros and cons lasted for decades, all these models had some common deficiencies because *none of them*:

- Portrayed the communication situation (the only environment a true sign really lives in) in full
- Took into consideration the speech versus language asymmetry
- Reflected the syntagm/paradigm dichotomy of speech/language



Creative Linguistics, Fig. 3 Universal model of sign, language, speech, and heuristic act

- Allowed the application of the systems approach
- Depicted the layers of coding/decoding
- Permitted the analysis of newness
- Could be used for real analysis of speech samples (they were more philosophical than linguistic)
- Had heuristic power (proved to discover something)

In other words, a new type of model was needed. Linguistics had been developing for so many years after F. de Saussure and all gathered knowledge had to be implemented into the sign and language model. In addition to the requirement to be more specific, the model should be also more general (or even universal) because both the act of communication and the act of modeling have heuristic power (Aleinikov 1988b).

The offered model was a four-side model, but it became a 3D model. Here is how the universal model of sign, language, speech act, and heuristic act looks (Fig. 3).

In general, as Fig. 3 shows, an individual (A) is the person who creates a vision of the world (D), expresses it in symbols of the system (C), and sends it to the society (B). Society (or its representative) is any person speaking the same language or using the same semiotic system, system of signs. The message (AB) is received by the society (B), decoded, evaluated, and appreciated or not appreciated. If answered, the speaker gets into position A, and the listener becomes the society B.

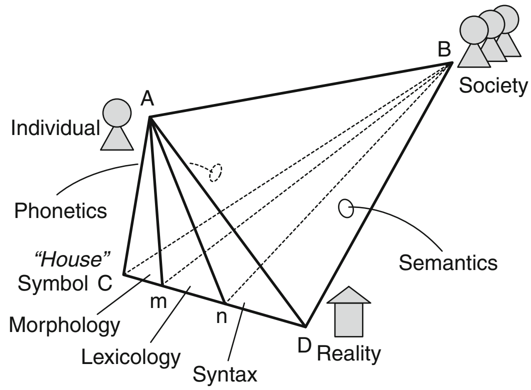
The size and the depth of the message can be easily reflected by the size and the depth of the model. That is why some messages would be ordinary (low on the creative scale) and quickly forgotten, while the others – deep and original (highly creative) – would be remembered (= valued) for centuries.

The newness of the model lies in the following:

- The essence of every sign is represented by four absolutely necessary and interrelated elements that form a tetrahedron of language functioning: individual (A) creating the message, society (B) or its representative receiving the message, symbolic system (C), and reflected reality (D). These are the invariant elements of every communication situation and, therefore, of the sign and of the language.
- Speech (AB) flows from individual (A) to society (B). Speech is now shown not as a one point object (word) as in the previous models, but linear, as it is in actual life. It is either a spoken message with one sound after another in line or a written message with letters one after another – also in line. Language (ABCD) on the contrary is shown as a volume. Linguists often noted the asymmetric relationship between speech and language. The model provides simple visual corroboration: line (speech) is one-dimensional, while volume (language) is three-dimensional. The model unites and separates them. Language is the organization (ABCD) that allows speech (AB) to fulfill its function.
- The model shows that it is not the mere symbol (word, statement) that has the meaning – it is somebody's speech directed to the society that includes the symbol (word, statement) which can be interpreted by the society. Symbols, pronounced or written, do not have meanings by themselves. Their meanings exist in the minds of the users (A and B), and, by the way, the depth of the model demonstrates the depth of understanding by the individual and the society.

- The depth of the language model allows researchers to visualize and reflect the paradigmatic relations (AC, AD, BC, BD, and any perpendicular to AB lines) as contrasted to syntagmatic relations (AB) existing in speech. Paradigmatic ("either or") relations, as opposed to syntagmatic ("and") ones, form the foundation of any language – if there are no paradigms, there is no language.
- The volume (ABCD) presentation of the language also allows researchers to visualize four constituting surfaces (planes): reflecting symbolic system (ABC), reflecting the reality system or the system of meanings (ABD), reflecting the society (BCD), and reflecting the individual (ACD). The internal organization of all these reflections makes the skeleton of the language.
- The tetrahedron configuration of the language model explains its strength and flexibility at the same time. It also exemplifies one of the Catastrophe Theory statements that the organized matter can go into unorganized (chaos) only by the sharp end. Language model has four tops – all sharp – and the tetrahedron, one of the basic archetype world structures, is truly one of the most stable forms. That is why languages, despite the everyday change, are stable enough to survive and grow.
- If the line (AB) represents speaking by A and listening by B, then the opposite to the speech line (CD) represents coding/decoding process. This is the process connecting the meanings (reality reflections, D) with symbols (symbolic reflections, C). The coding/decoding layers and fields of research studying them can be presented like this:

As it is seen in Fig. 4, the mind of the individual (A) has to do the coding from images of the reality (D), reflected by the plane ABD (semantics) in syntactic configurations (AnDB); then fill them with lexical units, words (AmnB); then shape the morphological units, like prefixes, roots, and suffixes (AmCB), and then express this all in sounds of the symbolic system (C) reflected by the plane ABC (phonetics). Note that the coding layers illustrate how language as a paradigmatic volume (ABCD) gives individual (A) some options to create the message (AB), and these paradigmatic options exist in all layers of coding/decoding shown in Fig. 4. When society or its representative (B) receives the message, it has to do the decoding process in the back order: from the sounds reflected by the phonetics (ABC) to the meaning reflected by semantics (ABD) or, in case of written speech, from the letters reflected by graphemics (ABC) to the meaning reflected by semantics (ABD).

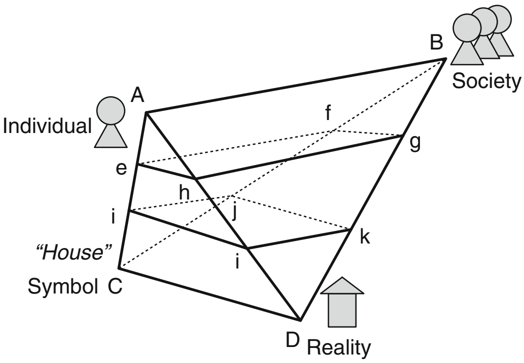


Creative Linguistics, Fig. 4 Layers of coding/decoding in the model

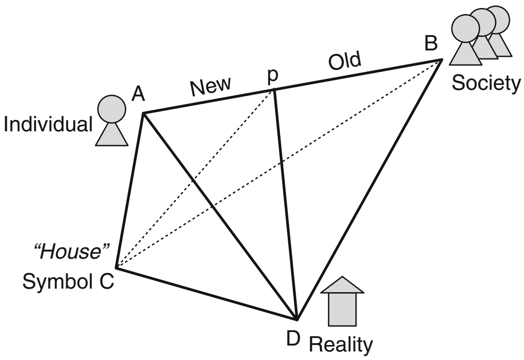
Further Interpretation:

- Now, when the model has a volume as seen in Fig. 3, researchers can apply the systems approach (Bertalanffy 1968) to the sign and language analysis. The systems approach offers to see any object (process) as a system with its function, elements, and structure. Mariam Karaeva suggested that these aspects should be viewed as three interconnected and interdependent levels: the levels of function, substance, and structure (Karaeva 1972). These levels, when applied to the model, can be visualized as follows: functional level (ABefgh), substance level (efghijkl), and structural level (CDijkl).

As it is illustrated by Fig. 5, the functional level (ABefgh), as most superficial and most changeable, lies close to the speech message AB (on top), while the structural level (CDijkl), as the deepest and least changeable, lies far from the speech.



Creative Linguistics, Fig. 5 System levels in the model



Creative Linguistics, Fig. 6 The new/old plane in the model

The next step in building the model:

- Finally, the new model gave an opportunity to introduce and to show one more cutting plane: the plane of new/old, CDp. This plane shows that there is old (part) and new (part) in every message, text, statement, and phrase, in every communicative act.

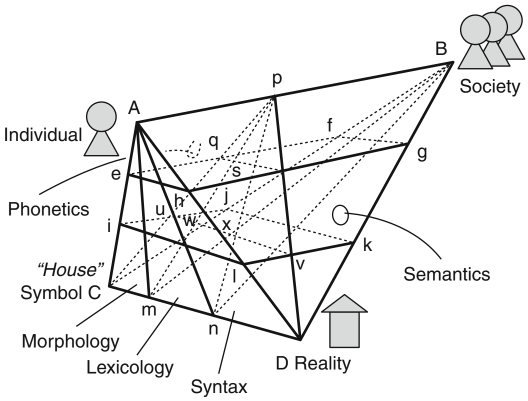
As Fig. 6 shows, every message of speech (AB) carries a part that is known to the society (B) that should recognize it in decoding (BCDp) and then the new part (ACDp) that the individual speaker (A) delivers as one's input. The amount of this new may vary in volume – the plane is flexible and movable.

The presence of new/old in every speech act was researched by the Prague Linguistic Circle and Functional Grammar as theme (topic) and rheme (comment, focus) dichotomy. They showed how the word order and intonation influence the presentation of theme (old) and rheme (new) in every speech act. For example, in the simplest case, the phrase stress (as opposed to word stress) emphasizes the new (rhematic information). One sentence "students arrived later" can be stressed differently: (1) *Students* (not teachers) arrived later. (2) Students *arrived* (not departed) later. (3) Students arrived *later* (not earlier).

What creative linguistics has proven is that every message exists to add newness and to deliver newness to the communicator (society B). Therefore, there is newness in every message. It may be significant or insignificant, but it is available. Otherwise, communication has no sense and it stops. In real life, if the person delivers too little newness in communication (for instance, repeats oneself all the time), people stop communicating with that person or limit the time of communication because it is boring. However, even the most boring communicative act is still an act: it delivers the fact that the individual A is still alive and communicating. This moment is frequently emphasized in the movies where a hero is shouting to the dying friend, "Stay with me! Talk to me!" Here, the newness of the message is nearly equal to the fact that message is available.

If every message delivers newness, then it is a creative act (big or small – this is another issue). If traditional creativity approach states that creativity is the process of combining existing ideas into new combinations, then a communicator does it in every speech act. A communicator (individual A) takes known elements of the language (nouns, verbs, adjectives, etc.) and combines them into a new message to solve the communicational problem. Every situation is unique (time is irreversible), and every message is unique because none of these can be repeated or reversed.

If a discovery or invention is tested on the model, then every discovery or invention has a unique (new) vision of the world (D), developed by individual (A) and expressed in the symbolic system (C) to be delivered to society (B) for evaluation and implementation. It may be in the form of an article or patent application, but it is still a message containing some old information



Creative Linguistics, Fig. 7 Complete model of sign (language)

(what was before) and some new information (what it is now in the opinion of individual A). So the model reflects a speech act and a heuristic act equally well. That is why it is called a universal model.

The final model that unites all the previous divisions looks as follows:

As Fig. 7 shows, the newness plane (CDp) cuts all the coding/decoding layers shown in Fig. 4, as well as all the systems levels shown in Fig. 5.

- The final model allows researchers to see the inner volumes or the outer surfaces of the fields to study. Having this instrument, a linguist or any other researcher will never "miss" a field. Many of the planes and volumes have already been discovered by linguists – the model only placed them visually and corroborated their existence. However, not all of them. In a case, when the model points at some unknown field of research, the model becomes a heuristic instrument. In some cases, the change is nominal: for example, the plane (ACD) "looking" at the individual (A) could be named competentics because it reflects the individual's competence, the command of language, or the proficiency, as educators call it. This plane is also reflected by such a well-known science as psycholinguistics.
- The side opposed to competentics (ACD) and represented by the field BCD that "looks" at the society (B) reflects the overall language knowledge of the speaking community (or its representatives). In commonly accepted linguistics, this plane is reflected by pragmatics (pragmalinguistics) and sociolinguistics. Creative linguistics gives it a general name gnosionics, from Latin *gnosis* – knowledge. The units of gnosionics may be called gnosemes (like the units of phonetics are called phonemes and the units of morphology are called morphemes). When somebody says, "You can't say so!" or "People do not speak like that!" or "Usually, we say it differently!" they state a discrepancy between what they know from their language experience (gnosionics) and what they hear. This generalized language experience forms gnosemes – patterns of the language knowledge. That is why foreign language learning takes so much effort: it is not only words but also the WAY it is said.
- Graphically, the superficial knowledge of the language may be depicted by a shallow model. On the contrary, profound knowledge of the language with its structural richness, substance fullness, and functional fluidity may be depicted by a deep model. The model, therefore, can serve as a visual diagnostic tool.
- The main achievement of the model is the visualization of the necessity for the creative linguistics represented by the volume ACDp. The science of new words called neology takes only the volume Amnp, thus totally skipping the grammatical coding changes (AnDB – syntax and AmCB – morphology). So, the model "pointed" in the direction of new research and, therefore, proved its heuristic value.

The development of the model and its extrapolation to the other fields continues till today. This model turned out a universal model of language and language consciousness (1988), sign, speech situation, and speech act. The model shows and explained things that have never been explained by any other sign models in linguistics. It is simple and heuristically powerful at the same time. Most importantly, though, it also gave the basis for introducing a structural plane between the old and the new. By doing this, in addition to all previous extrapolations, the model became a model of innovative act as well as a model of directions for future innovations. It is this model that determines what one needs in order to make an innovation. It is the model that shows the directions to the future research, including the research of genius (see ▶ Genius), education (see ▶ Creative Pedagogy), and leadership (see ▶ Creative Leadership).

New Methods and Results of Research

The model described above, in addition to its general philosophical and linguistic value as a universal model of sign, language, speech act, and creative act, becomes a practical everyday tool for creative linguistics research. The model helps:

1. To describe the newness in unified terms.
2. To figure out the location of the newness: whether it belongs to semantics (D), phonetics, graphemics, or, in general, symbolics (C), pragmatics (B), or competentics (A).
3. To find out the depth of newness: whether it belongs to the functional level (superficial), substance level (intermediate), or structural level (deep).
4. To place the newness to the coding layer (syntax, lexicology, morphology).
5. To visualize and describe the exact unique profile of particular newness as a combination of all points. Measuring the profile in quantity units makes the comparison of the created variants more objective (not as *I like it* or *I do not like it*, which is subjective). It means, for instance, that the marketing efforts (creating new ads) can be more precise and less expensive.

In short, the main advantage of this model is that it allows researchers to formalize and visualize the amount of newness – usually so vague or refined that for centuries it seemed impossible to measure.

New type of analysis, the sozidolinguistical analysis, analysis of the newness presented, is introduced as a new method of analyzing the speech products. Some speech products are trivial (low volume of newness), the others are original and interesting (high volume of newness). Geniuses create the top volume of newness in their works. That is why the creative act of a genius, illustrated by the model, looks different from the creative act of an ordinary person (see ▶ Genius).

The new measurement methods were introduced thanks to paradigmatic analysis used by creative linguistics (see ▶ Novology).

Applying Creative Linguistics to Education and Training

The first applications of creative linguistics were in the field of education. There were three directions: teaching theoretical disciplines, teaching practical disciplines (both belong to creative pedagogy), and then teaching teachers of both theoretical and practical disciplines how to teach creatively (creative metapedagogy).

The first article on creative pedagogy was published in 1989 (Aleinikov 1989b) and on creative metapedagogy in 1990–1992 (Aleinikov 1990c, 1992a).

Creative Orientation of Theoretical Programs

Creative linguistics was first introduced and tested on the theoretical studies of English grammar and history of English. The results of the application were unusually positive: students who were involved in the creation of their own props, posters, plays, and finally wrote a book, called it the best course in their lives. Students began (voluntarily) to apply new methods of learning to practical courses, like speech practice. The leadership of the Military Institute saw it as a new potential, a new direction in education. The author was awarded the first in the Soviet Union 3-year "doctorantura" fellowship (usually it was for 2 years) with the task to describe the new teaching system. A new book titled Созидание грамматики и грамматика созидания/ *Grammar Creation and Creation Grammar* became the first in the Soviet Union "creatively oriented" program (Aleinikov 1990a). A methodology manual for creative orientation in teaching and learning theoretical disciplines was published the same year (Aleinikov 1990b).

Creative pedagogy principles were applied to the theoretical courses of military translation, theory of translation, lexicology, and other disciplines at the Military Institute, Moscow.

In the United States, creative orientation was applied to:

- Word Origins and Usage (ENG2210), 1994–2006
- History of Russia (HIS335, 535, 336, 536), 1995–1996
- Psychology of Creativity (PSY3390), 2001–2006 (see ► Psychology of Creativity)

The latter became the third program in the USA offered at the university level and the first in the South East.

Creative Orientation of Practical Disciplines: Hyper Efficient Language Program (HELP +2000)

Creative linguistics was also applied to the practical foreign language studies – to the acquisition of English and Russian as foreign languages (Aleinikov 1989a, c).

Since the new definition of creativity states that creativity is **a human activity of accelerating organization and/or deceleration disorganization** (see ► Creativity Definitions, Approaches and ► Science of Creativity), the main task was to create a system of the fastest (most accelerated) course of foreign language acquisition from level 0 (zero).

Such a program was designed and tested in Perm, Russia. The experimental program was named Hyper Efficient Language Program (First HELP +2000) because the students acquired over 2,000 words and phrases in 40 h of learning (Aleinikov 1995b). A new methodology allowed participants to learn the basic dialogs and understand simple conversations needed for traveling to England. An episode that happened on the seventh day of studying can offer some illustration. Children of the adult students (CEO and managers) visited the class after 7 days of learning. When they saw their parents (without any previous knowledge of the language) communicating in English and doing it with fun, they declared that they were not going back to traditional school where they had been studying English for 3–5 years but could not speak at all. They wanted to join the experimental group.

After success in Perm, where the new methodological approach was first exposed to public, the author of the program was invited to teach and license this program with certification and recertification of the teachers for the Center "Professional" (Moscow) offering classes in 40 languages.

Later, the elements of the Hyper Efficient Language Program (First HELP +2000) were used in India for the Indian Navy officers and Russian specialists (1990–1991). At present, the elements of this program are used for the Immersion program of the Defense Language Institute Foreign Language Center, Monterey, California (2008–2012).

In the United States, Creative Orientation of Practical Disciplines was applied to:

- Russian (all levels) at Auburn University, Montgomery, Alabama
- Effective Communication (COM1110) at Troy University, Montgomery, Alabama

Creative Metapedagogy: Teaching Managers and Teachers

The next natural step after the creation of creative pedagogy was to check whether methodologies of creative teaching are teachable. **Creative metapedagogy – the science and art of teaching teachers how to teach creatively –** appeared and was reported in 1990–1992 (Aleinikov 1990c, 1992a).

Within 2 years, three professional development centers tested the new creative pedagogy methodologies – all with success:

- Russian Academy of Sciences Center for Creativity Research (Moscow)
- Russian Academy of Sciences Center ILAN (Moscow)
- Center for Pedagogical Innovations (Krasnodar)

The Russian Academy of Sciences Center for Creativity Research (Moscow) and Russian

Academy of Sciences Center ILAN (Moscow) used it for creative management programs to teach managers. Thus, after the collapse of the Soviet Union, creative linguistics and creative pedagogy were immediately applied as new tools for changing the methods of leadership and management in Russia (Aleinikov 1991). The Center for Creative Research (Moscow) offered training to military and civilian leaders and then published a five-volume book titled *Creative Management* – a totally revolutionary concept for the country under totalitarian regime for over 70 years. The book included the translation of the most famous Western authors on creativity as well as an article on how to use creative linguistics for the new realities (for details on the innovative vision of leadership developed thanks to creative linguistics, see ► Creative Leadership).

The Center for Pedagogical Innovations (Krasnodar) took it to educators. The center sponsored the development of the creativity test (Aleinikov 1990d) that could be used for individual and group creativity and then organized creative metapedagogy training for professors of five colleges.

The concept of creative pedagogy immediately became popular and got into the encyclopedia editions (Popov 1995).

In the United States, creative management training in the form of creative problem solving was offered to a number of Fortune 500 companies, such as 3M, Alabama Power, Georgia Power, Mississippi Power, Procter and Gamble, Schlumberger, etc.

Creative metapedagogy for the first time in the world was offered for the graduates as the course titled Foundations of Creative Education (EDU6625) at Troy University.

By 2010, creative pedagogy and creative metapedagogy in the form of numerous programs for teachers, managers, and educational and business leaders spread from the USA to Pakistan, Singapore, South Africa, and Thailand. It has been successfully applied to:

- School education (New Challenge School, Montgomery, Alabama; Franklin Junior High School, Franklin, Ohio; Jiemin Primary School, Singapore, etc.)
- Postsecondary education (five colleges in Russia, higher education institutions, like Military Institute, Moscow; Air War College, USAF University, Maxwell AFB, Alabama; Troy and Auburn Universities, Montgomery Alabama; Defense Language Institute, Monterey, California)
- Teacher and professor professional development (the University of Cincinnati, Ohio; United States Air Force Junior Reserve Officer Training Corps (USAF JROTC) Instructors, Garmisch, Germany, and Maxwell AFB, Montgomery, Alabama; Davis and Elkins College, Elkins, West Virginia; Ohio State University; Teachers Centers in Bangkok, Thailand; Karachi and Islamabad, Pakistan; principal education in Pretoria and Johannesburg, South Africa, as well as universities, colleges, schools, and officials of the Ministry for Education, Singapore)

The results of applying creative pedagogy to real education problems are more than positive. In Singapore, for example, the Jiemin Primary School officials selected 13 sixth-graders (out of 1,200 students) who were labeled "incorrigible and doomed to fail." After 2½ days of pedagogical intervention, all students proved to be "ideal learners" and. . .7 months later (without any follow-up), they passed all four state exams (math, science, English, mother tongue) and proceeded to the next level of academic education, thus leading to 100% success of the program. Teachers and parents called it a "miracle" (Aleinikov 2003).

At present, the term creative pedagogy is well spread. It is used for monograph titles and programs names. The concept is studied and taught at the university level. Some of the methods have already been considered "classic" (see ► Creative Pedagogy). Finally, a new Encyclopedic Reference Dictionary titled Creative Pedagogy (Popov V.V. - editor) is being published in Russia.

This is how creative linguistics contributed to solving world educational problems.

Applying Creative Linguistics Research to Science

The application of creative linguistics (sozidolinguistics) research to education led to the development of new field of research like creative pedagogy, creative andragogy, and creagogy as a combination of both. Creative pedagogy led to creation of Genius Education Methodology, the fastest method of human mind orientation to genius development (see ▶ Creative Pedagogy).

Studying the thinking methodologies of genius led to the discovery of the methodology of discovery. As a result, a group of California scientists discovered 11 new laws of conservation (Aleinikov and Smarsh 2010).

The application of creative linguistics research to the field of creativity, as a give-back, contributed to the development of the science of creativity, whether called sozidonics or creatology (see ▶ Science of Creativity and Magyari-Beck 1999).

Introduction of the new measuring units and ways to measure creative output by creative linguistics led to the development of the fastest methods and techniques boosting creativity to the level of megacreativity (see ▶ Genius and Aleinikov 2002).

The application of experience on how to create a new science like creative linguistics (sozidolinguistics) led to founding new sciences:

- Geniusology, the science of genius (see ▶ Genius)
- Novology, the science of newness (see ▶ Novology)
- Organizology, the science of organization (see ▶ Science of Creativity)
- Agogics, the science of leadership (see ▶ Creative Leadership)
- Generagogy, the general science of teaching that unites pedagogy and andragogy (see ▶ Creative Pedagogy)

In addition to new sciences, the application of creative linguistics (sozidolinguistics) research to the leadership and management field led to the development of concepts of creative leadership, ideal leadership, and IdeaLeadership© that broadened the classification of types of leadership and helped to define the field of agogics (see ▶ Creative Leadership).

In the same manner, new concepts like ideal learner, ideal teacher, and ideal education model have been introduced to pedagogy, thus expanding the field of education.

This is how new concepts, models, theories, and definitions that have been developed by creative linguistics, influenced the scientific vision of the world.

Disseminating Creative Linguistics: Dissertations and Conferences

The process of dissemination of creative linguistics concepts and achievements was going in a traditional pattern: from one country and one language to the other countries and other languages (Armenian, Azeri, and Georgian in thesis), and then via English (published first in India) to international recognition. The process was slowed down by the dramatic events in the life of the founder (transition from the Soviet Union to the USA), but still was going on. Despite the fact that the main work on creative linguistics (Doctor of Sciences Dissertation titled *Theoretic Foundations of Creative Linguistics*) has never been published, the applications of creative linguistics to education, creativity research, leadership and management field, advertising and publishing, as well as science in general, as corroborated by the author's national and international awards, including a Guinness World Record in publishing, are impressive.

The pioneering role of the author in the creation of the new trend of research was directly stated about 20 years later after the publication of the first article on creative linguistics by V.I. Karasik, who wrote:

> "In the contents aspect, this category [routine vs. creative aspects of communication], as far as I know, has never been the subject of linguistic research, except the publications of A.G. Aleinikov, who stated the need to develop Creative Linguistics. . .. (Aleinikov 1988a)" (Karasik 2008).

Creative linguistics continues to benefit both the linguistics field and the creativity field. As a relatively new trend in linguistics, it continues to attract new researchers. For example, the creative potential of linguistic units is studied in the dissertation of Remchukova (2005). On the other hand, the term creative linguistics is also used as a generic term for creative thinking techniques that employ the language heuristic power for finding new ideas (Vagin 2010).

Moreover, after over 20 years in existence, which had been predicted by the founding article (Aleinikov 1988a), creative linguistics became the theme of scientific conferences (Gridina 2008).

Finally, with the spread of the Internet, the term *creative linguistics* becomes a kind of commonly used word combination, and people apply it, for example, to create new logos and trademarks (Retrieved from http://www.multitran.ru/c/m.exe?a=4&MessNum=5522&l1=23&l2=2) or just to have fun in creating new combinations of words and statements. Some authors even call creative linguistics "a consultant's marketing tool in the new world order" (Binneman 2011). So the popularization stage of the term creative linguistics is going on.

Conclusion and Future Directions

Creative linguistics (sozidolinguistics) that appeared on the cross section of creativity domain and linguistics domain studies the creativity aspects in language and the language aspects in creativity. As a branch of linguistics, sozidolinguistics selects in any event having a sign nature the factors dealing with the generation of newness, that is, with the creative aspect of language and speech.

Creative linguistics was the first to prove that every speech act is a creative act because, by using the known elements of the language, a person *creates* a message (speech act) that is unique (will never be repeated) and, by doing so, solves the problem of communication just as an inventor or engineer solves a technical problem. This simple proof is so significant because it eliminates the dichotomy creative or not creative. If the person can speak, the person is creative. The question now is *how creative* or how much newness the person is delivering in his/her messages. This can be taught, and people who get through training in creativity begin to deliver much more creative results. This is how creative linguistics paved the way to creative pedagogy (that got into encyclopedia nearly immediately) and creative metapedagogy, both of which received wide international recognition for their innovative teaching methodologies, new vision of innovative education (Aleinikov 1995a), and impressive educational results.

Creative linguistics also contributed significantly to the science in general by founding seven new sciences and three subsciences, new models, new theories, and new concepts (see, e.g., Aleinikov 2002b).

In the creativity field, creative linguistics led to a new (scientific) vision of creativity (see ► Creativity Definitions, Approaches) and served a catalyst for shaping a new science of creativity (see ► Science of Creativity). Creative linguistics, with its well-structured approach, developed the way to measure creative output, thus leading to the development of the most powerful methods boosting creativity to megacreativity and more (Aleinikov 2002a).

Combining creative pedagogy methodologies and megacreativity concept led to the design of the unique educational system "Genius" and brought the author worldwide recognition in the form of best seller, invitations for keynote speeches at the international creativity and education conferences, numerous international awards, and even, as some creativity experts think, the title of "the most creative man in the world" (Ramos 2006).

When applied to business, creative linguistics worked its way to training managers of the Fortune 500 companies and showed the fastest results in publishing confirmed by the unbeatable Guinness World Record in publishing.

Since the main research on creative linguistics has not been published, the author's main task is to publish the work that brought so much to humanity but still remains hidden. Therefore, the task of translating creative linguistics from Russian to English and publishing it is one of the main directions of work.

Applying creative linguistics methods and models to business, advertising, marketing, media for practical improvements, and savings is another direction. Some of the directions that creative linguistics is working on may seem like science fiction, but what was predicted by creative linguistics and seemed science fiction 20 years ago has already been achieved.

If creative linguistics methods of research and achievements have proven to be so successful and powerful, then the future scientific directions it can lead to are limited only by the imagination of those who take them to work.

Cross-References

- ▶ Creative Leadership
- ▶ Creative Pedagogy
- ▶ Creativity
- ▶ Genius
- ▶ Novology
- ▶ Psychology of Creativity
- ▶ Science of Creativity

References

Aleinikov AG. On creative pedagogy. Higher Educ Bull. 1989b;12:29–34. russ. Алейников А.Г. О креативной педагогике//Вестник высшей школы.

Aleinikov AG. Grammar creation and creation grammar: creatively-oriented course of grammar and history of English. Moscow: Military Institute; 1990a. Созидание грамматики и грамматика созидания.

Aleinikov AG. Creative orientation in teaching and learning theoretical disciplines. Moscow: Military Institute; 1990b. russ. Алейников А.Г. Творческая ориентация в преподавании и изучении теоретических дисциплин.

Aleinikov AG. Creative pedagogy and creative metapedagogy. Progress in Educ. 1990c;66(12):274–80.

Aleinikov AG. Test battery “ALEANDR”. Moscow: Russian Academy of Sciences Center for Creative Research and Krasnodar Center for pedagogic innovations; 1990d. Алейников А.Г. АЛЕАНДР.

Aleinikov AG. Creative linguistics in creative management. In: Shmakova LE, Malovichko VS, editors. Creative management, vol. 1. Moscow: Creator, Russian Academy of Sciences; 1991. p. 227–68. russ. Алейников А.Г. Креативная лингвистика в креативном управлении. Креативный менеджмент.

Aleinikov AG. Creative metapedagogy: D-day. Alma-Mater. Higher Educ Bull. 1992a;1:34–9. russ. Алейников А.Г. Креативная метапедагогика. Время “Ч”. Alma Mater/Вестник высшей школы.

Aleinikov AG. Sozidolinguistics for creative behavior. J Create Behav. 1994;28(2):104–23.

Aleinikov AG. An approach to innovative education (Editorial). Int J Innov Higher Educ. 1995a;11:5–7.

Aleinikov AG. Humane creativity. In: Runco M, Pritzker S, editors. Encyclopedia of creativity, vol. 1. San Diego/London/Boston/New York/Sydney/Tokyo/Toronto: Academic; 1999. p. 837–44.

Aleinikov AG. Mega creativity: five steps to thinking like a genius. Cincinnati: Walking Stick Press, F&W Publications; 2002a.

Aleinikov AG. Creative linguistics (foundations, problems and perspectives). In: Sorokin YuA, Tarasov EF, Ufimtseva NV, editors. Language awareness: stereotypes and creativity. Moscow: Institute of linguistics, Academy of Sciences; 1988a. p. 77–89. russ. Алейников А.Г. Креативная лингвистика (обоснование, проблемы и перспективы). Языковое сознание: стереотипы и творчество.

Aleinikov AG. Creativity and language acquisition. In: Shiryaev A.F. Editor. Collected articles. Vol. 25. Moscow: Military Institute; 1989a. p. 5–10. russ. Алейников А.Г. Творчество и освоение языка. Сборник статей.

Aleinikov AG. Genius Education Methodology helps creating a nation of geniuses: new horizons, awards and rewards in creative and innovative education. (Retrieved from http://www.humiliationstudies.org/news-old/archives/000039.html June 13, 2012; 2003).

Aleinikov AG. Hyper efficient language program – “First HELP + 2,000.” Sharing the dream. NAFSA: Association of International Educators, Region VII Conference. Memphis, Tennessee; 1995b.

Aleinikov AG, Editor. Novology, the science of newness, for creativity and innovation research. The future of creativity: Dr. E. Paul Torrance lecture series at the University of Georgia. Bensenville, IL: Scholastic Testing Services; 2002b. p. 114–41.

Aleinikov AG. On the heuristics of communicative and modeling acts. In: Sorokin YuA, Tarasov EF, Ufimtseva NV, editors. Language awareness: stereotypes and creativity. Moscow: Institute of linguistics, Academy of Sciences; 1988b. p. 55–76. russ. Алейников А.Г. Об эвристичности актов коммуникации и моделирования. Языковое сознание: стереотипы и творчество.

Aleinikov AG. Sign. A four-side essence. Universal creative model. In: Sorokin YuA, Tarasov EF, Ufimtseva NV, editors. Language awareness: stereotypes and creativity. Moscow: Institute of linguistics, Academy of Sciences; 1988c. p. 89–115. russ. Алейников А.Г. Знак. Четырехсторонняя сущность. Универсальная креативная модель. Языковое сознание: стереотипы и творчество.

Aleinikov AG. Speech activity model and translation. In: Sorokin YuA, Tarasov EF, Ufimtseva NV, editors. Studies of translation and culture: goals, methods, results. Moscow: Institute of Linguistics, Academy of Sciences; 1989c. p. 27–40. russ. Алейников А.Г. Модель речевой деятельности и перевод. Переводоведение и культурология: цели, методы, результаты.

Aleinikov AG. Theoretical foundations of creative linguistics. Unpublished Doctor of Sciences in Philology Dissertation. Moscow: Military Institute; 1992b. russ. Алейников А.Г. Теоретические основания креативной лингвистики. Диссертация доктора филологических наук.

Aleinikov A, Smarsh D. Eleven new laws of conservation: the discovery of the century. Allied Academies. Spring International Conference, New Orleans, Louisiana, April, p. 37; 2010.

Bertalanffy L. General system theory: foundations, development, applications. New York: George Braziller; 1968.

Binneman D. Creative linguistics – A consultant's marketing tool in the new world order. (Retrieved from http://deonbinneman.wordpress.com/2011/06/23/creative-linguistics-a-consultants-marketing-tool-in-the-new-world-order/ on March 30, 2012; 2011.

Frege G. On sense and reference (Über Sinn und Bedeutung). Zeitschrift für Philosophie und philosophische Kritik C. 1892;1892:25–50.

Gordon W. Synectics. New York: Harper & Row; 1961.

Gridina TA. All-Russia conference with international participation on the problems of Russian language "Creative linguistics." Ural State Pedagogical University, 2008. russ. Гридина Т.А. Всероссийская конференция с международным участием по проблемам русского языка "Креативная лингвистика"), (Retrieved from http://www.rfh.ru/index.php?option=com_content&task=view&id=239&Itemid= 231&limit=1&limitstart=1 March 30, 2012).

Humboldt W. On language. Cambridge/New York: Cambridge University Press; 1987.

Jespersen O. Interlinguistics, International Communication; 1931.

Karaeva MS. To concretizing of the notion "language system." In: Scientific works of Azerbaijan pedagogical institute of languages, Series XII, Baku, 2, p. 38–42; 1972. russ. Караева М.С. К конкретизации понятия "система языка". "Ученые записки" Азербайджанского педагогического института языков.

Karasik VI. Routine and creative communication: functions, types, methods. In: Kaplunenko AM, editor. Vestnik of Irkutsk State Linguistic University, p. 112–8. russ. Карасик В.И. Рутинное и креативное общение: функции, типы, способы. Лингвистика дискурса, Вестник ИГЛУ. Retrieved from www.islu.ru/rar/vestnik_2008_3.pdf 20-Sep-2010; 2008.

Kuznetsov SN. Theoretical foundations of interlinguistics. Moscow: University of peoples friendship; 1987. russ Кузнецов С.Н. Теоретические основы интерлингвистики.

Labov W. Principles of linguistic changes: social factors. Malden: Blackwell; 2001.

Luria AR. Main problems of neurolinguistics. Moscow: Moscow State University; 1975. russ. Лурия А.Р. Основные проблемы нейролингвистики.

Magyari-Beck I. Creatology. In: Runco M, Pritzker S, editors. Encyclopedia of creativity, vol. 1. San Diego: Academic; 1999. p. 433–41.

Ogden CK, Richards IA. The meaning of meaning. 8th ed. New York: Harcourt, Brace & World; 1923.

Popov VV. Creative pedagogy. In: Polovinkin AI, Popov VV, editors. Encyclopedic dictionary "Technical creativity: theory, methodology, practice". Moscow: Logos; 1995. p. 165–7. russ. Попов В.В. Креативная педагогика. В энциклопедическом словаре "Техническое творчество: теория, методология, практика.

Ramos S. "The most creative man in the world" Press release of the International Academy of Genius, 2006 (Retrieved from http://www.eworldwire.com/pressreleases/13690 on Dec 20, 2011; 2006)

Remchukova EN. Creative potential of russian grammar: morphological resources of the Language. Doctor of Sciences in Philology Dissertation. Moscow; 2005. russ. Ремчукова Е.Н. Креативный потенциал русской грамматики: Морфологические ресурсы языка. Диссертация доктора филологических наук.

Saussure, F. de. Cours de linguistique générale. (Bally C, Sechehaye A (eds). with the collaboration of Riedlinger A) Lausanne and Paris: Payot, 1916 (trans: Baskin W) Course in general linguistics, Glasgow: Fontana/Collins, 1977; 1916.

Schubert K, editor. Interlinguistics. Aspects of the science of planned languages. Berlin/New York: Mouton de Gruyter; 1989.

Searle J. A taxonomy of illocutionary acts. In: Gunderson K, editor. Language, mind, and knowledge. Minneapolis: University of Minnesota Press; 1975. p. 344–69.

Solntsev VM. Language as a system-structural entity. Moscow: Science; 1977. russ. Солнцев В.М. Язык как системно-структурное образование.

Spencer G. Creative Linguistics. (Retrieved from http://www.vcn.bc.ca/~gartho/CreativeLinguistics.pdf June 2012)

Vagin IO. The best psycho-techniques for success. russ. Вагин И.О. Лучшие психотехники успеха. Retrieved from http://lib.ololo.cc/b/214699 (2010). 07-Nov-2010.

Creative Management

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Synonyms

Creative business; Creativity in business; Innovative management

Definition

Creative management is the study and practice of management, drawing on the theories of creative processes and their individual, group, and organizational application.

Origin of the Concept

Creative management has its origin in two academic research spheres: one is management studies and the other is creativity research. The former has a history that is longer than a century, and the latter is more 80 years old. Management studies paid more attention to a person than a thing, and creativity research has been developing applicable ranges since the 1980s; creative management was born as an inevitable result (Xu and Rickards 2007).

Research Activities in the Main Countries

Research on creative management began in the United States in the early 1980s, although one can find terms like "corporate creativity," "organizational creativity," and "creative business" in some books and academic journals prior to that time.

In 1982, the First Conference on Creative and Innovative Management was held October 5–6 at the RGK Foundation in Austin, Texas (Charnes and Cooper 1984). The second conference was held at the University of Miami November 7–9, 1984 (Kuhn 1985), and the third conference was held June 2–3, 1987, in Pittsburgh at the Graduate School of Industrial Administration, Carnegie-Mellon University (Ijiri and Kuhn 1988). All three conferences were sponsored by the IC^2 Institute at the University of Texas at Austin. The conference proceedings were published by Ballinger Publishing Company in 1984, 1985, and 1988. Such conferences have an influence on academic circles and the industrial world in the United States.

In the United Kingdom, the Open University Business School offered a course called "Creative Management" for MBA candidates in 1991 (Henry 1991). The course is now called "Sustainable Creative Management" and is still held at the school.

In China, Changzhou University established the Institute for Creative Management in 2005. It is the first institute on this research area in China.

In 2010, the Institute for Creative Management and Innovation was launched at Kinki University in Japan. It is the first institute on this research area in Japan.

Research on creative management has been developing from North America to Europe and Asia, and the level of research has become higher with the development from conferences to MBA courses and research institutes. Thus, creative management has become a promising research area for the future.

Research Subjects

There are two primary research subjects in creative management: the creative company and the creative manager (Xu 2005).

Creative Company

In assessment of a creative company, two aspects are observed: creative behavior and creative environment.

Creative Behavior
A creative company is an enterprise that has won intense competition with creative behavior. For a company, creative behavior has three layers: individual creativity, team creativity, and organizational creativity. Individual creativity is the foundation of team and organizational creativity. Because corporative competition in the market is not an individual play, it is an all-out play; a company must pull together individuals' creativity to become team creativity and organizational creativity.

Creative Environment
A created environment includes both physical environment and social environment. The former means facilities, materials, literature, and so on. The latter includes human relations, organizational atmosphere, and corporate culture. In short, hard (physical) environment and soft (social) environment come together at the same time. In this environment, employees can do their best creative work.

Canon is a high-technology maker of cameras and printers, and had about 194,000 employees and ¥3707 billion (US$46.5 billion) of revenue in the 2010 fiscal year. It is a creative company not just because of its share of the market but because it owns 80,000 patents and its achievement in new product development (Tanaka 2004). Other creative companies from the Fortune 500 include Apple, Samsung, Sony, Lenovo, and Haier.

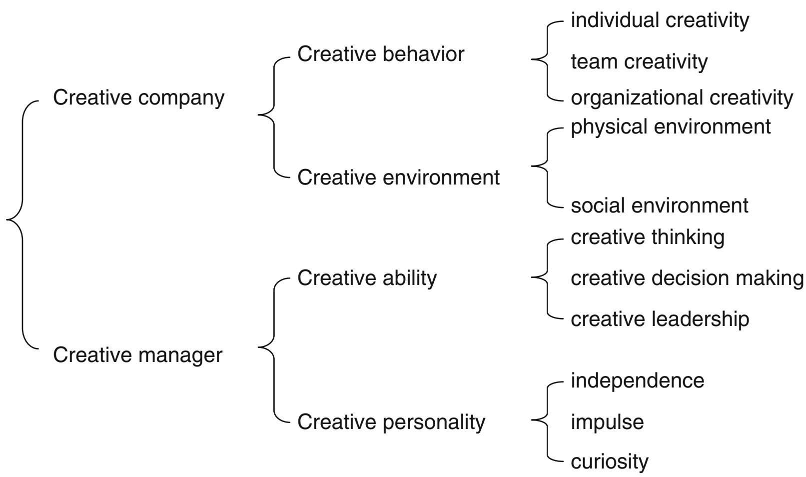
However, creative companies are not only large corporations. Some smaller companies have distinctive competitive power in the world. For example, Okano Industrial Co., Ltd is a small company in Japan with only six employees, including the president. However, its revenue is ¥600 million (about US$7.8 million) (Okano 2003). On the average, one person's revenue is ¥100 million (about US$1.3 million)! In general, average revenue for a small company is only ¥10 ~ 15 million, and even for a big company the average revenue is ¥20 ~ 25 million in Japan. Why is this company so successful? Because they have some original techniques and developed several unique products. They invented a needle so that patients never feel pain at injection. Sony asked the company to make the case for the lithium ion battery for its mobile phones, because of Sony was unable to find a maker to do it without Okano.

Creative Manager
The creative manager is a creative person who possesses a creative personality and has the abilities of creative thinking, creative decision making, and creative leadership. A creative personality is a psychological characteristic. It refers to an individual's overall constitution and capacity to be creative.

Creative Personality
Personality is a psychological concept. It consists of a person's make-up and interactions with the environment. A person's behavior is prescribed by his/her personality. Independence, impulse, and curiosity are characteristics of creative personalities.

Creative Thinking
Creative thinking is an original function of the brain that is related to problem solving. Creative thinking is not a gift but can be formed through training. The premise of creative thinking is to do away with common sense. If one sticks only to common sense, he/she never thinks creatively. It requires bravery to do away with common sense because of the potential risks – failure, loss of position or job. Therefore, it is necessary rational thinking – hypothesis, reasoning, verification, and so on – is also included.

Creative Decision Making
Decision making is the ability to decide something by one's self. It is a necessary ability for a CEO to judge the conditions and future when he/she wants to take action. But it is impossible to know whether all decisions will be correct. A CEO has to do such decision making every day. If a CEO's decision has brought about huge profit, one can consider that he/she has a capacity for creative decision making. Tadashi Yanai, the chairman, president, and CEO of Fast Retailing, has said, "1 win and 9 defeats (Yanai 2003)." This means that, although he had failed many



Creative Management, Fig. 1 The elements of creative management

times in his business life, if only one time was successful, the business will be sustainable.

Creative Leadership

Leadership is an ability to manage a company. A CEO should lead the company with a broad view of things and does not need to be involved in daily operations. A creative manager can make the best of the subordinates' creativity and lead them to solve the short-term problems and deal with longer-term research. Because leadership has an abstract character, it is difficult to assess from the outside. Therefore, creative managers often use their own words to explain it. For example, Liu Chuanzhi, the founder of Lenovo, subdivided leadership into three concrete abilities: the ability to make a managerial team, the ability to enact strategy, and the ability to pull together subordinates (Xu 2007).

The late Steve Jobs, founder of Apple, was one of the most creative managers in the world. Sometimes he was seen as an uncommon man by the people around him because of his strong creative personality. His abilities of creative thinking, creative decision making, and creative leadership were better than any manager in the industrial world. Apple became the one of the most creative companies in the world because of his leadership (Isaacson 2011).

Tadashi Yanai is a creative manager in Japan. He transformed a small clothes shop that was started by his father into the number one retailer of clothes in Japan and created the worldwide UNIQLO brand due to his creativity and management innovation.

Zhong Qinghou is the founder of the Wahaha Group, the larges maker of soft drinks in China. Under Zhong's creative leadership, the company competes with foreign giants such as Coca Cola, Pepsi, and Danone and has been developing rapidly. Zhong was named as the number one billionaire in Mainland China by *Forbes* in 2010 (March 29, 2010).

Figure 1 provides a summary of the elements of creative management that are explained above.

Creativity in Business

The history of creativity research in business goes back to the 1930s in America. It began in product development and advertising and explored aspects of people and organization within the development of management. "Brainstorming," the famous creative thinking method, was born at an advertising company, BBDO, in 1938 (Osborn 1953).

Later, other fields related to management identified the significance of creativity. For example, idea creation, product development, design innovation, acquisition of knowledge capital, enforcement of spin-off, marketing development, cost control, human resource development, and competition have acknowledged potential for creativity and its stimulation. Courses related to creativity and business are offered at many colleges and universities (Xu, McDonnell and Nash 2005). For example, Harvard Business School has a course called “Managing for Creativity”; Columbia Business School offered an MBA course called “Entrepreneurial Creativity”; DePaul University’s MBA program includes the required course “Creativity in Business”; Indiana University offered an MBA course entitled “Creativity and Innovation: Generating New Venture Ideas”; Northwood University has a course “Creativity and Business”; Stanford Business School has two courses entitled “Creativity in Business” and “Personal Creativity in Business”; Hass School of Business at University of California, Berkeley, offered an MBA elective course entitled “Creativity in Business”; Michigan Business School’s course is called “Managing Creativity” as is HBS’s; and University of Southern Maine’s business school offered an MBA course called “Change and Creativity”. These courses started in 1980s and 1990s.

Principles of Creative Management

The Universality Principle

Creativity is an inherent potential of all human beings. This appears to be contested by theories concentrating exclusively on extraordinary creative talents in arts, science, and even in business. However, the universality principal is more widely accepted in the educational domain, where intelligence is regarded as universal, although some people display evidence of having superior levels of intelligence than others.

This principle is related to corporate behavior. If a CEO believes everyone has creativity, he/she will do something for the all employees, not only for a few experts. For example, Canon, a Japanese maker of cameras and printers, gives a promotion opportunity to everyone every year. If someone passes the promotion test, he/she will be promoted (Mitarai 2001). Haier, a Chinese maker of home electric appliances, invites public applications in the company when an administrative post becomes vacant (Xu 2006). Canon and Haier consider everyone as a creative person.

The Developmental Principle

Potential creativity will become actual creativity under suitable developmental conditions. Conversely, actual creativity will decline if the person is restricted in opportunities to display his/her creativity. Creativity is not fixed attribute; it must be changing and developing. In most cases, development is the main characteristic. Development has two sides: outside and inside. Suggestion systems, group action, and project teams are outside. On-the-job training (OJT), self-education, and self-development are inside. Because employees’ potential creativity will gradually become actual creativity through development, a CEO should offer opportunities to apply actual creativity. For example, offering work that provides someone with a sense of purpose or higher responsibility.

It is possible that someone’s creative talent changes from one domain to another. For example, a sports champion may become a manufacturer’s CEO, a carpenter may become a famous painter, and so on.

The Environmental Principle

Environmental features influence the development and manifestation of creativity (the developmental principle). Research will increasingly shed light on the mechanisms through which contextual features limit or enhance creativity. There is gathering consensus that creativity is supported through features encouraging “ownership,” participation, and the enhanced sense of well-being through self-actualization. Generally speaking, a good environment stimulates creativity. For a researcher, “good” means both hard environment and soft environment. The hard environment includes having research funding, research assistants, laboratory, materials, and so on. And the soft environment includes human relationships, flextime, evaluation and encouragement, and so on. A bad environment represses creativity. For example, dirtiness, noise, small space, lack of funds and equipment, tense atmosphere in office, arbitrary boss, unfaithful colleagues, and so on, will represses creativity. However, some people are successful in a bad environment. In these cases, it is necessary to have the strong spiritual power.

Creating a good environment in order to make the best of employees' creativity is important work for a CEO.

Conclusion and Future Directions

Creative management has a history of 30 years. It began in the United States and has influence in Europe and Asia. Creative management, because of a lack of theoretical research and interpretation, has not yet gained a significant academic position. Research on creative companies is scarce, and more theoretical research, interpretation and case studies are needed in the future.

Cross-References

▶ Business Creativity
▶ Corporate Creativity
▶ Creative Behavior
▶ Creative Leadership
▶ Creative Personality
▶ Creativity Management Optimization
▶ Organizational Creativity

References

Charnes A, Cooper WW, editors. Creative and innovative management. Cambridge, MA: Ballinger Publishing Company; 1984.

Henry J, editor. Creative management. London: Sage Publications; 1991.

Ijiri Y, Kuhn RL, editors. New directions in creative and innovative management. Cambridge, MA: Ballinger Publishing Company; 1988.

Isaacson W. Stave jobs: the biography (in Japanese) (translated by Inokuchi K.). Tokyo: Kodansha; 2011.

Kuhn RL, editor. Frontiers in creative and innovative management. Cambridge, MA: Ballinger Publishing Company; 1985.

Mitarai F. Lifetime employment is competitiveness (in Japanese). Nikkei Sangyo Shinbun, March 6, 2001.

Okano M. I make it (in Japanese). Tokyo: Chukei Publishing Company; 2003.

Osborn AF. Applied imagination. Buffalo: Creative Education Foundation; 1953.

Tanaka Y. Invention of corporation and its value assessment (in Japanese). J Nikkeibp Chizai Aware, May 13, 2004.

Xu F. A proposal for establishment of creative management (in Japanese). J Jpn Creativity Soc. 2005;9: 111–23.

Xu F. Comparative study between Japanese and Chinese enterprises (in Japanese). Kyoto: Nakanishiya Shuppan; 2006.

Xu F. Liu Chuanzhi: the founder of Lenovo (in Japanese). Kyoto: Nakanishiya Shuppan; 2007.

Xu F, McDonnell G, Nash WR. A survey of creativity courses at universities in principal countries. J Creative Behav. 2005;39(2):75–88. Second Quarter 2005.

Xu F, Rickards T. Creativity management: a predicted development from research into creativity and management. J Creat Innov Manage. 2007;16(3):216-228.

Yanai T. 1 win and 9 defeats (in Japanese). Tokyo: Shinchosha Publishing Company; 2003.

Creative Mind: Myths and Facts

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Synonyms

Creative thinking; Inventive creativity; Productive thinking

Key Concepts and Definition of Terms

Creativity is a dazzling concept and a resource which refers to a human capacity to produce or create something new through imaginative skills. The product may refer to a new solution to a problem, a new method or device, or a new artistic object or form. In general, the term creativity refers to a richness of ideas and originality of thinking. Often it is associated with the development of ideas or particular fields of application.

Up to now, the concept of creativity has not been precisely defined. Nevertheless, it has attracted many researchers and practitioners for centuries. In consequence, creativity has many facets and aspects. For a long time, creativity was mainly considered as a disposition of artists. In the course of the twentieth century – and especially as a result of the "Sputnik shock" – psychologists began to focus on creativity and its nature, components, and variants. Nowadays, creativity has an ambiguous connotation, which ranges from the hype of the zeitgeist and a wholehearted emphasis of creative domains to a dismissive attitude toward other domains (e.g., creativity in business).

Creativity can be understood as a construct composed in accordance with many references to different fields of interest, such as fine arts, advertising, design, innovation, and *invention*.

Theoretical Background

Creativity is a natural human capability for the creation of and dedication to options. The idea of creativity is probably as old as humankind, and for centuries and in all cultures, it has been understood as imagination and ingenuity. This holds true with regard to the production of tools, the fine arts (e.g., during the Renaissance), or eccentric inventions. Usually, creativity ranges from necessary auxiliary means of survival to a form of expression of inventive geniuses. Some prominent examples from history are the lithic tools of primitive times, cave paintings, the invention of the wheel, metal tools of the Bronze and Iron Age, the telephone, battery, train, automobile, light bulb, and many other inventions of modern times (Brockman 2000).

Processes and Products of Creativity

For centuries, creativity was usually considered as a divine gift. Creative people were believed to be inspired by God. In medieval times, the idea of genius resulted from this original conception of divine creativity. The concept of *illumination* as the creative moment of enlightenment and insight (the so-called eureka moment) became the leading conception. It took some time for creativity to be transferred to fields other than the arts, and the idea of genius lost its attraction once people began to attribute creativity to common people. Contrary to earlier argumentations that focused on the preternaturalness of exceptional people in artistic and scientific domains, psychologists of the twentieth century emphasized the versatility of creativity. Evidently, there are as many forms of creativity as there are human activities, and there are as many aspects of creativity as human nature is capable of producing. Creativity can be found at all ages and in all cultures. An absolute creativity does not exist. Rather, its various forms and aspects differ in degree and level. For the industrial manager, the art historian, and the scientist, creativity appears in the creative *product*; for the psychotherapist and many artists, creativity means a *process*; whereas educators and psychoanalysts focus on the *creative personality* and its characteristics because they are interested in the predictability (and training) of creativity. Accordingly, a distinction should be made between the creative personality, the creative product, and the creative process. Innovation and invention refer to the creative personality, but invention also refers to the creative product and process.

Although creativity is no longer considered a capability of extraordinary and ingenious individuals, it is still associated with a hint of mysticism and some enduring myths (Boden 2004; Weisberg 1986).

Myths About Creativity

There are many age-old myths and legends about creativity. In most cases, these myths may be put down to a lack of knowledge or hindsight. However, they intentionally cultivate the idea that creativity should be considered as an inexplicable phenomenon that only a few chosen people possess (Anderson 1992).

Some myths are very old and go back to ancient times, while other myths are new. Most recently, for example, one can find the insistent myth that creativity can be traced back to hemispheric specializations of the human brain. It is consistently maintained that the right hemisphere of the brain is the creative one. The truth is that current research on brain functions does not support such a functional specialization but rather the observation that the human brain is a very complex organ that has the capability of adaptation and compensation (Stephan et al. 2007). However, in the past two decades research on neurophysiological correlates of creativity has produced contradicting results. Although some studies support the assumption of a right hemisphere dominance in creative thinking, there are also studies that report a left hemisphere dominance. Furthermore, research indicates that people who have access to only one hemisphere due to an accident or surgery develop cognitive capacities similar to those of "normal" people. Most recently, Mihov et al. (2010) performed a meta-analysis of studies in order to test the assumption of a relative hemispheric dominance. Their moderator analyses did not show any predominant right-hemispheric activation in any of a variety of cognitive tasks.

Other myths about creativity are as follows:

- *Creativity is innate*. The fact is that research has long shown that creativity is not innate but rather learned, i.e., it can be advanced and developed by the environment. Earlier theories have stated that creative people have often emerged from conflicted families. However, Csikszentmihalyi (1996) shows that these individuals usually experienced normal childhoods and grew up in families that provided them with a stable social background and a solid set of values. One difference between them and most other people, however, was that a number of them had suffered parental loss, particularly the loss of a father. In such cases, most were influenced and inspired by other supportive adults. Csikszentmihalyi's work culminates in the identification of a really distinctive characteristic of creative people: the capacity to experience "flow." This is defined as the timeless and complete involvement of individuals in an activity. Persons experiencing a flow have a sense that their abilities are only equal to the challenges at hand, and they become caught up in the creative process in order to achieve their goal. In addition, a number of personality characteristics have been shown to be associated with creative productivity. One of these is autonomy: creative individuals tend to be independent and nonconformist in their thoughts and actions. Equally important is mastery of a particular domain – that is, a sphere of activity or knowledge that requires a high level of ability.
- *Creative individuals are social outliers*. Indeed, some creative individuals behave in a nonconformist manner, and sometimes they have emotional or mental problems. However, this holds true with regard to less creative persons, too (Amabile 1983). Creative individuals may occasionally exhibit a high degree of self-assurance. Some possess an exceptionally deep, broad, and flexible awareness of themselves. Others are shown to be intellectual leaders with a great sensitivity to problems (Fleming et al. 2007).
- *Creativity emerges from chaos* (Abraham et al. 2001). The fact is that the desired openness and playful handling of issues do not imply that creative people are chaotic. Certainly, some creative individuals may be challenged by asymmetry and chaos, but there are also many creative persons who are disciplined, well-organized, and concentrative. The unconventionality of thought that is sometimes attributed to creativity is not an expression of chaos but rather a resistance to acculturation. A nonconformist lifestyle is not essential to creativity; indeed, many creative individuals live quite ordinary lives but express their autonomy and independence in unconventional ideas.
- *Experts are barely creative*. Actually, experts are made. However, this does not exclude the possibility that experts are creative because success breeds success. Gabora (2011) has pointed out that the standard view that creativity entails both originality and appropriateness often leads to the paradox conclusion that experts who *converge* on an optimal solution to a problem are considered less creative than nonexperts who are involved in divergent thinking which leads to manifold original solutions. Accordingly, it is maintained that

experts are too prejudiced with regard to new ideas. It is not easy to understand this argumentation because it is a fact that novices are often highly prejudiced and do not understand a given problem. This can be demonstrated through the example of politics, when people casually discuss proposals for better policy making over drinks. Most proposals made in such situations are neither realizable nor creative. True mastery in most domains requires a considerable investment in education, training, apprenticeship, and practice (Ericsson 1999). However, the time and resources required to master a particular domain preclude most people from excelling in other domains of interest. Additionally, creative people may not have equally strong gifts across the spectrum of all possible domains or the capabilities to master them effectively. A notable exception was Leonardo da Vinci, whose achievements in the visual arts, mechanics, and engineering disclosed the talents of a creative polymath. Another true polymath was Herbert A. Simon (Seel 2012).

- *Creativity is independent of intelligence*. In the literature, a sharp distinction is often made between creativity and intelligence. This distinction has historical reasons because research on creativity emerged from criticism of traditional research on intelligence (Getzels and Jackson 1962). The fact is that creativity is not the opposite of intelligence but rather its complement. If we suppose a hierarchy of intellectual abilities, creativity can be considered the highest level of this hierarchy. Numerous studies have shown that an extreme general intelligence does not necessarily imply high levels of creativity. The results of these studies as well as of meta-analyses (e.g., Kim 2005) support a "threshold" model of intelligence and creativity, which claims that, above a certain level, intelligence shows little correlation with creativity. That is, a very intelligent person may not be as highly creative. It seems that intelligence sets the limits on information processing, while creativity provides the flexibility necessary for producing of innovative ideas (Preckel et al. 2006). Both convergent and divergent thinking seem necessary for creative performance.
- *Creativity is idiosyncratic and, therefore, does not emerge in social groups*. Indeed, a characteristic of creative people is their individualism and introversion (Gancalo and Staw 2005). However, this does not imply a lack of social skills but rather a strong tendency to be reflective and thoughtful. Although creative people rely strongly on their intuition, they also respond to interactions with others and their attitudes and behaviors. Actually, interactions with other people may improve the creativity of the group as well as its members. Collecting ideas within a group may facilitate creative solutions. The extent to which social groups are creative has wide implications for their overall performance, including the quality of their problem solutions, judgments, and decisions. Bechtholdt et al. (2010), for example, report that groups produce more ideas when their members are characterized by high epistemic motivation as well as prosocial motivation. In accordance with the social norms of a group, the ideas produced are more original, appropriate, or feasible.
- *Children and adolescents are more creative than old people*. Traditionally, creativity was considered a specific characteristic of children and adolescents. This assumption is a correlate of the aforementioned myth that experts are not creative. Accordingly, older people are not considered to be creative. Actually, Smolucha and Smolucha (1985) reported that the development of creativity follows a nonlinear path; they describe this developmental path as a J-shaped pattern with a small peak at age 6 and a higher peak in the twenties. It is certainly true that children and adolescents are more open and adventurous than old people, but this does not rule out creativity in old age. Nevertheless, most studies reveal age differences in creativity to the disadvantage of the old (Ruth and Birren 1985; Wu et al. 2007). An age-related reduced speed in information processing, a lower level of complexity, and a decreased willingness to risk original solutions are offered as explanations. Most

recently, Jones and Weinberg (2011) analyzed data on Nobel Laureates which shows that the age–creativity relationship varies substantially more over time than across fields. Evidently, there are fundamental shifts in the life cycle of research productivity.

- *Creativity is connected with spontaneity,* which combines curiosity and problem seeking. Creative individuals seem to have a need to seek novelty and an ability to pose unique questions. A study on the relationship among spontaneity, impulsivity, and creativity by Kipper et al. (2010) shows a positive relationship between spontaneity and creativity, consistent with Moreno's (1953) "canon of spontaneity-creativity," but a negative relationship between spontaneity and impulsivity. Creativity is very often, if not regularly, the result of an extended cognitive confrontation with a complex problem. A number of other personality characteristics have been shown to be associated with creative productivity. One of these is autonomy: creative individuals tend to be independent and nonconformist in their thoughts and actions. Equally important is cognitive mastery of a particular domain – that is, a sphere of activity or knowledge that requires a high level of ability. An individual may therefore possess creative thinking abilities and exhibit a creative personality but fail to produce works that are valued and influential because he or she has not developed any specializations.
- *Creativity needs no techniques*. Creativity techniques are not a panacea. Their ultimate goal is only to provide a person with the best conditions for divergent thinking and breaking a blockade of thinking. The leading thought and the creative idea cannot be forced, but rather, thoroughgoing reflection always is necessary. However, creativity techniques may produce an open atmosphere which supports the emergence of creative ideas (Fasko 2000/01; Ferrari et al. 2009).
- *The novelty of a product is the criterion and measure of creativity*. Creativity is considered to be the first and unique operation involved in forming something; it is an expression of how a person may comprehend the world. Creativity is usually differentiated in accordance with the degree of how a creative product may change the world. A product is all the more creative depending on its breadth of applicability. Here, two levels can be distinguished. The first level causes new insights that fundamentally change a given world and culture; the second level only extends to existing insights. Ideas and products deemed worthy by the field are incorporated into the domain, and only then is the originator considered creative. In some cases, the field can be defined as the world at large as it adopts the product of the creative process – be it an idea, a product, or a solution to a problem.

Conclusion and Future Directions

Explaining creativity requires abandoning the various creativity myths. For a long time, they told us that creative inventions are a burst of spontaneous inspiration from a lone genius, that a person working alone is always more creative than a group, and that social conventions and expectations always interfere with creative invention and innovation.

As Sawyer (2006) states, "the myths quickly fall apart when we examine the lived reality of creativity" (p. 259). Psychological studies show that explaining creativity presupposes an action theory that explains how the process of creative invention results in a creative product. Usually, there is not a moment of spontaneous insight into a solution to a problem, but rather creative invention is "hard work peppered with mini-insight, and . . . these mini-insights don't seem that mysterious in the context of the preceding hard work" (Sawyer 2006, p. 259). Creativity is mostly the result of collaborative work.

Cross-References

▶ Adaptive Creativity and Innovative Creativity
▶ Age and Creative Productivity
▶ Creative Personality

▶ Freedom and Constraints in Creativity
▶ How does Material Culture Extend the Mind?
▶ Invention and Innovation as Creative Problem-Solving Activities
▶ Multiple Models of Creativity
▶ Nature of Creativity
▶ Psychology of Creativity
▶ Research on Creativity
▶ Strategic Thinking and Creative Invention
▶ Thinking Skills, Development

References

Abraham R, McKenna T, Sheldrake R. Chaos, creativity, and cosmic consciousness. 2nd ed. Rochester: Park Street Press; 2001.

Amabile TM. The social psychology of creativity. New York: Springer; 1983.

Anderson JV. Weirder than fiction: the reality and myths of creativity. The Executive. 1992;6(4):40–7.

Bechtholdt MN, De Creu CK, Nijstad BA. Motivated information processing, social tuning, and group creativity. J Pers Soc Psychol. 2010;99(4):622–37.

Boden MA. The creative mind: myths and mechanisms. 2nd ed. London: Routledge; 2004.

Brockman J, editor. The greatest inventions of the past 2,000 years. London: Weidenfeld & Nicolson; 2000.

Csikszentmihalyi M. Creativity: flow and the psychology of discovery and invention. New York: Harper Collins; 1996.

Ericsson KA. Creative expertise as superior reproducible performance: innovative and flexible aspects of expert performance. Psychol Inq. 1999;10:329–33.

Ferrari A, Cachia R, Punie Y. Innovation and creativity in education and training in the EU member states: fostering creative learning and supporting innovative teaching. Luxembourg: European Communities; 2009.

Fleming L, Mingo S, Chen D. Collaborative brokerage, generative creativity, and creative success. Adm Sci Q. 2007;52:443–75.

Gabora L. If experts converge on the same answer are they less creative than beginners? Redefining creativity in terms of adaptive landscapes. Kelowna: University of British Columbia; 2011. Retrieved from the Internet: http://arxiv.org/ftp/arxiv/papers/1106/1106.2265.pdf

Getzels JW, Jackson PJ. Creativity and intelligence: explorations with gifted students. New York: Wiley; 1962.

Goncalo JA, Staw BM. Individualism-collectivism and group creativity. Faculty publications – organizational behavior. Paper 1; 2005. http://digitalcommons.ilr.cornell.edu/obpubs/1

Jones BF, Weinberg BA. Age dynamics in science creativity. Proceedings of the National Academy of the United States of America (PNAS); 2011. http://www.pnas.org/content/early/2011/11/03/1102895108

jr Fasko D. Education and creativity. Creat Res J. 2000/2001;13(3&4):317–27.

Kim KH. Can only intelligent people be creative? A meta-analysis. J Second Gifted Educ. 2005;16(2–3):57–66.

Kipper DA, Green DJ, Prorak A. The relationship among spontaneity, impulsivity, and creativity. J Creat Mental Health. 2010;5(1):39–53.

Mihov KM, Denzler M, Förster J. Hemispheric specialization and creative thinking: a meta-analytic review of lateralization of creativity. Brain Cogn. 2010;73(3):442–8.

Preckel F, Holling H, Wiese M. Relationship of intelligence and creativity in gifted and non-gifted students: an investigation of threshold theory. Person Individ Diff. 2006;40(1):159–70.

Ruth JE, Birren JE. Creativity in adulthood and old age: relations to intelligence, sex and mode of testing. Int J Behav Dev. 1985;8(1):99–109.

Sawyer RK. Explaining creativity. The science of human innovation. Oxford: Oxford University Press; 2006.

Seel NM. Simon, Herbert A. In Seel NM, editor. The Encyclopedia of the Sciences of Learning. New York: Springer; 2012. pp. 3069–71.

Smolucha LW, Smolucha FC. A fifth Piagetian stage: the collaboration between analogical and logical thinking in artistic creativity. Vis Arts Res. 1985;11:90–9.

Stephan KE, Fink GE, Marshall JC. Mechanisms of hemispheric specializations. Insights from analyses of connectivity. Neuropsychologia. 2007;45(2–4):209–28.

Weisberg RW. Creativity: genius and other myths. New York: W. H. Freeman; 1986.

Wu CH, Cheng Y, Ip HM, McBride-Chang C. Age differences in creativity: task structure and knowledge base. Creat Res J. 2007;17(4):321–6.

Creative Music Education

▶ Using Movement, Music, and Humor - Creative Approaches to Enhance Student Engagement

Creative Pedagogy

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Synonyms

Creative teaching methodologies; System of creative teaching

Definition

Creative pedagogy is the science and art of creative teaching.

Introduction

If pedagogy in general is defined as the study of the process of teaching, then creative pedagogy is defined as the science and art of creative teaching (Aleinikov 1989). Creative pedagogy is a branch of pedagogy that emphasizes the leading role of creativity for successful learning. In its essence, creative pedagogy teaches learners how to learn creatively and become creators of themselves and creators of their future.

The functional definition of creative pedagogy is longer and more complex. The founding work on creative pedagogy gives a definition in the form of a formula of invention – a strict word pattern used to describe inventions for patenting:

> Creative pedagogy that includes educational influence on the learner for acquisition of certain study material (subject) [as pedagogy in general] and differing from the above by the fact that in order to achieve higher efficiency of learning, the pedagogical influence is provided on the background of centrifugal above-the-criticism mutual activity in which the learner is raised from the object of [pedagogical] influence to the rank of a creative person, while the traditional (basic) study material is transformed from the subject to learn into the means of achieving some creative goal, and the extra study material includes the description and demonstration of the heuristic methods and techniques. (Aleinikov 1989)

The first work on creative pedagogy was published in the *Bulletin of Higher Education* (Moscow, Russia), got noticed, and cited by numerous educators and innovative editions. The authors of *Encyclopedic Dictionary* not only included an article on creative pedagogy but also made some comments on its unusual form – the formula of invention (Popov 1995).

In its distilled methodological essence, as opposed to other pedagogies, creative pedagogy creates a creative learner who begins to create individual knowledge (learning techniques and methodologies), creative abilities (creativity techniques and methodologies, see ▶ Creativity Techniques), and finally innovative abilities (innovation techniques and methodologies), thus laying the foundations for life success.

The description of creative pedagogy includes its comparison with and contrast to the neighboring concepts, then discussion of the background, origins and development of the concept, and lastly the statement of some theoretical and practical achievements.

Differentiating Creative Pedagogy from Creative Education and Creative Teaching

The concept of creative pedagogy, on one hand, differs from the concept of creative education that is usually associated with teaching creativity as a subject. A very good example for this is the efforts of the Creative Education Foundation, Buffalo, NY, that serves to helping individuals, organizations, and communities transform themselves as they confront real-world challenges. Through well-organized efforts of this organization, creative education (education in creativity) is being spread around the world. As opposed to creative education in this particular sense, creative pedagogy (and creative andragogy) is specifically designed for teachers, professors, and education administrators. It aims at modifying the teaching process of any subject, whether it is arts, language, math, science, technology, and even the process of teaching creativity itself.

On the other hand, creative pedagogy as a concept is different from the concept of creative teaching that is usually emphasized in every good school. Creative teaching is actually the practice of teaching/learning that is more creative than traditional. As opposed to creative teaching, creative pedagogy is a philosophy, theory, and methodology with a theoretically predetermined sequence of activities that leads to the accelerated child's (or adult's) creative development – not just the teacher's own creative practice in the classroom. When this methodology is applied to any subject, it dramatically changes the process of teaching/learning and the results.

The concept of creative pedagogy has both historical (sociocultural) and etymological roots.

Historical and Etymological Roots

Etymological Analysis

The term creative pedagogy consists of two concepts. The word pedagogy derived from the Greek παιδαγωγέω (*paidagōgeō*) is combined of two roots:

1. παῖς (*país*, genitive παιδός, *paidos*) that means "child" – actually "boy"
2. άγω (*ágō, agogos*) that means "to lead." So literally it means "to lead a boy (a child)."

Historically, in Ancient Greece, παιδαγωγός was a slave (that could be a philosopher captured as a prisoner of war) who supervised the instruction of his master's son. This instruction could include taking the boy (girls received no public education) to school or gym, looking after him, carrying his musical instruments, and directing his behavior.

In English and other languages, the term "pedagogue" means a teacher who follows certain pedagogy, and pedagogy is used to refer to instructive theory. Pedagogy is studied at the universities by student teachers. Institutions that educate and train future teachers are called *pedagogical institutes*.

When Malcolm Knowles introduced the term andragogy (*andr*-, man; courageous + *agogos*, leader) and defined it as the art and science of teaching adults, the term pedagogy stepped down from the generic term to the complementary term, and there appeared a need in a new term – a generic term for "the art and science of teaching" (see below).

Note: For the etymological analysis of the word *creativity*, see ▶ Creativity.

Historical (Sociocultural) Roots

Different societies treat creativity differently (Ramos 2005), but whether named so or not, tolerated or not, it was still present in every new invention in technology, discovery in science, and methodology in education.

Creative pedagogy origins and ideas can be traced far back throughout history. Socrates, for example, instead of giving youth a one-time "wise advice" (as most wise men of the past and many teachers of all times do), asked engaging questions that led his interlocutors to profound answers. Actually, he was developing his contemporaries to the point they could *create* their own answer. Now it is called the Socratic Method.

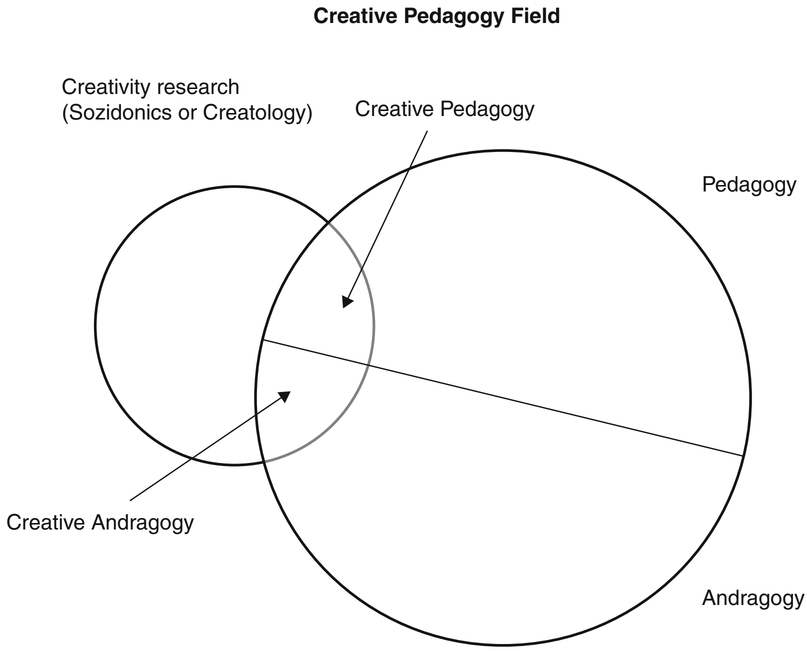
Just as this early prototype, creative pedagogy teaches students to *create* their own learning processes for continuous success in their lives.

Certain periods of history required certain pedagogies. History of education shows that the type of pedagogy usually depends on the needs of the society.

- Society of the ancient times needed followers. So the training expressed in the phrases, "Do after me! Do as I do!" worked best. This pre-pedagogy produced hunters, fishermen, gatherers, warriors, etc. Nowadays, it is known as "on the job training."
- In Ancient Greece, speakers were needed. Speakers were trained in rhetoric classes, in public discussions. Speech training pedagogies were used.
- Early capitalist society needed craftsmen and then workers. Technical schools were organized, and they employed training methodologies for technical teaching.
- Developed capitalism needed more knowledgeable professionals, like engineers, doctors, and teachers. As a response to this need, pedagogy of knowledge acquisition and testing spread to schools, colleges, and universities.
- The twentieth century put forward the need in problem solvers. Naturally, there appeared problem-oriented education as well as schools for creative problem solving. Creative pedagogy grew out of them to reflect and explain the trend.

All these types of pedagogy can be dominant at a certain time, but they do exist and coexist in contemporary education as well. This century, however, has been many times called the century of creativity and innovation, so as society matures, there are more and more creative

Creative Pedagogy, Fig. 1 Creativity research and education domains



people, and the need in educating such people is becoming more vivid. The emergence and growth of the creative class (Florida 2003) is a reality. That is why there appeared creative pedagogy as pedagogy aiming at the upbringing of a creator (a creative person) capable of meeting the constantly growing complexity and accelerating development of the society (Aleinikov 1999b).

In the field of education, creative pedagogy is opposed to critical pedagogy, just as creative thinking is opposed to critical thinking. While critical pedagogy calls for criticism (Giroux 2010) and actually aims at growing the number of political radicals (Searle 1990), creative pedagogy offers the philosophy, theory and methodology of constructive (creative) development for individual and society.

The twentieth century brought the creativity research to prominence, and it began to extrapolate to the other domains. Creative pedagogy is the result of extrapolating creativity research to the domain of education that includes pedagogy (teaching children) and andragogy (teaching adults, Knowles 1950, 1968). These concepts can be illustrated by the following picture.

Figure 1 illustrates how the field of creativity research and the field of education, divided into pedagogy and andragogy, make a cross section named creative pedagogy and creative andragogy.

Historically, creative pedagogy appeared in 1989 (Aleinikov 1989) – a year after creative linguistics (Aleinikov 1988a). Creative pedagogy was so successful that later its principles and practices were applied to adult education thus giving birth to creative andragogy. Creative pedagogy and creative andragogy together were generalized into creagogy (Aleinikov 1998) which is also depicted on Fig. 1.

Theoretical Foundations

If creative pedagogy could be seen as a structure, then as any structure it stands on some cornerstones.

- E. Paul Torrance and Torrance Tests of Creative Thinking Tests (TTCT)

  The first cornerstone for the building of creative pedagogy was the theoretical separation of creative thinking as opposed to critical thinking and then practical designing of Torrance Tests of Creative Thinking (Torrance 1974, see also ► Creativity Tests). The concept of critical thinking earlier gave birth to critical pedagogy (Giroux 2010; Searle 1990), while the concept of creative thinking paved the way for creative pedagogy.

- S. Parnes and Creative Problem Solving (CPS)

  The second cornerstone for the structure of creative pedagogy is creative problem solving (Parnes 1992) that developed and advanced the methods and techniques for a deliberate creativity in technology and social life. Creative pedagogy applied it for teaching.
- G. S. Altshuller and TRIZ

  The third cornerstone for the building of creative pedagogy was the development of Algorithm and Theory of Inventive Problem Solving (ARIZ/TRIZ) by G. Altshuller and many of his followers, including Azerbaijan Institute of Inventive Creativity (see ► Inventive Problem Solving (TRIZ), Theory). Their concepts (discussed below) and vision of the genius life strategies were fundamental for the growth of the creative pedagogy (Altshuller and Vertkin 1994).
- V. A. Moliako and Creativity Activation Methods

  The fourth cornerstone in the foundation of creative pedagogy was laid by Dr. V. A. Moliako who offered the description of the methods aiming at the activation of the person's creative thinking (Moliako 1985).

Summarizing the stated above, creative pedagogy is the result of generalizing the new achievements in the creativity research field (G. Wallas, A. Osborn, J. P. Guilford, S. Parnes, E. P. Torrance, etc.) and applying them to the processes of teaching – the field already developed by the best educators of the past like Jan Amos Komensky, Johann Heinrich Pestalozzi, Rudolf Steiner, Lev Vygotsky, Maria Montessori, Anton Makarenko, etc.

Creative pedagogy then matured with further discovery of the universal formula of creativity development (Aleinikova and Aleinikov 1991), ideal education, ideal learner, and ideal teacher models, thus contributing to the solutions of numerous educational problems.

The Main Components of Creative Pedagogy

The main components of creative pedagogy include philosophy, theory, and methodology of creative teaching.

Philosophy of Creative Pedagogy

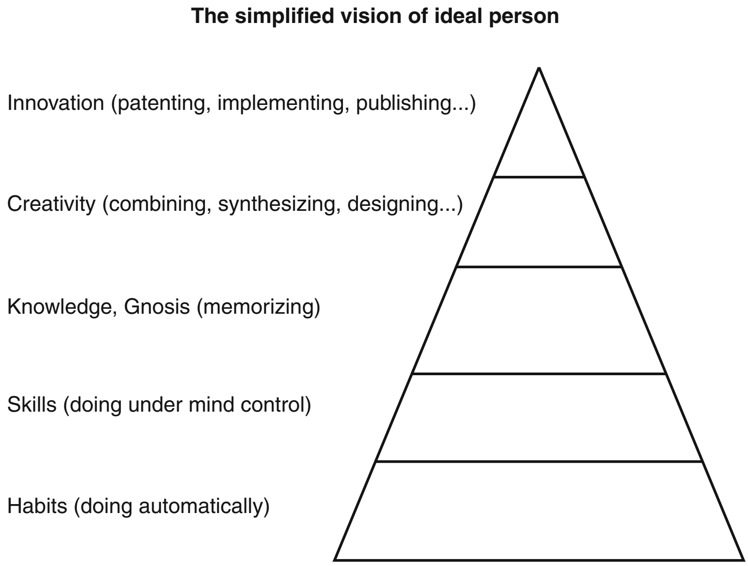
For the Humanistic Trend: Every human being is creative, but the rate (see ► Measurement of Creativity), the domain, and style of creativity (see ► Creative Styles) may differ. Nature generates newness on all levels, so the phenomenon of creativity existing at the psychological level of newness generation is natural. Creativity accelerates the natural newness generation process results which become greatly appreciated and valued by the social level (society). Therefore, research of this phenomenon by science (Sozidonics or Creatology, see ► Science of Creativity) and utilizing this research for the accelerated development of society is the trend in social life while accelerated development of creative ability in humans (creative education and creative pedagogy) is the next trend in education for the century of creativity and innovation, or the next step to ideal education (Aleinikov 1999b).

For the Religious Trend: God is the creator, and he created humans in his image. Therefore, people are designed and destined to be creative. People are the creators of the new world around them; thus, they can create new objects, new processes, and certainly they can create new educational systems, including new methodologies for developing creativity to the higher levels. God is the ideal, so striving for this ideal is the human being's mission. The more creative, the closer to the ideal!

Theory of Creative Pedagogy

The first and foremost achievement of creative pedagogy is the determination of the core feature, or the main link in the success of any education – interest – and development of the steps to maintain this interest till it becomes the internal (self) motivation of the person. For this purpose, creative pedagogy employs the

Creative Pedagogy, Fig. 2 Ideal person model



universal formula of creativity development (Aleinikov and Aleinikova 1990, 1991) and introduces the models of ideal learner and ideal teacher that participate in the process of ideal education (Aleinikov 1999a). The formula and models are based on the universal **model of sign**, language, speech act, and heuristic act (Aleinikov 1988b, see ► Creative Linguistics) that led to the creation of ideal person and ideal education model (Aleinikov 1999a).

Ideal Person Model

To avoid complex graphs, this article offers a simplified vision of an ideal person.

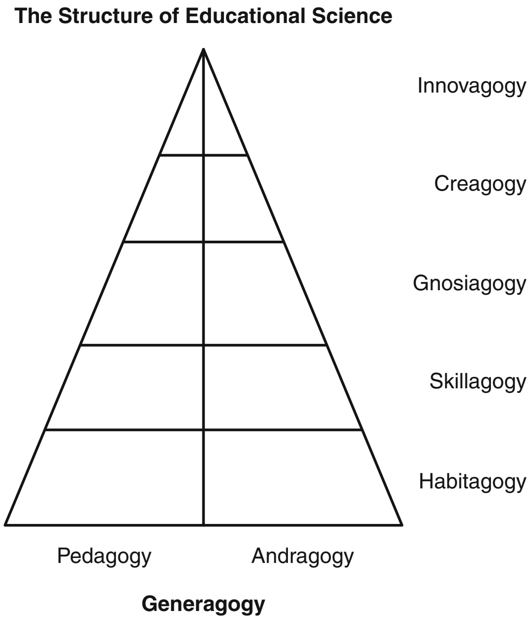
The model on Fig. 2 illustrates that a child (baby, toddler, teen, adult) learns:

- Habits (looking, crawling, walking, etc.), then based on them
- Skills (playing toys, reading, writing, counting), then based on them
- Facts and theories (studying, testing, etc.), then based on them
- Combining and synthesizing patterns and models (problem solving, designing, modeling) then based on them
- Presentation methods and techniques for delivering newness to the society

The teaching methodologies for these five levels are different. The first in the pyramid level (habit) requires 100–1,000 repetitions. When applied to adults, it is called a drill, even more negatively, a rot. The second level (skills) requires 10–100 repetitions. It is usually referred to as training. The third level (knowledge) requires 1–10 repetitions. Some students can remember things after one-time presentation; some others need more. The next level up (creativity or creative act) occurs only once – there is no such a thing as creating the same thing by the same person for the second time. Teaching creativity is teaching how to make these one-time creative acts more often or at will. The teaching methodologies for this level are discussed below. Finally, innovation is an act of transferring the result of creativity to the society in a real-life situation.

Ideal Education Model

So the activity of leading (*agogos*) human beings through these stages is an education process. For the childhood period, there is pedagogy to explain this process. For adult education, all ages after childhood, there is andragogy to explain the process. When andragogy split from



Creative Pedagogy, Fig. 3 Educational science model

pedagogy and proved its right for existence, it became obvious that from the logical point of view a generic term is needed to include these two branches. That is why the term generagogy (*generalis*, common + *agogos*, leading) was offered to embrace both (Aleinikov 1998).

Now, based on the above model of ideal person (Fig. 2), the simplified vision of education domain looks like the following:

As you see from the model on Fig. 3, pedagogy and andragogy (split since 1950s) are united back by the generic science of education – Generagogy (below). In the same manner, creative pedagogy and creative andragogy are united into the generic science of creative teaching – creagogy (fourth from below).

IdeaLearner = Ideal Final Result in Education

The concept of ideal person, shown above on Fig. 2 (above), requires progressing through the steps of development via education. This progression naturally leads to the concept of an ideal learner (or IdeaLearner©).

All terms that include the term "ideal" are derived from the concept of ideal final result (IFR), which is widely mentioned in the works of G. S. Altshuller who offered the Algorithm of Inventive Problem Solving (ARIZ) and then the Theory of Inventive Problem Solving (TRIZ) – for details, see ▶ Inventive Problem Solving (TRIZ), Theory. The IFR method proved to be a powerful approach in solving technical problems (Altshuller 1986).

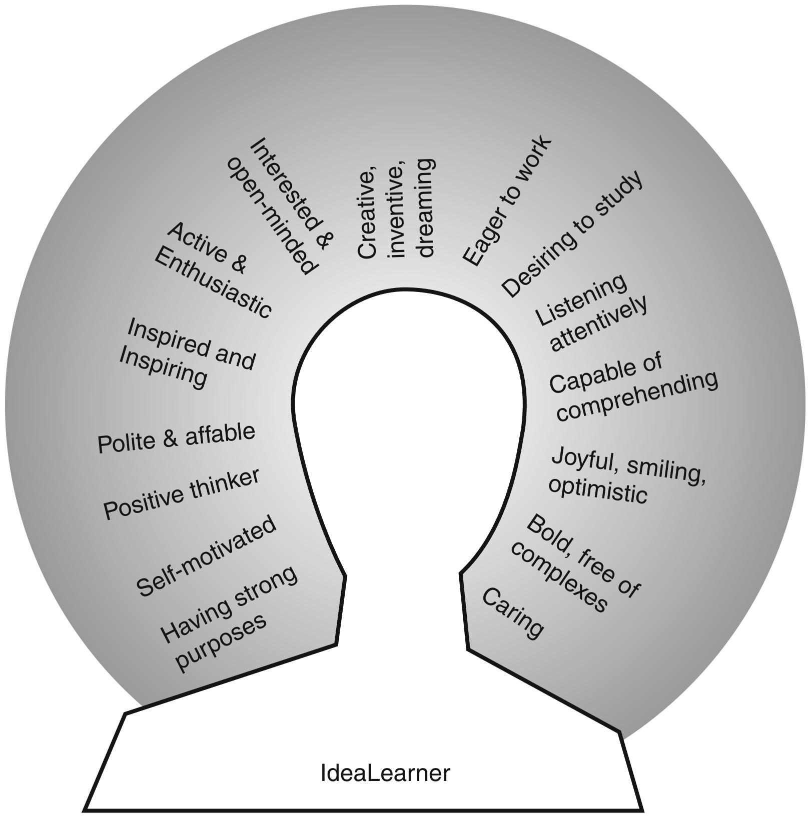
In technology, the idea of perpetual motion machine is one of the most famous IFRs. Though such a machine has never been built, so many outstanding technical discoveries were made and physical processes described in the attempts to make it, that this example alone can corroborate the value of the quest for the "impossible" (ideal).

Similarly, in ethics and ideology, religion is still one of the most powerful IFRs. With some vision of the "ideal" (or divine) in their minds, people strive for it, and though not a single one of them can become equal to their ideal, the results achieved trying to obtain the ideal can be powerful.

If the results of employing IFR are so impressive in technology and ethics, why not use the same idea or concept in education? Creative pedagogy does employ this method by empirically (in classes with teachers and education administrators) collecting and selecting the characteristics of an IdeaLearner.

Prioritizing these characteristics helped educators to understand that the basic feature determining the others is creativity. If a person is creative, he/she is interested, listening, active, self-driven, joyful, open-minded, and eager to work. Creativity is not only the basic feature but also the moving force of gaining knowledge. True creators are enormously laborious learners. Thomas Edison, Marie Curie, Johann Goethe, Ludwig van Beethoven, Albert Einstein, Wolfgang Amadeus Mozart, etc., have been learners for their entire lives because they needed more and more knowledge for their creations. The variant picture of an IdeaLearner is shown on Fig. 4.

The ideal learner model depicted on Fig. 4 shows the empirically gathered characteristics that teachers under training ascribed to the best learner possible. The prioritizing and putting the



Creative Pedagogy, Fig. 4 Ideal learner (IdeaLearner) model

features like "creative/inventive" to the top of the list has been done after elaborated discussion and voting because if the learners are creative, they are interested and open-minded, active, enthusiastic, inspired, eager to work, etc. On the other hand, if they are "bold and free of complexes" but destructive (instead of being creative), they might be a trouble for the class and the school.

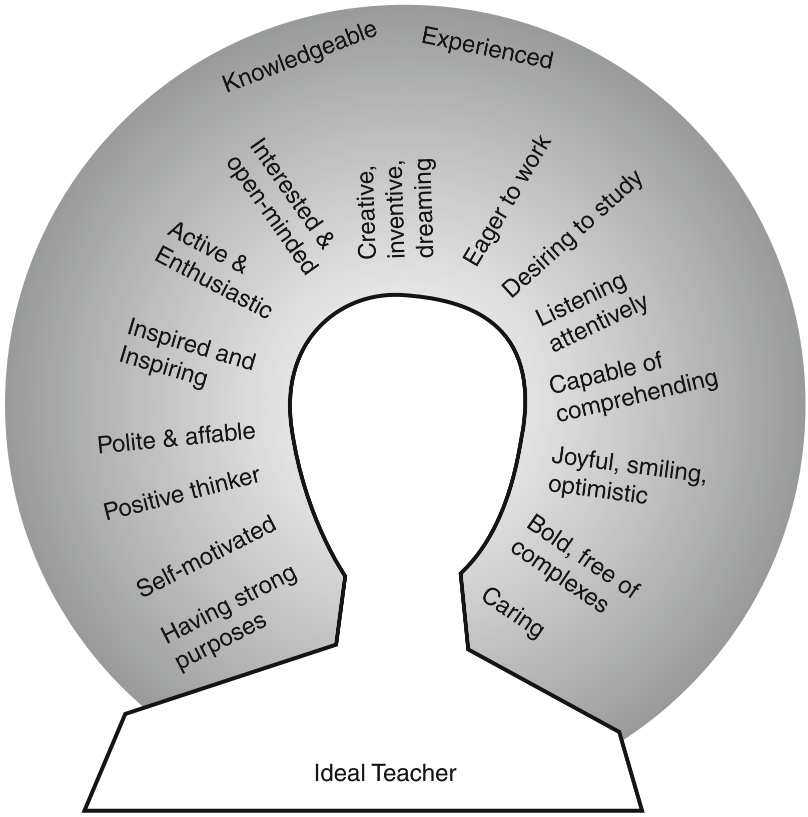
Ideal Teacher

The question, where the ideal learner comes from, leads to the answer – from an ideal teacher. Collection and selection of characteristics of ideal teacher, to the surprise of many teachers, gave the same features as ideal learner plus only two features: experience and knowledge. A model of the ideal teacher can be seen on Fig. 5.

The ideal teacher model depicted on Fig. 5 shows characteristics empirically gathered by a different group of teachers and ascribed to the best teacher possible. The prioritizing and putting the features like "knowledgeable" and "experienced" to the top of the list as features differentiating a teacher from learner has been done unanimously.

When compared, these two lists of characteristics coincide with all groups trained. When presented in the form of the table, they look like that (Table 1).

Very naturally, the teachers under training come to the conclusion that in order to have ideal students in the classroom, they themselves have to be ideal teachers! If they are, then the ideal teaching/learning process becomes the process of creation. The ideal final result of ideal teaching/learning is to make another individual a creator of one's knowledge, of one's surrounding, a creator of one's own life, and a creator of new reality of the future. This is an exciting, joyful process of active, interested participation in transferring knowledge, skills, and habits with the purpose of making a self-learner, a doer (maker),



Creative Pedagogy, Fig. 5 Ideal teacher model

Creative Pedagogy, Table 1 The comparison of ideal learner and ideal teacher characteristics

Ideal learner	Ideal teacher
Interested and open-minded	Interested and open-minded
Active, ready to take knowledge and initiative	Active, ready to take knowledge and initiative
Desiring to study	Desiring to study (and teach)
Listening attentively	Listening attentively
Capable of comprehending material	Capable of comprehending material
Joyful, smiling, optimistic	Joyful, smiling, optimistic
Eager to work	Eager to work
Inspired and inspiring the others (charismatic)	Inspired and inspiring the others (charismatic)
Polite, socially positive, affable, communicable	Polite, socially positive, affable, communicable
Self-driven or self-motivated	Self-driven or self-motivated
Having strong purposes	Having strong purposes
Creative, inventive, and capable of dreaming	Creative, inventive, and capable of dreaming
Bold and free from psychological complexes	Bold and free from psychological complexes
Caring about the others (loving)	Caring about the others (loving)
Positive thinker (deep thinker, true believer)	Positive thinker (deep thinker, true believer)
Capable of kindling the light	Capable of kindling the light
–	*Knowledgeable*
–	*Experienced*

Creative Pedagogy, Fig. 6 Creative pedagogy methodologies

CREATIVE PEDAGOGY
Three-level methodology

Object-oriented methods (OOM)

- Morphological analysis
- BAMMA (Brainstorming Advanced by Morphological Matrix Analysis)
- Focal object
- Fantastic analogy
- Personal analogy
- Symbolic analogy
- Title (+ Non-scientific cut)
- Check list
- Semiotic modeling
- Dynamization
- Vitalization

Subject-orients methods – open (SOM-o)

- Method of paradox pedagogic inversion
- Method of extra difficulties
- Method of time limitations
- Method of space limitations
- Method of substance limitations
- Method of stupid limitations
- Method of extra variants
- Method of dramatization
- Method of absurd
- Method of unexpected prohibitions
- Method of insufficient information
- Method of excessive information

Subject-oriented methods – closed (SOM-c)

- Omitation – universal method of creativity formation
- Method of highest (genius) orientation
- Method of applied nonverbal dominance

and a creator. The process creates an ideal learner and the bright future for this ideal learner – the path to the ideal person achievements.

After creating this theoretically "ideal" picture of education, creative pedagogy can be put into practice by using its methodologies.

Methodologies of Creative Pedagogy

Since encyclopedia article is limited in space and should avoid detailed descriptions, this article addresses three layers of methods as they are explained to teachers in metapedagogy (teacher training):

- Methods that teach a learner work with an object (process). They are called object-oriented methods. The majority of them was taken from creative problem-solving techniques (see ▶ Creativity Techniques) and then adjusted for *any* subject.
- Methods that teach a teacher to influence the learner, to open the mind, to activate the mind, and to make the person interested. They are called subject (individual)-oriented methods. The majority of them was borrowed from the work of Moliako and then developed further. These methods are open – it means in the process of learning, a teacher can explain what happened in the classroom and how the process influenced the learner. The learner actually learns these methods.
- Methods that are also subject (individual)-oriented, but they are taught only to teachers in Creative MetaPedagogy (Aleinikov 1992).

Figure 6 illustrates the methodology as it is presented to teachers. It illustrates the levels of influence and the arsenal of the teacher. All methods, except closed ones are revealed to students. Some of the methods in the methodology developed by predecessors of creative pedagogy; the other are designed within creative pedagogy.

The first layer of methods shown on Fig. 6 among object-oriented methods (OOM) includes not only well-known creativity boosting techniques such as brainstorming and focal object (see ▶ Creativity Techniques) but also developed by the author methods like BAMMA, leading to MegaCreativity (Aleinikov 2002). The group of methods in the second layer (SOM-o) includes not only techniques designed and described by Moliako but also new methods like paradox pedagogic inversion (teaching from difficult to easy, from complex to simple which contradicts all educational principles). Finally, all methods of the third layer (SOM-c) constitute the unique innovative contribution of creative pedagogy to the field of pedagogy. The power of these methods is so high that they form the foundation of Genius Education Methodology (see ▶ Genius). For more detailed description of these methods, please see Teaching for Success, an online magazine for professors, which published and republished (as "classics") the most powerful of these methods (Aleinikov 2007, 2008).

Practical Applications

As *The Encyclopedia of Creativity* article on Humane Creativity states, "Creative Pedagogy, as a trend in science, generalizes and explains everything from music and art classes to creatively oriented courses so thoroughly gathered and precisely described by Alex Osborn." Creative pedagogy generalizes:

- Art (creativity) classes
- Technical creativity
- Psychology of creativity (see ▶ Psychology of Creativity)
- Creative problem solving (CPS)
- Creatively oriented courses (so thoroughly collected by A. Osborn) (Aleinikov 1999b).

The Spread of the Term and Perspectives

Since 1990s, after the first publications in India (Aleinikov 1990), creative pedagogy and then creative metapedagogy (teaching teachers how to teach creatively) has spread around the world.

Some examples of the first creative pedagogy applications include:

- Creatively oriented Linguistics, Military Institute, Moscow, Russia, 1984–1992
- Creative Management, Center for Creative Research, Russian Academy of Sciences, Moscow, Russia, 1990–1992
- Word Origins and Usage (ENG2210), Effective Communication (COM1110), Psychology of Creativity (PSY3390), Foundations of Creative Education (EDU6625), Troy University, Montgomery, Alabama, 1994–2006

By 2010, creative pedagogy and creative metapedagogy in the form of numerous programs for teachers, managers, and educational and business leaders, spread from the USA to Pakistan, Singapore, South Africa, and Thailand. It has been successfully applied to:

- School education (e.g., New Challenge School, Montgomery, Alabama; Franklin Junior High School, Franklin, Ohio; Jiemin Primary School, Singapore, etc.)
- Postsecondary education (five colleges in Russia, higher education institutions, like Military Institute, Moscow; Troy and Auburn Universities, Montgomery, Alabama; Defense Language Institute, Monterey, California)
- Teacher and professor professional development (The University of Cincinnati, Ohio; United States Air Force Junior Reserve Officer Training Corps (USAF JROTC) Instructors, Garmisch, Germany, and Maxwell AFB, Montgomery, Alabama; Davis and Elkins College, Elkins, West Virginia, Teachers' Centers in Bangkok, Thailand; Karachi and Islamabad, Pakistan; Principal education in Pretoria and Johannesburg, South Africa, as well as universities, colleges, schools, and officials of the Ministry for Education, Singapore).

The results of applying creative pedagogy to real education problems are more than positive. In Singapore, for example, the Jiemin Primary School officials selected 13 sixth graders (out of 1,200 students) who were labeled “incorrigible and doomed to fail.” After 2½ days of pedagogical intervention, all students proved to be what Creative Pedagogy calls “ideal learners,” and. . .seven months later (without any follow-up), they passed all four state exams (Math, Science, English, Mother tongue) and proceeded to the next level of academic education, thus leading to 100% success of the program. Teachers and parents called it a “miracle” (Aleinikov 2003).

In Russia, where the description of creative pedagogy was developed, it turned most “boring” university programs into outstanding ones as well as moved some colleges from the bottom of the list to the top of the list.

The term creative pedagogy that was so new in late 1980s has become popular. Now it is used for educational conferences and monograph titles. Creative pedagogy received further development as “collective creative pedagogy” by I. P. Ivanov. The methodologies of creative pedagogy are taught and studied at the university level (Kruglov 2002; Morozov and Chernilevsky 2004).

B. Zlotin and A. Zusman, the TRIZ specialists, state, “Creative pedagogy is an attempt to replace the battle between the teacher and students with the child’s struggle for self-perfection. The teacher is the child’s assistant and ally in this struggle” (Zlotin and Zusman 2005).

At present, a new electronic Encyclopedic Reference Dictionary on Creative Pedagogy (russ. Энциклопедический словарь-справочник “Креативная педагогика”) is being developed by a group of researchers headed by V.V. Popov in Russia (retrieved from http://www.thisisme.ru/ Aug 25, 2012).

Since creative pedagogy provides the philosophy, theory, and methodology of creative teaching, it is also becoming an educational movement for positive change in schools.

Conclusion and Future Directions

Creative pedagogy that appeared on the cross section of creativity domain and education domain is defined as the science and art of creative teaching. As a branch of pedagogy, it emphasizes the leading role of creativity for successful learning. It teaches learners how to learn creatively become creators of themselves and creators of their future. In over 20 years of existence, creative pedagogy with its specific philosophy and methodology of creative teaching, its own models of ideal learner, ideal teacher, and ideal learning/teaching process led to solving numerous educational problems and experienced a widespread to a number of educational institutions from kindergartens to universities in many countries. The most remarkable impact is not only changing pupils (students) but also igniting the creative spark in teachers and principals (creative metapedagogy) which quickly leads to the change of atmosphere and institutional improvement. Since creative pedagogy provides a sound theoretical and practical foundation for change at school, it is also becoming an educational movement for positive change in schools.

The future directions of development include the continuous spread of the ideas and values that creative pedagogy already contributed to the field of education to new communities and new countries (see ▶ Creativity Across Cultures). The future directions of research include collection of empirical data from international sources, evaluation of general impact on the global scale, comparison of the generalized data to the established theoretical model, review and modification of the theoretical model, and finally the publication of the overall results for education researchers as well as popularized version for general population.

Cross-References

▶ Creative Linguistics
▶ Creative Styles
▶ Creativity Across Cultures
▶ Creativity Definitions, Approaches
▶ Creativity Techniques

- ▶ Creativity Tests
- ▶ Genius
- ▶ Inventive Problem Solving (TRIZ), Theory
- ▶ Measurement of Creativity
- ▶ Psychology of Creativity
- ▶ Science of Creativity

References

Aleinikov AG. On creative pedagogy. Higher Educ Bull. 1989;12:29–34. russ. Алейников А.Г. О креативной педагогике. Вестник высшей школы.

Aleinikov AG. Creative pedagogy and creative metapedagogy. Progress in Educ. 1990;65(12):274–80.

Aleinikov AG. Creative metapedagogy: D-day. Alma-Mater. Higher Educ Bull. 1992;1:34–9. russ. Алейников А.Г. Креативная мета-педагогика. Время "Ч". *Alma Mater*. Вестник высшей школы.

Aleinikov AG. Creative Pedagogy+Creative Andragogy =Creagogy (How to create a creator). Paper presented at the IX International Conference on Creativity in Universities and Colleges. Midland, Michigan: The Alden B. Dow Creativity Center; 1998, July.

Aleinikov AG. Mega-creator: From creativity to mega-, giga-, and infi-creativity. Montgomery, Alabama: MIMII; 1999a.

Aleinikov A. Humane creativity. In: Runco MA, Pritzker SR, editors. The encyclopedia of creativity, vol. 1. San Diego/London/Boston/New York/Sydney/Tokyo/Toronto: Academic; 1999b. p. 837–44.

Aleinikov A. Megacreativity: five steps to thinking like a genius. Cincinnati: Walking Stick Press; 2002.

Aleinikov AG. New horizons in creative & innovative education: Genius Education Methodology helps creating a Nation of Geniuses. Human dignity and humiliation studies; 2003 (retrieved from http://www.humiliationstudies.org/news-old/archives/000039.html June 2012).

Aleinikov AG. Creative linguistics (foundations, problems and perspectives). In: Sorokin YuA, Tarasov EF, Ufimtseva NV, editors. Language awareness: stereotypes and creativity. Moscow: Institute of linguistics, USSR Academy of Sciences; 1988a. p. 77–89. russ. Креативная лингвистика (обоснование, проблемы и перспективы). Языковое сознание: стереотипы и творчество.

Aleinikov AG. Sign. Four-side essence. Universal creative model. In: Sorokin YuA, Tarasov EF, Ufimtseva NV, editors. Language awareness: stereotypes and creativity. Moscow: Institute of linguistics, USSR Academy of Sciences; 1988b. p. 89-115. russ. Знак. Четырехсторонняя сущность. Универсальная креативная модель. Языковое сознание: стереотипы и творчество.

Aleinikova EN, Aleinikov AG. The stages in creativity development: options for universalizing the methods. In Shmakova LE, Malovichko VS, editors. Creative Management. Vol. 1. Moscow: Creator, Center for creative research, Russian Academy of Sciences, 1991; p. 269–96. russ. Алейникова ЕН, Алейников АГ. Этапы формирования творчества: возможность универсализации приемов. Креативный менеджмент.

Aleinikov AG, Aleinikova EN. Forming creativity: Psycho-pedagogic and Creative Linguistics aspects. In Y. Sorokin YuA, Tarasov EF, Ufimtseva NV, editors. Structures of language awareness. Moscow: USSR Academy of Sciences, Institute of Linguistics; 1990, p. 70-96. russ. Алейникова ЕН, Алейников АГ. Формирование творческой активности: психо-педагогические и креативно-лингвистические аспекты. Структуры языкового сознания

Aleinikov AG. Openness – It's that simple. Republished by Teaching for Success (TFS) as "The TFS Classic" 2007; 8 (5) and (6), p. 15. First published in 1997.

Aleinikov AG. How GEGA (Genius expectations - genius achievements) supercharges learning, Teaching for Success, 2008;19 (4), p. 1-2.

Altshuller GS. To find an idea. Novosibirsk: Nauka; 1986. russ. Альтшуллер Г.С., Найти идею.

Altshuller GS, Vertkin IM. How to become a genius. The life strategy of a creative person. Minsk: Belorussia; 1994. russ. Альтшуллер Г. С., Верткин И. М. Как стать гением: Жизненная стратегия творческой личности.

Florida R. The rise of the creative class. North Melbourne: Pluto Press; 2003.

Giroux HA. Lessons from Paulo Freire. The chronicle of higher education (Oct 17, 2010, Retrieved 11/14/11); 2010.

Knowles MS. Informal adult education: a guide for administrators, leaders, and teachers. New York: Association Press; 1950.

Knowles MS. Andragogy, not pedagogy. Adult Leadership. 1968;16(10):350–2. 386.

Kruglov JG, editor. Creative pedagogy: methodology, theory, practice. Moscow: Center "Alfa"; 2002. russ. Креативная педагогика: методология, теория, практика. Под ред. Ю.Г. Круглова.

Moliako VA. Technical creativity and labor upbringing. Newness in life, science and technology. Ser Pedagogy Psychol. 1985;6:20–1. russ. Моляко, В.А. Техническое творчество и трудовое воспитание. Новое в жизни, науке и технике. Серия "Педагогика и психология", 6, 1985, 20–21.

Morozov AV, Chernilevsky DV. Creative pedagogy and psychology. Academic Project; 2004. russ. Морозов А.В. Чернилевский Д.В. Креативная педагогика и психология, Академический проект.

Parnes SJ, editor. Source book for creative problem solving. Buffalo: Creative Education Foundation; 1992.

Popov VV. Creative pedagogy. In: Polovinkin AI, Popov VV, editors. Encyclopedic dictionary "Technical creativity: theory, methodology, practice." Moscow: Logos; 1995. p. 165–7. russ. Попов В.В. Креативная педагогика. В энциклопедическом словаре "Техническое творчество: теория, методология, практика". Под ред. А.И. Половинкина, В.В. Попова.
Ramos SJ. Cross-cultural studies of implicit theories of creativity: a comparative analysis between the United States and the main ethnic groups in Singapore. Unpublished master's thesis. New York, Buffalo, N.Y: State University; 2005.
Searle J. The storm over the University, The New York Review of Books, Dec 6, 1990.
Torrance EP. Torrance tests of creative thinking. Bensenville: Scholastic Testing Service; 1974.
Zlotin B, Zusman A. TRIZ and pedagogy. Southfield: Ideation International; 2005.

Creative Performance

► Effects of Intuition, Positive Affect, and Training on Creative Problem Solving

Creative, or a Behavior Problem?

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Synonyms

Creativity and behavior problems

Introduction

A creative personality is closely related to certain personality types, various classifications developed over the past half-century. Personality classifications have neurological bases, though sociocultural factors also influence a person's personality type. Different personality types are not positive or negative. Rather, individuals with particular personality types have particular dispositions. Those dispositions are better suited for some contexts than for others. Evaluation of a personality, such as a creative personality, depends upon context. In many settings, the traits of a creative personality are highly valued, but in others criticized. For example, as schools are currently constituted, many traits common to creative personalities are often perceived negatively. Awareness of what common characteristics of a creative personality are may reduce negative evaluations of creative dispositions and might lead to enhanced mentorship of creative children.

Personality Types: Type A, Type B, and Type T

An individual's personality type influences their creative behavior. One of the more commonly referred to personality typologies is that of Meyer Friedman and Ray Rosenman, American cardiologists; in 1959, they developed the theory of Type A and Type B personalities. A Type A personality shows angry and impatient behavior, which raises their risk of heart attacks. "Type A" individuals are competitive, driven, and stressed, and are workaholics. The Type B personality is relaxed, patient, and friendly.

Another classification of personality is that of Frank Farley: Type T, the thrill-seeker. Farley (1983) spent decades interviewing mountain climbers, marine adventurers, balloonists, and skydivers and explained that these people shared some element of Type T personality. They thrive on challenge and are self-confident, believing that they can control their destiny. Often notorious rule breakers, they are hungry for constant variety; sheer repetition would drive them crazy. Farley explained that many of the world's daredevils, doers, and delinquents, whether scientists, criminals, or mountain climbers, share a common Type T personality.

Low Arousable Individuals and Type T Personality

Arousal refers to cortical activation. Individuals fall on a spectrum of low- to high-cortical activation. Arousal has a negative relationship with stimulation seeking (for example, someone with low-cortical activation seeks high degrees of stimulation seeking). Farley (1983) explained that low arousable individuals have thought processes that have greater flexibility and greater transferability between modes of cognitive representation. Their thought processes also have greater interrelatedness of cognitive process, more emphasis on parallel (as opposite to serial) processing of information, greater simultaneous (as opposite to successive or sequential) processing, and greater functional dependencies among processing. Highly arousable individuals process information in an opposite way to the Type T personality individuals. Type T personality individuals respond quickly with no careful examination, and they make frequent errors. Highly arousable individuals, on the other hand, evaluate problems and possible solutions slowly, and they commit few errors. Research shows that this reflection and impulsivity dimension is stable in elementary school children. Reflective individuals are low stimulation-seekers, and they are less active out of doors, less distractible in a classroom, and less impulsive in problem-solving situations than impulsive individuals. In contrast, impulsive individuals are high stimulation-seekers, and they are more restless than reflective individuals (Kagan and Rosman 1964).

Various Kinds of Type T Personality

Farley (1986) indicated that national differences in Type T personality can be identifiable, and the United States can be characterized to "Type T nation." Farley explained that Type T personality is more biologically based than psychologically. They are driven by temperament to a life of constant stimulation and risk-taking. Farley suggested that Type T personality includes T-mental, T-physical, and T-balanced: A T-mental is for an individual whose stimulation seeking is cognitive or psychological, a T-physical is for an individual whose stimulation seeking is physical, and a T-balanced is for an individual who is balanced in the relative role of mental versus physical stimulation seeking. Farley also discussed T-positive and T-negative personalities. Both socially useful (positive) and socially appalling (negative) Type T personality individuals reject the strictures and rules, pursuing the unknown or uncertain. They seek thrills, stimulation, excitement, attention, and arousal. They are risk takers, unruly, and get into more trouble. Thus, Type T personality leads to specific human behaviors including creativity, aesthetics, crime, drinking and drug taking, human sexuality, and others.

Jung's Personality Types and Type T Personality

Research shows that intuitive type individuals have a positive attitude and higher degrees of tolerance for complexity and that they enjoy using their mind and open-ended instructions. Type T personality is related to Jung's *intuitive* type in that these individuals are drawn to complexity and novelty, which are important features of the Type T personality.

Introversion-extroversion is a way of relating to an object, the world, and people. Extroverts are not necessarily stimulation-seekers but rather are defined as having an objective view of the world. Farley explained that *extroverts* are high risk-taking, frequent alternation behavior, greater alcohol and cigarette consumption, greater extent of physical movement, less stimulus-deprivation tolerance, and greater pain tolerance as compared to introverts. With greater inhibitory potential of the extroverts compared to the introverts, the extroverts seek arousal-producing stimuli in order to maintain some optimum level of arousal potential, whereas introverts attempt to avoid arousal-producing stimuli. Jung suggested that especially the extroverted intuitive type, rather than the introverted intuitive type, feel imprisoned by the very activities and projects that may have earlier been so satisfying, and that neither reason nor fear would prevent them from pursuing a new challenge (Myers and Myers 1980). This disposition is similar to

Type T personality. Jung believed that the extroverted intuitive types are very important because of their initiative and ability to promote new enterprises. However, he was concerned that some extroverted intuitive types misspent their energy.

Additionally, the *perceptive* type individuals also are related to the Type T personality in that the perceptive type individuals prefer a flexible and spontaneous way of life to a planned, decided, and orderly one (Myers and Myers 1980). Type T personality also has the preference for change and variety.

Creativity with Positive and Negative Type T Personality

Eisenman (1991) explained that people usually think of creativity as a good thing, but creativity can help a few individuals and can hurt others, which is similar to Type T-negative personality. Creativity involves being different or doing something different than what is done by most people. Deviance can be positive and negative because it means being different and thus, the deviance inherent in creativity can be stigmatized and its perpetrator dealt with in a negative way, receiving punishment and scorn. Arousal influences both creativity and delinquency, and the relationship between arousal and stimulation seeking strongly influences behavior and cognitive processes. Therefore, the very qualities that cause creative individuals to have problems facilitate their creative accomplishments.

The characteristics of creative people can be viewed as positive or negative. For example, is a creative person imaginative or bizarre? Robert Frost, society has decided, was imaginative, but in school, he daydreamed and he was eventually dismissed. Also imaginative, Frank Lloyd Wright daydreamed so much that often people had to shout at him just to get his attention. Albert Einstein is remembered for some of his bizarre behaviors. Are creative people persistent or stubborn, high energy or hyperactive, verbally expressive or overbearingly talkative, emotionally sensitive or emotionally unstable, stubborn and rebellious, curious or annoying, spontaneous or impulsive? In her day, Madame Curie showed the very unlady-like traits of both stubbornness and rebelliousness – without which her creative potential would never have borne fruit. Thomas Edison experienced problems in school, in part because of his high energy. Samuel Taylor Coleridge demonstrated restlessness and verbal diatribes. Virginia Woolf talked too much. Van Gogh is remembered for some of his emotionally unstable behaviors. Nikola Tesla's tendency to act out of curiosity and spontaneity found him plunging from the roof of a barn clutching an umbrella, being chased by angry hogs, and nearly drowning in a vat of hot milk, among other misadventures.

Creative Personality in Schools

The above approaches to examining creativity consider the question from the perspective of relationships, scientifically measured, between certain types of personality and creativity. The connection between the two can be considered at a more day-to-day level: in schools, students who are creative are often considered "troublemakers." Teachers who fail to recognize the highly creative capacity of certain children and instead labeling these children as problems may be making the situation worse, both for the teachers and for the students.

As currently constituted, most schools function to homogenize students; schools have industrial timetables, uniform curricular expectations, and numerous rules that children are expected to follow. One of their primary goals is to be a place where the culture and values of society are transmitted to students; those students who most quickly and thoroughly adopt these values tend to excel in the school environment, both among teachers and peers. Teachers themselves have particular personality biases that reflect the conservative and self-reinforcing nature of schools. According to the Myers-Briggs Type Indicator, a commonly used personality preference test based upon the theories of Carl Jung, 56 % of American teachers are "SJs." SJ reflects a bias toward *Sensing* and *Judging* and, as a personality type, reflects a preference for rules, order, stability, and maintenance of the status quo. Even though SJs make up only 38 % of the general population of American society, 56 % of teachers in American public schools are SJs, reinforcing the conservative, convergent nature of schools (Duck 1996). Thus, when children come to school, regardless of their creativity or tendency toward divergent thinking, they are confronted with a system designed to homogenize and teachers largely eager not to challenge the system but to reinforce it. In this context, many creative children are isolated or, worse, labeled "problem children" because they buck the system, try to evade the rules, or take pleasure in seeing exceptions to the rule.

Teachers often make this situation worse. Despite having completed teacher training programs, many teachers in public schools are given woefully limited time to reflect on the purposes of education and the assumptions of educational philosophies. As a result (and especially reinforced because of their tendency to be SJs), classroom instruction tends to be essentialist in philosophy, direct instruction in approach. For mature, focused, and motivated students, such instructional approaches may be satisfactory. However, for any student who struggles to "sit still" (that is, is high energy), unfocused (has a divergent thinking tendency or tendency to imagine things), or who has lost motivation (because of years in schools that have not rewarded their tendency), contemporary American schools challenge them to the very core of their being. For their high energy, they are punished and forced to "sit still"; for their divergent personalities and minds, they are labeled "trouble" in a social context, "wrong" in an authoritarian Essentialist intellectual context. Finally, these students are viewed as lazy or unmotivated. In other words, creative students or students with tendencies toward creativity do not fit in and are often labeled "problem children."

Instructional practices of teachers tend to reinforce this negative labeling process. Despite decades of research demonstrating that teachers should frequently use alternatives to direct instruction models, many teachers today continue to rely on instruction grounded in the idea that the purpose is to deliver information. Students are expected to sit and listen, take notes, and regurgitate information. Students for whom such approaches are not a comfortable fit, due to personality, maturity, or creativity, often are perceived as problem children. Boys, in particular, who generally lacked the maturity of girls and who are not in the same degree socialized *to please*, often find these instructional approaches difficult to bear. As a result, many boys have been identified as problems, an appellation that has led to a proclaimed "boy crisis" in schools (Thompson 1999, 2009; Pollack 1998). However, creativity in instruction and honoring creativity in students can diminish the perception of the problem, raising the question whether the problem inheres in the students or in the teachers. In a multiyear, empirical study based upon schools in six countries, Reichert and Hawley found that if teachers are creative in their instruction, boys feel greater attachment to learning (2010). Identified were three factors that give meaning to instruction, enhance student responsiveness, and lead to greater achievement: transitivity, elicitation of student responsiveness, and positive relationships (mentorship). From this perspective, the problem is not the boys (and their energetic or creative behavior), but rather the intentional efforts of teachers to suppress boys' energy and enthusiasm and the structures of schools that seek to homogenize.

Although the problem of mis-appelation may be more pronounced with respect to boys, girls who do not fit the mold are not immune from being labeled problems. That girls generally are less likely to engage in high-risk behaviors (crime, drinking and drug taking, high-risk sexual activity) does not mean that they do not experience ill effects of repressed creativity. Repression of any sort is at some level violent, and violence begets violence in a process known as *traumagenisis* (Bloom and Reichert 1998). When society, schools, teachers, and parents suppress a child, ill effects will emerge eventually, whether overtly dangerous and destructive or more subtle.

Conclusion and Future Directions

While Paul Torrance was a counselor at the Georgia Military College, he noticed that many of the boys were there because of discipline problems. However, many of these troubled students seemed to display a special quality that he later recognized as creativity. The more recent research of Pollack, Thompson, Reichert, and Hawley has borne this out. To Torrance, boys who were like wild colts (and, thus, typically labeled as problems) needed to learn to direct their creative energy in positive ways. Teachers need to take responsibility for their mentorship role. All students, not merely those who patiently sit and listen, deserve teachers' full effort. Torrance stated that creative imagination is like a wild colt roaming the prairies, unless it is used and directed into the right channels, and that if it is well directed and developed, the aptitude can lead to outstanding creative work. Torrance's career was interrupted by military service in the US Army, and he was appointed to head a task force to study factors in fighter interceptor effectiveness in Korea with particular emphasis on the jet aces. He found that the outstanding aces had once behaved like wild colts, but had learned discipline and adapted successfully in the Air Force.

A powerful implication of these findings is that the "diagnosis" of a child as creative or troubled is partially in the eyes of the beholder. Given that, beholders – parents, teachers, psychologists, counselors – have a responsibility to recognize creative potential and nurture it constructively rather than work to suppress "misbehavior" by punishment or medication. One means to nurture creative potential is through mentorship. Identifying numerous practical strategies to reach boys, Reichert and Hawley nonetheless identified relationships with boys as crucial to their success. Torrance did too. In his 40-year longitudinal study, Torrance (2002) followed participants from 1958 through 1998, and he found that successful creative individuals had at least one significant mentor who recognized, understood, and supported their creative potentials. Therefore, exposing children to intrinsically motivated, creatively thinking adults is critical to encourage invention, innovation, and entrepreneurship. Introducing children to creative inventors or entrepreneurs is necessary to inspire creativity. Books, videotapes, and movies describing creative individuals are helpful for children who exhibit creative behaviors with regard to developing their self-understanding, self-acceptance, and self-esteem. This kind of attention can help make the difference between a problem behavior and a creative behavior by satisfying the children's social and emotional needs.

Torrance also identified the effect of various environmental climates including home, peer, school, society, and culture that either encourages or discourages creative behavior. The most important requirement for successful creativity is creative climate that fosters creative attitude and creative thinking. The environment or climate controls how individuals think and behave as well as whether their product is useful or useless. If group climate is encouraging the creative attitude, the members of the group are lucky. Schools today rarely foster this environment. To the contrary, the climate is killing the creative attitude of students. Educators and parents, then, should do their best to try to change the climate. After they have done their best, if it still does not change, then they should leave the environment before it changes them.

Cross-References

▶ Creative Behavior
▶ Divergent Versus Convergent Thinking
▶ Measurement of Creativity
▶ Science of Creativity

References

Bloom S, Reichert M. Bearing witness: violence and collective responsibility. New York: Haworth Maltreatment and Trauma Press; 1998.

Duck L. Understanding American education: its past, practices, and promises. Burke: Chatelaine Press; 1996.

Eisenman R. From crime to creativity: psychological and social factors in deviance. Dubuque: Kendall/Hunt; 1991.
Farley FH. Psychobiology and cognition: an individual differences model. In: Strelau J, Farley FH, Gale A, editors. Biological bases of personality and cognition. New York: Hemisphere; 1983.
Farley FH. The big T in personality. Psychol Today. 1986;20(May):44–52.
Kagan J, Rosman BL. Cardiac and respiratory correlates of attention and an analytic attitude. J Exp Child Psychol. 1964;1:50–63.
Myers IB, Myers PB. Gifts differing (special anniversary edition). Palo Alto: Consulting Psychologists Press; 1980.
Pollack W. Real boys: rescuing our sons from the myths of boyhood. New York: Random House; 1998.
Reichert M, Hawley R. Reaching boys teaching boys: strategies that work – and why. San Francisco: Jossey-Bass; 2010.
Thompson M. Raising cain: protecting the emotional life of boys. New York: Ballantine Books; 1999.
Torrance EP. The manifesto: a guide to developing a creative career. West Westport: Ablex; 2002.

Creative Personality

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Synonyms

Innovation; Temperament

Introduction

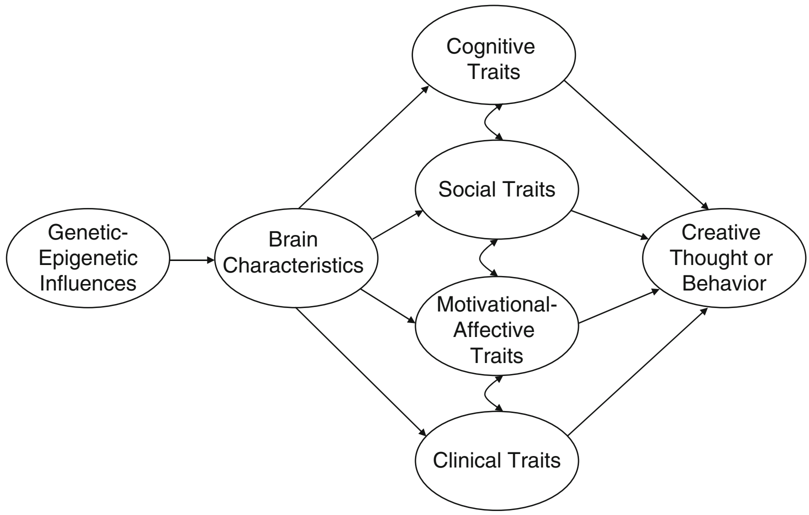
Does creativity stem from nothing? Of course not. All new ideas, products, art and music pieces, and works of literature owe their origin to ideas or products already in existence. Often these previous ideas and art forms directly inspire the future creator and innovator. Newton's well-known adage that he was "standing on the shoulders of giants" was not simply false humility. Even for someone as great as Newton, creativity only springs forth from things already in existence. Personality is one of those conditions that makes creative and innovative thought and behavior more likely in some people and less likely in others.

Creativity comes in many different forms, shades, and hues. First, the creativity of great artists and scientists is what attracts most attention, and for good reason. These enterprises are cornerstones of culture and provide mileposts of our cultural development and progress. And yet, not everyone who is an artist or scientist is equally creative nor are all creative people either artists or scientists. Some are creative in business, in their understanding of other people, or simply in living. In short, creativity's qualities that are both fascinating and yet frustrating is its complexity and variability. In this contribution, Feist reviews the current (last 15 years of) research on personality and creativity that mostly support but sometimes modifications in the model he proposed in both qualitative and quantitative reviews (Feist 1998).

Personality and Creativity Defined

Many people assume, especially artists, that creativity is inherently unknowable, mysterious, and immeasurable. Hence, the argument continues, that researchers cannot agree even on what creativity means. It may be true that creativity is difficult to measure and to quantify, but it is not impossible and it is false to say no consensual definition has emerged on how to define it. In fact, creativity researchers have for the last 60 years been nearly unanimous in their definition of the concept (e.g., Simonton 2008): Creative thought or behavior must be both novel/original and useful/adaptive. It is easy to see why originality per se is not sufficient – there would be no way to distinguish eccentric or schizophrenic thought from creative. To be classified as creative, thought or behavior must also be socially useful or adaptive. Usefulness, however, is not meant in merely a pragmatic sense, for behavior or thought can be judged as useful on purely intellectual or aesthetic criteria.

What about personality? How do we define that? When psychologists use the term



Creative Personality, Fig. 1 Functional model of the creative personality (From Feist (2010) reprinted with permission from Cambridge University Press)

"personality," they are referring to the unique and relatively enduring set of behaviors, feelings, thoughts, and motives that characterize an individual. There are two key components to this definition. First, personality is what distinguishes us from one another and makes us unique. Second, personality is relatively enduring, or consistent. In sum, personality is the relatively enduring unique ways that individuals think, act, and feel. As it turns out, recent research has begun to demonstrate that unique and consistent different styles of behaving (i.e., personalities) are found within many different species of animal, from octopus and mice to birds and horses. Personality is not just a trait of humans, but of most mammals and some birds, reptiles, and fish.

Functional Model of Personality and Creativity

As Feist proposed in the late 1990s, personality influences creativity by lowering behavioral thresholds. In his model, genetic differences influence brain structures and temperamental differences, which lead to personality variability (social, cognitive, and motivational-affective, and now clinical traits), which finally effect creative thought and behavior. The idea was and still is that a particular constellation of personality traits functions to lower the thresholds of creative behavior, making it more rather than less likely. The part of the model that has been most intensively investigated over the last decade since the model was first proposed is biological foundations component, especially genetic and neuroscientific. However, one component of the model is completely new, reflecting even greater growth in research, namely, the clinical personality traits of psychoticism, schizotypal personality, latent inhibition, negative priming. Hence, this entry will give more weight to these components than the others.

Feist's functional model builds ties between biology and personality variability and argues for the causal primacy of biological factors in personality in general and the creative personality in particular. To be clear, the updated model of the creative personality includes six main latent variables, in order of causal priority:

- Genetic and epigenetic influences on personality
- Brain qualities
- Cognitive personality traits
- Social personality traits
- Motivational-affective personality traits
- Clinical personality traits

By combining the biological and the function of traits arguments, Feist presents in Fig. 1 an updated model for the paths from specific biological processes and mechanisms to psychological dispositions to creative thought and behavior.

The basic idea is that causal influence flows from left to right, with genetic and epigenetic influences having a causal effect on brain influences. Brain-based influences in turn causally influence the four categories of personality influence: cognitive, social, motivational, and clinical. These traits individually and collectively lower thresholds for creative thought and behavior, making each more likely in those individuals who possess that cluster of traits. For sake of space, however, in this contribution, the focus here is only on the psychological traits and the interested reader may find the biological details elsewhere (Feist 2010).

Personality Influences on Creativity

In fact, the causal nature of brain influences is precisely what the model of creativity assumes. These brain differences function to make creative traits more or less likely, which in turn make creative thought and behavior more or less likely. So personality traits mediate the relationship between brain and creative thought and behavior. By having genetic dispositions that create CNS differences that facilitate creative thinking, highly creative people also develop a set of personality traits consistent with their biological dispositions.

Building upon the qualitative and quantitative reviews of personality and creativity from 10 years ago, the personality traits most consistently connected to creativity are clustered into cognitive, social, motivational-affective, and clinical groups. Clinical traits are new to the model and therefore will get more attention than the other three classic trait dimensions.

Cognitive Personality Traits. Feist classified particular traits as "cognitive" because they deal with how people habitually process information, solve problems, and respond to new situations. Chief among the cognitive personality traits is "openness to experience." Open people tend to be imaginative and curious, and so it is not surprising that open people are more creative. This is not just a theoretical connection but an empirical one. In addition to the large empirical literature supporting this claim up until the mid-1990s, much recent research continues to build the case for the association between openness and creativity.

A recent representative study of personality and creativity was conducted with college students. It examined the Big Five personality dimensions and their relation to creativity. The participants are told that an artist started the drawing and they are asked to "continue with this drawing. You are allowed to draw anything you wish" (Dollinger et al. 2004, p. 38). Results showed that none of the personality dimensions, with the exception of Openness, consistently correlated with the creative personality scales, creative behavior, and the creative drawing task. The only other personality dimension that had some reliable association with creative production, behavior, and personality was Extraversion.

Social Personality Traits. Social traits of personality involve first and foremost behaviors and attitudes that concern one's relationships to other people, such as questioning or accepting what authority figures say, being comfortable or uncomfortable around strangers and large groups of people, being warm or hostile toward others, and believing one is better or worse than others. The trait terms that summarize these tendencies are norm-doubting, nonconformity, independence, extraversion-introversion, aloofness, hostility, coldness, and dominance/self-confidence/arrogance.

As Feist made clear with the meta-analysis on personality and creativity, the general factor of extraversion does not quite reflect its accurate relationship with creativity. When one splits extraversion, however, into two of its main components, sociability-gregariousness and confidence-assertiveness, a clearer association emerges. Highly creative people are generally not sociable and outgoing, but they are independent, confident, and assertive. The recent angle on confidence and assertiveness has morphed into research on self-efficacy and creativity.

Conservatism and conformity continue to conflict with creativity. Conservatism is the opposite pole of norm-doubting and reflects a tendency to value tradition and authority. Rubinstein (2003), for instance, examined authoritarianism and creativity in Israeli college students (design, behavioral science, and law). Rubinstein found strong negative relationships between creativity and authoritarianism as well as a linear relationship between career choice (major) and authoritarianism. Law students were more authoritarian than behavioral science students who were more authoritarian than design students. Others have reported that the more politically conservative students were less likely to have reported creative hobbies or accomplishments and their photo essays and drawings were judged as less creative than the liberal students. Highly creative people doubt, question, and often reject norms, traditions, and conservative ideology. Indeed, one could argue these findings validate both constructs, for creativity concerns producing novel and unusual ideas and conservatism/authoritarianism values tradition.

Motivational-Affective Personality Traits. Motivational traits are defined by a person's desire to persist in activities and to be successful it his or her activities. Trait terms characteristic of motivation are persistent, driven, ambitious, and impulsive. That some people are driven to be creative is both undeniable and perplexing. Why do people want to create? Some people are willing to forgo social relationships and economic well-being to create lasting works.

If those who have a desire to produce works that leave a mark on the world are to succeed, they also need to be driven, focused, and ambitious. They are not the kind of person who gives up easily in the face of hindrances and roadblocks. And that is generally what the research on drive and creativity continues to show: Creative artists, businesspeople, and scientists are driven, ambitious, and persistent (e.g., Batey and Furnham 2006).

But what kinds of things motivate them? Need to know? Self-Expression? Success? Recognition? Money? Joy from the process? It could be each of these depending on the nature of the creative task. Scientists are probably driven more by the need to know and artists more by the need for self-expression. And both are often driven by the pleasure the process of discovery or expression brings, otherwise known as intrinsic motivation. Indeed, intrinsic motivation is often associated with highly creative thought or behavior and quite a body of research supports this idea (e.g., Amabile 1996). That is, when the drive and energy for carrying out a task is pleasure and excitement, then the end product often is more creative than if the drive is lacking or extrinsic. Amabile's classic work on motivation and creativity has reported that often extrinsic motivation (reward, surveillance, or recognition) has a detrimental effect on creative achievement. Experimentally, this effect has been demonstrated by offering people rewards for a creative task and comparing the creativity of the outcome to those not offered rewards for doing the task. The typical finding is the non-rewarded group produces products judged to be more creative than the rewarded group. Similarly, positive affect (feeling good) seems to facilitate creative thinking.

Yet it is clear to even those who established the intrinsic motivation principle of creativity to recognize that positive affect and intrinsic motivation do not always facilitate creative thought and extrinsic motivation does not always hinder it. Other researchers, for example, have argued that reward, which leads to positive affective, is unconnected to creativity. Eisenberger and colleagues have conducted much of this research and when they inform participants in a reward condition that they will be not just rewarded but rewarded for producing a *creative* product, then reward does increase rather than decrease the creative performance. But, reward is not reward is not reward. If told explicitly that they are being rewarded for producing something creative, reward can apparently facilitate creative thinking. Given the complex nature of the findings on intrinsic and extrinsic motivation and creativity, it is probably safest to conclude that it is drive and ambition that matter most and whether the reward is internal (pleasure) or external (reward, money, or recognition) is not as important as the drive and ambition to create something new and worthwhile.

Clinical Personality Traits. One of the biggest changes in the field of personality and creativity over the last 10 years – besides the steady rise in neuroscientific studies – is the tremendous growth in research on personality disorders, mental health, and creative thought and behavior. The influences of mental health on creative thought and behavior are so robust now that Feist recently added a new dimension to the three major trait groupings from his previous model. So now in addition to cognitive, social, and motivational-affective, he included a clinical traits group that includes the normal personality dimension of psychoticism and its related concept of schizotypy. The evidence for the connection between clinical personality traits and creativity is stronger in the arts than in the sciences (e.g., Ludwig 1995).

Eysenck's well-known model of personality proposed psychoticism to be the third of the three super-factors of personality. People high in psychoticism are cold, aloof, eccentric, hostile, impulsive, and egocentric. Moreover, Eysenck argued that psychoticism was the personality dimension most closely aligned with creative thought and behavior (Eysenck 1995). Empirical investigations continue to provide support for Eysenck's general theoretical model linking psychoticism to creative thought and behavior.

Consistent with Eysenck theory, Martindale (2007) theorized the thread that ties schizotypal personality disorder and creativity together is loose semantic processing of information in the right hemisphere. Therefore, ideas are associated in global and holistic manner rather than in a narrow and analytic way. The idea, consistent with a lot of the research on heightened right hemispheric activity in highly creative people, is that there is a relative weakening of the left hemisphere and strengthening of right-hemisphere processing. Moreover, latent inhibition and primordial thinking are commonly found elements both in creative thought and schizotypal personality. Latent inhibition is the ability to selectively attend to only the most relevant sensory experience and tune out the irrelevant. Highly creative people are often less able to tune out the irrelevant information. In this sense, failure to screen out irrelevant sensory experiences and ideas might enrich one's source for ideas, which would explain the greater ideational fluency of creative people.

Recently, some researchers have begun to question the validity of Eysenck's psychoticism dimension, especially as it relates to pathology and instead have turned their attention to a more specific (and narrower) clinical personality dimension – schizotypy or schizotypal personality disorder. A person with schizotypal personality disorder is isolated and asocial, but in addition has very odd or magical thoughts and beliefs. For instance, people with schizotypal personality disorder may believe that stories on TV or in the newspaper were written directly about them or people they do not know are saying things about them behind their backs.

During the last decade or so, many researchers have examined the connection between schizotypal personality disorder and creativity. Creative artists, more than scientists, tend to have elevated schizotypy scores. For example, poets and visual artists are higher on schizotypy dimensions of unusual experiences, cognitive disorganization, and impulsive nonconformity than nonartists. Moreover, there is a curvilinear relationship with degree of involvement in poetry and visuals arts. Serious amateurs show the highest levels with professionals being next followed by hobbyists.

Conclusions and Future Directions

The research and theory on the connection between personality and creativity remains a vital topic of investigation for psychological scientists. The basic conclusions from 10 years still hold and yet two areas of research have grown so drastically that they deserve being added to the functional model in Fig. 1. These two areas are brain influences and clinical traits. The model proposes that genetic, epigenetic factors create conditions in the central nervous system that make particular personality traits more likely. These personality traits cluster into cognitive, social, motivational-affective, and clinical groups. Being high or low in certain personality dispositions does make creative thought and behavior more or less likely.

The literature on the genetic and brain influences has expanded as well as the clinical traits of psychoticism and schizotypy. The main conclusions from neuroscience research demonstrate the importance of frontal lobe functioning, greater neural complexity, and increased right-hemisphere activity in highly creative people or during creative problem solving. These biological markers in turn make personality traits more likely. The cognitive traits (openness and cognitive flexibility), social traits (norm-doubting, nonconformity, independence, extraversion-introversion, aloofness, hostility, coldness, and dominance, self-confidence/arrogance), motivational-affective traits (drive, persistence, intrinsic motivation, and positive affect), and clinical traits (psychoticism, latent inhibition, and schizotypy), all function to make creative thought, behavior, and achievement more probable.

One methodology that will be of most help to future researchers is true longitudinal designs whereby large groups of young children are assessed at regular points in their development up through early to mid adulthood, much like the well-known Terman studies of the intellectually gifted. The question of cause and effect – Is personality a cause or an effect of creative thought and behavior? – can only be answered with longitudinal evidence.

In the 1970s and 1980s, some psychologists argued that personality was a dying or even dead field. Personality does exist and traits are not mere hypothetical concepts with no effect on behavior. Traits function to lower behavioral thresholds – one could even say they cause behavior. Creative behavior is no exception and future researchers will no doubt continue to investigate the complex connection between personality and creativity.

References

Amabile T. Creativity in context. Boulder: Westview; 1996.

Batey M, Furnham A. Creativity, intelligence, and personality: a critical review of the scattered literature. Genet Soc Gen Psychol Monogr. 2006;132:355–429.

Dollinger SJ, Urban KK, James TA. Creativity and openness: further validation of two creative product measures. Creat Res J. 2004;16:35–47.

Eysenck HJ. Genius: the natural history of creativity. New York: Cambridge University Press; 1995.

Feist GJ. A meta-analysis of the impact of personality on scientific and artistic creativity. Pers Soc Psychol Rev. 1998;2:290–309.

Feist GJ. The function of personality in creativity: the nature and nurture of the creative personality. In: Kaufman JC, Sternberg RJ, editors. Cambridge handbook of creativity. New York: Cambridge University Press; 2010. p. 113–30.

Ludwig AM. The price of greatness. New York: Guilford Press; 1995.

Martindale C. Creativity, primordial cognition, and personality. Pers Individ Differ. 2007;43:1777–85.

Rubinstein G. Authoritarianism and its relation to creativity: a comparative study among students of design, behavioral sciences and law. Pers Individ Differ. 2003;34:695–705.

Simonton D. Scientific talent, training, and performance: intellect, personality, and genetic endowment. Rev Gen Psychol. 2008;12(1):28–46.

Creative Potential

► Divergent Thinking

Creative Problem Solving

► Promoting Student Creativity and Inventiveness in Science and Engineering

Creative Problem Solving Training

► Creative Thinking Training

Creative Problem-Solving

► Creative Styles

Creative Process

▶ Creative Styles
▶ Creativity and Innovation: What Is the Difference?
▶ Four Ps of Creativity and Recent Updates

Creative Process in Brain

▶ Creative Brain

Creative Products

▶ Four Ps of Creativity and Recent Updates

Creative Scientific Enquiry

▶ Scientific Inventive Thinking Skills in Children

Creative Styles

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Synonyms

Creative behavior; Creative problem-solving; Creative process; Creativity

Definition

Creative styles are individual preferences or approaches in which people are creative, solve problems, and make decisions.

A Preamble

There are many varying approaches for understanding individual differences in creative persons. Some of them seek to understand differences in levels of creativity ("to what extent is this person creative?"), while other approaches focus on differences of how individuals show their creativity. These "how is this person creative?" models incorporate the assumption of differences in approaches to creative problem-solving, or creative styles. People differ in the cognitive styles in which they are creative, solve problems, and make decisions. An approach to cognitive style is that each person expresses a preference for processing information and making decisions based on psychological patterns (Fox and Fox 2004). There are several well-known theories and corresponding instruments directly related for assessing creative cognitive styles. Three of them which got the most popularity and strongest reputation among scholars and practitioners for the last three decades are briefly described in this article.

Kirton Theory of Adaptive and Innovative Styles

According to *Kirton adaption-innovation theory* (Kirton 1999), all individuals have some preferences for an adaptive or innovative style of problem-solving, decision-making, and creativity. The adaptive style is characterized by working within the given paradigm: structure of a problem, precision, reliability, and conformity. The innovative style is characterized by approaching tasks from unsuspected angles, not to be limited by the boundaries of the paradigm, and been seen as undisciplined. These style differences, which lie on a normally distributed continuum, range from high adaption to high innovation. The more adaptive people prefer their problems to be associated with more structure, while the more innovative people prefer solving problems with less structure and are less concerned about a consensually agreed structure. Adaptors seek to solve problems by introducing change that supports the current system. Adaptors develop novelty within the existing system and expect to succeed by using the rules. Adaptors strive to provide "better" solutions rather than "different" solutions. They tend to stay within the current paradigm too long, while innovators tend to abandon the current paradigm too soon.

The value of adaptors is obvious: they provide stability for an organization. Innovators more readily perceive the radical views and solutions, although that involves more risks. The value of innovators for an organization is also obvious: they provide new opportunities. No organization can survive long without adaptors, and no organization can effectively develop without innovators. It is very important to note that adaptors and innovators can be equally creative by level, they can be equally good or bad at problem-solving, and they just do so differently (Kirton 1987).

The key point of this theory is that those differences behave stable and no life experience (becoming more mature, knowledgeable, or senior) will change them. Each of the mentioned styles has its own strengths and weaknesses, so the whole range is essential for solving the wide diversity of problems that face the organization or group over a long time, although these differences are less useful on particular problems that obviously require mostly adaptive or innovative solutions. Therefore, a diversity of problems requires a diverse team, and one of the goals of optimally managing creativity is to build an appropriate (i.e., optimal) creative team.

The organization's goals, problems, and objectives vary constantly. How can a corporation manage creative people best? One way is by understanding and using the insights gained by the study of styles. Identifying creative styles may increase the performance of a team and organization. Managers should ensure that a creative team is optimal for (i.e., suits) the organization's goal, job requirements, and problem type. For example, what is needed by the organization, stability or flexibility? In which direction is the company heading, upward or downward? If the company needs a fast retreat or repositioning in the marketplace, a flexible individual should make the best in such a situation. An innovator would be the best choice. However, if the company is in a position of steady and continuous growth, in the process of consolidation, and harvests steady profits, then the stable personality of an adaptor would make a better managerial choice. One of the most critical tasks for corporations is to match the skills of people with the demands of a job. Creative styles may be particularly important in certain areas of a business. For example, if the main focus of the business concentrates on the development of new products necessary for long-term survival, a company needs innovative problem solvers at the top levels of management who enjoy the task of creating and developing novel solutions and ideas that progress to new products. Adaptors are better suited for administering existing product lines, improving existing production and delivery systems, developing ideas into products, and "keeping things running" through administration and maintenance (Fox and Fox 2004).

As a practical realization of his theory, Kirton designed an instrument for measuring creative styles (not creative capacity), the *Kirton adaption-innovation inventory* (*KAI*). KAI is a popular, well-known, and practically used instrument. At least 78 theses and 210 articles have been written about the KAI for two decades since 1978 (Puccio and Murdock 1999, p. 511).

Basadur Model of Creative Styles

Basadur developed a concept of creative personal styles based on the stages of the creative problem-solving process. He characterizes creative problem-solving as "a continuous circular process involving two opposite ways of getting knowledge and two opposite ways of using knowledge." Based on this idea, Basadur identified eight steps for the creative problem-solving process and *Creative Problem Solving Profile* (Basadur and Finkbeiner 1985; Basadur et al. 1990).

For an organizational team, which wants to be effective in creative problem-solving, all four styles are needed. *Generators*, who are especially sensitive to the situational environment, are needed for picking up data and suggesting possible opportunities for change and improvement. *Conceptualizers* are needed to pull together the facts and ideas from the generation phase into well-defined problems and challenges and more clearly developed ideas and concepts for further evaluation. *Optimizers* are needed to find a best solution from a practical point of view. *Implementers* are needed for effectively realizing practical solutions and plans. For identifying creative styles, a particular instrument, the *Basadur Simplex*, was developed (Basadur 1997).

Puccio Conception of Creative Styles

Puccio developed another model and instrument for assessing creative styles to help individuals and/or teams for understanding better how they approach solving problems. His instrument, the *Foursight*, is designed to improve collaboration of individuals, teams, groups, and organizations in problem-solving situations (Puccio 2002). The Foursight is based on the *Creative Problem Solving* model (*CPS*). The CPS model has a history of more than 50 years of development and is being considered as one of the most widely used and best researched about creative thinking models worldwide. The six stages of the CPS model are as follows.

- Identifying a goal, wish, or challenge that requires creative thinking
- Gathering information about the goal, wish, or challenge
- Clarifying the problem by identifying the specific issues that need to be resolved
- Generating many varied and original ideas to resolve the problem
- Selecting, strengthening, evaluating, and refining promising ideas into workable solutions
- Developing a plan of action that builds on sources of assistance and overcomes potential sources of resistance

The Foursight has 37 questions, which are designed to measure with which “sections” of the CPS model a person is most comfortable with. These may be single preferences or a combination of two or more preferences. Each preference has its strengths and its potential weaknesses. Therefore, a balanced creative team depends on the diversity of styles. Single preferences are called *clarifier*, *ideator*, *developer*, and *implementer*.

Clarifiers like to spend time on clarifying the problem, because they want to be sure that the right problem is being addressed. They gather information to understand the situation and are inclined to look at the details. They may have a tendency to analyze to the extreme and keep the process from moving forward. Clarifiers are focused, orderly, serious, methodical, deliberate, and organized. In order to be effective, they need to have order, to get the facts of the problem situation, have an understanding of the history of the situation, and appreciate ready access to information.

Ideators like to look at the “big picture.” They enjoy switching ideas and possibilities by stretching imagination. When solving problems, ideators take a more intuitive approach to problem-solving. They enjoy thinking in more global and abstract terms. This may cause a tendency to overlook the details. Ideators are social, flexible, independent, imaginative, and adaptable. Ideators need constant stimulation, variety, and change to be most effective.

Developers like to put together workable solutions. They enjoy thinking and planning about the steps of implementing an idea. They analyze very well and compare potential solutions and like to examine the strengths and weaknesses of an idea. Developers might get stuck in trying to develop the perfect solution. Developers are reflective, cautious, pragmatic, structured, and very planning oriented. To be effective, they need time to consider the options and develop their ideas.

Implementers like to see things happen. They enjoy focusing on ideas and solutions, which, as they feel, are workable. One potential drawback to this preference is that the person may leap to action too quickly. Implementers are persistent, decisive, determined, assertive, and very action oriented. They are the most effective when they feel that others in their group are moving just as quickly as they are. They need a sense of control and need to receive timely responses to their ideas. Committing too soon to one idea may leave other more powerful ideas undiscovered (Puccio 2002; Fox and Fox 2004).

Conclusion and Future Directions

It is important to note that all of the three conceptions and instruments, described above, identify and measure only preferences, and they do not measure abilities. Testing these instruments with hundreds and thousands of people indicates that the instruments have a good reliability and validity. They provide a method for understanding how people of different inclinations in the creative process can work together and may be organized in a balanced team to complement each other to initiate, develop, and implement new and potentially useful ideas. Understanding and measuring creative styles may help a manager and team members to identify the team's strengths and weaknesses in problem-solving, as well as to select and use training programs and techniques in accordance to the problem, they want to solve, and the contingent of participants in terms of their creative styles. Therefore, these instruments may support a manager in understanding how to organize a team for increased creativity by synergizing the team members' similarities and differences. By recognizing the potential contributions of all of the creative personality styles, organizations can build balanced, creative teams and enhance organizational effectiveness.

Cross-References

▶ Adaptive Creativity and Innovative Creativity
▶ Convergent Versus Divergent Thinking
▶ Creative Behavior
▶ Creative Personality
▶ Creative Problem Solving
▶ Creative Thinking Training
▶ Creativity Tests
▶ Divergent Versus Convergent Thinking
▶ Four Ps of Creativity
▶ Measurement of Creativity
▶ Psychology of Creativity
▶ Simplexity Thinking

References

Basadur M. Basadur simplex manual. Ontario: Center for Research in Applied Creativity; 1997.
Basadur M, Finkbeiner CT. Measuring preference for ideation in creative problem-solving training. J Appl Behav Sci. 1985;21:37–49.
Basadur M, Graen G, Wakabayashi M. Identifying individual differences in creative problem solving style. J Creative Behav. 1990;24:111–31.
Fox JM, Fox RL. Exploring the nature of creativity. 2nd ed. Dubuque: Kendall/Hunt; 2004.
Kirton MJ. Kirton adaption-innovation inventory (KAI) manual. 2nd ed. Hatfield: Occupational Research Centre; 1987.
Kirton MJ. Adaptors and innovators: a description and measure. In: Puccio GJ, Murdock MC, editors. Creativity assessment: readings and resources. Buffalo: Creative Education Foundation Press; 1999. p. 121–32.
Puccio GJ, Murdock MC (Eds.). Creativity Assessment: Readings and Resources. Buffalo: Creative Education Foundation Press; 1999.
Puccio GJ. Foursight manual. Buffalo: International Center for Studies in Creativity; 2002.

Creative Teaching Methodologies

▶ Creative Pedagogy

Creative Thinking

▶ Creative Mind: Myths and Facts
▶ Creativity and Innovation: What Is the Difference?
▶ Method for Creating Wisdom from Knowledge

Creative Thinking Education

▶ Creative Thinking Training

Creative Thinking in Music

▶ Creativity in Music Teaching and Learning

Creative Thinking Techniques

▶ Creativity Training in Design Education

Creative Thinking Tests

▶ Creativity Tests

Creative Thinking Training

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Synonyms

Creative problem solving training; Creative thinking education; Innovation training

Introduction

Kirkpatrick (1967) noted four levels of evaluation of training:

- Level 1: *Reaction*. How well did the participants like the program?
- Level 2: *Learning*. What principles, facts, and techniques were learned?
- Level 3: *Behavior*. What changes in job behavior resulted from the program?
- Level 4: *Results*. What were the tangible results of the program in terms of reduced cost, improved quality, improved quantity, etc.?

Impact research focused on creative thinking and creative problem solving (CPS) programs details levels two and three, plus less common level four, evaluation (Firestien 1990; Firestien and McCowan 1988; Keller-Mathers 1990; Miller 1992; Neilson 1990; Puccio et al. 2006; Reid 1997; Vehar 1994; Vehar et al. 2000). In addition to published research, there are unpublished proprietary impact studies for companies ranging from large publishing companies to large consulting firms.

In the majority of courses delivered by the authors, feedback forms are administered asking participants to provide a level one evaluation of the components of the course as well as various aspects of the entire program both quantitatively and qualitatively. As additional anecdotal evidence, the authors also regularly receive feedback from participants about the aspects of courses that they find to be particularly impactful. This feedback takes the form of conversations, phone calls, emails, and letters. All of these items are used to address a common research question that has been under discussion for as long as the authors have been working together which is, "how might instructional designers and trainers improve the stickability of our training?" In other words, how might trainers increase the likelihood that the participants will remember and apply what they have learned?

Individually and collectively, the authors have worked with hundreds of organizations ranging from the largest corporations (according to *Fortune's* list), to fast-moving growth companies, to small family-owned enterprises, to not-for-profit organizations and governmental departments and agencies. They have worked with most of their clients multiple times, and so have had the opportunity to refine and develop their programs for each organization. Since each organization has unique strengths and challenges, the authors engage in some degree of customization of the training programs to meet their needs. Having noted that, there are common elements that show up in almost all of their creative thinking programs.

The authors have undertaken regular discussions over the past 15 years, both formal and informal explorations of the fundamental principles of their work. While working together and separately, they have come to a shared conclusion that there are four key principles responsible for most of the value of a training program in creative thinking, whether that course lasts for an hour, a day, a week, or a semester. The purpose of this entry is to discuss these four principles and to provide examples of their impact in various organizations. This is not meant to be an exhaustive study of impact, but rather reflects the culmination of years of working with individuals and groups to help them think more creatively.

The Four Key Principles of Creative Thinking

Here are the four key principles. While there are many elements of a creative thinking training program, the authors often begin and end a program by focusing on these four:

1. Phrase problems as questions, using statement starters, or what Parnes (1981) called, "invitational stems," such as, "How to. . .," "How might. . .," "In what ways might. . .," and "What might be all the. . .."
2. To get good ideas, generate a lot of ideas.
3. Evaluate all ideas positively with Praise First: POINt.
4. Take personal responsibility for your own creativity.

In the pages that follow, each of these four principles will be explained in more depth, along with anecdotal stories that reflect their application in the workplace.

Phrase Problems as Questions

The first of the core principles is a key component of the "Clarify the Problem" or "Problem-finding" stage of Osborn-Parnes Creative Problem Solving (CPS) and its many variations (Miller et al. 2004; Parnes 1981, 1992). What is a slight, yet specific, use of language in CPS – phrasing a problem or obstacle in the form of a question – in practice beyond the process becomes a fundamental shift in the way in which people approach challenges. More than just a technique, it operates in a way that requires people to shift from viewing something as a limitation, or something that cannot be done, into an inquiry in how something might be done (Eckert and Vehar 2007; Miller et al. 2004; Osborn 1948).

Using this technique, one would take a problem such as "I don't have any money," and turn it into a question starting with one of four statement starters: "How to. . .," "How might. . .," "In what ways might. . .," or "What might be all the. . .." Examples of possible questions include the following:

- How to obtain sponsorship?
- How might we lower the cost?
- In what ways might we reduce spending?
- What might be all the ways to get money?

Success Stories: Phrasing Problems as Questions

At a large consumer products company, two direct-reports walked into the manager's office and explained that because there was not enough money, the research that had been planned to have consumers taste and provide feedback on a particular product needed to be canceled. The senior manager listened to the assistant brand managers and applied the principle of phrasing problems as question by asking them, "How might we make sampling a reality?" Her two assistant brand managers stared blankly back at her and repeated that the vendor's price was too high making the sampling impossible. So she rephrased her question as, "In what ways might we make the sampling a reality?"

This time, the managers understood what they were being asked. With the reframing of the challenge the managers began to see a new course of action. In minutes, the three had generated ideas for a solution that was ultimately successful with no increase in budget. What unlocked this situation for the senior manager was her ability to step back from the situation, to keep the overall objective in mind, and to start phrasing the problem with questions that invited solutions.

In another notable example, a chemist at another consumer products company solved a vexing 77-year-old consumer problem by using the same approach. For more than seven decades scientists in the R&D department had tried and failed to fix a glitch that generated more than 50 % of all consumer complaints on a popular product. The scientists and some colleagues spent more than a man-year trying to find their own solutions – until the chemist decided to apply a lesson learned in a creative thinking training session and challenge the accepted problem statement. In 15 min, he set up a crude experiment which 2 weeks later validated his answer to the problem that the company had worked on for so long.

To Generate Good Ideas, Generate a Lot of Ideas

One of the major contributions to the study of creative thinking made by Alex Osborn was an emphasis on generating a large number of ideas *before* selecting the best one to move forward, thus separating the generation from the evaluation phase of idea generation (Osborn 1993). His four guidelines for brainstorming, or divergent thinking, emphasize a focus on quantity to generate quality. The research of Firestien and McCowan (1988) demonstrated the value of generating many ideas as a strategy to generate high quality ideas, along with the positive improvements in the communication behaviors of the participants. Most famously, Linus Pauling, the chemist who earned two Nobel prizes is quoted as saying, "If you want to have good ideas you must have many ideas" (cited in Crick 1995).

During training programs, the authors emphasize many tools and techniques to help develop the skill of seeking a large quantity of ideas. The authors emphasize the point that Pauling made, and encourage participants to take this on not only as a deliberate technique, but also as an approach to generating solutions for the challenges they face.

Success Stories: Generate a Lot of Ideas

A Training Project Manager at a large daily newspaper facilitated a creative thinking session focused on how to develop a system to check the paper for accuracy before printing. That afternoon, after generating hundreds of ideas, the production team went back to the composing room and refined the ideas down to a comprehensive checklist. By using the list that very night, the team caught an error in a full page color advertisement that would have cost $22,000 to fix. The manager noted that, "We made our money back on the first day!"

In another situation, the Director of Consumer Promotions at a consumer products company was assigned by her Vice President to structure a division-wide brainstorming session for 300 people that would deliver millions of dollars in savings during the remaining months of 1998 and throughout 1999. Rather than sequester the cost cutting to the offices of a few high-level directors, the division took a vastly different approach. The director set up a day on which 29 teams generated ideas on the challenge. The thousands of ideas went through a feasibility screen manned by director-level managers whose job was to "reality check them." Even after a critical screening, the ideas totaled up to millions of dollars in potential savings. Unfortunately, the group fell short of its year-end target for the current year since there was not enough time left in the year to implement them. But the following year cost cuts were a different story. The group more than doubled the targeted amount for the following year. Not only did the participants generate thousands of ideas, but the division, in one day, pocketed ideas worth millions of dollars in potential savings.

Evaluate Ideas Positively with PRAISE First: POINt

The third key principle is that of evaluating all ideas positively. The authors specifically recommend a tool called Praise First: POINt (Miller et al. 2004). POINt is an acronym that represents the four specific aspects that should be examined in each idea that is being evaluated:

- Pluses: What is good about the idea right now?
- Opportunities: What are the good things that might result if the idea were to be implemented?

- Issues: What are some of the issues, concerns, or things that need to be improved about the idea?
- New thinking: For each of the significant issues, what are some new ideas that will overcome the issues identified?

While the concept of examining the advantages and disadvantages of an idea is hardly new, it was Synectics (1979) that identified Itemized Response as a systematic approach for evaluating ideas, and the work of Foucar-Szocki, Firestien, and Shephard who first coined PPC (Pluses, Potentials, and Concerns), an earlier version of Praise First: POINt (Firestien 1996; Miller et al. 2004).

Success Stories: Evaluate Ideas Positively with Praise First: POINt

An international consumer products company required a group of plant managers to attend a 2-day creativity training. After the first day, the participants were given homework: to apply POINt to a work situation before coming to class the next morning. One seasoned plant manager shook her head saying, "I am not paid to be creative. My job is to run the plant efficiently and keep my workers safe." She went on, "I don't like new ideas. It's just more work for me." But she dutifully took on the homework assignment, and called a worker who was always offering new ideas. During their conversation, the plant manager forced herself to first reflect the positive aspects of the worker's new idea and articulate what positive outcomes might happen if the idea was implemented. The next morning, she reported back to the class. "That idea is going to save my plant $5,000 a week!" She further admitted that if she hadn't used POINt, she would never have had the patience to hear the idea through.

In another application, a peer in a meeting – not a manager or facilitator – shifted the way a group was evaluating ideas worth millions of dollars. A large pharmaceutical company created a governance committee to evaluate proposals from teams challenged to look for ways to speed both drug development or promising compounds and the decisions to stop development earlier on dead-end projects. A member of the committee noticed that his peers on the governance committee were reacting to each proposal by looking for what was wrong or weak with the idea. Finally, after noticing this pattern among his team members, he made a subtle intervention by asking the team to first look for the pluses. His peers agreed, and rather than killing the idea, worked through a process of searching for pluses, then opportunities and next identified issues, before turning it back to the team to fix the issues and then implement the solution. The idea was one that could save 3 days on drug development for any drug that made it to the 3-year mark in development, which equates to about $3 million on each drug in development. One person interviewed said that without the use of the Praise First: POINt technique, this solution was headed where all the other ideas headed: a binder on the shelf never to be implemented.

Take Personal Responsibility for Your Own Creativity

Trainers regularly hear people leave training programs saying something like, "these are good tools and methods, but my boss/peers/direct-reports/etc., won't let me be creative." Or later participants would say, "that was a good course, but no one's using it on my team." The authors interpreted this to mean that there was a lack of responsibility being taken for implementing the course learnings, in spite of the fact that the organization, and in some cases the participants themselves, were paying good money for, and spending valuable time in, the training. The principle of taking personal responsibility for creativity is an invitation to people not to wait around, but rather to make it happen on their own at whatever level they can manage.

Frankl (1984) pointed out the importance of choosing one's own attitude to make a difference, and this is what participants are directly asked to do. Neilsen (1990) and Keller-Mathers (1990) pointed out the need for this in their impact research, and Vehar (1994) pointed in this direction as well. The authors were confident that their courses could change the way that an organization works, and had also heard from people through the years that the course and the content changed their lives. What was notable about those whose lives were changed is that they took the responsibility to implement what they had learned.

Success Stories: Take Personal Responsibility for Your Own Creativity

At a large multinational corporation's R&D facility, a mid-level member of the organization took on the responsibility to share these key principles with other members of her team who had not attended the training. She specifically mentioned the need to take personal responsibility for improving the climate for innovation and communication on the team, which fostered excitement and numerous conversations about ideas for implementation, many of which were subsequently implemented. To keep these conversations energized, she created an ongoing support group that sent out weekly reminders of the tools and mental attitudes to drive innovation.

A large publishing organization conducted a week-long executive leadership program that focused on having participants craft real solutions to difficult organizational challenges. One participant, an assistant corporate counsel, was charged with working on organizational diversity. During dinner early in the week, he confided to one of the trainers a grave concern: that if, at the end of the week, he presented to the Chairman of the company what he *really* needed to hear, it might spell the end of his career. The participant and trainer discussed the need for personal responsibility around creativity. The next day, the participant reported that he was going to tell the Chairman the difficult news and propose the challenging solutions that needed to be heard. Plus, he had already called the Chairman to tell him who else among the executive team needed to attend his presentation at the end of the week. The participant was subsequently promoted in the organization, and 2 weeks after the presentation, on the front page of *the Wall Street Journal*, the Chairman was quoted talking about the importance of the company changing and improving their diversity efforts in order to be more competitive.

Recommendations

The authors are strong advocates of helping people remember these four items by repeating them often in their programs, by using posters that focus on these items, by giving away reminder cards that people can keep handy, and by reinforcing the principles in follow-up newsletters.

Focusing on these four principles, rather than on every page in the manual, allows for the most effective transfer of learning. While other items in the course build on and enable the principles, the four key principles are the foundation on which the courses – and their ultimate impact – are based.

As people who enjoy generating ideas and are always finding new things to add to their presentations, the authors regularly have to remind each other that, "less is more." That is why they focus on the four key principles that after a half, full, or two-day training program are critical that people remember and apply. These things will create the most value, and are worth remembering.

Conclusion and Future Directions

While these four key principles seem fairly basic, they are quite profound. In the words of Etienne Verber, the former President of Nutra-Sweet, "a lot of this stuff seems basic, but the fact is, when you apply the principles again and again, the results are amazing" (Schoen 2000). In the collective experience of the authors, they believe the four keys reflect the Pareto principle that: 80 % of the value comes from 20 % of the course

(Retrieved April 8 2008 http://www.gassner.co.il/pareto/), which is not to say that the other 80 % of the course is worthless, but in fact reinforces the four key principles. Effective creative thinking course content serves to provide additional tools and techniques that aid these four principles such as: (1) ways to help determine what are other questions that frame the problem, (2) tools for generating more ideas, (3) techniques for searching for the value of new ideas, and (4) ways to help people in their efforts to apply their creativity.

These four keys are also immediately implementable. They do not require additional time, money, authority, staffing, or a change in context. These are all suggestions that can be applied in all types of situations, from the second that the course is over to many years down the road as principles to guide life-long development.

Yes, the principles are easy to understand and harder to apply. Is it possible to teach these principles in 5 min? Yes. However, it takes considerably longer to help people move from cognitive understanding to habitual practice. This is the challenge on which the authors and the field in general are still working.

Note

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Cross-References

▶ Brainstorming and Invention
▶ Business Creativity
▶ Convergent Versus Divergent Thinking
▶ Corporate Creativity
▶ Creative Collaboration
▶ Creative Leadership
▶ Creative Problem Solving
▶ Creativity Techniques
▶ Divergent Thinking
▶ Divergent Versus Convergent Thinking
▶ Ideas and Ideation
▶ Imagination
▶ Research on Creativity
▶ Strategic Thinking and Creative Invention
▶ Thinking Skills, Development

References

Crick F. (1995). The impact of Linus Pauling on molecular biology. Retrieved April 8, 2008, from the website: http://oregonstate.edu/dept/Special_Collections/subpages/ahp/1995symposium/crick.html.

Eckert R, Vehar J. More lightning, less thunder: How to energize innovation teams. 3rd ed. Paul Smiths: New & Improved; 2007.

Firestien RL. Effects of creative problem solving on communication behaviors in small groups. Small Group Res. 1990;21(4):507–21.

Firestien RL. Leading on the creative edge: gaining competitive advantage through the power of creative problem solving. Colorado Springs: Pinon; 1996.

Firestien RL, McCowan RJ. Creative problem solving and communication behaviors in small groups. Creativ Res J. 1988;1:106–14.

Frankl VE. Man's search for meaning. 3rd ed. New York: Simon & Schuster; 1984.

Keller-Mathers S. Impact of creative problem solving training on participants' personal and professional lives: a replication and extension. Unpublished Masters Project, Center for Studies in Creativity, State University College at Buffalo, Buffalo, NY; 1990.

Kirkpatrick DL. Evaluation of training. In: Craig RL, Bittel LR, editors. Training and development handbook. New York: McGraw-Hill; 1967. p. 87–112.

Miller BJ. The use of outdoor-based training initiatives to enhance the understanding of creative problem solving. Unpublished Masters Project, Center for Studies in Creativity, State University College at Buffalo, Buffalo, NY; 1992.

Miller BJ, Vehar JR, Firestien RF. Creativity unbound: an introduction to creative process. 4th ed. Evanston: THinc Communications; 2004.

Neilson L. Impact of creative problem solving training: an in-depth evaluation of a six-day course in creative problem solving. Unpublished Masters Project, Center for Studies in Creativity, State University College at Buffalo, Buffalo, NY; 1990.

Osborn AF. Your creative power: How to use imagination. New York: Charles Scribner's Sons; 1948.

Osborn AF. Applied imagination: principles and procedures of creative problem solving. 3rd ed. Buffalo: Creative Education Foundation; 1993.
Parnes SJ. The magic of your mind. Buffalo: Creative Education Foundation; 1981.
Parnes SJ. Visionizing. Buffalo: Creative Education Foundation; 1992.
Puccio GJ, Firestien RL, Coyle C, Masucci C. A review of the effectiveness of creative problem solving training: a focus on workplace issues. Creativ Innovat Manag. 2006;15:19–33.
Reid DG. Facilitating creative problem solving: a study of impact and needs an internship experience. Unpublished masters project, State University of New York College at Buffalo; Center for Studies in Creativity, Buffalo, NY; 1997.
Retrieved April 8, 2008 http://www.gassner.co.il/pareto/
Schoen R. Winning the race to market: a case for creativity coaching. Unpublished manuscript. Evanston: THinc. Communications; 2000.
Synectics. Innovative teamwork program: course workbook. Cambridge, MA: Synectics; 1979.
Vehar JR. An impact study to improve a five-day course in facilitating creative problem solving. Unpublished Masters Project, Center for Studies in Creativity, State University College at Buffalo, Buffalo, NY; 1994.
Vehar JR, Doebler C, Eckert RP. Innovation training as profit center? Yes! A 750 % return on investment. Unpublished manuscript; available at: http://www.newandimproved.com/roi/ (2000). Accessed October 8, 2012.

Creativity

▶ Analogies and Analogical Reasoning in Invention
▶ Applied Design Thinking Lab and Creative Empowering of Interdisciplinary Teams
▶ Creative Styles
▶ Creativity, Experiential Theories
▶ Creativity Training in Design Education
▶ Experiential Learning and Creativity in Entrepreneurship
▶ Gender and Innovation
▶ In Search of Cognitive Foundations of Creativity
▶ Innovation System of India
▶ Invention and Innovation as Creative Problem-Solving Activities
▶ Invention and Modification of New Tool-Use Behavior
▶ Interaction, Simulation, and Invention
▶ Systems Theory and Innovation

Creativity Across Cultures

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Synonyms

Cross-cultural creativity

Creativity and Culture: A Preamble

Creativity is a multifaceted phenomenon. This phenomenon can be illustrated by diverse research studies in the field of creativity. One view is that creativity is an attribute of individuals (e.g., Davis 1989). Other studies include the analysis of creative production (e.g., Besemer and Treffinger 1981) as well as creativity as a cognitive process (e.g., Ward et al. 1999). Apart from the people, product, and process, creativity is also understood within a social context (Mayer 1999). This suggests that the concept of creativity is inextricably linked with the social, cultural, and historical milieu.

One controversy in the creativity literature concerns whether the concept of creativity has a universal meaning or is perceived differently in various cultures. For example, some researchers believe that there is a universal understanding of the concept of creativity while another group suggests that people in different cultures perceive creativity differently.

There seems to be a major breakthrough where theories of creativity have been established based on the latter point of view. Although the fundamental idea of creativeness seems to be deeply rooted in all cultures, definitions and attributes of creativity, the level of creative activity, and the domains in which creativity is promoted, vary across cultures. Culture plays a fundamental role in defining creativity. Creativity is not only influenced by organizational factors (i.e., organizational culture) but also greatly depends on the surrounding (societal) culture as a whole (Weiner 2000).

Arieti (1976) was one of the first to suggest that potentially creative persons and creativogenic cultures are essential facets of creativity. He introduced the term "creativogenic society" to describe a type of society that enhances creativity. These sociocultural factors are (1) availability of cultural means (i.e., an elite that has access to materials, equipment, etc.); (2) openness to cultural stimuli (cultural stimuli are not only present, but requested, desired, or made available); (3) stress on becoming and not simply on being; (4) free access to cultural media; (5) freedom (or even retention of moderate discrimination after severe oppression); (6) exposure to different and contrasting cultural stimuli; (7) tolerance for and interest in differing views; (8) interaction of significant persons; and (9) promotion of incentives and awards.

The Dichotomy of "the West" and "the East"

From the literature, the dichotomy of "the West" and "the East" is one of the most popular approaches in the characterization (at a surface level) of differences in understanding and defining creativity. However, it is not obvious what these terms exactly mean and these terms are sometimes used rather stereotypically. The term "East" usually refers to East Asian countries like China and other countries influenced by its culture like Japan or Korea. Most published works on cross-cultural studies involve this group. Some researchers include in this group another Asian country that is not East Asian, and that is India. These mentioned countries possess general similarities in terms of the social and cultural aspects distinct from "Western" countries. One of these similarities is the tradition that traces its origin from Asian thought like Buddhism, Confucianism, Taoism, and Hinduism. The term "Western," although can be used broadly, usually refers to the USA, Canada, Western Europe, Australia, and New Zealand (Weiner 2000). This conception has a long association with ancient Greece and the ideas of Judaism, Christianity, capitalism, and rationality (Weiner 2000). In the next sections, the "Western" and "Eastern" views on creativity are outlined as described in the literature.

Differences in the Understanding and Definitions of Creativity and Inventiveness

In the 1960s and 1970s, the conceptual 4-P model of creativity ("person," "process," "product," "press") was suggested and developed (Rhodes 1961). However, all of these four aspects of creativity actually accent, as the most important feature of this phenomenon, the link to an observable product, which can be assessed by an appropriate group or judges, either peers or experts. For example, when creativity is considered in the "person" perspective, it is defined as the ability to produce work (*object* or *product*) that is novel and appropriate (useful, applicable, etc.). If creativity is considered in the "process" perspective, the corresponding definitions also refer to a product in the end.

The product-centered conception of creativity prevails in "the West." This conception fits with the "Western" perspective on cosmic creation (Lubart and Georgsdottir 2004; Raina 1999), which involves a linear movement toward a new point and the assessment of what was created: God created *something* and God saw that what was created thing was good. Thus, the "Western" conception of creativity stems from Judaic and Greek views of producing the universe by an uncreated being who brings order to the formless void (Raina 1999).

Creativity as it is understood in "the West" is rather a state of doing, not a state of being. During the last decades, creativity is considered to be a normal ability which is inherent to all normally functioning people. It is an essential life skill which includes specific cognitive, meta-cognitive, and affective skills. Creative skills can be taught and enhanced through training and can be measured, in at least to some degree. Undoubtedly, creativity is considered one of the most important and principal "Western" values of an enriched life.

In "the East," a product-centered creativity is less valued than a process-centered creativity (Raina 1999). The typical "Eastern" conception of creativity is more focused on the process than on the result. Creativity is a personal state of being rather than an output, a connection to a primordial realm, or the expression of the inner essence of ultimate reality. Creativity is attributed less to personal factors but rather to spiritual or social forces. Such an understanding of creativity was also proper for ancient Greece (for instance, "mania" or "enthusiasm" in Plato's sense) and, partially, for Medieval Europe but was suspended with more individualistic conceptions during the Renaissance.

In contrast to "the West," tradition is not the antithesis of creativity. "The Eastern" creativity may take the form of intellectual or aesthetic modification, adaptation, renovation, reinterpretation, revision, reconfiguration, etc., rather than a dramatic break with tradition. For example, in "the East," artists fully respect the traditions in striving to establish their own styles, and their creativity is expressed in a form of reinterpretation of the past (Leung et al. 2004). This conception of creativity fits with the "Eastern" view on cosmological process, which is characterized as an ongoing, developing, or unfolding process.

The dramatically different (although some exaggerated) visions of creativity in two poles, "West" and "East," have attracted the attention of many scholars who explain them by referring to some philosophical fundamentals of "Western" and "Eastern" cultures. Comparing American and Japanese approaches to creativity, Herbig and Jacobs (1996) connect these differences with a historical and geographical context. The "Western" view of creativity refers to the generation of new or novel ideas as a result of the competitive spirit driven by a long history of rival empires in "the West." Anything new, an idea, product, or technique, that provided a kingdom an advantage over a neighboring rival was rewarded and recognized. On the other hand, Japanese innovation refers to the application and refinement of an idea. By not having nearby rivals, cooperation, not competition, was espoused in Japan. Cooperation and conformity were crucial components to ensure the survival of Japanese society.

Philosophical, Religious, and Ethical Fundamentals

One of the themes in the context of cross-cultural creativity is the comparison of Socratic and Confucian philosophical traditions and intellectual and moral paradigms. Kǒng Fūzǐ (Confucius is a Latinized variant of his name) and Socrates imparted practical wisdom for their followers and founded the traditions which have often been considered as a basis to understand the differences between the "East" and "West."

"Western" thought is based on Socrates' ideas that the sole function of knowledge is self-knowledge (individualistic cognitivism), and such knowledge is the basis for a person's intellectual, ethical, and spiritual growth. Rationality, research exploration, cross-examination, public debate, and factual information are much valued (Herbig and Jacobs 1996). On the other hand, Confucius taught that the stability of society is based on unequal status relationships between people – the family is the prototype of all social organizations. A person is not primarily an individual but rather a member of a family. Children should learn to restrain themselves, to overcome their individuality, and to maintain harmony in a family and society. Values like trying to acquire skills and education, working hard, not spending more than necessary, as well as patience, perseverance, and persistence, closely fit this principle.

Another philosophical tradition, Zen Buddhism, is clearly imprinted in Japanese creativity and inventiveness. This philosophy does not place considerable value on rational thought. Instead, it emphasizes spiritual enlightenment and intuitive understanding. The emphasis on intuitive understanding partly explains Japan's weakness in basic scientific research where logical reasoning and systematic thinking play important roles. As a result, Japan's base of scientific knowledge and research methods has not been fully realized compared to the "West." This has led to entirely different meanings of enlightenment and discover in the two cultures. "*Eurek*a (West) refers to the discovery of rational scientific principles while *satori* (East) means personal enlightenment" (Herbig and Jacobs 1996, p. 68).

Differences in Attributing Creativity and Inventiveness

In the context of what has been discussed so far, creativity in the "West" is associated with breaking or rejecting traditions; it is considered a discontinuous, revolutionary, relatively rapid, and insightful process. Creativity is based on and involves individual traits; it is expressive, emotional, and somewhat spontaneous. Creativity is often understood as creative thinking, which should be task and method focused. Creativity is contextually pragmatic in the area of problem solving, and it often tends to look outward toward "progress."

Creativity in the "East" is associated with respecting traditions and does not run contrary to them. It is considered to be a continuous, evolutionary, and slow process requiring much effort, hard work, repetition, attention, and a strong knowledge base. Creativity is based on and involves collective effort and a more structured, team-oriented approach. Creativity is understood to be socially utilitarian since the aspects of social influence on creativity are most important – creativity should help society, improve society, and contribute to society. For example, the Chinese prefer a more practical, utilitarian conception of creativity, and, as a consequence, politicians are considered the most common examples of creative individuals in China (Leung et al. 2004).

Differences in Valuing Creativity and Inventiveness

In addition to diverse understanding of creativity, cultures value various creativity aspects differently. Creativity characteristics as defined in "the West" are less valued and encouraged in "the East" and vice versa. The principal "Western" values related to creativity – individual freedom, less conformity, and self-reliance individuality – are rewarded and expected. As a result of cultivating such values, a "Western" individual attempts to be open, original, and innovative. "Western" societies are more likely to produce individuals who are oriented toward newness.

The principal "Eastern" values related to creativity are social order, cooperation, duty, and acceptance of an in-group authority like family, its norms and obligations; hard work and a strong knowledge base; consensus which is valued more than difference; fear of making mistakes and "losing face." As a result of cultivating such values, the tendency to delay creativity development can appear. However, the tendency of delayed creativity development and putting strong emphasis on knowledge and skills acquisition does not necessarily imply that creativity is not valued. "Eastern" societies are more likely to produce individuals who are oriented toward improvement.

Neither the cultures in the West nor the East are totally homogeneous in nature. Cultural influence can also differ between subgroups within the same culture. For example, Singapore, an Asian city, comprises three main ethnic groups – Chinese, Malays, and Indians. These groups, within an Eastern national culture, exhibit differing conceptions of what creativity entails (Ramos 2005).

Conclusions and Future Directions

Concluding this entry, the following are the key postulates and conclusions. No one model or approach to creativity may fit all cultures. Different cultures place emphasis on different aspects of creativity. The capability of a country to create and innovate is related to its culture. There are different culturally conditioned styles of creativity and innovation. However, the relationship between cultural values and creativity is complex as the impact of culture on creativity interplays with historical, political, and economic factors. Culture is important, but culture alone does not serve as a guarantee for a high level of creativity, inventiveness, and innovativeness. It is noted that most of the research in this field is speculative since there are not enough significant statistical bases for such types of studies thus far. A future research area would be to systematically examine culture, creativity, and inventiveness in their dynamics by empirically investigating the relationship between changes in values and changes in rates of inventiveness.

Cross-References

- ▶ Creativity and Confucianism
- ▶ Creativity Definitions, Approaches
- ▶ Creativity, Experiential Theories
- ▶ Creativity, Intelligence, and Culture
- ▶ Creativity: Cultural Capital in Mathematics
- ▶ Four Ps of Creativity
- ▶ Multiple Models of Creativity
- ▶ Nature of Creativity
- ▶ National Culture
- ▶ Research on Creativity

References

Arieti S. Creativity: the magic synthesis. New York: Basic Books; 1976.

Besemer SP, Treffinger DJ. Analysis of creative products: review and synthesis. J Creat Behav. 1981;15:158–78.

Davis JS. Testing for creative potential. Contemp Educ Psychol. 1989;14:257–74.

Herbig P, Jacobs L. Creative problem-solving styles in the USA and Japan. Int Mark Rev. 1996;13(2):63–71.

Leung K, Au A, Leung BWC. Creativity and innovation: east-west comparisons with an emphasis on Chinese societies. In: Lau S, Hui ANN, Ng GYC, editors. Creativity: when east meets west. Singapore: World Scientific; 2004. p. 113–35.

Lubart TI, Georgsdottir A. Creativity: developmental and cross-cultural issues. In: Lau S, Hui ANN, Ng GYC, editors. Creativity: when east meets west. Singapore: World Scientific; 2004. p. 23–54.

Mayer RE. Fifty years of creativity research. In: Sternberg RJ, editor. Handbook of creativity. New York: Cambridge University Press; 1999. p. 35–61.

Raina MK. Cross-cultural differences. In: Runco MA, Pritzker SR, editors. Encyclopedia of creativity, vol. 1. San Diego: Academic; 1999. p. 453–64.

Ramos SJ. Cross-cultural studies of implicit theories of creativity: a comparative analysis between the United States and the main ethnic groups in Singapore [unpublished master's thesis] Buffalo: State University of New York; 2005.

Rhodes M. An analysis of creativity. The Phi Delta Kappan. 1961;42(7):305–10.

Ward TB, Smith SM, Finke RA. Creative cognition. In: Sternberg RJ, editor. Handbook of creativity. New York: Cambridge University Press; 1999. p. 189–212.

Weiner RP. Creativity and beyond. Albany: State University of New York Press; 2000.

Creativity and Age

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Synonyms

Achievement and age; Achievement in life; Productivity and age; Productivity curve; Relationship between creativity and age

Creativity and Age

At present, no large-scale empirical studies exist that allow for fully supported conclusions on the relationship between age and creativity across the entire human life cycle. A further limitation on the ability to generalize about the relationship between age and creativity is the degree to which culture can influence an individual's creativity (Kim et al. 2011). Most explanations on the relationship between creativity and age have been based upon speculations from nonempirical studies or from studies with small sample sizes. The first major empirical study on creativity and age, Kim's "The Creativity Crisis" (2011), was based upon almost 300,000 scores on Torrance Tests of Creative Thinking (TTCT) administered to American kindergarten through 12th grade students and to adults between 1966 and 2008. Though Kim's study marks a breakthrough in empirically based studies, with important implications, major gaps remain in understanding the relationship between age and creativity.

After secondary schools, adults generally have enhanced cognitive capacity for certain mental functions that can contribute to creativity. However, adults generally experience diminished creativity in the late phases of the life cycle in passing through various adult stages of the life cycle. Individuals generally face pressures inhibiting development of their creative potential or practicing their creative skills. These pressures include (1) mastery of a convergent body of knowledge and skills for a vocation or profession and (2) affiliation with organizations (employers, religious institutions, civic institutions, etc.) that require some degree (in some cases, a high degree) of conformity. Eminent adults often manage to resist these pressures, and eminent adults are often creative well into advanced adulthood.

Creativity and for Children and Adolescents

Long-standing assertions on the relationship between changes in individuals' creativity and age are not consistent. Gardner (1982) argued that preschool children are highly creative. Upon entering school, however, as they learn conformity, their creativity usually declines. Their creativity starts increasing between grades 5 and 7 and continues throughout adulthood.

According to Piaget (1950), children think concretely, and only after grades 5 and 7 do they have the abstract thinking skills required for genuine creativity. By adolescence, according to Piaget, individuals can assimilate previous events and acquired knowledge with their own personal thoughts and feelings. Thus, their creative expressions increase between grades 7 and 12.

Smith and Carlsson (1983) explained that children lack the cognitive sophistication to be truly creative before grades 5 or 6. Before this age, children are dependent on accidental impressions and only the material that they have incorporated into their own private self. Thus, their creative activities are limited and inadvertent, that is, by chance. As their cognitive abilities cross a developmental threshold around grade 5, they experience high anxiety and creativity (grades 5 and 6), only then to experience, in grades 7 and 8, an increase in compulsive and compulsive-like strategies of adults and peers, which reduces creativity. Subsequently, in grade 9, adolescents' creativity slowly increases, as they learn to control anxiety better and learn to be more flexible (Smith and Carlsson 1985). By grade 11, children have generally acquired a high degree of social equilibrium. They can manage anxiety and confusion by balancing internal drives and external pressures. By this age, individuals have also developed strategies for flexibility, which also allows them to better manage anxiety. With anxiety better controlled, creativity increases.

Kim's study (2011) rested on an empirical basis, almost 300,000 TTCT scores. The TTCT measures fluency, elaboration, abstractness of titles, originality, and resistance to premature closure. The results of the study indicate that:

1. Fluency – the ability to produce many ideas. Children's fluency improves up to grade 3, plateaus between grades 4 and 5, and then decreases. This decline may indicate that at this age children are becoming aware that some ideas are socially inappropriate or that some of their ideas are inaccurate. They become more concerned about accuracy rather than aesthetic appeal. Decreases in creative thinking have some inverse relationship to preference for accuracy and evaluative thinking and for perceptions of social appropriateness.

   In the United States, many educators worry that current trends in student assessment that have emerged out of the standards movement and because of the federal legislation No Child Left Behind (NCLB) may be further decreasing students' fluency and, in general, their creativity. These assessments are almost entirely objective multiple-choice tests. To prepare students for these assessments, educational systems and teachers increasingly rely on similar types of tests, which provide no opportunities for fluency or other forms of creative expression. Moreover, one expectation of No Child Left Behind and parallel legislation in the various states is that schools show "adequate yearly progress" in test performance. To achieve continuous improvement in results, especially at schools with already strong test scores, schools and teachers are relying increasingly on convergent instruction solely to prepare students for tests. This instructional method likewise limits students' opportunities for creative expression.

2. Elaboration – the ability to think in a detailed and reflective manner.

   Children's ability to elaborate and their motivation to be creative increase steadily until high school, when it levels off and then decreases throughout adulthood. This pattern may indicate that children, rewarded for elaboration in schools, are willing to do so through their school years.

   After high school, rewards for elaboration decrease as do the motivation and, with time, the ability. This trend begins as individuals enter college or the workplace, where mastery of an established body of knowledge and skills becomes a priority in order to establish a stable life structure. An objective for many individuals becomes demonstration of competence, not creativity. Further, in the industrial era and continuing into the postindustrial era, a premium has existed on *efficiency*. Efficiency encourages economic growth by way of achieving economies of scale but inhibits elaboration, which can be perceived as an inefficient activity. Some thinkers have argued that the premium on efficiency has inhibited creativity and *effectiveness* (McDonough and Braungart 2002). Institutionally, in the name of efficiency and risk management, organizations frequently resist new and untested ideas (Baker et al. 1987).

   Resistance to elaboration may be true only for non-eminent adults and not for all adults. Eminent creative adults elaborate more with age. Simonton (1983) explained that early in their careers, eminent creative adults generate many ideas (fluency) but later elaborate on their ideas. Creative productivity increases with elaboration. Thus, for eminent creative adults, creative productivity and level of elaboration may not decrease with age (see the explanations below for eminent adult creators). For non-eminent adults, entering midlife transitions may signal a cognitive readiness for elaboration and other aspects of creativity, but the constraints of professional life may not permit such qualities to exhibit themselves (Beswinger 1987).

3. Abstractness of titles – ability to think abstractly, to synthesize and organize, and to capture the essence of the information.

   Individuals' ability in abstractness of titles increases through a lifetime, suggesting that individuals' skills and abilities for abstract thinking improve with age. Vygotsky (1990) also concluded that, with age, individuals' abstract thinking improves and that imagination and abstract thinking are integrated with each other throughout adulthood. This allows creative imagination to be transformed into creative products.

   For creativity to occur, generally someone must spend 10 years acquiring mastery before they can begin to be creative in their field. Once that mastery has been achieved, individuals can synthesize new information or imagine new possibilities. Nevertheless, working against this enhanced capacity for abstractness is a tendency for experts in specialized knowledge areas to resist concessions to (or even to combat with) experts in other areas of specialized knowledge. Even Machiavelli warned of the resistance to what is new in favor of what was tried and tested (Pavitt 2005). Thus, for individuals, an ability to think abstractly may increase with age, but "real world" contexts and constraints work against it.

4. Originality and resistance to premature closure – the ability to produce unique and unusual ideas and to have intellectual curiosity and open-mindedness. Children's' ability to be original and to resist premature closure increases up to grade 5, decreases through high school, and then increases in adulthood. Before grade 5, children are increasingly

open-minded and curious and tend to produce unique responses. After that, they trend toward conformist thinking, which lasts through high school, probably reflecting social pressure to conform in middle and high schools. At this stage, most children lose some ability to generate original ideas. This finding matches Kolberg's conventional thinking stage, the idea that adolescents feel and conform to the expectations of society and especially their peers. Many adults in the workplace participate in brainstorming activities. These activities are presumed to generate creative outcomes, though many studies have revealed weaknesses in brainstorming processes.

Creativity Slump for Children: The Sixth-Grade Slump

Torrance (1967) was the first to conclude that a child's creativity slumps in grade 4, which other studies corroborated and which has become known as the *fourth-grade slump*. Many studies have concluded that, in Western society, a large drop in creativity and curiosity occurs when socialization and conformity are initially taught, which begins in grade 4. Torrance blamed peer pressure and demands for conformity in the classroom. As a result, originality and creativity are discouraged. After grades 4 and 5, creativity scores reportedly increase.

The fourth-grade slump has also been reported not only in Western society. Torrance identified a fourth-grade slump in seven different cultures, though his results showed some variance in timing. In some cultures, the drop in creativity occurs at the end of grade 3 or the beginning of grade 4, whereas in other cultures a drop does not occur until grade 6. Further, some have disputed the fourth-grade slump. One study found a slight increase in creative thinking scores between grades 4 and 5. Another found a peak at grade 4. Another study found little change at grade 4.

Kim's "The Creativity Crisis" study (2011) found that creative thinking scores in individuals increases in general until grade 6, when it either remains static or decreases, suggesting a *sixth*-grade slump, rather than the well-known *fourth*-grade slump. In grade 6, individuals develop logical thinking and experience improved reasoning, which together might be associated with losing creative thinking. Piaget (1950) considered assimilation process in a spontaneity state as creative imagination, which does not decrease with age. However, as creative imagination is integrated into intelligence, due to the accommodation process, creative imagination may decrease.

Before grade 6, efforts should begin to preserve an individual's creativity, for which everyone has the potential from birth. The slump may originate from children's earlier experiences or lack of experiences. Childhood fantasies and play should be encouraged, as creative imagination develops from children's play. Play in grades 1 and 2 predicts creative thinking in grades 5 and 6. In addition, well before grade 6, children should reflect on the personality characteristics common to creative individuals. Children should be supported in their nonconformities and taught to embrace their idiosyncrasies. Students in grade 6 and beyond should have opportunities to exercise their creativity through choice, for example, choice of topics on academic projects. Originality, fluency, elaboration, abstract thinking, and open-mindedness should be taught instead of an exclusive focus on accuracy.

Creativity and Age for Eminent Adult Creators

In the United States, the relationship between creativity and age appears different for non-eminent adults from that of eminent adult creators in the world history (Simonton 1994). The creativity of eminent creators does not necessarily decrease, as it does for non-eminent adults. The productivity of eminent creators tends to begin in their 1920s, though it can vary depending on when the career began. In addition, career changes tend to rejuvenate eminent creators' creativity. Once the productivity starts, the productivity curve ascends quickly to an optimal near age 40. So, most creative products are generated in their 1930s. And then, after the optimum, the curve turns around and gradually descends. However, age of decline varies by domain. Research also shows that quantity is a function of quality. Thus, fluency is important for originality.

Historically, eminent political leaders peak in their career at later ages than other creators, though revolutionary leaders tend to be younger than diplomat leaders. Status quo politicians and leaders of established faiths last longer than revolutionary leaders, thus having more opportunities for creative achievement later in life. Additionally, poets tend to be younger than novelists.

Though about 80 % of most important creative contributions are completed by age 50, many eminent creators were productive late in life, sometimes well past their 1970s. Benjamin Franklin developed bifocal lens at age 78 and helped to frame the US Constitution at age 80. Goethe wrote *Faust* in his 1980s. Thomas Edison worked in his laboratory until he was 84. Titian painted his masterpieces at age 98. Henri Chevreul conducted gerontological research in his 1990s, and his last paper was written at age 103.

Conclusion and Future Directions

Kim's study shows a trend of decreasing creative thinking with age, especially the ability to produce many ideas, the ability to think in a detailed and reflective manner, and the motivation to be creative. Scholars differ about creativity among small children (roughly 7 years old or younger). After grades 5–7, cognitive capacity for abstract thought improves, thus strengthening certain capacities for improved creativity. In certain respects, creative capacity improves in high school, though students must learn how to balance needs for creativity and self-expression with social acceptance. In adulthood, despite improved cognitive abilities, most adults experience a flattening or decrease in creativity. This trend could stem from the limited rewards for creativity that many adults experience as they master their adult vocation or profession and because of various forms of institutional pressure for conformity. In later life, non-eminent adults experience a decrease in creativity. On the other hand, eminent individuals show creativity in later life and, in special cases, well into the final stages of life. In light of the central role of creativity in the contemporary global economy, countries experiencing decreases in creativity among its adulthood population could suffer economically.

References

Beswinger GL. Why corporations stifle creativity. In: Timpe AD, editor. Creativity. New York/Oxford: Facts on File Publications; 1987. p. 156–9.

Gardner H. Art, mind, and brain: a cognitive approach to creativity. New York: Basic Books; 1982.

Kim KH. The creativity crisis: the decrease in creative thinking scores on the torrance tests of creative thinking. Creat Res J. 2011;23:285–95.

Kim KH, Lee H, Chae K, Andersen L, Lawrence C. Creativity and confucianism among American and Korean educators. Creat Res J. 2011;23:357–71.

McDonough W, Braungart M. Cradle to cradle: rethinking the way we make things. New York: New Point Press; 2002.

Norman RB, et al. How management can influence the generation of ideas. In: Timpe AD, editor. Creativity. New York/Oxford: Facts on File Publications; 1987. p. 57–68.

Piaget J. The psychology of intelligence. New York: Harcourt Brace; 1950.

Simonton DK. Creative productivity and age: a mathematical model based on a two-step cognitive process. Dev Rev. 1983;3:97–111.

Simonton DK. Greatness: who makes history and why. New York: Guilford Press; 1994.

Smith GJW, Carlsson I. Creativity in early and middle school years. Int J Behav Dev. 1983;6:167–95.

Smith GJW, Carlsson I. Creativity in middle and late school years. Int J Behav Dev. 1985;8:329–43.

Torrance EP. Understanding the fourth grade slump in creative thinking. Final Report. Athens: The University of Georgia; 1967.

Vygotsky LS. Imagination and creativity in childhood. Sov Psychol. 1990;28:84–96.

Creativity and Behavior Problems

► Creative, or a Behavior Problem?

Creativity and Church

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Synonyms

Ecclesia; Innovation

Creativity God's way is seen as an expression of His nature through His creation. Creativity without God is not meaningless as it still reflects Him since man was made in God's creative image. If man can achieve such high creative acts such as visiting the Moon, how much more will the Church be able to achieve as a coworker with God, the Moon's creator. However, the creative purpose of the Church may differ in its outcome to that of man. The Church's purpose has been established to restore a relationship with Him. God is furthermore interested in restoring all things to His purpose: A place of His peace and abundance, a place devoid of poverty, greed or sickness. This is because Creativity God's way and through the Church will always reflect His nature, His love, and His power and it is bound to surprise or *offend* us. A case in point is that Jesus Christ's death on the cross was God's creative act of salvation for mankind. Though God has shown Himself highly creative, the Church has not always followed suit. The main reason has been a misunderstanding of how God works through the Church. Instead we have worked with our efforts on His behalf. The creative result has been religion. From the religious perspective, the church is a building instead of a group of people called out by God to represent Him, His nature, and His power.

Definitions of Church and Creativity from a Biblical Perspective

From a biblical perspective, Creativity is first seen as God's activity in a vacuum. There is a creation stage where God speaks and whatever He wills happens. It is that will of God and His voice or Word which are at the origin of God's creativity. For instance, in Genesis, we hear Him speak "Let there be light" and something happens "there was light." In a survey of God's miracles and creative acts we can see them as a result of His word at the beginning. When those who hear that word obey what it says, creative acts happen: from Abraham's miracle son Isaac (Genesis 15) to Naaman's (2 Kings 5) miraculous healing dipping himself in the Jordan river seven times through the deliverance of the Canaanite's daughter (Matthew 15) or the centurion's servant (Matthew 8) by a word spoken by Jesus or a fig tree that withers it is always by a word that originates from God (Mark 11). At the center of God's creativity we see His Will carried out through the power of His Word. For instance, Psalm 36:6 indicates that by His Word God created the heavens and in Isaiah 45 He is established as the creator of the heavens and the Earth.

God's partnership with men is also seen by the creative power of His Word in man's mouth. In Genesis, Adam is instructed to name animals or declare their nature. In the same way that God spoke "Let there be light" God commissions Moses to speak a similar powerful word "Let My people go," which resulted in a miraculous deliverance. All through the Old Testament prophets speak words of restoration, judgment, healing and miracles as they are led by God to speak those creative words. In the New Testament we also find that apostles have received that creative power. In Acts 3, Peter and John speak a word of healing to a lame person who is begging. The say that they do not have money but that what they have (creative power to heal) they can give to him. God's Word of healing results in a miracle.

God's perspective on creativity as it relates to the Church is therefore not only unilateral but He seeks those who are willing by faith to engage them so that He can express His creative power through a Church that bears His Name.

The origins of the word church come from the word Ecclesia meaning the ones who have been called out. The Church is called out from a system ruled by the desires and motives of men and submits herself to the desires and motives of God acting under the same principles and dynamics that God has used before the Church started. The Church is then a foreign body in society: a group of creative people that emanate the nature and power of God. God shows repeatedly that it is by His power that we do His Will: the spiritual and physical battle that His church fights belongs to Him and He gives victory not by human wisdom but by His Spirit (Zechariah 4.6, 2 Chronicles 20). The Church is in itself a creative act by God who said "I will build my Church" (Matthew 16), a group of people that have received and continue to receive divine life by God to demonstrate Him on Earth. That is the creative purpose of the Church. Dedmon and Johnson (2012) provide a similar definition based on God's design when they state that "embracing our creative design *(originated at the heart of God)* gives us the freedom to supernaturally use that creativity to transform the lives of those around us".

Creativity and the Church: False Creativity and a False Church from a Biblical Perspective

History shows that as the church lost influence and relevance in society it was relegated to a building. Nowadays many people "go" to church, or belong to "a" church. They refer to a building or an organization. It may be the most impressive architectural feat of the century but that building, according to Scripture (Matthew 6), will never be the biblical church. Even though all that talent may be created or inspired by God, the building will never replace the biblical church: a group of born again (by His Word) believers that have faith in God, His power, and His way of creating. Those members of God's church have been born in Heaven. They belong to a different world and are strangers and pilgrims on Earth where they are agents of God's love and restoration. That is why they exhibit the creative characters and motivation of God. On the one hand it is God's love: the ability to love the destitute and the enemy. And on the other hand the ability to express God's power through God's creative acts: healings, deliverance, miracles, and wonders.

What is then the church's false creativity about? It is everything that has been achieved with man's motive and purpose, with man's ability, or for man's glory. A group of people that have invested large amounts of money for a wonderful building where they have programs in the name of a God they do not know personally. It is trying to please God with human efforts instead of the ability and power that He freely provides. The heart of the religious person is full of false creativity (from God's perspective): man wants to achieve great things for God: gather many people in one place, build big buildings, have big programs, communicate to millions of viewers over Christian TV. They have been deceived into believing that they are blessed as they equate blessings to material possessions. However, God is interested in a different creativity. He wants to anoint and empower human's talents and efforts so that men can do exploits. Exploits are creative acts that can only be explained accepting God's intervention.

The Church's Great Creative Challenge: Corporate Faith

How can the Church connect with the power of God to express His creativity?

Johnson (2006) suggests that the answer is desire according to Proverbs 13.12. He points out that "hope deferred makes the heart sick, but when the desire comes, it is a tree of life." These desires come from communion with God and His Word. Since this life must be His life, it will reveal His creativity. In the words of Jesus this is the lasting fruit that the Father provides and glorifies Him (John 15).

In His own wisdom He has refrained Himself from creating through the Church unless there is a faith on Earth that correspond to the word that comes from Heaven. Faith in this sense is the ability to receive the revelation of that creative word, trust in its power, and obey it to see its miraculous results. One of the Bible's main assumptions is that those who have faith can do exploits, for nothing is impossible for him who believes (Mark 9). The Church's challenge is to find and grow that faith to carry out God's creative will on Earth. For instance, God shows as His promises of His Word that there is no soul that God does not want to save (2 Peter 3) and no illness He does not want to heal (Isaiah 53). Therefore, the Church's ability to make a breakthrough in faith will bring a flood of God's creative acts on Earth to achieve that purpose. How can the Church access that faith?

1. If the Church positions Itself in a place of humility then It will have access to the revelation of His Word. This in itself needs an additional uncovering of truth: our present naked and destitute position: the fact that we can do absolutely nothing without Him of eternal value. Fasting and prayer should lead to true repentance and confession of a particular sin: doing a creative work on our own strength that requires no faith or power from God, a creative work that is greatly valued by men but despised by God. For instance, Abraham had an idea to answer God's promise by having a child with an Egyptian woman (Hagar) instead of Sarah, chosen by God. The name of the child Ishmael was not accepted by God as His answer to Abraham's desire. God's creative act was fulfilled in Abraham's and Sarah through a miracle baby Isaac. This process of humility is God's process of restoration (2 Chronicles 7) for healing as in Naaman's case (2 Kings 5).
2. Receiving revelation from the Word of God by the Holy Spirit. You can understand how God speaks by seeing how God has spoken through His Word. A basic perusal of the word reveals a common pattern: man's tendency to understand God within his own limitations and failings. For instance, a greedy mind-set as in Gehazi's example (2 Kings 5) cannot understand or accept the creative provision of God. Peter's warring nature leads him to cut a soldier's ear (John 18) working against the purpose of God to bring restoration through the sacrifice of Jesus on the cross. This is also called a carnal mind-set that always works against God. That is why in order to receive the creative revelation of God through the Church the humility of confession and repentance is needed. The Church may have assumed a level of holiness (accordance to God's Will and Ways) that is not real. However, God has a vision, a revelation, a plan for everybody, and for the Church as a whole that He wants to impart.
3. Obedience to the Word of God. If we understand what God has spoken to us we know what is our part in that creative process. God is looking for people who agree to what He is speaking by the way they think, the way they speak, and they way they act. This action could be something sensible or ridiculous, something that costs us nothing or everything. These actions are in God's creative acts a shaping of who we are. God calls Elisha through Elijah in 1 Kings 19. God wants to shape a prophet to fulfill a purpose: deal with the spiritual challenge of Jezebel in the nation. Elisha obeys in the following way: he sacrifices the oxen and farming tools saying to God "this is the end of my life as a farmer, I will follow you from now on." Elisha does not request from God to use a sword to put an end to Jezebel but lives step by step in obedience to God's creative power and finally sends Jehu to speak a word that brings to an end that oppressive regime.

These three points can be summarized as follows: our walk of humility allows God to show us the revelation of His will and pour His grace on us to obey whatever is required no matter the cost. This is God's strategy to make His creative acts known in the Church and through the Church.

Conclusion and Future Directions

The Future of Creativity in the Church: The Prophetic and Apostolic Challenge

The Church will continue to create and prosper: it is God's creative design. However, this will take two different shapes:

(a) A church will continue to grow that exalts everything that impresses man: greater buildings, greater numbers of people, greater finances, greater popularity.

(b) Another Church will continue to emerge. A humble unknown group of people doing exploits where God is seen everywhere, full of God's power that transforms mind-sets and therefore media, art, business, education, and the way society works. This is a Church that will be the channel of God's blessing and where people can receive a revelation of His Nature.

There is no systematic study of God's creative work through the Church. A basic and complicated obstacle is that a Godless church has already achieved many creative works that have impressed men. It is incumbent on the members of the Church to study and document God's creative acts in society that go beyond personal healing, deliverance, and provision to societal value change that is willing to lay down a human value system for God's purposes and ways.

Cross-References

► Church and Entrepreneurship

References

American King James Bible.

Dedmon T, Johnson B. Born to create: stepping into your supernatural destiny. Shippensburg: Destiny Image; 2012.

Johnson B. Dreaming with god. Shippensburg: Destiny Image; 2006.

Creativity and Confucianism

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Synonyms

Culture; Rote learning; Values

Creativity and Confucianism

Confucianism – the ideas of the teachings of Confucius (551–479 B.C.) – prescribes the practical ethics of daily life without religious considerations. Confucianism is the major cultural influence in Asian societies including China, Japan, Hong Kong, Korea, Singapore, Taiwan, and Vietnam. Confucian cultural tradition and values have served as the ethical and moral foundation for East Asian thinking, permeating every interaction, from business to social to family. Confucian values contrast sharply with Western values, which encourage individuality, individual achievement, and various means of standing out, such as displaying creativity. Confucianism, with its emphasis on rote learning, hierarchy, and inequality, has traditionally dampened creativity. Though various forces have worked to diminish Confucianism's impact in recent years (Kim and Pierce 2012), considerable differences in conceptions of creativity have traditionally existed, and continue, between East and West.

Creativity and Different Cultures

Many factors influence individuals' creativity. While some factors are unique to an individual, most have a relationship with social factors, for example, environment and culture. Creativity is more a function of cultural and social phenomena than of individuals' mental process: it is the product of the social systems that judge the product

(Csikszentmihalyi 1999). Creativity does not exist in the same form across cultures because creativity is understood differently and associated with other cultural values in different cultures. The culture, including the economic, political, social, and cultural climates, has a significant effect on contributions and evaluations of creativity. The extent to which an individual or a product is judged as creative is influenced by where the individual or the product originates, and thus, culture has a critical impact on judgments of creative individuals or creative products. Individuals from different cultures use different psychological processes when they engage in creative endeavors because of their concepts of creativity. Language may influence the development of creativity, and culture either encourages or discourages creativity (Sternberg and Lubart 1996). Thus, a focus on enhancement of an individual's creative attitude and creative thinking may be insufficient to enhance creative productivity when the individual's cultural setting does not foster creative expression and growth (Kim and Pierce 2012).

Confucianism

The principles of Confucian teaching can be summarized as emphasizing education, family system, hierarchical relationships, and benevolence (Chen and Chung 1994). In Confucianism, the purpose of education is to help people develop ideal personalities. A Confucian gentleman consciously cultivates, practices, and displays his virtues, and never flaunts individuality. The holistic and idealistic model of a human being is a well-rounded person with a perfect personality who makes a positive contribution to society (Cheng 1998). These characteristics are manifested in the citizenry through the education system, where uniform virtues with regard to each individual's role in life are instilled. Like pieces in a puzzle, individuals must fit seamlessly together to assemble the Confucian society, and if any of the pieces is misshapen, it does not fit.

The first principle of Confucianism is its emphasis on education. This principle is evident throughout Confucian societies. Confucian-influenced societies are characterized by a high degree of cooperation between teachers and parents, and parents place special emphasis on education in early childhood, engage students in learning, and support schools (Henderson et al. 1999). Positive influences from Confucianism are high motivation to acquire an excellent education, including a motivation, an expectation, and even a responsibility to obtain higher degrees and diplomas when possible (Martinsons and Martinsons 1996). In the past several decades, Confucian societies have enjoyed strong economic growth because of their educated workforce. However, Confucianism emphasizes learning in a mechanical way without thought or meaning, somewhat like a parrot which learns to mimic speech, and this emphasis has evolved to the extent that students in Confucian cultures are considered to lack abstract thinking abilities, originality, and creativity (Chan 1999).

In the West, education has historically celebrated individuality, self-expression, and capitalist values. These values are represented in various educational philosophies that prevail in the West. For example, "inquiry-based learning" seeks to awaken ideas within students and avoids inculcating established truths: it encourages divergent thinking. Teachers practicing inquiry-based learning in their classrooms need to be open-minded, tolerant, and intellectually non-authoritarian. These teachers act as experienced co-learners, rather than as authorities with the "correct" answers. This type of teaching environment would not work in a Confucian education system because Confucian societies have historically been based on examination systems where the goal of schooling is to prepare students to pass examinations. However, this narrow reliance on standardized testing for educational assessment forces schools to emphasize rote learning and memorization; it encourages convergent thinking. Traditionally in the West, many students reject the value of standardized testing and scholastics and seek instead to develop other characteristics and abilities, such as their artistic abilities, interpersonal skills, senses of humor, and abilities to get along with many types of people. These skills traditionally lead to success in the West, where employers share these same values and have historically rewarded original and useful thinking. In contrast, Confucian employers have historically punished individuality, and original and useful thinking. Exhibiting traditionally Western characteristics in a Confucian society may lead to social ostracism, pillory, and ineffective efforts to succeed.

The second principle of Confucianism is the family system. Confucian teachings consider Confucian society itself as a large family, in which the father comes first and the eldest son comes second. The unquestioned obedience of the son to the authority of the father is essential (Fah 2002). Confucianism is a social bond that fixes family members in the network and roles of their hierarchical relationships. Furthermore, Confucian concepts of filial piety, obedience, and loyalty practiced in the family are transferred to social organizations, where customs of disciplined subordination and acceptance of authority are cultivated. The concept of filial piety has no comparable concept in non-Confucian cultures. Filial piety is not only the supreme principle of Confucian life, but it is also the most essential value to East Asians (Hwang 1999). According to filial piety, obedience to parents is so important that a son cannot even stop his parents from doing wrong (Fah 2002). East Asian parenting practices are very restrictive in what is acceptable behavior, and children must accept all advice and demands from parents without question. The Confucian hierarchy also inflicts upon its subjects a rigid system of inequitable obligations, thus hindering human potential. Confucianism dictates an inequitable status for women especially, which forces them into submissive roles as servants to their husbands' families. Confucianism states that all women are to be obedient: a woman is to be obedient to her parents in childhood, to her husband and his family in marriage, and to her oldest son in old age Chung 1994).

The third principle of Confucianism is that of hierarchical relationships. Confucius philosophized that all relationships are between people of unequal power. He described five basic relationships: ruler/subject, father/son, husband/wife, older brother/younger brother, and between friends. The parties to these relationships are presumed to be both unequal in status and complementary, in that neither can exist without the other (Hwang 1999). In the rigid hierarchical society of Confucianism, age is a mark of personal prestige and social authority. One positive aspect of the hierarchical code is the respectful treatment accorded to elders. As a result, the older generation can exercise discipline and control over the young.

The last principle of Confucianism is benevolence. Benevolence includes self-discipline, brotherly love to elders, loyalty, personal duty, and positive interpersonal behaviors among society members (Chen and Chung 1994). Research shows that the principle of benevolence negatively influences creativity by suppressing emotion, minimizing verbal interaction, and imposing conformity. The principle of benevolence requires self-control of emotional expressions in all relationships. Even affectionate expression to loved ones is considered inappropriate and must be internalized to conform to collectivist ideals. This cultural value denies people natural freedoms of expression and individuality. Confucianism restricts verbal interactions, especially for males, and being a talkative man is considered to be inappropriate. A man's words hold more authority than women's, so restraint is taught to boys because talking too much diminishes the man's power.

Relationship Between Creativity and Confucianism

A review of the four principles of Confucianism demonstrates the ways they conflict with creativity. The first principle of Confucianism is its emphasis on education, which inhibits creativity through rote learning and extreme competition. The second principle of Confucianism is the family system, which blocks creativity through rigid parent–child relationships, an overemphasis on obedience, filial piety, and loyalty, and strict gender role expectations. The third principle of Confucianism is the hierarchical relationships, which decrease creativity through unequal relationships, rigid social structure, gender role expectations, and authoritarian relationship between teachers and students. The last principle of Confucianism is benevolence, which stifles creativity through suppression of emotion, the silence ethic, an extreme value of humility, conformity, and stigmatized eccentricity.

In Western societies, liberal moral-political values emphasize individual rights and self-determination, but Confucianism in East Asia emphasizes collective good and harmony, along with self-cultivation and self-regulation. In Eastern societies, the welfare of the group is seen as inseparable from that of the individual, but Western societies emphasize the rights of the individual, even at the expense of the group. In Eastern societies, adherence to group interests for the sake of achieving harmony is often justified at the expense of individual interests (Chung 1994). Students seek to avoid appearing different from others, individuals learn to restrain themselves in order to maintain group harmony, and the fear of making a mistake or embarrassment keeps many students silent. These expectations are related to their propensity for compromise and conflict avoidance (Martinsons and Martinsons 1996).

Western culture is based on the ideals of individuality, democracy, and freedom, whereas Eastern culture is based on the ideals of collectivity, interdependence, conformity, and authoritarianism (Rudowicz 2003). This difference is evident in many ways. When evaluating artistic expressions, Western culture tends to be flexible, reflecting values of individualism and the personal preferences of the artists or judges, but the standards of Eastern culture tend to be consistent, reflecting collectivism (Li 1997). These two cultures have developed different perspectives on the meaning of novelty and originality. Novelty and originality are valued more in Western culture, whereas appropriateness is valued more in Eastern culture (Rudowicz 2003).

This difference is especially evident in the long-term historical development of China. China is known as the "sleeping giant." It is home to one billion of the world's seven billion people. China could have exerted itself as a world force but has chosen not to do so even in its own geographical backyard, leaving smaller countries like the Koreas and Japan autonomous. The Chinese came to view unfamiliar people and new ideas with suspicion.

During much of the Common Era, the West had a remarkably less impressive cast about it. After the Roman Empire in the West collapsed, Europe became divided into a number of competing polities, a situation that has sometimes been referred to as a long civil war. The economy weakened, as did the use of advanced Roman technologies. Even education – so prized in Confucian cultures – barely survived; the literate tradition was maintained only by a small group, mostly monks, who preserved Roman and Greek culture by copying the few remaining Ancient texts.

In the long run, however, the West has been a greater commercial success than the East. Because the West was fragmented politically political with multiple poles of power (Emperor and Pope, Kings, high-ranking nobility, independent cities, and comparatively independent universities), Westerners had a far more open disposition to new ideas. Each competing power was searching for a way to excel, which had a transformative impact on society. This transformation received the social and economic impetus for a breakthrough with the Black Death (1347–1349), which set Europe off on a path of autocatalytic change, innovation, and creativity. This autocatalytic process of change allowed the West to surge ahead of China. By 1800, Westerners were breaking new boundaries of human achievement when many Chinese officials were insisting that access to status and power in China be based upon knowledge of the Confucian classics. The Chinese could not compete with this transformative Western society, and the Chinese Confucian imperial regime eventually collapsed.

Today, the relationship between Confucianism and creativity remains strained. On the one hand, because of traditional Confucian values, the Chinese and Asians generally demonstrate remarkable qualities related to achievement, especially a high regard for education and a strong work ethic. This positions students from Confucian societies to have mastery, which is required for the creative to bear fruit. On the other hand, because of traditional Confucian values, Chinese and Asian students show many of the traditional qualities that constrained creativity: passivity, silence, and conservatism. In light of the highly competitive economic world today that has resulted from globalization, it is uncertain whether China will break out from its Confucian past to harness the amazing human and intellectual capital it possesses, or will the Chinese return, following decades of Communism, to its Confucian values. Time will tell.

Confucianism and Invention and Innovation

Ancient Chinese society was known for its advanced inventions, including fireworks and paper. Later, because Confucian society did not value creative production, few people, if any, were encouraged to be creative. According to Confucianism, education is a much more important quality for a leader to have than technical competence or professional expertise. In this sense, education itself is an essential component of the virtues (Chan 1999). Confucian education valued mostly abstract values from the classics as something to be memorized instead of developed. In addition, the Confucian educational philosophy prioritizes the teaching of ethics. School curriculum in East Asia still places great importance on subjects related to ethics, offering and emphasizing classes such as ethics and manners (Chen and Chung 1994) which, again, are memorized not explored or debated.

However, given the changing needs of today's organizations and the growing demand for flexibility in dynamic work environments, creative problem solving and decision making are more important than loyalty and obedience, which are emphasized by Confucianism. Overemphasis on following rules and traditions at work creates organizational barriers to creative innovation. Creative potential can be realized in work situations where employees can influence decision making and communicate new ideas.

Despite the cultural weight against innovation and creativity in Chinese-influenced societies, Confucian countries face an opportune moment. Creativity in the United States, the major engine of creativity and innovation in West in the last 100 years (Kim and Pierce 2012), is demonstrably in decline (Kim 2011). Chinese-influenced societies may now have the incentive to make cultural adjustments that foster creativity.

Conclusion and Future Direction

Confucianism, which supports a constellation of values and ideas based upon the writings of Confucius, has had a strong influence on the culture of Asian societies, including China, Japan, Hong Kong, Korea, Singapore, Taiwan, and Vietnam. Confucianism fosters a set of hierarchical values that generally diminishes creativity. Its emphasis on education, for example, has created a culture that cherishes education, but a type of education that reinforces hierarchy and traditional values. In this system, creativity has virtually no place. This cultural setting contrasts sharply with the West, where individuality, self-expression, and capitalist values are nurtured, even celebrated. These values partially explain how the West became so technologically advanced in the early modern and modern eras. Mainly as a result of its Confucian culture, the East has discouraged creativity and change. Today, in the global economy, in which Confucian countries are important participants, pressure exists for them to become more flexible and to foster a greater spirit of innovation; it must if it is to remain a force in the world economy. Time will tell whether that transformation occurs and, if it does, how it will happen. Confucian countries possess much strength because of their cultural influences.

If they can retain those strengths and become more flexible and foster creativity, the great potential of Confucian countries could be fully realized.

Cross-References

- ▶ Divergent Versus Convergent Thinking
- ▶ Innovative Milieus and Entrepreneurship (Volume Entrepreneurship)
- ▶ Techno-Globalization and Innovation

References

Chan S. The Chinese learner – a question of style. Educ Train. 1999;41(6/7):294–304.

Chen G-M, Chung J. The impact of Confucianism on organizational communication. Commun Q. 1994;42(2):93–105.

Cheng KM. Can educational values be borrowed? Look into cultural differences. Peabody J Educ. 1998;73:11–30.

Csikszentmihalyi M. Implications of a systems perspective for the study of creativity. In: Sternberg RJ, editor. Handbook of creativity. New York: Cambridge University Press; 1999. p. 313–35.

Fah YC. The spirituality of Chinese social obligations. Transformation. 2002;19(1):34–6.

Henderson BB, Marx MH, Kim YC. Academic interests and perceived competence in American, Japanese and Korean children. J Cross-Cult Psychol. 1999;30(1):32–50.

Hwang K-K. Filial piety and loyalty: two types of social identification in Confucianism. Asian J Soc Psychol. 1999;2(1):163–83.

Kim KH. The creativity crisis: the decrease in creative thinking scores on the Torrance Tests of Creative Thinking. Creat Res J. 2011;23(4):1–11.

Kim KH, Pierce RA. Torrance's innovator meter and the decline of creativity in America. In: Shayinina LV, editor. The international handbook of innovation education. London: Taylor & Francis/Routledge. In press 2012.

Li J. Creativity in horizontal and vertical domains. Creat Res J. 1997;10:107–32.

Martinsons MG, Martinsons AB. Conquering cultural constraints to cultivate Chinese management creativity and innovation. J Manag Dev. 1996;15(9):18–35.

Rudowicz E. Creativity and culture: a two way interaction. Scand J Educ Res. 2003;47:273–90.

Sternberg RJ, Lubart TI. Investing in creativity. Am Psychol. 1996;51:677–88.

Creativity and Emotion

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Synonyms

Affect; Feeling; Mood; Novelty

Key Concepts and Definition of Terms

While the field of study concerning the relationship between *creativity* and *emotion* is comparatively small, the fields of *creativity* and *emotion* as distinct areas of research are vast. Each area is replete with theory abounding in differing perspectives and orientation. Consequently, the number of definitions for each term is large, many of which may only be deeply understood in the light of theoretical orientation from which the definition is derived. This is particularly the case for the term emotion, whose definitional efforts have historically been elusive, despite its frequency of use.

For the purposes of shared understanding and this entry however, the terms *creativity* and *emotion* are defined as follows:-

The term *creativity* is derived from the Latin *creatus* "to make or produce" and in more recent canon is defined as "the production of effective novelty." It is used in scholarly writing of psychology in much the same way as in popular writing but with some refinement. The word "production" implies that some act or action is required. Thus, within the cognitive orientation, the act of creation or the "creative process" is studied. However, within other orientations such as the personality perspective of individual differences, the "creative person" is studied, while within the psychosocial perspective, the press of the environment or the "creative environment" is studied and within the psychometric perspective, the "creative product" is studied. Central to each orientation is the assumption that the novelty produced is both useful and meaningful and that its operation lies within the moral domain. Thus, for example, the creation of a new method in mathematics is considered useful, and the creation of an artistic work is meaningful.

The term *emotion* is derived from the Latin *emovere* "to move, to excite, to stir up, or to agitate" and is often used to describe any of a number of subjectively experienced affect states. In this sense, the term emotion in scholarly writing is used in much the same way as that in popular writing. However, in everyday language, emotions are often equated with feeling, whereas in psychological literature, emotions are considered to encompass much more than feeling. While not all feeling originates in emotion, all emotions generate feeling. Emotions are acute, relatively short-lived affective episodes that are accompanied by high levels of arousal and momentary desires to act. They arise in response to information perceived in both the internal and external environments of the body. The emotions of happiness, sadness, fear, disgust, surprise, and anger are said to be "universal," "primary," or "basic" since these emotions are evidenced in infants soon after birth and have been observed by anthropologists among people in remote cultures. Other emotions, such as those of shame and embarrassment which involve breaking a social or moral code, are considered to be culturally determined and are therefore called "social," "self-conscious," or "secondary" emotions. Needless to say, emotions are complex, multifaceted phenomena characterized (but not exhaustively so) by subjective experience (e.g., feeling), expressive reactions (e.g., smiling, frowning), physiological reactions (e.g., increased heart rate, flushed face, perspiring hands), responsive behaviors (e.g., fleeing, fighting, laughing), and various kinds of cognition (e.g., altered attention and thought) (Cornelius 1996).

Given the complex multifaceted nature of emotion, it is not uncommon to find disagreement arising among proponents concerning the relative importance of a given aspect. Taking the aspect of subjective experience and "feeling" as a case in point, the relative importance ranges from "not at all important" to "highly important," depending on perspective. This range of perspective reflects well the different theoretical orientations within the field of emotion. Among these are the Darwinian orientation that emphasizes the universal and adaptive function of emotions, the James-Lange orientation that focuses largely on the bodily responses, the cognitive orientation that investigates the cognitive processes of mental appraisal, and the social constructivist orientation that weighs the influence of social and environmental interactions. Considering the broad set of representations surrounding the concept of emotion, together with confusion created by its use in everyday language, the more expansive term "affect" is often times preferred.

Mapping the Four Ps of Creativity onto Emotion Research

There are some interesting relationships to be established when the four Ps of creativity (namely, person, product, process, and press of the environment) are over laid onto the field of emotion research. The Darwinian orientation which describes emotion as a trait of adaptive advantage is consistent with the person approach to creativity that seeks to identify trait characteristics of the creative personality. The James-Lange orientation that describes emotion as a bodily response (or outcome) is consistent with the product approach to creativity that frames creativity in terms of an original output or response. Not surprisingly, the terms "emotional expression," "emotional competency," and "emotional output" are found. In the cognitive tradition, emotion is framed in terms of cognitive processing which is consistent with the process approach to creativity that describes creativity as involving a set of cognitive processes that take time. Here emotion is presented as a so-called intelligence, and the terms "emotional intelligence" and "noncognitive capability" are found. Finally, the social construction approach to research in emotion may be likened to the press of the environment in studies of creativity. Within this orientation, terms such as "emotional capital" and "emotional stresses" are found highlighting the interaction that takes place between the individual and the social environment.

Further, recent technological development has allowed the advancement of other orientations particularly from within the fields of neuroscience, medicine, and brain imaging research. The hypothesized relationship of mirror neurons to social and emotional behavior is one such case.

Theoretical Background and Open-Ended Issues

Advances in understanding about the relationship between creativity and emotion have, by comparison with other fields of research, been relatively slow and the field itself comparatively new. The reasons for this are complex and require an understanding of the way in which creativity, thinking, and emotion have been framed throughout history. During the industrial age of the late eighteenth and nineteenth centuries, explanations of human functioning drew inspiration from analogies with power-driven machinery. Questions such as "what is the 'power' and what is the 'machine'?" were asked. Utilizing the notion of the instinctive *drive*, emotions were conceptualized as "power" and intelligence or reason as "machine." Thus, this mechanist conception meant that the emotionally actuated human, needed to be instrumented by reason. Indeed, in the decision-making arena, information obtained through reasoning, rather than feeling, was to be believed.

With the advent of the information age in the latter half of the twentieth century and on into the twenty-first century, and a burgeoning knowledge economy, the machine metaphor continued. This time, models of "information processing" developed, drawing as they did so on mental representations inspired by analogy with computer technology. Terms such as "brain power" and "processing speed" were used, and in more recent history, emotion is represented as "data" and "output."

Nevertheless, there have been many people in history who rejected the "mechanist" perspective and the separation of thinking from emotion. One such person was Graham Wallas (1926), who, working early last century, became well known for distinguishing four stages of control in the process of creative problem solving. These stages were preparation, incubation, illumination, and verification. However, what appears to be lesser known was that Wallas also described a substage called intimation associated with the stage of illumination. Intimation was defined as awareness, infused with affect, presenting itself in the form of a feeling or intuition that preceded and/or accompanied the "flash" of illumination. According to Wallas, if illumination were to be controlled, then intimation or feeling would need to be attended to. Just as an idea may call up an emotion, an emotion could call up an idea.

However, the semi-recognition of intimation as a mere substage within the creative process meant that its significance was over looked together with the affective dimension of creativity research. This begs the question "Is emotion (or affect) important to creativity?" and if so "How is emotion (or affect) involved in the creative process?"

Implications for Theory, Policy, and Practice

With the dropping of the atomic bomb and the unleashing of uncontrolled power in the mid last century, interest in the concept of creativity grew as nations, particularly in the west, competed for technological advantage in the ensuing cold war that followed. However, the association of emotion with power that arose out of the industrial age meant that research in the information age would target its more respectable cognitive aspects.

Using the "four P" approach as a framework, what follows is a brief overview of research pertaining to creativity and emotion. In some instances, emotion and feeling appear as the antecedents of creativity, in others as the mediators and accompaniments of creativity, while in still others as the products of creativity. The former representation predisposes the notion that emotion fuels cognition, the latter case that emotion is the product of cognition, while in the center case that emotion and cognition interact.

Affect and the Creative Person

Many of the initial studies into creativity attempted to identify the creative *person* through an analysis of personality traits. However, no single differentiated personality profile common to all highly creative people has been found capable of distinguishing them as a group from less creative people. Some personality traits identified are tolerance of ambiguity, perseverance, openness to new experiences, a preference for challenge and complexity, willingness to take risks, and courage of one's own conviction. In particular, the trait of "openness to new experience" was regarded as the strongest predictor of creativity (Feist 1999). Not only did the trait involve a willingness to try out and explore new ideas, it also predicated the qualities of aesthetic sensitivity and an awareness of one's own inner feelings.

Within the psychoanalytic tradition, the personality trait "openness to experience" is associated with preparedness to access emotion-laden thoughts and primary process thinking (Russ 1993). Primary process was conceived as being a primitive form of thinking that was heavily laden with affect, unconstrained by logic and largely unconscious. However, expression of primary process appears to be more conducive to males than females. Interestingly, access to affect-laden thoughts is related to divergent production and transformation abilities. Transformation ability involves the mental flexibility to break from old ways of thinking and to see new patterns and configurations (i.e., to break mental set). Affect-laden thinking, it is theorized, activates nodes in memory that assist in the search process enabling a wide range of associations to occur. In these representations, emotion and affect are seen as antecedents and accompaniments of creativity.

One emotional resonance model of creativity postulates the existence of endocepts, emotions attached to concepts or images in memory. These emotional memories play a role in generating creative metaphors by resonating endocepts initiating associations between attached images and concepts. Further, the presence of resonance detection thresholds influences whether a resonance-activated endocept or concept enters conscious working memory (Lubart and Getz 1997).

Another trait related to the expression of creativity and systems of affect particularly as it pertains to motivation is that of perseverance. Early historiometric work found that many eminent individuals such as Newton, Galileo, and Darwin were not only highly intelligent but also extremely perseverant. Central to the attribute of perseverance is the concept of intrinsic motivation. Intrinsic motivation is defined as the motivation arising from a personal desire to participate in an activity for its own sake, be it enjoyment, challenge, or interest. Amabile (1996) and her coworkers have done much to highlight the importance of this kind of motivation in the generation of creativity. Intrinsic motivation is accompanied by positive affect and the love of the task. Extrinsic motivation on the other hand is the motivation which arises within an individual from the desire to meet some external reward, be it a praise, prize, or fame. Early studies have found that individuals who perform a task for a reward were less creative than those who receive no reward or a reward that is not associated with the task. However, the findings of more recent studies have been mixed and may relate to the stage of the creative process at which the extrinsic motivators are applied. When interpreting the research literature however, due consideration needs to be given to the manner in which creativity is measured (e.g., whether by consensual assessment or by tests of divergent production), the type of participants under study, as well as the specificity of the domain in which the research is conducted.

Affect and the Creative Environment

Another line of research into the relationship between creativity and emotion has involved the investigation of various affect states induced by stimuli, both internal and external to the individual. In particular, the rapid expansion of business and industry into a global market place in the final decades of the twentieth century has generated a plethora of research seeking to optimize the creative *environment*. Many of these studies have involved the induction of positive or negative mood through the deployment of psychosocial and environmental factors. Specific affect states may be induced, for example, by involving participants in an enjoyable activity, watching a movie, or recounting happy or sad memories. In these experiments, emotion is seen as an antecedent to the creativity. Interestingly, in a study investigating creative problem solving, positive mood resulted in more creative solutions when compared with control groups (Isen et al. 1987). As with the previous discussion related to personality traits, positive affect was thought to cue positive memories and a large amount of cognitive and affective material resulting in a defocused state of attention. Consequently, the cueing of cognitive content enabled a wider range of associated ideas to occur.

Recent research in business organizations has also supported the view that creativity emerges from positive affect. Studies of induced positive mood lead to higher creativity, while studies of induced negative mood lead to lower creativity. When creative work contributed to a positive mood, a self-reinforcing cycle of creativity and positive affect was initiated. While the above description would at first glance appear relatively straight forward, a recent large-scale meta-analysis of mood-creativity research reveals (Baas et al. 2008) that the field is in fact highly complex. The interested reader is directed to that account.

Affect and the Creative Product

The field of affect and the creative *product* is perhaps best represented by those domains of activity in which the person and the creative product intersect. Actors, dancers, and mime artists, for example, are both simultaneously the creative person and the creative product. In the execution of their role, actors, for example, need to understand, interpret, and express emotion. Learning to act such that a smile is not forced but appears natural is not simple, as Ekman's research on emotion affirms. While some performers act the expression of an emotion, other performers will live the emotion in an authentic response of their craft. The capacity to emotionally engage an audience requires a great deal of energy and creativity. Thus, emotions may not only be mediators of the creative process but they may also be the product of the creative process. In this sense, emotions themselves are the *product*. Another example of emotions as creative product is to be found in individuals with the ability to manage emotion such that different emotions may be combined and expressed in unusual ways. To do so requires a great deal of improvisation and creativity.

Clearly, the expression of emotion as a creative product either through acting or through bodily movement would seem to contraindicate emotion and cognition operating as separate systems.

Affect and the Creative Process

Building on Wallas's classic four-stage model, there have been a number of *process* models of creativity. Some of these process models have expanded upon the number of stages given in the classic model, while others collapse them into broader categories preferring instead to describe a wider range of substages or processes. However, few of them address the affective dimension in the creative process. One model to have done so was that proposed by Shaw (1989) who, working with a group of scientists and engineers, mapped a set of affect states both positive and negative to a series of feedback loops arising between each phase of the classic model. A unipolar positive set of emotions (e.g., happy, euphoric) were identified at the illumination stage and again at the validation stage (e.g., elation) if the creative work received collective acceptance. However, a unipolar negative set of emotions (e.g., sadness, shame) were identified if the creative work were not. Further, a bipolar set of emotions ranging from the positive (e.g., excited) to negative (e.g., frustrated) were identified during the preparation and incubation phases with movement back and forth between these stages apparent. Shaw labeled cycling between preparation and incubation the Areti loop.

Another set of bipolar affect states ranging from positive (e.g., exuberant) to negative (e.g., burned out) were also identified between the elaboration and creative synthesis (i.e., outcome) stages. Shaw labeled cycling between elaboration and the outcome the communication loop. Many such loops operating simultaneously and successively were proposed to exist and whose occurrences are consistent with neural network models of the brain. Thus, emotion as represented in this model may be seen as both a mediator and accompaniment of creativity.

However, recent advances in neuroscience, on the role of feeling and emotion in human reasoning and consciousness, would seem to indicate that emotion is much more than a mediator and an accompaniment of creativity. Working with brain damaged patients, Damasio (1994) found individuals presenting with normal IQ, language ability and learning capacity, being unable to solve problems, due to impairment of the feeling function within the brain. Indeed feeling, it was found, was needed to successfully move through a decision-making space. Three kinds of feelings, notably feelings of basic universal emotions, feelings of subtle universal emotions as well as background feelings, were identified. These feelings arising from the complex interplay of the brain core (namely, hindbrain, mid brain, and limbic systems) and the cerebral cortex provide a window on the body's internal state justapositioned with information received about the external one. According to Damasio, emotion and cognition were inextricably linked and that feelings were essential to human survival and consciousness. The traditional mechanist perspective that feeling interfered with an individual's ability to solve problems failed to take cognizance of the fact that in the absence of feeling, an individual was unlikely to solve the problem at all.

At this point, it is perhaps useful to recall Wallas's view, propounded over 80 years ago, that better thinking meant attending to intimation and its associated affect. It is interesting, therefore, to note the finding of a much more recent large-scale study, which found that students who attended to a feeling approach to reasoning were more likely to be successful in solving a novel mathematics problem than those who did not (Aldous 2009).

Conclusion and Future Directions

Discussion in this entry began with the question "Is emotion (or affect) important to creativity?" This was followed with the question "How is emotion (or affect) involved in the creative process?" In light of the evidence presented above, the answer to the first question must surely be "yes." With respect to the second question, the answer may very well be "in almost every way." Emotion is not just an antecedent of creativity, nor is it merely a product of creativity, and it is certainly more than a mediator of creativity. Emotion and creativity are inextricably linked. Only now, in recent history, is the significance of the relationship between cognition, creativity, and affect being fully realized. Perhaps, a better question might be "Can creativity be studied without a study of emotion and affect?"

In his treatise the *Art of Thought*, Wallas (1926) understood the importance of providing a language for thought. More recently, Nobel laureate Daniel Kahneman (2011, p. 13) highlighted the need to "introduce a language for thinking and talking about the mind." With hind sight, it is possible to see how the language of emotion being associated with "power" and the language of mind being associated with "machine" have shaped the kinds of questions that have been asked and the sorts of decisions that have been made.

Kanheman won his Nobel Prize in 2002 for demonstrating the integrated nature of cognition and affect and for showing how the biases associated with system one (affect related) and the biases associated with system two (cognition related) have impacted human decision making particularly under uncertainty. For Wallas, intimation was the moment, to use Kahneman's language, when the interactions of system one and system two were about to reach consciousness.

Consequently, when arriving at an intimation concerning creativity and emotion, it behooves the researcher to check for biases, both affective and cognitive, be they important or not.

Cross-References

- ▶ Creative Brain
- ▶ Creative Personality
- ▶ Effects of Intuition, Positive Affect, and Training on Creative Problem Solving
- ▶ In Search of Cognitive Foundations of Creativity

References

Aldous CR. The genesis of new ideas: models, feeling and solutions. In: Matthews B, Gibbons T, editors. The process of research in education: a festschrift in honour of John P. Keeves. Adelaide: Shannon Research Press; 2009. p. 338–66.

Amabile TM. Creativity in context: update to the social psychology of creativity. Boulder: Westview; 1996.

Baas M, Carslen KW, Nijstad BA. A meta-analysis of 25 years of mood-creativity research: hedonic tone. Activation or regulatory focus? Psychol Bull. 2008;134:779–806.

Cornelius RR. The science of emotion: research and tradition in the psychology of emotion. Upper Saddle River: Prentice Hall; 1996.

Damasio AR. Descartes' error: emotion reason and the human brain. London: Papermac; 1994.

Feist GF. The influence of personality on artistic and scientific creativity. In: Sternberg RJ, editor. Handbook of creativity. New York: Cambridge University Press; 1999. p. 273–96.

Isen A, Daubman K, Nowicki G. Positive affect facilitates creative problem solving. J Personal Soc Psychol. 1987;52:1122–31.

Kahneman D. Thinking fast and slow. Maryborough: Allen Lane; 2011.

Lubart TI, Getz I. Emotion, metaphor and the creative process. Creativity Res J. 1997;10(4):285–301.

Russ SW. Affect and creativity: the role of affect and play in the creative process. Hillsdale: Lawrence Erlbaum; 1993.

Shaw MP. The Eureka process: a structure of the creative experience in science and engineering. Creativity Res J. 1989;2:286–98.

Wallas G. The art of thought. London: Jonathan Cape; 1926.

Creativity and Environment

▶ Social Psychology of Creativity

Creativity and Innovation: What Is the Difference?

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Synonyms

Creative process; Creative thinking; Innovative thinking; Innovativeness; Invention

Introduction

Innovation is again the buzzword du jour (Kanter 2006). As such, many well-meaning practitioners use the words creative process, creativity, and innovation interchangeably, which sews the seeds of confusion and does not help the field flourish. There is a need for rigor in language, a need to be clear about what it is that people lead, research, seek, teach, and facilitate. As practitioners and researchers march down the path of making the study of creative thinking, creativity, and innovation more deliberate, repeatable, useful, and accepted, mixing words that have different meanings creates confusion which makes it more difficult to fully understand the topic at hand. When one presents research on "innovation," when they really mean a "creative process," it jeopardizes the acceptance of both by causing furrowed brows and making it easier to raise objections that derail the presentation and uptake of learning.

What Is Creativity?

So what does "innovation" really mean? And how is it different than creativity? First, it is important to define terms, starting with creativity.

The definitions of creativity are many and focus on many different areas depending upon the context and need of the research and researcher. A common and popular theme in many definitions builds from the research of Barron (1955), who noted that a creative product must be (1) "original" and (2) "adaptive to reality" or, in other words, useful or valuable. Stein (1974) summed it up by saying that "creativity is a process that results in a novel work that is accepted as useful by a significant group of people at some point in time." This entry will build on this definition later to summarize innovation.

Stein's definition agrees with MacKinnon's (1978) notion that "the starting point, indeed the bedrock of all studies of creativity, is an analysis of creative products, a determination of what it is that makes them different from more mundane products" (p. 187). Rickards (1996) boldly stated, "most creativity researchers would find no strong objections to a definition of creativity which considers the process to be one in which new and valued ideas are generated" (p. 24). Add to the mix Ackoff and Vergara's (1981) definition which focuses on a personal ability to overcome self-imposed constraints, and the researcher begins to see the structure that Amabile (1996) points out in her review of definitions of creativity where she notes that there are definitions which focus on (a) process and (b) product in addition to (c) person. MacKinnon (1978), however, adds one more aspect to Amabile's list by pointing out (d) the creative situation.

This begins to sound rather like the classic definition by Rhodes (1961), in which he conducted a meta-study of definitions in order to conclude with a definition of creativity as follows:

> The word "creativity" is a noun naming the phenomenon in which a person communicates a new concept (which is the product). Mental activity (or mental process) is implicit in the definition, and of course no one could conceive of a person living or operating in a vacuum, so the term *press* is implicit. The definition begs the questions as to how new the concept must be and to whom it must be new. (p. 305)

The Four Ps and "Teaching Creativity"

He refers to this as the "four Ps of creativity," which include (1) person, (2) product, (3) process, and (4) press. While the shorthand is useful as a teaching practice or as a way to focus efforts designed to enhance creativity in organizations, what is often missed is the fact that creativity is a "noun naming the phenomenon..." If one teaches creativity, then by definition, one teaches a phenomenon. While one can certainly teach *about* the phenomenon of creativity, what is true is that those who teach about it are really teaching a creative process to people in a press so that they can create new products. One does not teach creativity; one teaches a creative process.

Those people that study the phenomenon of creativity and teach about the research and theory can certainly be said to teach creativity, but teaching a phenomenon is not what is happening in the creative thinking classes, courses, and conferences that abound. The author would propose that "creative thinking" is a subset of Rhodes's definition focusing on the "mental activity (or mental process)," in other words, the process that is necessary for the phenomenon to occur, or as MacKinnon (1978) said it, "the creative process or processes are those that result in creative products" (p. 187). Certainly there is much evidence that this mental process can be defined by creative problem solving, TRIZ, Synectics, six hats, or other methods (Altshuller 1994; De Bono 1985; Gordon 1972; Osborn 1953; Parnes 1992; Prince 1968), yet that is beyond the scope of this entry.

It is also not the purpose here to propose yet another definition of creativity but rather to further promote Rhodes' definition as one sufficiently robust and relatively concise that encapsulates the necessary elements for fully understanding the phenomenon. A bonus is that at the time of publication, it was novel, and in practice, it is useful, which links nicely to Stein's 1974 definition.

Why Is It Important to Define Innovation?

In his article, Rhodes (1961) stated that:

> Granted, the word creativity has been overworked. And it is used loosely. Students of creativity have not yet taken the time to distinguish the strands of the phenomenon and then carefully to classify new knowledge according to the pertinence thereof to either person, process, press or product. I submit that the time has come for more precision in definition and usage, that only when the field is analyzed and organized – when the listener can be sure he knows what the speaker is talking about – will the pseudo aspect of the subject of creativity disappear. (p. 310)

The author believes that thanks to the many researchers who have been turning over this question since J.P. Guilford's call to arms for the deliberate study of creativity in his 1950 address to the American Psychological Association, this is much less true today of creativity (Guilford 1950). However, by substituting the word "innovation" for "creativity," one discovers that Rhodes provides a place to start with innovation:

> Granted, the word ***innovation*** has been overworked. And it is used loosely. Students of ***innovation*** have not yet taken the time to distinguish the strands of the phenomenon and then carefully to classify new knowledge according to the pertinence thereof to either person, process, press or product. I submit that the time has come for more precision in definition and usage, that only when the field is analyzed and organized – when the listener can be sure he knows what the speaker is talking about – will the pseudo aspect of the subject of ***innovation*** disappear.

Given the proliferation of books on innovation, from the well researched to the opinion pieces that clog the bookshelves, it is important to help break down the barriers to a common understanding of what innovation is all about.

Are Creativity and Innovation Synonymous?

The definition of creativity is useful for understanding innovation, because the former yields the latter. A traditional view of the relationship between creativity and innovation is to say that "creativity is getting the idea, and innovation is doing something about it (Firestien 1996, p. 16)".

Indeed, Davila et al. (2006) note that the words creativity and innovation are regularly used as synonyms, and they strike a blow for rigor by noting that they are distinct. They describe innovation as a combination of creativity and commercialization, indicating that innovation is bringing to life creative ideas. Puccio, Murdock, and Mance (2007) also note that "the creative product is the starting point for business innovation" (p. 24).

Kaufman (1993) goes a step further, noting that the criteria for creativity are novelty and usefulness (he used the term "validity" rather than usefulness) and that innovation adds an additional two to those criteria: increment (an addition to existing knowledge) and realization (made up of subcomponents of adoption, implementation, and diffusion).

Rickards (1996) noted that "The implicit assumptions in much of the literature suggest that innovation is a process which begins with a creative idea and ends when that idea is implemented" (p. 14). He also defined innovation as "a social problem-solving process of a non-routine kind" (Rickards 1991, p. 105). And indeed, Amabile et al. (1996) said that "All innovation begins with creative ideas. . .In this view, creativity by individuals. . .is a starting point for innovation; the first is necessary but not a sufficient condition for the second" (p. 39).

Creativity Does Not Equal Innovation

So while there are those that would use the two words interchangeably, they are in fact very different. This then requires a definition of innovation and a desire to be more robust with the definition.

Rhodes, in his research, reviewed 40 definitions of creativity (and 16 of imagination) to distill his own definition. Similarly, the author reviewed a similar number of definitions of innovation by those authors, thinkers, scholars, and bloggers who had the rigor to define their terms. Given that the number of books on innovation has been skyrocketing every year with a total of 2,425 published books alone on the subject through mid-2007 (Smith 2007), it may not be possible to find them all. However, this represents the best efforts of two researchers to find definitions that are in use, in the press, and that are public. Reviewing them required a qualitative analysis process. This process involved reviewing all of the definitions for emergent themes and then synthesizing them and building a single definition (Murdock 1994). Out of this process emerged the following themes:

- Value
- Improvement
- Invention
- Climate
- Introduction
- Process
- Renewal
- Design
- Acceptance
- Renewal
- Product-focused
- Recombinations
- New:
  - Idea
  - Approach
  - Practice
  - Object
  - Method
  - Device
  - Service
  - Program
  - Technique
  - Technology

What is notable is that while there are overlaps among these words and definitions of creativity, there are some elements that are different.

An additional analysis of the definitions provided the following words that were offered as synonyms to innovation:

- Renewal
- Invention
- Creativity
- Entrepreneurship
- Improvements
- Brand new
- Paradigm-breaking
- (Creative) destruction
- Change
- Experiment
- Take risks
- Origination
- Different
- Growth
- Value creation

Based on this analysis, and using the framework set forth by Rhodes, the following robust and bulky definition of innovation emerged:

> Innovation is a noun that describes the phenomenon of the introduction of a new product that adds value. Implicit in this definition is engaging in a creative thinking process to develop new concepts and implementation strategies, which requires a multitude of skill-sets, and thus, usually, a team. Also required for successful implementation is awareness of the internal and external press.

Core Components of the Definition

Introduction: A common theme in most definitions was that innovation was characterized by the fact that a creative product was brought forth and made available to some part of the world (however one defines the "world" given the context of the product). It could be consumers, clients, readers, patrons, a community, etc. This is what Kaufman referred to as "realization," in his definition of innovation (1993). Rather than merely fashioning a creative product, what distinguishes innovation from creativity is the notion of introducing or launching or getting it out to the social system at large. According to this explanation, a prototype of (the proverbial) new widget is a creative product, but it is not yet an innovation until the means have been devised to launch it to the marketplace. There is a focus on commercialization, as Puccio, Murdock, and Mance (2007) note when they stated that "innovation occurs when an organization has successfully commercialized a new product or implemented a new program or service" (p. 24). Perhaps this explains why business focuses on "innovation" in their taglines rather than promoting their "creativity." Roberts (1988) defined innovation using the word "exploitation" to connote this concept of introduction of the creative product, but in usage, one finds that this word has emotional baggage that blocks understanding of the concept.

New Product: Equally important in determining what is innovative or not is the notion of a new product. While introductions of products happen every day, the innovative ones are those that are new to the observer. And like Rhodes' definition of creativity, this definition begs the question as to how new the concept must be and to whom it must be new. After all, creativity, like beauty, is in the eye of the beholder. Product is used here to refer not just to tangible objects but also intangibles such as services. In other words, they are the output, results, or artifacts of the creative process.

Adds Value: Similar to the notions of usefulness and value in the definitions of creative products, whether value is defined monetarily, qualitatively (i.e., quality of life), or through utility, a key element of innovation is that it must add value through its introduction to the world.

Creative Thinking Process: For newness to happen requires a process whereby new ideas can be generated, thus a creative thinking process. Whether that process is creative problem solving, TRIZ, six hats, Synectics, summoning the muse through dance, or any other is up to the innovator.

Implementation Strategies: Implementation is easy to observe in its completed state, yet for many organizations, it is the strategies that bring forth the successful introduction that is a challenge. In most cases, implementation does not happen on its own and in fact requires a deliberate strategy for it to occur. In the case of innovations, typically it requires many applications of creative process to result in a successful launch. This may be observed at each step of the pathway to launch. Not just at the front end of the process but also in the development, production, distribution, marketing, and sales stages of an introduction.

Multitude of Skill-Sets: The introduction of something new requires many skills that are required to move from idea into the marketplace. These skills can be viewed functionally (research, operations, manufacturing, sales, etc.) from a content perspective (form, formulation, user, competition, geography etc.), a disciplinary perspective (psychology, education, engineering, anthropology, etc), or any other differentiating framework. What makes them stand out is the vast range of areas that are required for success. Typically, creativity is much more narrowly focused on one particular area or function. And while creative thinking methodologies frequently involve a group (either heterogeneous or homogeneous), the actual creative thinking comes from a connection (spark, "aha," eureka moment, or satori) that occurs within one brain (like Ackoff and Vergara's (1981) definition of creativity), while the process of introducing an innovation usually requires many brains, thus a team of individuals with different skills.

Internal Press: As Rhodes (1961) stated, "of course no one could conceive of a person living or operating in a vacuum, so the term *press* is implicit" (p. 305) for the development of an innovation. The internal press refers to the environment in which the innovation takes shape, where the team engages in the process and creates new value-creating concepts.

External Press: Is relevant since the product must enter the world in order to be launched. And for the innovation to be successfully launched, it must fit a need for an audience generally not involved in the creation process. Whether it is through "customer-centered design," "audience analysis," "consumer research," "stakeholder analysis," or any other way of gauging the needs to be satisfied by the concept, knowledge of the external environment, or press, is critical for successful innovation.

Creativity Versus Innovation

Functionally, creative thinking is a critical part of the innovation process, likely with more than one occurrence. In fact, an innovation requires multiple rounds of creative thinking throughout the

Creativity and Innovation: What Is the Difference?, Table 1 Comparison of key components of the definitions of “creativity” and “innovation”

Creativity	Innovation
Person	People (i.e., a team)
Process	Repeated creative thinking processes
Product	Product introduction
	Implementation strategies
Press	Internal press of creation
	External press of the marketplace

process leading to introduction. Rickards (1996) suggested that the traditional model of creativity and innovation trap creativity in the “front end” of the innovation process, and he argued that creativity is needed throughout the innovation process. He further “makes the case for a long-needed break with this assumption...Ideas and actions occur and interact as long as innovation is being pursued. Creativity continues as long as action continues” (Rickards 1996, p. 24). The act of introducing or launching a product may require creativity at all stages of the development process including research, concept development, refinement, production, marketing, sales, distribution, and more. Another way to think about it is that innovation is a combination of creative ideas. So what sets creativity apart from innovation?

In comparing the definitions of creativity and innovation, the reader will notice overlaps and differences among the key components (Table 1).

Where the creative idea can come from one person (and of course from a team), an innovation typically requires people working together to make it happen from different places in an organization or throughout its value chain (e.g., in the case of a consumer product: consumer research, product development, marketing, manufacturing, sales, distribution, service, etc.).

And while both require a creative thinking process, the innovation requires multiple applications of creative thinking processes to guide it to launch. While creativity is about sparking a creative product, the innovation requires the introduction of it frequently in multiple copies, and in order for that to occur, that requires strategies to get the innovation out to the world. Creativity takes place not in a vacuum, rather in a constrained press, and the implementation does as well. Plus it must exist in the broader external press of the marketplace that determines its success or failure.

Concise Definition

Given the bulkiness of the definition, the author has found it useful to build on the Stein (1974) definition of creativity to define innovation this way:

> Introducing something new that adds value, which requires many skill-sets (thus usually with a team).

This definition provides enough distinctness from creativity in a concise way that is useful for people to grasp quickly in order to move on to the actual work of innovating.

Conclusion and Future Directions

Given that “words mean something,” it is important to distinguish between creativity and innovation and to not use the two words synonymously. Creativity is required for innovation, but is not the same thing, since the innovation goes beyond the phenomenon of the creative product to its introduction, launch, commercialization, or exploitation. Innovation is broader and the iterative use of creative thinking in order to solve the challenges associated with bringing a product to see the light of day. Certainly there is overlap between the two definitions, just as there is a gray area that separates black from white. Yet creativity and innovation are not equivalent. Although one cannot have the latter without the former, one can have creativity without innovation. The accurate researcher and practitioner will use the most appropriate term for the phenomenon that they are describing.

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Cross-References

- ▶ Business Creativity
- ▶ Convergent Versus Divergent Thinking
- ▶ Corporate Creativity
- ▶ Creative Leadership
- ▶ Creativity and Innovation: What Is the Difference?
- ▶ Creativity from Design and Innovation Perspectives
- ▶ Divergent Versus Convergent Thinking
- ▶ Four Ps of Creativity
- ▶ Imagination

References

Ackoff R, Vergara E. Creativity in problem solving and planning: a review. Eur J Operat Res. 1981;7:1–13.

Altshuller G. And suddenly the inventor appeared: TRIZ, the theory of inventive problem solving. Worcester: Technical Innovation Center; 1994.

Amabile TM. Creativity in context. Boulder: Westview; 1996.

Amabile TM, Conti R, Coon H, Lazenby J, Herron M. Assessing the work environment for creativity. Acad Manage Rev. 1996;39:1154–84.

Barron F. The disposition toward originality. J Abnorm Soc Psychol. 1955;51:478–85.

Davila T, Epstein MJ, Shelton R. Making innovation work: how to manage it, measure it, and profit from it. Upper Saddle River: Wharton School; 2006.

De Bono E. Six thinking hats. Boston: Little, Brown; 1985.

Firestien RL. Leading on the creative edge: gaining competitive advantage through the power of Creative Problem Solving. Colorado Springs: Pinon; 1996.

Gordon WJJ. On being explicit about creative process. J Creat Behav. 1972;6(4).

Guilford JP. Creativity. Am Psychol. 1950;5:444–5.

Kanter EM. Innovation: the classic traps. Harv Bus Rev. 2006;2006:73–83.

Kaufman G. The content and logical structure of creativity concepts: an inquiry into the conceptual foundations of creativity research. In: Isaksen SG, Murdock MC, Firestien RL, Treffinger DJ, editors. Understanding and recognizing creativity: the emergence of a discipline. Norwood: Ablex; 1993.

MacKinnon DW. In search of human effectiveness. Buffalo: Creative Education Foundation; 1978.

Murdock MC. Designing and conducting qualitative research using creative analysis. Paper presented at the Eastern Education Research Association's Annual Conference and Qualitative Special Interest Group, Sarasota, FL, 1994

Osborn AF. Applied imagination: principles and procedures of creative problem solving. New York: Charles Scribner's Sons; 1953.

Parnes SJ. Visionizing. Buffalo: Creative Education Foundation; 1992.

Prince GM. The operational mechanism of synectics. J Creat Behav. 1968;2(1).

Puccio GJ, Murdock MC, Mance M. Creative leadership: skills that drive change. Thousand Oaks: Sage; 2007.

Rhodes M. An analysis of creativity. Phi Delta Kappan. 1961;4:305–10.

Rickards T. Innovation and creativity: woods, trees and pathways. R&D Manag. 1991;21(2):97–108.

Rickards T. The management of innovation: recasting the role of creativity. Eur J Work Organ Psychol. 1996;5(1):13–27.

Roberts EB. Managing invention and innovation. Res Technol Manag. 1988;31:11–29.

Smith R. Innovation alignment to maximize market penetration. Paper presented at the Innovation Network's Immersion 360 Conference, Scottsdale, AZ. 2007. Available at: http://www.modelbenders.com/papers/RSmith_InnovationImmersion.pdf

Stein MI. Stimulating creativity. New York: Academic; 1974.

Creativity and Systems Thinking

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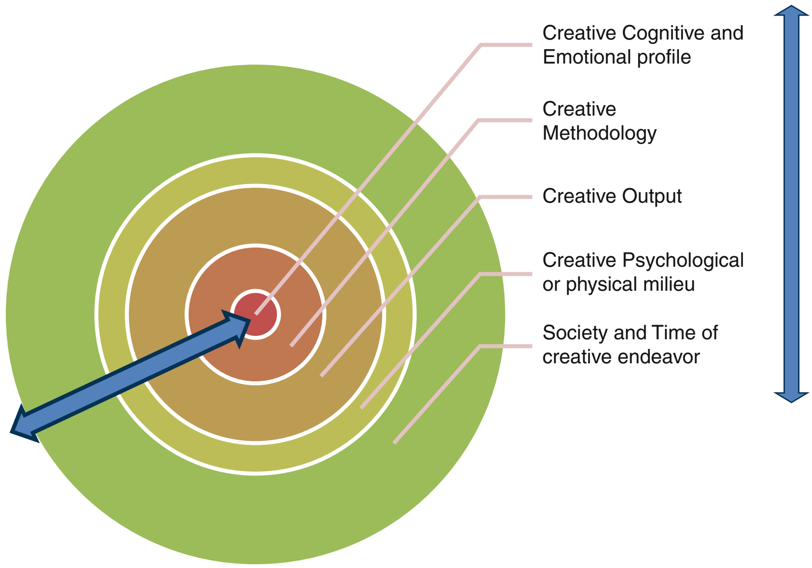
Synonyms

Innovation; Originality; Systems design

Definition

Creativity can be viewed from many different perspectives. They are interconnected in a system that reinforces each of them (Fig. 1). A definition of these perspectives is:

1. Creative cognitive and emotional profile. The innate and nurtured cognitive and emotional abilities that help generate creative ideas or products. These could be boldness, risk-taking, or flexibility in idea production.
2. Creative methodology. It can be a tool, a mechanism, a roadmap, or a process that helps a person generate, evaluate, or implement creative ideas and solutions.



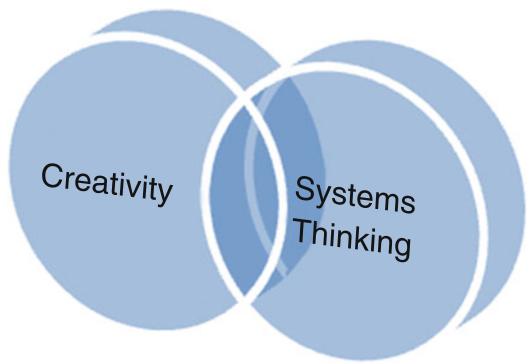
Creativity and Systems Thinking, Fig. 1 Creativity: an evolving system

3. Creative output. The characteristics of any production including ideas that add novelty or usefulness in a certain societal context.
4. Creative psychological or physical milieu where creativity happens. For instance, a company that fosters and supports new ideas.
5. Society and time context of the creative endeavor. The ability of the society as a whole to accept and appreciate that novelty.

Some examples of these relationships are as follows:

(a) Cognitive creative abilities are used to generate creative output. This could be facilitated by a creative method.
(b) Creative methodologies help sharpen creative abilities (i.e., increased fluency in idea generation through the use of thinking tools).
(c) Creative outputs are better designed through a methodology that identifies societal market needs at a certain time. For instance, people who appreciate small light products containing many songs would favor the iPod machine over a Walkman cassette player.
(d) The behavioral and cultural norms in a certain society will determine what type of novel output is accepted.

Systems thinking, as a process to understand how parts interact with the whole, provides however far more value to the field of creativity through a synergistic relationship (Fig. 2). Systems thinking helps creativity to understand the "why" question of the creative endeavor. As creativity is increasingly required to solve complex problems, there is also a great need for greater clarification and understanding of those systems where creativity will be applied.



Creativity and Systems Thinking, Fig. 2 The synergy between creativity and systems thinking

One of the simplest ways to look at this relationship is through the systems thinking concept of **reinforcing loops**. They establish a relationship and direction of movement that creates a system.

For instance, should a company wish to generate creative ideas to increase sales, a systematic understanding of the company's operation (Fig. 3)

Creativity and Systems Thinking, Fig. 3 A reinforcing loop to find the real issue affecting sales

would be useful instead of just increasing advertising expenditure. Figure 3 shows that as satisfied customers increase, so does positive word of mouth that in turn generates increased sales. On the assumption that positive word of mouth causes 90 % of the sales, then an effort to increase advertising could shift to finding ways to increase satisfied customers.

The interaction between creativity and systems thinking goes far beyond: through the systemic analysis of a complex context, the creative person can find multiple points of leverage. This in turn will help that person to enhance his creative ability to analyze and understand problems from different perspectives, which has long been considered a creative thinking ability.

Cross-References

▶ Creative Collaboration
▶ Creative Personality
▶ Innovation Systems and Entrepreneurship
▶ Product Innovation, Process Innovation

Creativity Assessment

▶ Measurement of Creativity

Creativity Assessments

▶ Creativity Tests

Creativity Crisis

▶ Decrease in Creativity

Creativity Definitions, Approaches

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Synonyms

Concept development, trends

Definition

Approaches to creativity definitions are conceptual trends on the way from the myths to the scientific reflection of creativity within the science of creativity.

Introduction: Creativity as a Phenomenon

The phenomenon of creativity and real-life people doing creative work seems simple at first glance. When people see someone who is unusually original, they say that this person is “creative.” However, when one tries to describe what “creative” means in order to teach others to be creative or to research the phenomenon, it becomes difficult. The reason of the difficulty is that creativity surfaces in so many ways. Additionally, creativity is psychological. This is a challenge in itself because creativity is a complex multifaceted phenomenon. No wonder, Parkhurst noted “the confusion and lack of consensus” in the issue of defining creativity (see Parkhurst 1999). This entry is a summary of various approaches in defining creativity that finally leads to a universally applicable scientific definition.

People often think that creativity was always understood as it is today. This is simply not the case. The evolution of the concept reflecting the understanding of creativity is amazing in-and-of itself. The views on creativity and definitions of creativity have changed dramatically. They range from only God's ability for "Creatio ex nihili" – "*Creation from nothing*" – to considering poets (first only poets) creative, then artists, and in modern views also scientists, engineers, and all people too, which is expressed in the slogan, "We are all creative!" (see ► Creativity Definitions, Approaches).

This entry, however, presents the conceptual analysis of creativity on the way to forging a scientific view rather than chronological or historical analysis (see ► Science of Creativity). While doing this, as opposed to the article titled "Definitions of Creativity" in the comprehensive *Encyclopedia of Creativity* which dwells on the elements, phases, and aspects of creativity but does not offer a single definition of creativity, except the paraphrased "Creativity is 1% inspiration, 99% perspiration" (Cropley 1999), this entry operates with real names and real definitions. Clearly, out of hundreds of definitions available in literature (Aleinikov et al. 2000; Treffinger 1995), thousands of definitions published on the web, and probably millions of unpublished definitions (e.g., students in creativity classes create a few definitions each), this entry deals only with a small number of these definitions. Nevertheless, it shows tendencies or approaches to defining creativity that can be found in the field, thus helping readers to gain a general understanding of the difficulties on the way to scientific definition.

Traditional and Modern Views on Creativity

Theoretically, the volume of the notion (the set of phenomena conceived in the concept) "creativity" could be maximized, minimized, or optimized. When maximized, it approaches infinity; when minimized, it approaches zero.

Maximizing the notion of creativity volume leads to omitting the aspect of originality and equalizing the terms *create* = *creative*. It may sound like this: "God created this world, so God is creative. Nature creates plants, animals, and people, so nature is creative too. People create their homes, products, etc., so they are creative. A mouse creates stores of grain for the winter, so a mouse is creative too. Trees create leaves and fruit, so they are creative as well. Therefore, everything creates everything, everything is creative, and creativity is everywhere." Such a point of view may be called pancreationism or maxi-creationism.

On the contrary, when minimized in volume, the notion of creativity can be related only to a very specific moment of mental activity in producing new ideas. For instance, a person generated a new idea. Creativity was present only at this moment. From this restricted point of view, creativity is a short-lived and very space-limited phenomenon. Such a point of view may be called mini-creationism.

All variations between these two polar points of view, maxi- and mini-creationism, may be conditionally called opti-creationism, where the task of the researcher is to optimize the understanding of creativity to make it realistic, thus avoiding absolutism on both sides.

A very common understanding of creativity achieved by this level is the following: creativity is an ability and process of producing something new and useful.

At first sight, it looks like a good definition until you try to use it. A spider, for example, produces a web – new and useful. Is this creativity? A very able person (assume that tests showed it; see ► Creativity Tests) just sits in the corner, daydreams (produces new and useful ideas), but does nothing to make them real. In this case, can anyone prove his/her creativity? Another person is always in the process of doing something new but then immediately destroys it. Is this creativity? The third person "produces" children – all new and useful. Is this creativity? The fourth person produces ways of self-entertainment – new and useful for oneself only. Is this creativity? Questions of this type could go on and on. It is doubtful that the answers to all these questions would be "yes," but they all fit the given definition of creativity. Obviously, something must be wrong with this definition. Either it does not include all necessary features of creativity or it needs to be more specific because the features mentioned are not sufficient. It may also be missing the essence of creativity.

Within opti-creationism, there are three major approaches to defining creativity:

- Dictionary approach – explaining the phenomenon in simpler (understandable, known) terms
- Metaphoric approach – describing the phenomenon by analogies, by images, by poetic forms
- Intuitive, common sense, or neighboring notion approach – describing the phenomenon by concepts that are neither higher nor lower in the ladder of abstraction.

It is useful to analyze these before applying the scientific approach.

Dictionary Approach

In the majority of dictionaries, readers find that creativity is "the quality of being creative; the ability to create." So the reader is sent to the adjective "creative" or to the verb "create." As the reader goes on to the word "creative," the article might say, "marked by the ability or power to create; of creation." So the reader is sent to the verb "create" and the noun "creation." And finally in the definition of "create, creating," the reader may find, "to do something creative or constructive," while in the article for "creation" – something like "the act of creating." Thus, the reader is sent back to the adjective "creative" and the verb "create." Dictionaries often make such "circles" by defining concepts via each other. Stanislav Lem, a famous science fiction writer, once described the dictionary, where the term "sepulka" sends the reader to "Sepulkowate," which sends to "sepulkarium," which, in its turn, sends back to sepulka, giving practically no definition of the term.

Metaphorical (Poetic, Artistic) Approach

Creativity can have an unlimited number of metaphorical definitions:

- "Creativity is jazz without the music" (Jack Allday, Professor, Northwood University, Dallas Texas)
- "Creativity is the river that runs through our human spirit. When we hear its running waters, we are reminded who we are." (John Osborn, Senior Vice President BBDO, NY, NY, the grandson of Alex Osborn who coined the term *brainstorming* and founded Creative Education Foundation, Buffalo, NY)
- "Creativity is the child in me, screaming to get out" (David Whalen, EDS Mod-Michigan Solution Centre)
- "Creativity is. . .
  wanting to know
  listening to a cat
  crossing out mistakes
  getting in deep water
  getting out from behind a locked door
  cutting corners
  plugging in the sun
  digging deeper
  singing in my own key
  shaking hands with tomorrow" (Dr. E. Paul Torrance, "The Creativity Man," author of *Torrance Tests of Creative Thinking*)
- "Creativity is the process of mining the mind" (John Sedgwick, President of Managing imaginations)
- "Creativity. . .the febricity of the soul becoming reality" (Eleanor Pierre, Professor, Sheridan College, Trafalgar Campus, Ontario Canada)
- "Creativity occurs when we tilt the jelly dish in a different direction and force the water (information) to flow into new channels and make new connections" (Michael Michalko, the author of *Thinkertoys*, A Handbook of Business Creativity and *Cracking Creativity*, The Secrets of Creative Genius)
- "The defeat of habit by originality" (George Lois)
- "Creativity is the song that sings itself" (Jeff Pokorney, Inventor, Minneapolis, MN).
  (All definitions from Aleinikov et al. 2000)

Such definitions do not pretend to be scientific; they are poetic. These definitions are metaphors. They poeticize creativity rather than describe it. These definitions explain very little but bring good feelings and inspiration. This is what metaphors are supposed to do.

Actually, within this approach, creativity can be defined through nearly every noun. For instance, one of the exercises in teaching creativity is to define creativity via any noun. The model of such a metaphoric definition is N_1 (creativity) = N_2 (any noun) + its characteristics.

Intuitive (Common Sense or Neighboring Notion) Approach

As opposed to metaphoric (poetic, artistic) approach, there exists a more philosophical or common sense approach, where authors attempt to define creativity through the notions and concepts found in the neighboring domains. Researchers and consultants may call such definitions "working definitions, research definitions, temporary definitions, or personal definitions."

Examples of such definitions include:

- "Creativity is a continuous process of finding good problems to solve, and finding and implementing good solutions to these problems" (Min Bassadur, Founder of the Center for Research in Applied Creativity, Simplex Worldwide©)
- "The production of novel, appropriate ideas" (Teresa M. Amabile, Ph.D., Professor of Business Administration, Harvard Business School, Boston, MA)
- "We define creativity as the ability to make useful, novel associations" (S.S. Gryskievicz, Center for Creative Leadership, Greensboro, NC)
- "Creativity is the art of self-expression" (Jennifer Page, at 17, the graduate of School of Geniuses, 1996)

(All definitions from Aleinikov et al. 2000)

The main concepts employed to define creativity, as instruments or tools of defining, logically are supposed to be higher in the level of abstraction. But many of them are not. For example, in the first definition, creativity is defined as a process, but it is broader than a process. In the second definition, it is defined as production, but it is broader than production. In the third definition, it is defined as ability, but it is more than ability. In the fourth definition, it is defined as art, but it is more than art. Four definitions placed together also demonstrate the insufficiency of each. They may work for some cases but not for all the domain of creativity. The selection of the main category that creativity falls into is extremely important. It has to be able to encompass the phenomenon in all its variety.

The situation can be illustrated by analogy. Imagine a tool like a chisel made of clay. It is weaker or more fragile than the object it is supposed to affect. So it will break at the first strike. Another example: a pot made of plastic with a melting temperature lower than the temperature of boiling water. In this case, when a person tries to boil some water, the pot will melt before the water begins to boil. The same dangers exist for the process of defining creativity.

Example 1. "Creativity is an internal dialog for generating new ideas." Seemingly, this is not a bad definition. But dialog itself is a complex essence too. There are quite a few thick books on dialog. Furthermore, "internal dialog" is even more complicated and less vivid. Finally, dialog itself can be defined through the notion of creativity: dialog is communicative creativity. Therefore, the question arises, "What defines what?"

Example 2. "Creativity is the combining of earlier nonrelated ideas." At first glance, this definition looks good too. However, the word "idea" requires definition. Moreover, the word "nonrelated" in the phrase "nonrelated ideas" is very weak. It is logical to ask how these ideas were produced in the first place. One has first to create something in order to relate it to something else and to combine it later. So should the phrase "generating ideas" be added to the definition? Why then the word "combining" is needed at all?

The history of research counts numerous attempts of explaining creativity in neighboring notions and concepts. As G. Davis states in his book *Creativity is Forever* (Davis 1981), creativity has been explained in terms of:

- Psychoanalysis (Freud 1925)

- Neo-psychoanalysis (Kubie 1958)
- Gestalt (Wertheimer 1959)
- Associations (Locke 1968)
- Humanism (Maslow 1968) and
- Factor analysis (Guilford 1968).

Definitions of this type may look appropriate for some training purposes; however, they define creativity by the notions taken from the same or lower level of abstraction. When placed together, such definitions demonstrate the multifaceted character of the phenomenon, but they also corroborate the above-mentioned conclusion that the issue of instrument (tool) becomes critical.

Scientific Approach

The scientific approach traditionally compresses things to their essences in order to free the brain from excessive information (compression, though, is not equal to reduction!). The search for the essence (definition) can be hard and exhaustive, but discovering the essence is the same as discovering the formula of gravity by Newton: it explains in one manner the entire world from a falling apple to the stars and galaxies moving in far space. Defining things and concepts exemplifies the principle of economy of force in science. A scientific definition is a must for establishing a science of creativity.

While developing such a definition, one has to use the terms and methods of the established natural sciences like physics, chemistry, and biology, as well as mathematics and logic, the key attributes of any science.

Logic and Paradoxes of Creativity Nondefiniteness

While using logic one has to know the difference between formal logic, dialectical logic, mathematical logic, modal logic, deontic logic, etc. For example, if a researcher stays within one type of logic, let it be formal logic, it is easy to fall into the trap of paradoxes.

Paradoxes are logical traps or loops that cannot be solved within the same type of logic. A typical one is the paradox of a liar. Suppose you come to an island and the first person you meet at the shore says that all inhabitants of the island are liars. Is he telling the truth? If he is saying the truth, then all the inhabitants are liars. But he is an inhabitant too. So he is lying. Therefore, he is saying the truth and lying at the same time. Contradiction! Try to approach the statement from the other side. If he is telling lies, then the inhabitants are not liars – they are truth tellers. But he is an inhabitant too, so he must be telling the truth. Again, a contradiction! It does not matter whether he is lying or he is telling the truth; you are in a paradox situation. It is the formal logic that leads to a paradox.

In reality (reflected by dialectical logic – the logic that accepts contradictions as part of life), a person may lie in one case and tell the truth in some other case. Moreover, it would be very wrong to say that *all* inhabitants are liars. Some of them may be liars, but the others are not. The use of "absolutizers" like *all, everyone, every, never, forever*, etc., when they are not supported by evidence may lead to logical errors.

So while defining creativity, researchers get into logical paradoxes as well:

Paradox 1. Creativity is (nearly) everywhere. It means you can define creativity through everything (as in metaphoric and intuitive approaches above), and you can also define everything through creativity. It looks to be limitless. So while trying to define creativity (i.e., to limit, to find the finite features), people try to limit this phenomenon, which supposedly has no limits. It is a paradox.

Paradox 2. In order to define something in logic, one must go higher in the hierarchy of notions. For example, a table is a piece of furniture; a rooster is a bird, etc. In language, some words are more abstract, and some are less. So while defining creativity, one can say creativity is ability, but in reality, creativity is more than ability. One can say creativity is a process, but creativity is more than a process. Some people say creativity is originality, but it is more than originality. Seemingly, there is no term that will logically embrace creativity because these concepts are not rising to the next level of abstraction. It is the same as the word about a word is a word too. In mathematics, Bertrand Russell was the first to show this type of paradox when he asked whether the set of sets belongs to the set it includes as its components.

Paradox 3. Here is how Dr. E. Paul Torrance describes one paradoxical situation: "Many definitions have been offered and none is considered precise, yet almost all of them seem to mean essentially the same thing. I think that Aleinikov (1999b) accurately summarizes where we are with regard to defining creativity. He relates an incident that occurred at a creativity conference in Russia. A presenter reported that he had found 1,000 definitions of creativity and that it was time to stop defining it. The speaker went on to say, 'Nothing principally new can be invented.' Thus, he offered what he thought was a final definition. Aleinikov inadvertently laughed. The presenter felt embarrassed and asked why. The explanation was simple. 'You suggest that producing definitions must be stopped after 1,000; why do you offer the 1,001st?' Trying to stop further defining is the same as banning creativity because creation of a definition is creativity too, Aleinikov explained. Aleinikov went on to relate that the presenter came up to him afterwards. He then bet the presenter that he could give him at least two definitions that had no parallels in the presenter's collection. The presenter lost his bet." Then Dr. Torrance makes a conclusion, "Definitions will continue endlessly, but people will learn not to be disturbed by it and continue finding out more about creativity" (Torrance 2002).

Paradox 4. The definition, which is supposed to define, very often *un*defines the concept. For example, the definition offered by the above-mentioned presenter included 17 terms which were vague and needed to be defined in their own right.

Paradoxes are neither good nor bad, but they obviously show the limitations of formal logic and thus remind researchers of the necessity to make a leap to some other logic. Paradoxes indicate the availability of a deeper level in the paradox situation, and it is wise to be aware of them while working with definitions.

Mathematics

Ruth Noller, Distinguished Service Professor Emeritus of Creative Studies at Buffalo State College, once offered the following equation for creativity: $C = f_a(K, I, E)$, where

- C is creativity
- K is knowledge
- I is imagination (see ▶ Imagination)
- E is evaluation

As Isaksen, Dorval, and Treffinger explained, "she suggested that creativity is a function of an interpersonal attitude toward the beneficial and positive use of creativity in combination with three factors: knowledge, imagination and evaluation" (Isaksen et al. 2011).

The strength of such a definition is its symbolic form: it is easier to recall and visualize. Another plus is the attempt to use mathematics (or at least the symbolic expressions) to reflect a very complex phenomenon. However, there are some questionable issues in such a definition as well.

(a) The term *function* is as complex as creativity. Since the time it was coined by Gottfried Leibnitz in 1673, it too has acquired multiple meanings.
(b) The word *creativity* inside of the definition is used to define *creativity* as the defined concept. This is a tautology.
(c) The formula contains commas. They are not symbols of mathematical operations (like × for multiplication, + for addition, – for subtraction, etc.). So the constituents of creativity – K(nowledge), I(magination), and E(valuation) – are not functionally connected by any mathematical operations.
(d) The term "interpersonal" is not represented in the formula at all.
(e) The terms "beneficial" and "positive" are subjective. They express an opinion of a person.

Analysis, therefore, suggests that it is not a mathematical formula; this is rather a symbolic representation for Noller's understanding of creativity, some kind of abbreviation. The trend, nevertheless, is obvious: researchers begin to employ mathematical means in search of scientific definitions.

Since logic and mathematics alone do not constitute the scientific approach, the search for a scientific definition is still needed.

Scientific Terms

The fact is that well-established sciences do not use the terms like "idea" that is commonplace for dictionary and intuitive definitions. They use the terms "time, space, speed, acceleration," etc. Science also avoids such subjective terms as "useful/useless" because something that is totally useless now may be useful in the future or something completely useless for one person may be useful for another. Finally, sciences exclude any emotionally charged vocabulary so abundantly present in metaphoric definitions.

With this in mind, applying the terms from established sciences can make the creativity definitions more scientific.

As a case in point, Dean K. Simonton made an attempt to define creativity and genius in terms of Darwin theory (Simonton 1999). Numerous authors state that physical, or better called physiological, activity affects creative output. These are the samples of employing biological level terms for explaining creativity. Some researchers investigate the brain chemistry, as well as the chemical substances affecting creativity, including alcohol, drugs, etc. (Pritzker 1999; Plucker and Dana 1999). These are obviously the samples of chemical level notions employed for the explanation of creative output. There is also research and equipment employing electromagnetic fields affecting creativity (see, for instance, the Functional States Corrector by S.V. Koltsov). This is the level of physics. All these three levels are below the creativity level – the level of psychology – but psychology cannot exist without them: its existence depends on the existence of physical bodies and chemical reactions and biological processes.

The scientific research of the phenomenon of creativity is growing fast, and therefore, the need of a scientific definition of creativity itself is becoming more and more obvious.

A preliminary definition that would employ a paradox (logic), mathematics, and scientific terms may look like this: "Creativity is the search of search activity on the psychosocial level of nature's ectropy trend" (Aleinikov 1994, 1999b).

(a) The word "search" reflects the essence of creativity because people who are creative are in search of solutions. Moreover, they like the process of search (problem solving) so much that they are in search of problem to be solved (see Bassadur's definition above).
(b) The phrase "search of search" is using the basic biological term (not available on the level of chemistry) but also making it a paradox, so the paradox logical situation explained above (like "the word of word") is included. This phrase on the one hand relates creativity to natural biological search which is common for all living beings, but on the other hand separates creativity as search of search from the elementary search for food, search for partners, which hardly may be considered creative activity (see the "creative" mouse example in maxi-creationism).
(c) The other terms in the definition are physics- and psychology-based which make them scientific rather than metaphoric or any of the previous types.

The physical part of this definition deals with the term *ectropy*. The term *ectropy* (coined by mathematician and philosopher Willard Van Orman Quine) denotes the trend toward harmony. It was introduced as an antonym to the term *entropy* coined in 1875 by a German physicist Rudolf Clausius. Entropy, as opposed to ectropy, is the trend to chaos (Second Law of Thermodynamics).

There are only two trends in nature: to harmony (organization) and to chaos (disorganization). They coexist as the opposites. On the physical level, they exist as accumulation of organization (ectropy) versus loss of organization (entropy). On the chemical level, they exist as composing new substances versus decomposing existing substances. On the biological level, these two tendencies exist as birth, growth, and development versus withering and death. On the level of psychology, they function as personal development versus destruction (self-destruction).

On the level of social life, peace versus war and collaboration versus competition represent these two tendencies.

Using the term *ectropy* allows researchers to find the most general term for the phenomenon that embraces creativity as a whole, not just a part of it. Logically, therefore, creativity is first placed into a higher rank of abstraction (concept, notion) and then is restricted by the psychosocial level of this ectropy trend of nature. It means creativity, as a phenomenon, does not appear until psychology (reflecting and self-reflecting live beings) comes into existence. In other words, stars, planets, trees, worms, birds, etc., do not create – they exist, live, and reproduce.

After placing the phenomenon of creativity into a higher rank level and limiting it to the psychosocial level, its essence is further described by the phrase "search of search activity." The notion of "activity" contrasts creativity to passive fantasizing and cuts off the cases of sitting in the corner and doing nothing but daydreaming. In such a case, creativity is not seen, and therefore, its existence cannot be proven. Creativity should be expressed in order to be seen.

The complex term "search of search" also corresponds to a mathematical expression of squaring (self-multiplication, or degree, or to the power of) that on the conceptual level signals of another concept. When creativity is defined as "search of search" (Aleinikov 1994), it is understood as squared search activity (search^2). This understanding is based on the following. What is traditionally expressed in mathematics as 2^2, 3^2, 4^2. . .n^2 may be translated into language as "two of two's" (2×2), "three of three's" (3×3), "four of four's" (4×4), and finally, as "n of n's." When this regularity is applied to seemingly nonmathematical essences, like concepts, it gives "father of father" = grandfather, "child of child" = grandchild, etc. Some other notions (not all) can be self-multiplied too. However, what is most interesting for the language is that such a "squared notion," as a rule, gets another name as a concept of the next level of abstraction.

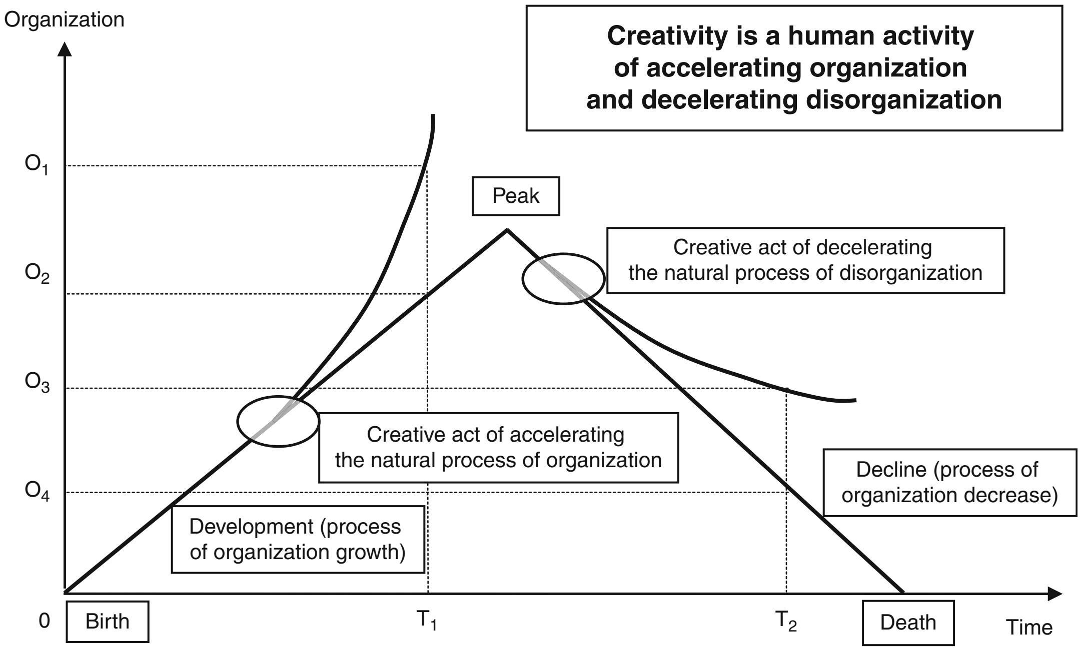
So the first attempt, the first definition of creativity is quite scientific. This definition is good for practical applications, especially for educators because it points precisely at what to teach and train for success in learning – search abilities.

The next step in developing a scientific definition of creativity is to find a more common name for the "search of search activity on the psychosocial level."

A closer look at the creativity phenomenon shows that creativity is a complex and highly regarded ability, skill, and practical activity of producing new (original, innovative) ideas, products, and problem solutions. Creativity is newness production on the psychological level, while innovation is newness consumption on the social level.

Ontologically, since ever-changing nature produces newness on all its levels (physical, chemical, biological, psychological, and social), producing newness on the psychological (individual) level is a natural process. Actually, new feelings, emotions, images, memories, thoughts, associations, as well as new movements and actions, are all natural phenomena every day occurring in intellectual beings. While constantly reflecting the newness produced by nature, human mind/intellect first learns how to produce newness by itself and then how to do it faster than nature. This accelerated process of human-produced newness that advances civilization (society, social level in general) is conceptualized as creativity. Since the results of creativity accelerate the development processes of a society over the natural speeds, the society begins to value creativity more and more until it becomes "highly regarded."

Thus, in scientific terms, creativity is not just ectropy, but an ectropy accelerator and/or entropy decelerator. In other words, it is a human activity, not just ability and/or skill, of accelerating the natural process of organization (ectropy) and decelerating the natural process of disorganization (entropy). The fact that accelerated ectropy is the process of accelerated (over natural) newness production is understood. The types, kinds, levels, layers, ranks, and amounts of newness are studied by novology,



Creativity Definitions, Approaches, Fig. 1 The essence of creativity

the science of newness (Aleinikov 2002; see also ▶ Novology).

So if the complicated expression "search of search activity on the psychosocial level" is changed to a simpler expression "human activity" and the high-level of abstraction physical terms "ectropy/entropy" are changed into more understandable to public terms "organization/disorganization," then the new definition of creativity might read as follows: **Creativity is a human activity of accelerating the natural process of organization and/or decelerating the natural process of disorganization**, or even shorter, **creativity is a human activity of accelerating organization and/or decelerating disorganization** (see ▶ Creativity Definitions, Approaches).

The following figure illustrates the essence of creativity.

Note: See how Fig. 1 shows that at a certain moment of time (T_1 or T_2), the organization level O_1 (accelerated development) is higher than O_2 (natural speed development), and the organization level of O_3 (restoration, repairing to decelerate the decline) is higher than O_4 (natural speed decline).

Gnosiologically, it is a simpler, clearer, and therefore, better definition. It looks like distilled essence.

If assumed that both organization and acceleration can be positive and negative (as in disorganization and deceleration), then the new essence can be expressed even shorter: **Creativity is organization accelerator**.

Testing Theory (New Scientific Definition) by Theory

In theory, ideally, there must be one definition for one object (process). If some definition fits several objects, then it does not define the one under analysis. This seemingly simple requirement is seldom observed in the prescientific practice. Many people say, "A chair is a piece of furniture to sit on." Seemingly, it is not a bad definition: first, the defined notion is generalized – it is sent to a higher abstraction level ("piece of furniture"), and then it is specified by function ("sitting"). Such a definition may look good until it is tested. A stool is not a chair, but it is a piece of furniture to sit on, so it fits the definition. A sofa is a piece of furniture to sit on, so it fits the definition too. These counterexamples show that the given definition of the chair is not specified enough.

The counterexample of the spider "producing new and useful things" and fitting some discussed above definitions of creativity is a book case.

Therefore, from the theoretical point of view, it is necessary to check whether some other notions or concepts fit the new scientific definition of creativity.

Maybe the concept of intellect fits it? Is intellect accelerating organization? Intellect is reflecting things, finding the organization of things, the connections and relations between them, but it is only creativity that produces new organization vision, and then intellect implements it. So the concept of intellect does not fit the definition.

Maybe the concept of fantasy fits the definition? Is fantasy accelerating organization? Fantasy is probing different organization, combining earlier noncombined elements. However, they need to be selected, developed, verified, tested, evaluated, and implemented until they become a new organization. This is what creativity does – it accelerates organization. Fantasy may be the start of creativity or the basic component of creativity but not creativity, so it does not fit the definition.

Maybe some other notions, like production or reproduction, would fit the new definition? Is reproduction accelerating organization? Reproduction is totally natural, so it goes with natural speed. No acceleration. So, no fit. Is production accelerating organization? Those who created new machines for the new processes were creative, but after the machines are done, they actually reproduce the idea of the creator. Therefore, the concepts of production and reproduction do not fit the definition of creativity.

There is a need to try something totally different. Is God accelerating organization? May be... Not proven by the science, so the term "human activity" excludes God as well as machines or aliens (not proven by science yet).

Thus, the new definition of creativity fits *only* creativity and not other phenomena. So testing theory by theory is successful.

Testing Theory (New Scientific Definition) by Practice

Any definition should be tested by practice, that is, by applying it to reality and seeing whether it works properly. Here is how this testing works for the final definition.

- In arts (considered creative activities), artists, sculptors, actors, writers, poets, etc., develop their works much faster than nature could by just random typing, random coloring, carving, burning, etc. They accelerate the harmonization (organization) of the world and decelerate the disorganization by restoring old paintings, churches, sculptures, etc.
- In science, the researchers by discovering the laws of nature accelerate the human world development (as compared to the noncreative, nonaccelerated = natural animal world development). Scientists also work on preserving the available resources and restoring the depleting ones: this is deceleration of disorganization.
- In technology, inventors and engineers accelerate the human world organization by new tools (the computer and the Internet are just a couple of examples). Inventors also work on decelerating disorganization – preservation and restoration of old planes; buildings, like the Tower of Pisa; and the millions of artifacts in museums.

Obviously the new definition works.

The preliminary (experimental) definition must be tested as well:

- Some people become artists to seek new images, new colors, new ways of self-expression, and new understanding of themselves as well as the environment.
- Some people become programmers to seek the best computer solutions.
- Some people become actors to seek the performance situations, etc.

Creative people are hungry for search. They practically lead themselves into search activities, and they enjoy these activities. It is the "search of search" that keeps them creative.

This definition also works.

By the way, as a corroboration of the correct direction this definition offers, all five steps in the original Osborn-Parnes model of creativity are expressed through a search-related word: fact-*finding*, problem-*finding*, idea-*finding*, solution-*finding*, and acceptance-*finding* (Parnes 1992).

Applying New Definitions to Real World

The new scientific definitions of creativity taken to real-world practice have proven their ability to improve it (or in new terms "to accelerate its organization") in science, technology, business, education, etc. The new scientific understanding of creativity led to:

- The new science of creativity, as well as five more new sciences and three new fields of research, like Creative Linguistics (see ▶ Creative Linguistics) and Creative Pedagogy (see ▶ Creative Pedagogy) in Aleinikov 1988, 1992, 1999a – faster than anyone in the world (top result for comparison: Wilhelm von Helmholtz – 3)
- Eleven new laws of conservation – faster than anyone in the world (top result for comparison: Johannes Kepler – 2; see also ▶ Creative Leadership)
- Six new creativity-enhancing techniques that accelerated the process many times, including to the level of megacreativity, over 1,000,000 ideas/min (Aleinikov 1999b, 2002) – faster than anyone in the world (the most famous result for comparison: Brainstorming – 1 idea/min; see ▶ Creativity Techniques)
- New measurement units for measuring objective and subjective newness, quantitative and qualitative newness, as well as the efficiency of creative output (Aleinikov 1999b; see also ▶ Measurement of Creativity, ▶ Novology)
- New tools of research, such as, a universal model of creative act (Aleinikov 1988, 1992; see ▶ Creative Linguistics)
- New educational methodologies, including the Genius Education Methodology (GEM) with 37 min to make an ideal learner, 3 days for mind setting to genius development (see ▶ Creative Pedagogy) – faster than anyone in the world
- New business organization processes, including the Guinness World Record in publishing (the book *Making the Impossible Possible* was written, printed, and published in 15 h and 46 min – accelerated over 300,000 times).

For detailed description on how the new understanding of creativity accelerates the organization of the world in science, technology, business and education, see ▶ Creative Leadership, ▶ Creative Linguistics, ▶ Creative Pedagogy, ▶ Genius, ▶ Novology, and ▶ Science of Creativity.

Conclusion and Future Directions

Approaches to creativity definitions (see ▶ Creativity) depend on the historical background, the general level of science development, and subjective preferences. To reduce the influence of the past (etymology, myths), to minimize the factor of subjectivity, thus increasing the objectivity of the definitions, a scientific approach is becoming a necessity, and scientific definitions are being developed. These scientific definitions are conscientiously built with scientific terms, logic, and mathematics – the key attributes of any science. With such an approach, creativity is defined as "**a human activity of accelerating organization and/or decelerating disorganization**." This new definition works equally well for all fields of human activities from art to science, from technology to education, from military to civilian, economic, social and political life, thus proving its universal applicability, as a true scientific definition, and laying the foundation for the science of creativity. The discovery of these new sciences and research fields, new laws, models, techniques, units, teaching methodologies not only corroborates the process of *acceleration* in science, technology, business and education development but also clearly illustrates a direct giveback from the new science of creativity to the creativity of science.

Just as any theoretical breakthroughs in any field open new horizons for future researchers and technology specialists, the new scientific definition of creativity and new science of creativity (see ▶ Science of Creativity) will lead to new investigations in theoretical and applied research. Future directions of research include applying the generic definition to all particular fields to specify its work in all human activities. New mathematical tools will be applied to measuring creative output as accelerating organization. Business and education will recognize creativity as the most powerful accelerator. The scientific definition of creativity as accelerating organization also requires a new, more structured vision of organization itself, so the development and further publications on the new sciences of organizology and intensiology are in the plans.

Cross-References

▶ Creative Leadership
▶ Creative Linguistics
▶ Creative Pedagogy
▶ Creativity
▶ Creativity Models
▶ Creativity Techniques
▶ Creativity Tests
▶ Genius
▶ Imagination
▶ Measurement of Creativity
▶ Novology
▶ Science of Creativity

References

Aleinikov AG. Sozidolinguistics for creative behavior. J Creat Behav. 1994;28(2):104–23.

Aleinikov AG. Humane creativity. In: Runco MA, Pritzker SR, editors. The encyclopedia of creativity, vol. 1. San Diego/London/Boston/New York/Sydney/Tokyo/Toronto: Academic; 1999a. p. 837–44.

Aleinikov AG. Mega-creator: from creativity to mega-, giga-, and infi-creativity. Montgomery: MIMII; 1999b.

Aleinikov AG. MegaCreativity: five steps to thinking like a genius. Cincinnati: Walking Stick Press; 2002.

Aleinikov AG. Theoretical foundations of creative linguistics. (russ. Теоретические основания креативной лингвистики). Unpublished Doctor of Sciences dissertation. Moscow: Military University, 1992.

Aleinikov AG. Creative linguistics (foundations, problems and perspectives). In: Language awareness: stereotypes and creativity; 1988. Moscow: Institute of Linguistics, USSR Academy of Sciences, (russ. Креативная лингвистика (обоснование, проблемы, перспективы). Языковое сознание: стереотипы и творчество. Институт языкознания, Академии Наук СССР, Москва, 1988).

Aleinikov A, Kackmeister S, Koenig R, editors. Creating creativity: 101 definitions (What Webster never told you). Midland: Alden B. Dow Creativity Center Press; 2000.

Cropley AJ. Definitions of creativity. In: Runco MA, Pritzker SR, editors. The encyclopedia of creativity, vol. 1. San Diego/London/Boston/New York/Sydney/Tokyo/Toronto: Academic; 1999. p. 511–24.

Davis G. Creativity is forever. Cross Plains: Badger Press; 1981.

Freud S. Creativity and the unconscious. New York: Harper; 1925.

Guilford J. Intelligence, creativity, and their educational implications. San Diego: Knapp; 1968.

Isaksen SG, Dorval KB, Treffinger DJ. Creative approaches to problem solving: a framework for innovation and change. 3rd ed. Thousand Oaks: SAGE; 2011.

Kubie L. Neurotic distortion of the creative process. Lawrence, Kansas: University of Kansas; 1958.

Locke EA. Toward a theory of task motivation and incentives. Organizational Behavior & Human Performance. 1968;3(2):157–189.

Maslow AH. Towards a psychology of being. 2nd ed. New York: D. Van Nostrand Company; 1968.

Parkhurst HB. Confusion, lack of consensus, and the definition of creativity as a construct. J Creat Behav. 1999;33(1):1–19.

Parnes SJ, editor. Source book for creative problem solving. Buffalo: Creative Education Foundation Press; 1992.

Plucker JA, Dana RQ. Drugs and creativity. In: Runco MA, Pritzker SR, editors. The encyclopedia of creativity, vol. 1. San Diego/London/Boston/New York/Sydney/Tokyo/Toronto: Academic; 1999. p. 607–11.

Pritzker SR. Alcohol and creativity. In: Runco MA, Pritzker SR, editors. The encyclopedia of creativity, vol. 1. San Diego/London/Boston/New York/Sydney/Tokyo/Toronto: Academic; 1999. p. 53–7.

Simonton DK. Origins of genius: Darwinian perspectives of creativity. Oxford: Oxford University Press; 1999.

Torrance EP. Future needs for creativity research, training, and programs. In: Aleinikov AG, editor. The future of creativity. Bensenville: Scholastic Testing Services; 2002. p. 1–10.

Treffinger DJ. Creativity, creative thinking, and critical thinking: in search of definitions. Sarasota: Center for Creative Learning; 1995.

Wertheimer M. Productive thinking. New York: Harper & Row; 1959.

Creativity from Design and Innovation Perspectives

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Introduction

The notion of innovation is associated with abundant literature presenting a variety of viewpoints, some complementary and others contradictory. In this literature, the concept of innovation is often associated with novelty and the added value provided by new products, processes, or services to groups or individuals. This viewpoint is clearly present in the third edition of the Oslo Manual (2005) which defines innovation as "the implementation of a new or significantly improved product (good or service), or process; a new marketing method, or a new organizational method in business practices, workplace organization or external relations." Elsewhere the same reference to novelty is used to describe creativity, "the creative process is seen as the sequence of thoughts and actions that leads to a novel, adaptive production" (Lubart 2010). This type of ambiguity and confusion in the definitions of the two concepts is often encountered in many related works.

The confusion is further maintained by the fact that research in the fields of creativity and innovation addresses similar questions. For example, the Organisation for Economic Co-operation and Development (OECD) definition of innovation defines three levels of "new": new to the world, new to a nation, and new to the firm. Thus, this raises the question of whether a product or process that is new to a particular nation, geographic, or political region can be considered innovative in the same manner as a product or process that is new to the world, and therefore obviously innovative (Holbrook and Hughes 2003). Such a question is also considered to be central in creativity research focusing on the analysis of creative products (MacKinnon 1978) and on the challenge of comparing two novel ideas to show which one is the most creative (Boden 1996). Moreover, the ambiguity between the concepts of creativity and innovation is accentuated as they seem to correspond to distinct processes, the first being the starting point of the latter (Amabile et al. 1996).

In an attempt to clarify the notions of creativity and innovation, the design process can be considered as the central process of innovation as claimed by Kline and Rosenberg, "the central process of innovation is not science but design" (Kline and Rosenberg 1986). Multiple recent studies confirm Kline and Rosenberg's statement by providing pragmatic evidence that design plays a major role in innovation. For instance, a recent survey of Swedish companies shows that firms that use design activities geared toward innovation as a strategic driver are five times more likely to develop new products as compared to firms that do not (Swedish Industrial Design Foundation 2008; European Commission 2009). Moreover, these firms increase their chances of developing radical innovation (Irish Center for Design Innovation 2007; Tether 2009).

This entry aims to explore the relationship between creativity, design, and innovation. To this end, a first part develops a short state of the art review of creativity and the point of view of creativity as a process. Then, design is presented as a process and considered in its creative character. In a third part, the link between creativity and design is made through the notion of *ingenium*. Finally, the entry introduces a new manner of considering creativity from a design-centered perspective.

Creativity as a Process

Interest in research linked to the field of creativity began to grow in the 1950s. In 1950, Guilford emphasized the scarcity of research on creativity: less than 0.25 % (only 183 among 121,000 abstracts) of the entries in Psychological Abstracts for the preceding 23 years dealt with the subject of creativity (Guilford 1950). He then went on to underline the social importance of creativity and invited his colleagues to develop research on the topic.

Since then theories on creativity have focused on a variety of aspects. Rhodes was the first, in 1961, to note that there are four fundamental areas of inquiry in creativity research. He called these areas the four Ps of creativity, referring to *person*, *product*, *place*, and *process*.

The first one focuses on the characteristics of the creative *person* which, related research shows, tends to have such characteristics as risk taking, autonomy, humor, open-mindedness, tolerance of ambiguity, curiosity, etc. Researchers have also studied creativity aspects linked to the creative *product*, "the starting point, indeed the bedrock of all studies of creativity, is an analysis of creative products, a determination of what makes them different from more mundane products" (MacKinnon 1978, p. 187). The focus on *place* considers the best circumstances which nurture creativity; these include degrees of autonomy, access to resources, and the nature of gatekeepers. The final P, *process*, examines the thinking stages occurring when people behave in a creative manner; this aspect has been principally studied in psychology and cognitive science. To consider creativity as a process means adhering to a tradition of thought that diverges from the myth of creativity being a matter of divine inspiration (Sternberg and Lubart 2005).

A way of considering creativity as a process is through a widely accepted model which was introduced by Wallas and Smith (1926) initially in the form of four stages:

1. Preparation to a problem: Focuses the mind of individuals and explores the problem's dimensions.
2. Incubation: The problem is internalized into the unconscious mind; nothing appears to be happening externally.
3. Intimation: The creative person has a "feeling" that a solution is coming.
4. Illumination: Eurêka! The creative idea bursts forth from preconscious processing into conscious awareness.

This initial model was later completed with a fifth stage:

5. Verification: The idea is verified, elaborated, and starts toward an application.

Further developments include Guilford's model which underlined the distinction between convergent and divergent thinking (Guilford 1967), and Amabile et al. (1996) who suggested that it is important to distinguish a problem-finding or problem-formulation phase, in which relevant information is gathered and preliminary ideas are proposed, from the preparatory phase. Other authors have also considered that more detailed subprocesses are involved in creativity such as perception and information encoding using heuristics as well as the process of forgetting which has been found to play a role in overcoming initial mental fixations. The process of reorganizing information as part of creative thinking has also been considered.

Furthermore, according to Mumford et al. (1991), the phases introduced by Guilford and Amabile occur in a certain kind of approximately organized sequence. In the case of problem formulation, they involve the stages of problem construction, search for relevant information, information retrieval and encoding, specification of best fitting categories of information, combination and reorganization of category of information to generate new solutions, idea evaluation, implementation of ideas, and monitoring. According to the same authors, this fuzzy organization explains, to a great extent, the variance in the creative performance during problem-solving tasks related to the study domains; these included advertising, managerial, and public policy. A model sharing numerous commonalities with the model of Mumford has been proposed by Finke et al. (1992). This model decomposes this loosely organized process into generative and exploratory subprocesses. The generative subprocess includes knowledge retrieval, idea association, synthesis, transformation, and analogical transformation. The exploratory subprocess includes interpretation of reinventive structures, hypothesis testing, and searching for limitations. These different subprocesses are combined together in the form of iterative cycles leading to creative results. The relationships between the phases and subprocesses of the creative process are complex because they operate almost always simultaneously.

The necessity of analyzing the creative process from different viewpoints and perspectives is also emphasized by Sternberg and Lubart (2005, p. 12). They note that "unidisciplinary approaches have tended to view a part of the phenomenon (e.g., the cognitive processes of creativity, the personality traits of creative persons) as the whole phenomenon; often resulting in what we believe is a narrow, unsatisfying vision of creativity." Considering creativity from a multidimensional perspective leads to a better understanding of the creative process and to a more complete picture of its dynamic. In order to push forward this initial state of the art, the further sections focus the design process and later its interdependence with the creative process.

Design as a Process

Defining design from its results makes little sense as designed artifacts have varied characteristics. They can be produced in varying numbers (from unique large structures to mass-produced goods), vary in terms of user perception (be surprising or commonplace), be tangible or intangible (goods vs. software), be produced on varying scales (from nanoparticles to macroscopic level environments), act passively or actively, bring positive or negative additions to life, etc. This list of traits of existing artifacts is, of course, easily expandable but such a list is useless unless one wants to create an exhaustive typology or taxonomy of a set of artifacts. If design cannot be defined purely from its outcome, there is nevertheless a converging vision of design seen as a process (Design Council 1995; Love 2002; European Commission 2009).

The starting point of this process is a need (Simon 1997) that cannot be satisfied immediately by taking resources from nature, by buying or by applying traditional routines (Micaelli and Forest 2003). In other words, in order to understand what an artifact is, one should first understand its purpose, "what is it made for?" Indeed, a specific feature of designed artifacts is that their essential purpose is to be used and to serve users. The first attribute of an artifact is therefore its function rather than its organic composition or its concrete structure. The adaptation criterion is the adjustment level to a need, defined as an "external constraint." As a consequence, a designer's main assignment does not consist in producing perfect artifacts or artifacts that copy nature as closely as possible; it resides in producing functional artifacts that properly fit particular needs (Coatanéa 2005). To sum up, a function is seen as a connection made between the "inner environment" of the artifact and its "outer environment" by way of "interfaces" (Simon 1997). The verification of the functions of the artifact is made by the analysis of its behavior. The artifact has to fulfill an expected behavior.

For designers, this implies the use of deduction in order to select the adequate principles and avoid non-desired effects associated with physical principles. The justification of the design decisions related to artifacts has to be supported by a rational analysis. This rational approach has been developed and explored in the 1980s by the Systematic Design School (Pahl and Beitz 1984) and in a certain extent by the Value Analysis School (Gage 1967) in the 1950s and 1960s. This exploration has produced guidelines structuring the design process. These guidelines are now largely used in industry. Commonly these guidelines separate the design process into five key phases:

1. Evaluation and selection of ideas: The objective of this first stage is to use the firm's knowledge of its market to identify a promising idea and to insert this new product idea into the firm's "strategic objectives and business sector" (Perrin 2001, p. 117).

2. Preliminary reflection: This stage aims to understand and clarify the need, in other words, to define the problem and the design environment. This involves setting up a functional analysis process for the new product in order to list the different functions to be fulfilled.
3. Feasibility study (preliminary project study): This stage looks for possible solutions for each of the functions listed as needing to be fulfilled, and evaluates some of the possible combinations.
4. Search for a global solution by assembling solutions to each function: This stage involves some dimensioning of the product.
5. Final design: The objective is the production and verification of a final design.

The design process is an integrative process considering and merging together multiple expectations such as the functionalities, the aesthetic, security, and environmental aspects as well as, from an architectural point of view, multiple components or subsystems. Due to its complexity and to time and resource constraints, the design activity is seldom a process involving an isolated actor. It relies, on the contrary, most of the time on the cooperation of numerous designers with different expertise and competences. Design is a process where creativity plays a central role; the following section dwells on this aspect.

The Creative Nature of Design: Ingenium

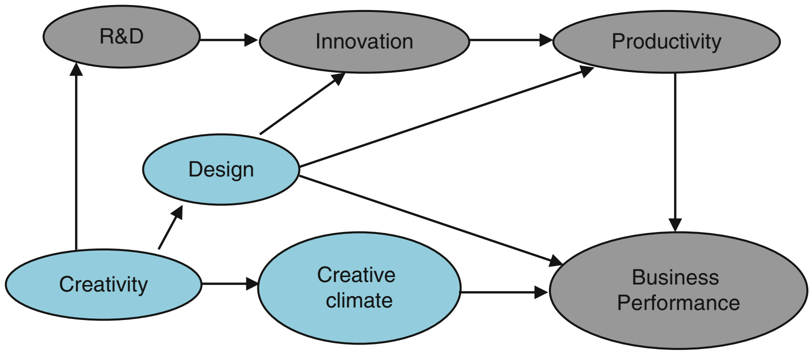
One of the essential properties of design is its creative nature, this aspect has been clearly marked by several authors (Medyna et al. 2009): "Design involves (. . .) the presence of a creative step" (Archer 1984); "all designing is iterative, using creativity and compromise to move from a field of possibilities to one unique solution" (Roy and Wield 1986); "Design is a structured creative process" (UK Department of Trade and Industry 2005); "Design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life cycles" (ICSID 2009). Considering the creative nature of design leads to the rehabilitation of a kind of reason Western tradition seems to have forgotten (Faucheux and Forest 2011). It was recognized by Vico through his notion of *ingenium* and similar to a form of thinking the Greeks called *metis*.

In *De Nostri Temporis Studiorum Ratione* (1709), Vico defines *ingenium* as the ability to understand the relationships that exist between separate elements of reality, therefore establishing relationships between disparate things or concepts. It can be defined as the ability to associate in an effective way scattered items (concepts, things, technologies, knowledge domains. . .). As such, it is the faculty to bring together different perspectives, to make distinct domains closer, to find and explore relations that none have previously made. Creativity as a whole does not necessarily equate to *ingenium*. *Ingenium* is a way of thinking a kind of rationality, involved in design. According to Vico himself *ingenium* explains how the main Western inventions of the end of the Middle-Ages and the Renaissance (e.g., Brunelleschi's works) were created. Contemporary researchers in innovation (Nonaka 1994; Maskell 2001; Antonelli 2006; Nooteboom et al. 2007) consider knowledge combination, close to the notion of *ingemium*, as the very origin of innovation.

Contribution of a Design-Centered Perspective for Understanding Creativity from a Holistic Point of View

If creativity and the notion of *ingenium* are considered as attributes of the design process, the relationships between creativity, design, and innovation need to be clarified in new terms. This perspective modifies, for example, the viewpoint proposed by Swann and Birke (2005). In their interactive model (Fig. 1), creativity and design are linked to innovation as the first contributes to the expansion of available ideas and the second increases the chances of successfully commercializing these ideas. Furthermore, in the same model, creativity directly influences design

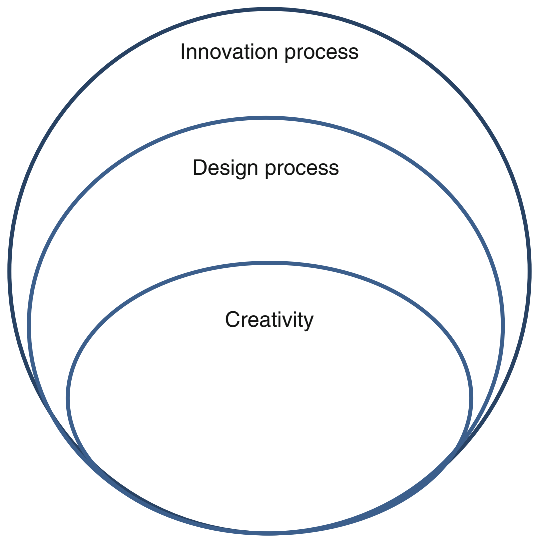
Creativity from Design and Innovation Perspectives, Fig. 1 Interactive model of the design process (Swann and Birke 2005)



and appears to be a prerequisite for it, while design similarly directly influences innovation.

Recognizing *ingenium* as the creative rationality involved in design shows, however, that design can no longer be described as a process linking creativity to innovation channeling ideas for commercial advantage. Creativity becomes a fundamental component of a more global process – the design process – which is itself the central process of the innovation process. This vision is presented in Fig. 2.

More precisely, different creative episodes occur during the design process that could be considered as sub-creative processes. The nature of the relationships built during the successive steps of the design process leads to the conclusion that *ingenium* is a way of thinking which is used during the different phases of the design process *creating* the link between the firm's knowledge and a market during the first phase of the design process, then establishing links between the future product and its outer physical environment, directly concerning functions. A third type of links is established mainly during the third phase where physical structures have to be imagined for fulfilling functions and steadily linked to those functions by the application of some form of deduction. In a fourth phase, the assembly of components is a form of *ingenium*. Finally, during the entire design process, and specifically during the last phase, problems have to be regularly considered using creative problem solving approaches (Choulier 2011).



Creativity from Design and Innovation Perspectives, Fig. 2 Creativity is part of a more global process

Conclusions and Future Directions

The previous analysis highlights the complex links between the notions of design, creativity, and innovation. Creativity can no longer be considered as separate from design but rather it must be considered as part of the different subprocesses of design and innovation. The form of creativity involved during design refers to the notion of *ingenium*, a form of rationality that establishes links between things or concepts.

Such a point of view leads to the conclusion that it is possible to enhance creativity during the design process in order to generate value for individuals, customers, companies, or other stakeholders. Another aspect is the innovation that has been analyzed only partially in this short work. It should be developed further in future entries that innovation involves a process of acceptance by the public and the users as well as a historical analysis of the outcome of the creative design process. An innovation is only considered as such if it has gone through the selection of a community of users.

Some other aspects of the links between the three notions of creativity, design, and innovation remain open. For example, is it possible to have creativity without design? Some authors seem to defend such a thesis when considering the creative process in artistic domains.

Cross-References

▶ Adaptive Creativity and Innovative Creativity
▶ Age and Creative Productivity
▶ Convergent Versus Divergent Thinking
▶ Creative Behavior
▶ Creative Brain
▶ Creative Mind: Myths and Facts
▶ Creative Personality
▶ Creativity Across Cultures
▶ Creativity and Innovation: What Is the Difference?
▶ Divergent Thinking
▶ Divergent Versus Convergent Thinking
▶ Invention and Innovation as Creative Problem-Solving Activities
▶ Research on Creativity

References

Adam Holbrook A, Hughes L. Operationalizing definitions of innovation at the level of the firm. Centre for Policy Research on Science and Technology, working paper. http://www.Utoronto.ca/isrn/documents/holbrook1.Pdf (2003). Accessed 19 Dec 2011.

Amabile TM, et al. Assessing the work environment for creativity. Acad Manage Rev. 1996;39(5):1154–84.

Antonelli C. The business governance of localized knowledge: an information economics approach for the economics of knowledge. Indus Innov. 2006;13:227–61.

Archer L. Systematic method for designers. In: Cross N, editor. Development in design methodology. New York: Wiley; 1984. p. 57–82.

Boden M. Dimensions of creativity. Cambridge, MA: MIT Press; 1996.

Choulier D, Weite PA. Découvrir et appliquer les outils de TRIZ. Belfort: Université de Belfort-Montbéliard; 2011. ISBN 978-914279-55-0.

Coatanéa E. Conceptual modeling of life cycle design: a modeling and evaluation method based on analogies and dimensionless numbers [PhD dissertation]. ISBN 951-22-7853-7, ISBN 951-22-7852-9; 2005.

Council D. Definitions of design. London: Design Council; 1995.

European Commission. Design as a driver of user-centred innovation, SEC (2009)501; 2009.

Faucheux M, Forest J. Stimulating creative rationality to stimulate innovation. Creat Innov Manage. 2011;20(3):207–12.

Finke RA, et al. Creative cognition: theory, research, and applications. Cambridge, MA: MIT Press; 1992.

Gage WL. Value analysis. London: McGraw Hill; 1967.

Guilford JP. Creativity. Am Psychol. 1950;5:444–54.

Guilford JP. The nature of human intelligence. New York: McGraw-Hill; 1967.

ICSID. http://www.icsid.org/about/about/articles31.htm (2009). Accessed 05 Aug 2009.

Irish Center for Design Innovation. The design difference. A survey od design and innovation amongst Ireland's SME's; 2007.

Kline S, Rosenberg N. An overview of innovation. In: Landau R, Rosenberg N, editors. The positive sum strategy. Washington, DC: National Academy Press; 1986. p. 275–305.

Love T. Constructing a coherent cross-disciplinary body of theory about designing and designs: some philosophical issues. Des Stud. 2002;23(3):345–61.

Lubart T. Models of the creative process: past, present and future. Creat Res J. 2010;13(3–4):295–308.

MacKinnon DW. In search of human effectiveness: identifying and developing creativity. New York: Creative Education Foundation; 1978.

Maskell P. Knowledge creation and diffusion in geographic clusters. Int J Innov Manage. 2001;5(2):213–37.

Medyna G, Coatanéa E, Lahti L, Howard T, Brace W, Christophe F. Creative design: an initial analysis and ontology. Submitted to MCPC 2009 (Mass Customization and Personalization Conference 2009), Helsinki, Finland; 2009.

Micaelli JP, Forest J. Artificialisme. Lausanne: Presses Polytechniques Universitaires Romandes; 2003.

Mumford MD, Mobley MI, Uhlman CE, Reiter-Palmon R, Doares LM. Process analytic models of creative capacities. Creat Res J. 1991;4:91–122.

Nonaka I. A dynamic theory of organizational knowledge creation. Organ Sci. 1994;5(1):14–37.

Nooteboom B, et al. Optimal cognitive distance and absorptive capacity. Res Policy. 2007;36(7):1016–34.

Oslo Manual. The measurement of scientific and technological activities. http://www.oecd.org/dataoecd/35/61/2367580.pdf (2005).
Pahl G, Beitz W. Engineering design: a systematic approach. London: Springer; 1984.
Perrin J. Concevoir l'innovation industrielle. Méthodologie de conception de l'innovation. Paris: CNRS Editions; 2001.
Roy R, Wield D. Product design and technological innovation. Philadelphia: Open University Press, Milton Keynes; 1986.
Simon HA. The sciences of the artificial. 3rd ed. Cambridge, MA: MIT Press; 1997.
Sternberg RJ, Lubart TI. The concept of creativity: prospects and paradigms. In: Sternberg RJ, editor. Handbook of creativity. Cambridge: Cambridge University Press; 2005. p. 3–14.
Swann P, Birke D. How do creativity enhance business performance? A framework for interpreting the evidence. Think piece for DTI Strategy Unit, final report. Nottingham University Business School; 2005.
Swedish Industrial Design Foundation. 2008.
Tether B. Design in innovation coming out from the shadow of R&D an analysis of the UK innovation survey of 2005. Department for Innovation, Universities and Skills Research Report 09–12, London; 2009.
UK Department of Trade and Industry. Creativity, design and business performance. Econ Paper, 15; 2005.
Vico G. De Nostri Temporis Studiorum Ratione; 1709.
Wallas G, Smith R. Art of thought. New York: Harcourt Brace; 1926.

Creativity in Business

► Creative Management

Creativity in Invention, Theories

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Synonyms

Change management; Creativity techniques; Innovation; Originality; Problem-solving; Radical invention

Creativity and Invention

Creativity is a capacity or trait, inherited or acquired, implying a more or less unique ability to apprehend new ideas and insights (Taylor 1988). Departing from standard definitions of creativity, the concept lies at the heart of invention. In Western history, it has thus been viewed as problematic, even heretical. Since God created the world out of nothing, *creatio ex nihilo*, any attempts to similarly create inventions out of nothing was conceit (Tatarkiewicz 1980; Perkins 1988). In research into the sources of creativity, individual characteristics are occasionally combined with environmental influences. Likewise are particular situations of insight, described by their unexpectedness and sudden effortlessness, often combined with the stressing of preparations as in knowledge accumulation (Gruber and Davis 1988; Finke 1995). The view that creativity is more the result of an enduring process has led to many attempts to identify phases of creative thinking (Funke 2009). Today, however, phases or stage models of the creative process seem dated. Instead, the focus is on multiple subprocesses of creativity such as problem finding, problem formulation, problem redefinition, generation of alternative ideas (divergent thinking), combining information, synthesis work, perception, and information encoding. In addition, it seems as if multiple subprocesses may be combined in different ways in order to lead to creative paths (Lubart 2000–2001).

Secondly, the problems of defining the concept of invention have been stressed by many researchers, an insight that has caused still more of them to refrain from it altogether (e.g., Gilfillan 1935). Here, the definition of invention will be the broadest possible and thus assumed to signify anything made different from everything already existing, any thought, practice, or material manifestation that is new because it is qualitatively different from existing or historical forms. Note that some inventions may remain as mental organizations exclusively because of their nature, whereas others may be materialized. Likewise, this definition does not limit inventions to technical novelties. Instead, any type of novelty introduced to any type of practice such as literature or art may be called an invention. Inventions as defined here may also well include ideas, explanations, and theories, as well as social institutions and organizations.

In order to be called an invention, however, it needs to be genuinely and globally new. It does not suffice to create something already existing but unknown to the inventor through so-called personal creativity. For inventions, so-called historical creativity is the more relevant form, leading to new and hitherto nonexistent entities (Csíkszentmihályi 1996; Pope 2005). Departing from this narrower definition of creativity, it is likewise important to point out that creativity is sought for and acclaimed in many different contexts, from the world of sports to literature and science. Although it has been claimed that creativity in science and art is one and the same, different institutions, that is, social mechanisms that govern human behavior, clearly promote different creative ideas in different contexts resulting in different standards regarding what is to be considered relevant creativity and what is not.

Over the past two decades, creativity research has become more refined regarding the different domains in which it is studied and it is clear that we need to also take into account the specific contexts and institutions that determine creativity in invention as understood in the domain of innovation and entrepreneurship. Thus, we here assume that differences between tasks lead to at least some differences in the creative process and that creativity to some extent is domain specific although not altogether domain general (Amabile 1996; Baer 2010). When specifically dealing with creativity in invention such as new devices, methods, or processes developed from study and experimentation, as well as in innovation, that is, the implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new organizational method in business practices, workplace organization, or external relations, the applicable institutions reward creativity leading to potential realization, business opportunities, and commercialization.

It has correctly been pointed out that inventions may be abundant in a specific culture without ever being developed into innovations. One often cited example is ancient China where a lot of techniques such as paper, gunpowder, and printing were invented but more seldom implemented on a broader scale. Thus, it is possible to have inventions in abundance and still lack innovations. Nevertheless, inventions are a necessary precondition for innovations. From this perspective, creativity in invention that never ever leads to products or services with possibilities of being commercialized is thought to be of lesser value than that which does. The theories reviewed in this entry have all been selected because of their relevance from this specific perspective and thus only constitute a small subset of theories of creativity (Kozbelt et al. 2010).

The concept of innovation usually denotes the process that takes place when a new product or a new process is developed, from idea to market, while the concept of invention only denotes the process that takes place when new ideas or solutions are generated per se (Tidd et al. 2001). Thus, invention is assumed to precede innovation, which in its turn is assumed to precede implementation, that is, the process that takes place when a product or a process is adjusted and further developed to fit market conditions. Although invention is thought of occurring early in the context of innovation and entrepreneurship, creativity, departing from the broad definition used here, occurs throughout the whole area of invention, innovation, and entrepreneurship activities. The causal linearity between these entities is more of a historical construct than an empirical observation (Godin 2006).

In the literature, it is moreover common to introduce distinctions between different types of inventions such as radical versus conservative (incremental) or independent versus routine, both regarding perceived extent of change (Abernathy and Clark 1985). Here, the former denotes inventions leading to radically new forms of systems and behavior with examples as the telephone or the automobile and the latter denotes inventions or innovations that in one way or another improve existing systems and behavior (Garcia and Calantone 2002). Another common distinction is often made between product and process inventions (or innovations) regarding what is changed. Here, product inventions are seen as a new thing or service, while process inventions are seen as changes in the ways in which they are created, produced, and delivered (Tidd et al. 2001, p. 8). An important tendency regarding this distinction is that it seems as if the rate of product innovations is high and the rate of process innovations is low in the early phases of a new industrial sector or product class. Later though, it seems as if this is reversed so that product innovations become less frequent and process innovations more so (Utterback and Abernathy 1975). (Another category sometimes added on to these two is organizational invention (and innovations), which is then considered likely to be more frequent after the rationalizing of both product and process.)

When discussing creativity in invention, however, we seem to deal even more frequently with uncertain ideas that have yet to be tested and evaluated from the perspective of potential realization and commercialization. Thus, creativity in all types of invention to some extent needs to take into account the calculated consequences of the realization of the invention in question, something not always the case when discussing creativity in other areas such as art or literature. This is even more the case for creativity in innovation and entrepreneurship. So even if the concept of invention is defined in broadest possible way, the scope of creativity in invention can be narrowed down and classified according to explanations of the emergence of inventions. Most commonly, theories propose that (technical) inventions occur in the context of problem-solving as in neoclassical economic theory. Other theories point out individual creativity that can be spurred by organizational and social conditions (Vandervert 2003; Shavinina and Seeratan 2003).

Perspectives, Theories, and Models

Creativity in invention from the perspective of innovation and entrepreneurship can appear in many different forms. It can, for instance, be a novel combination to solve an old problem such as Samuel Langley's use of aerodynamics and power engines to construct a flying machine for humans rather than mimicking natural flight with muscle power as pursued by different nonhuman organisms. Or it can include the novel application of customer skills as in flat-pack furniture to achieve lower prices and avoid bulky packages as developed by IKEA.

Theories of creativity in invention range from the very broad to the very individual. At the broadest end, domain-general cultural theories are found such as anthropologist Cavalli-Sforza (2001) that cultures where the transfer of information predominantly takes place between people in the same generation – horizontal or intragenerational – which tend to be dynamic and changeable compared to cultures where the information is disseminated between generations – vertical or intergenerational – which tend to be preserved and to be less prone to change since older generations teaching the younger ones tend to conserve traditions and customs. This idea can be expanded with the insight that some basic knowledge should probably be transferred vertically in order to form the basis for a more accurate and effective exchange of knowledge, for instance, reading and writing.

In the context of creativity in invention, implications are even less clear and it is an open issue whether intergenerational transfer of knowledge about creativity promotes invention or not. In fact, theories of cultural determinism can be interpreted as implying little or no room at all for creativity in invention (McGee 1995). In conjunction to Cavalli-Sforza's theory of information transfer are ideas of creative inspiration generated by changes in the external environment, for instance, through migration to new physical and ecological environments or encounters with other cultures (McNeill 1963). The same may be true for material artifacts and systems that are transferred from one social context to another and in the process generate creativity in the new setting (Pacey 1990).

Theories of somewhat lesser scope involve institutional environments. Karl Marx, for instance, argues that capitalists invent because they are forced to do so by competition and they are able to innovate because they can draw on a stock of inventions and on science (Elster 1983). Marx also introduces the concepts of forces of production and relations of production arguing that forces of production (often interpreted as science and technology) over time always depart from being in correspondence with the relations of production. This process implies that forces of production sooner or later will become in contradiction to the relations of production. These contradictions may take many forms such as crisis or lead to too many restrictions on changes in the forces of production. The general problem for those interested in Marx' theory of invention is that the factors behind the changes in forces of production are described differently in different texts. In some, it is claimed that contradiction between forces and relations of production only appear when all productive forces for which there is room (within a set of relations) have been developed. In other texts, innovative activities are regarded as springing from the inner individual sources. Marxian theory comes in many different shapes and colors, making it hard to pinpoint views on creativity in invention, more specifically (Rosenberg 1982).

In common, however, is the idea of periodic crises of commercial activities leading to destruction of capital, production, and productive forces followed by creativity in invention generated by exploitation of new markets and new forces of production. Joseph Schumpeter (1942) for one made use of the notion of temporality in inventive activities when popularizing the concept of creative destruction and pointing out the entrepreneur as the force behind the transformation of inventions into innovations paving the way to further creative destruction and new inventions.

Institutional conditions for inventive activities are often assumed to be more specifically defined in theories of creativity in invention. A widely accepted idea is that market conditions, that is, competition between inventions, with their inherent profit motives almost guarantee a drive for creativity leading to new inventions. Demand generates powerful economic incentives for the development of new technologies – whether it solves a problem of such a scale that the invention is likely to sell itself or needs commercials to be put on the market – a notion often summed up under the concept of neoclassical economic theory. And if a technology fails to emerge, it can always be explained by the too high investments needed to realize it, for example, time machines or until recently space tourism. Thus, demand is a necessary but not sufficient condition for the realization of an invention in neoclassical economic theory.

Economist Ester Boserup (1965) has presented a variant of this idea stressing the demographic environment when analyzing new technologies of agriculture. She claims that new methods and technologies for growing provisions are invented only under pressure of lacking resources, which occur when the population grows to such an extent that existing methods and technologies do not suffice to supply the food needed using the land at hand. Boserup's originality lies in her view of the necessity of an imperative force stronger than demand to explain invention, in the case of agrarian technologies, demographic pressure.

Departing from the economic environment, economic historian Nathan Rosenberg has pointed out certain features that both promote and constrain creativity such as the existing technologies and its institutions. In reaction to neoclassical theories where scientific and technological change is entirely endogenous to economic forces (Schmookler 1966), he stressed their exogenous character (Rosenberg 1974). To some extent, scientific and technological changes are endogenous to economic factors, not the least in a world where new technologies and scientific results to a large degree depend on material resources such as laboratory equipment. On the other hand, Rosenberg argues, economic demand does not entirely decide what knowledge is acquired and what is not. There is an independent and non-negligible supply side of science and technology changing along lines determined by other factors than economic that "imposes significant constraints or presents unique opportunities which materially shape the direction and the timing of the inventive process"

(Rosenberg 1974, p. 95). Similarly, it has been claimed that market incentives leave room for scientific research carried out without motives of rent seeking, although the value of research is always created through endogenous processes (Romer 1990).

A more domain-specific feature of existing technologies that, in combination with market forces, may create enormous pressure for inventive creativity is reverse salients or bottlenecks (Hughes 1992; Hirschman 1958). No matter how the idea is labeled, the common denominator is the notion of a crucial problem that, if solved, will generate profit with high certainty. Hughes points out that technology always exists in relations to other technologies in systems that only work as well as its weakest link. If a link of a system seems to functionally lag behind other parts, there will be very high (demand-driven) incentives to improve or replace it with something that continues to match the output of other parts of the system.

An often-used metaphor for market economy as stipulated by neoclassic theory is that of natural selection. Here, inventions are metaphorically seen as genetic variation with or without involving creativity, whereas the mechanisms of decision made on a market as well as the institutions surrounding it correspond to selection pressure exercised by the environment in natural selection acting blindly on a set of inventions (Brooks 1980). Inventions are continuously tried in an existing environment and the one that on the whole is most efficient for the time being is adopted until the environment is changed to favor some other invention or new alternatives emerge that prove more efficient again.

A more sophisticated version is represented by evolutionary economic theories where a company is viewed as a phenotype that is fitted to a changing economic environment where fitness now is defined as profitability. And if the firm corresponds to the phenotype, then routines within the firm corresponds to the genotype of a particular firm (Nelson 1995; Dosi and Nelson 2010). In most evolutionary models, the company employs scientific methods and information, as well as other means to make processes and products fit existing (market) conditions better. In evolutionary economic theories, the firm may adjust their fitness (profitability) consciously and according to carefully planned strategies and tactics.

These ideas of creativity and invention as responses to problems and critical situations can be contrasted by the concept of path dependence (David 1988, 2007). Technological change is path dependent in the sense that inventions are produced in a historical context that severely limits the alternatives available for solving a specific problem or developing an idea for any other reason, no matter how strong (market and other) incentives may be. The emergence of an invention can only be understood through an analysis of the existing pool of knowledge, its possibilities, and its limitations. From this perspective, existing technologies to a large extent determine what will come, both in defining the problems that are to be solved and in supplying the solutions possible and in this way severely constrain creativity. It is hardly bold to conclude that the concept of path dependence works well when trying to explain the dynamics behind conservative inventions but usually is less satisfactory when explaining radical inventions relying on larger measures of creativity.

A different way of understanding creativity and invention is supplied by actor-network theory where it is claimed that a problem is best seen as a resource to promote an invention. Finding a problem that the potential invention may solve creates an argument and engages more resources for its realization. Here, it is stressed how inventions need engagement from different actors such as individuals and organizations and even artifacts, named actants, that cannot speak for themselves and therefore need spokespersons in order to be realized (Latour 1987). The more resources that can be mobilized, the better are the possibilities to go from idea to invention. In the end, success is depending on the engagement that can be mobilized; this is where the creativity is needed more than any other place.

Another concept mirroring institutional forces behind invention and innovation different from economic factors is technopolitical regimes (Hecht 1998). Under technopolitical regimes, creativity may be driven by a strive for satisfying some culturally defined demand valued in the regime, for example, an internationally unique solution to how nuclear power can be exploited in order to produce both electricity and plutonium for weapons. The main point is that concepts such as efficiency and functionality are extremely context dependent. Socially and culturally conditioned demand decides which inventions and innovations are created and realized even if calculated and economically motivated demand points in other directions. Functionality of an invention does not necessarily have anything to do with consumer demand or market decisions. Instead, group identity or trust may be just as important promoters of creativity in invention.

An alternative theoretical approach to inventions and innovations is the notion of systems of innovation. These come in different shapes, are most commonly defined by geographical scope or industrial branch, and thus are usually national, regional, or sectorial. But no matter of attribute, this is in essence an institutional perspective stressing both the interdependence between different actors involved in innovation activities such as firms, individuals, public authorities, and special interest groups and that creativity underlying inventions more often than not emerge in the intersection between different organizations and fields of knowledge (Godin 2009). It should perhaps be added that these ideas most effectively describe invention and innovation of capital goods, where it is often essential for a producer to cooperate closely with a customer, often a state agency.

Another concept used in order to illustrate the importance of institutional and networks as conditions for invention and innovation is development blocks. They are constituted by the factors linked to a specific industrial activity. The growth of a development block depends on the complementary investments made in other fields related to it. As a result, imbalances and structural tensions may appear within the development block, which may cause further changes and invention creativity. Imbalances may arise for different reasons, either by market signals through a drive for efficiency or by changes in network relations between firms and other organizations. They may be the result of activities within a single firm or of cooperation between numbers of actors (Lindgren 1996).

Moving down to more specific contexts, the notion of collective invention departs from the observation that invention takes place in nonprofit institutions such as universities, in profit-seeking firms, and in the mind of individual inventors. As the proponents of the model hypothesize, a collection of agents may produce collective inventions characterized by exchange and free circulation of knowledge and information among themselves creating positive feedback allowing for high innovation rates and fast knowledge accumulation (Cowan and Jonard 2003). More specifically, the componential theory of organizational environment on creativity highlights the organizational motivation, resources, and management practices of organizations to promote creativity in the work environment and the individual expertise, creative thinking (depending on independence, self-discipline, risk-taking, ambiguity tolerance, perseverance), and intrinsic or extrinsic task motivation to promote individual creativity (Amabile 1997). Individual and organizational creativity with these components are likely to promote each other.

Theories regarding innovative organizations like these tend to list features of firms and other types of organizations that promote creativity and inventiveness (e.g., Heinze et al. 2009). Such features may include specialization, professionalism, and knowledge resources as shown in an analysis of determinants for organizational innovation (Damanpour 1991). In addition to the sheer listing of determinants, conclusions regarding organizational invention may also include different importance of different determinants observed in different types of organization or for different types of inventions. For the purposes here, though, it is enough to note that the determinants analyzed can with only a few exceptions be decided upon internally within the firm, for example, through recruiting policies, decision-making processes, and external relations.

The strong focus on internally decided determinants makes the theories on organizational creativity in invention resemble theories of individual invention as, for instance, laid out by Hatfield (1933), where determinants listed as having positive influence on creativity and capacity to invent are often seen as acquired by the individual. In this sense, both theories of individual inventors and theories regarding innovative organizations are internalist in relation to their respective object. Another similarity between theories of individual inventors and theories regarding innovative organizations is the focus on the individual and organizational qualities that promote rather than prevent innovation. In the analysis of determinants for organizational innovation mentioned above, 10 out of 13 determinants were considered positive for the ability to innovate or adopt innovations in an organization (Damanpour 1991).

When considering theories of individual inventors, the stress on positive qualities is even stronger. Traditionally, the individual's abilities have often been stressed, especially in theories developed in romantic contexts stressing the importance of the individual when explaining cultural change. These types of theories are still common (Friedel 1992). The distinction between theories of processes going on inside the heads of individual actors and processes generated by the interaction of individuals is not absolute. Many theories blend components from both categories (Isaksen 2009). One classic model bridging culture and individual creativity with the help of Gestalt psychology is Usher's (1929) four-stage model with the recognition of demand reviews of existing cultural elements, critical revision of them, and creative insight of invention. However, it is striking how often the scope of a theory of invention mainly falls within one of the two categories.

The results emanating from historical studies of individual inventors point to the importance of systematic searches for both problems and potential solutions in the invention process. Systematic searches of problems almost automatically lead to specialization in order to be efficient and thus individual or collective expertise. The problems may be acquired from journals or patent statistics while the solutions may come from scientific findings communicated through journals or a highly skilled staff assigned to keep track of scientific developments. In addition, Hughes has stressed the ability to reason metaphorically, that is, to understand the similarities that are necessary to take into account and the dissimilarities that can be ignored (Hughes 1985). This is similar to the idea of inventors having abilities for remote associations (Gordon 1972). A feature making the individual inventor more inclined to radical or independent inventions in comparison to larger organizations with a large number of employees which typically have routinized the innovation process is the lack of restricting hierarchies directing inventive thinking to certain well-known problems promising high profits for a patented solution (Baumol 2002).

Another idea that has been presented as a common feature among successful individual inventors is their exclusive combination of knowledge in one specific field that proves to hold some interesting clues to the solution of an important problem in another field. Many individual inventors testify of the efficiency of such an advantage. In the development of plastics, for example, the chemist Leo Baekeland had learned of the key problems, problem-solving methods, goals, theories, and tacit knowledge of a so-called technological frame, that is, a set of the issues and knowledge in common for a relevant social group and structuring the interactions between the individuals of that group (Bijker 1995). When he then equipped with one technological frame became a member of another relevant social group connected to another technological frame, it turned out that his experiences could be used in order to solve problems of the new technological frame using insights he had already acquired elsewhere. The same type of ideas has also been proposed to be valid on a cognitive level where the ability to invent to some extent also depends on genetic inheritance (Findlay and Lumsden 1988). More broadly, it is often also claimed that creativity materialized in inventions emerges when individuals in new ways combine their earlier insights and experiences from different frames, analogical transfer, regardless of if the combination appears within the mind of one individual or in the interaction between several individuals with different but complimentary experiences (Magee 2005). On a larger scale, the same ideas appear when inventive cultures or civilizations are discussed as above.

In addition to these ideas regarding individuals' abilities to invent, there are a vast number of psychological theories of how the mind can be set to generate new ideas. One pick of these ideas may include Edward de Bono's (1970) claim that creativity stems from the ability to recognize patterns and arguing for lateral thinking in order to boost creativity. Other usually includes the importance for the individual to depart from a challenge or a problem, to document the ideas that pop up, and to work on ideas that are within the realm of one's competence (e.g., Dasgupta 1994). Yet another set of theories come in the form of tool kits with specific strategies for the individual or the organization that wants to be inventive (Drucker 1985). These have in common the notion that generation of creative inventions can be systematized on an individual or organizational level.

In contrast to these ideas are listings of different individual motives to invent including recognition and financial gains (Westrum 1991). Most intriguing and elusive of these are the so-called intrinsic motives, that is, those where the drive to invent cannot be identified as coming from phenomena external to the individual. Such intrinsic motives have also been claimed to result in higher creativity in comparison to when incentives are external (Amabile 1997).

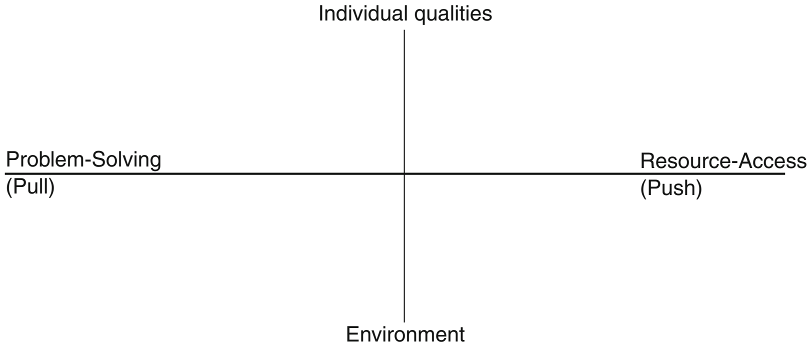
In conclusion, theories of creativity in invention tend to list qualities that promote creativity rather than qualities that restrict it irrespective of the object of the theory: cultures, institutional contexts, organizations, groups, or individuals. In addition, theories in this area are seldom explicit about what qualities are to be viewed as necessary or sufficient or both (or none) in order for the individual or the organization to actually be creative enough to produce inventions. In this simple sense, theories of creativity in invention tend to be constructive rather than restrictive. In addition, theories of individual and organizational creativity in invention tend to list correlations between specific internally chosen determinants rather than external conditions such as education and practical training or the access to resources. To sum up, theories within these fields seem to aim at supplying sets of qualities and routines for successful inventing and innovation management more than anything else.

Conclusions and Future Directions

Theories of creativity in invention are often classified according to how they explain the emergence of creativity leading to inventions. Traditionally, psychological capabilities in individuals underpinning creativity have often been pointed out. Theories have to a large degree also proposed that problem-solving activities under certain circumstances and in certain contexts generate creativity and (technical) inventions. Both individual and contextual perspectives can be connected to organizational and social conditions. The distinction between theories of processes going on inside the heads of individuals and processes generated by the interaction of individuals is not an absolute one. Theories also blend components from both categories. It is, however, striking how often the scope of theories of invention mainly falls within one of the two categories.

Another dividing principle that can be used in order to characterize theories of invention is whether invention is assumed to be mainly a process of problem-solving or if the focus is on access to resources. In the first case, systematic methods and analytical approaches are generally stressed while the other usually points out the importance of different resources such as technical equipment and knowledge of relevant natural phenomena. In this context, it is important to stress that the distinctions made here are theoretic, not empirical. This means that in each single case, an invention may be accounted for by stressing problem-solving activities as well as the resources at hand. In addition, the individual efforts involved may be studied in conjunction

Creativity in Invention, Theories,
Fig. 1 Dichotomized pairs of theoretical principles arranged to span a plane where theories of creativity in invention can be plotted (original graph made by author)



to the social environments in which they occur. Thus, irrespective of the data used, the perspectives outlined here can usually be found in the empirical material studied. There are no inventions without individual efforts or social environment. There are no inventions without resources or problems to be solved.

These different theoretical principles can be summed up in a graph (below) where the dichotomized pairs have been arranged along two different axes. The plane they span can then be used to classify existing theories of creativity in invention. Some theories highlight problems and individual qualities to explain the occurrence of creativity in invention, while others stress the environment (often, but not always its social character) and resources (material as well as human and others). Needless to say, there are also categories of theories stressing other combinations of the principles given here, or all of them (Jewkes et al. 1969). But there are yet no theories that include building blocks apart from individual or environmental qualities and activities characterized by the solving of problems or access to resources. A challenge for the future is of course to determine if it is possible to develop such theories and, if so, what alternative theoretical principles they could rely on? (Fig. 1).

It can be claimed that this analysis of theories of creativity in invention mirrors a historical development. Since it is often assumed that inventions tend to be more and more dependent on both systematically produced knowledge and different resources, material as well personal as for instance proposed by Gilfillan (1935), the graph presented in Fig. 1 below, a historical trend could presumably be represented by a line from the above left corner toward the lower right of the graph. Such a line would at least doubtlessly represent the development of theories of creativity in invention.

Cross-References

▶ Actor-Network-Theory and Creativity Research
▶ Adaptive Creativity and Innovative Creativity
▶ Analogies and Analogical Reasoning in Invention
▶ Art of Innovation: A Model for Organizational Creativity
▶ Brainstorming and Invention
▶ Cognition of Creativity
▶ Convergent Versus Divergent Thinking
▶ Corporate Creativity
▶ Creative Behavior
▶ Creative Brain
▶ Creative Destruction
▶ Creative Knowledge Environments
▶ Creative Leadership
▶ Creative Management
▶ Creative Mind: Myths and Facts
▶ Creative Personality
▶ Creative Problem Solving
▶ Creative Styles
▶ Creativity Across Cultures
▶ Creativity and Innovation: What Is the Difference
▶ Creativity and Systems Thinking

- ▶ Creativity Definitions, Approaches
- ▶ Creativity from Design and Innovation Perspectives
- ▶ Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon
- ▶ Creativity Machine® Paradigm
- ▶ Creativity Management
- ▶ Creativity Optimization
- ▶ Creativity Techniques
- ▶ Creativity, Experiential Theories
- ▶ Creativity, Intelligence, and Culture
- ▶ Divergent Thinking
- ▶ Divergent Versus Convergent Thinking
- ▶ Effects of Intuition, Positive Affect, and Training on Creative Problem Solving
- ▶ Entrepreneurship in Creative Economy
- ▶ Four Ps in Organizational Creativity
- ▶ Four Ps of Creativity
- ▶ Freedom and Constraints in Creativity
- ▶ Imagery and Creativity
- ▶ In Search of Cognitive Foundations of Creativity
- ▶ Innovative Milieu as a Driving Force of Innovative Entrepreneurship
- ▶ Innovative Milieux and Entrepreneurship (Volume Entrepreneurship)
- ▶ Innovator
- ▶ Interdisciplinarity and Innovation
- ▶ Invention and Innovation as Creative Problem-Solving Activities
- ▶ Invention Versus Discovery
- ▶ Inventive Problem Solving (TRIZ), Theory
- ▶ Inventive Resources
- ▶ Knowledge Society, Knowledge-Based Economy, and Innovation
- ▶ Levels of Invention
- ▶ Mental Models and Creative Invention
- ▶ Metaphorical Reasoning and Design Creativity: Consequences for Practice and Education
- ▶ Models for Creative Inventions
- ▶ Multiple Models of Creativity
- ▶ National Innovation Systems (NIS)
- ▶ Nature of Creativity
- ▶ Nonlinear Innovations
- ▶ Organizational Creativity
- ▶ Organizational Slack and Innovation
- ▶ Psychology of Creativity
- ▶ Radical Invention
- ▶ Research on Creativity
- ▶ Schumpeterian Entrepreneur
- ▶ Science of Creativity
- ▶ Scientific Creativity as Combinatorial Process
- ▶ Strategic Thinking and Creative Invention
- ▶ Teaching as Invention
- ▶ Technology Push and Market Pull Entrepreneurship
- ▶ Thinking Skills, Development

References

Abernathy WJ, Clark KB. Innovation: mapping the winds of creative destruction. Res Policy. 1985;14:3–22.

Amabile TM. Creativity in context: update to. In: Amabile TM, editor. The social psychology of creativity. Boulder: Westview Press; 1996.

Amabile TM. Motivating creativity in organizations: on doing what you love and loving what you do. California Manag Rev. 1997;40(Fall):39–58.

Baer J. Is creativity domain specific? In: Kaufman JC, Sternberg RJ, editors. The Cambridge handbook of creativity. Cambridge: Cambridge University Press; 2010. p. 321–41.

Baumol WJ. The free-market innovation machine: analyzing the growth miracle of capitalism. Princeton: Princeton University Press; 2002.

Bijker WE. Of bicycles, bakelites, and bulbs: toward a theory of sociotechnical change. Cambridge, MA: The MIT Press; 1995.

Boserup E. The conditions of agricultural growth: the economics of Agrarian change under population pressure. London: Allen & Unwin; 1965.

Brooks H. Technology, evolution and purpose. Daedalus. 1980;109(Winter):65–81.

Cavalli-Sforza LL. Genes, peoples, and languages. Berkeley: University of California Press; 2001.

Cowan R, Jonard N. The dynamics of collective invention. J Econ Behav Organ. 2003;52:513–32.

Csíkszentmihályi M. Creativity: flow and the psychology of discovery and invention. New York: Harper Collins; 1996.

Damanpour F. Organizational innovation: a meta-analysis of effects of determinants and moderators. Acad Manage J. 1991;34(September):555–90.

Dasgupta S. Creativity in invention and design: computational and cognitive explorations of technological originality. Cambridge: Cambridge University Press; 1994.

David PA. Path dependence: a foundational concept for historical social science. Cliometrica. 2007;1:91–114.

David PA. Path-dependence: putting the past into the future of economics. Institute for the Mathematical

Studies in the Social Sciences Technical Report 533. Stanford (CA): Stanford University; 1988.
de Bono E. Lateral thinking: creativity step by step. New York: Harper & Row; 1970.
Dosi G, Nelson RR. Technical change and industrial dynamics as evolutionary processes. In: Hall BH, Rosenberg N, editors. Economics of innovation, Handbooks in economics series, vol. 1. Amsterdam: North-Holland; 2010. p. 52–126.
Drucker PF. Innovation and entrepreneurship: practice and principles. New York: Harper & Row; 1985.
Findlay CS, Lumsden CJ. The creative mind: toward an evolutionary theory of discovery and innovation. J Soc Biol Syst. 1988;11:3–55.
Finke RA. Creative insight and preinventive forms. In: Sternberg RJ, Davidson JE, editors. The nature of insight. Cambridge, MA: The MIT Press; 1995. p. 255–80.
Friedel R. Perspiration in perspective: changing perceptions of genius and expertise in American invention. In: Weber RJ, Perkins DN, editors. Inventive minds: creativity in technology. Oxford: Oxford University Press; 1992. p. 11–26.
Funke J. On the psychology of creativity. In: Meusburger P, Funke J, Wunder E, editors. Milieus of creativity an interdisciplinary approach to spatiality of creativity, Knowledge and Space, vol. 2. Heidelberg: Springer Science + Business Media; 2009. p. 11–23.
Garcia R, Calantone R. A critical look at technological innovation typology and innovativeness terminology: a literature review. J Prod Innovat Manag. 2002;19:110–32.
Gilfillan SC. The sociology of invention. Chicago: Follett; 1935.
Godin B. The linear model of innovation: the historical construct of an analytical framework. Sci Technol Hum Val. 2006;31:639–67.
Godin B. National innovation system: the system approach in historical perspective. Sci Technol Hum Val. 2009;34:476–501.
Gordon G. The identification and use of creative abilities in scientific organizations. In: Taylor CW, editor. Climate for creativity, Pergamon general psychology series, vol. 9. New York: Pergamon; 1972. p. 113.
Gruber HE, Davis SN. Inching our way up Mount Olympus: the evolving-systems approach to creative thinking. In: Sternberg RJ, editor. The nature of creativity: contemporary psychological perspectives. Cambridge: Cambridge University Press; 1988. p. 243–70.
Hatfield HS. The inventor and his world. New York: Dutton; 1933.
Hecht G. The radiance of france: nuclear power and national identity after World War II. Cambridge, MA: The MIT Press; 1998.
Heinze T, et al. Organizational and institutional influences on creativity in scientific research. Res Policy. 2009;38:610–23.
Hirschman AO. The strategy of economic development, Yale studies in economics, vol. 10. New Haven: Yale University Press; 1958.
Hughes TP. How did the heroic inventors do it? Am Herit Invent Technol. 1985;1(2):18–25.
Hughes TP. The dynamics of technological change: salients, critical problems, and industrial revolutions. In: Dosi G, Gianetti R, Toninelli PA, editors. Technology and enterprise in a historical perspective. Oxford: Clarendon; 1992. p. 97–118.
Isaksen SG. Exploring the relationships between problem-solving styles and creative psychological climate. In: Meusburger P, Funke J, Wunder E, editors. Milieus of creativity an interdisciplinary approach to spatiality of creativity, Knowledge and space, vol. 2. Heidelberg: Springer Science + Business Media; 2009. p. 169–88.
Jewkes J, Sawers D, Stillerman B. The sources of invention: a study of the causes and consequences of industrial innovation through the inventions of the nineteenth and twentieth centuries. 2nd ed. London: Macmillan; 1969.
Kozbelt A, Beghetto RA, Runco MA. Theories of creativity. In: Kaufman JC, Sternberg RJ, editors. The Cambridge handbook of creativity. Cambridge: Cambridge University Press; 2010. p. 20–47.
Latour B. Science in action: how to follow scientists and engineers through society. Cambridge, MA: Harvard University Press; 1987.
Lindgren H. Economic dynamism, Stockholm Business School, Institutet för ekonomiskhistorisk forskning, Research Report No 6. Stockholm: Stockholm Business School; 1996.
Lubart TI. Models of the creative process: past, present and future. Creative Res J. 2000–2001;13(3–4):295–308.
Magee GB. Rethinking invention: cognition and the economics of technological creativity. J Econ Behav Organ. 2005;57(1):29–48.
McGee D. Making up mind: the early sociology of invention. Technol Cult. 1995;36(4):773–801.
McNeill WH. The rise of the West: a history of the human community. Chicago: University of Chicago Press; 1963.
Nelson RR. Recent evolutionary theorizing about economic change. J Econ Liter. 1995;33(March): 48–90.
Pacey A. Technology in world civilization: a thousand-year history. Oxford: Basil Blackwell; 1990.
Perkins DN. The possibility of invention. In: Sternberg RJ, editor. The nature of creativity: contemporary psychological perspectives. Cambridge: Cambridge University Press; 1988. p. 362–85.
Pope R. Creativity: theory, history, practice. London: Routledge; 2005.
Romer PM. Endogenous technological change. J Polit Econ. 1990;98(5):S71–102.
Rosenberg N. Science, invention and economic growth. Econ J. 1974;84(March):90–108.
Rosenberg N. Marx as a student of technology. In: Rosenberg N, editor. Inside the black box: technology and economics. Cambridge: Cambridge University Press; 1982. p. 34–51.

Schmookler J. Invention and economic growth. Cambridge, MA: Harvard University Press; 1966.
Schumpeter J. Capitalism, socialism and democracy. New York: Harper & Brothers; 1942.
Shavinina LV, Seeratan KL. On the nature of individual innovation. In: Shavinina LV, editor. The international handbook on innovation. Amsterdam: Pergamon; 2003. p. 31–43.
Tatarkiewicz W. A history of six ideas: an essay in aesthetics, Melbourne international philosophy series, vol. 5. The Hague: Martinus Nijhoff; 1980.
Taylor CW. Various approaches to and definitions of creativity. In: Sternberg RJ, editor. The nature of creativity: contemporary psychological perspectives. Cambridge: Cambridge University Press; 1988. p. 99–121.
Tidd J, Bessant J, Pavitt K. Managing innovation: integrating technological, market and organizational change. 2nd ed. New York: Wiley; 2001.
Usher AP. A history of mechanical inventions. New York: McGraw-Hill; 1929.
Utterback JM, Abernathy WJ. A dynamic model of product and process innovation. Omega. 1975;3:639–56.
Vandervert LR. The neurophysiological basis of innovation. In: Shavinina LV, editor. The international handbook on innovation. Amsterdam: Pergamon; 2003. p. 17–30.
Westrum R. Motives for inventing. Polhem. 1991;9:2–26.

Creativity in Music Teaching and Learning

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Synonyms

Composition; Creative thinking in music; Group musical creativity; Improvisation; Individual musical creativity; Listening creativity; Performance creativity

Definition

Creativity in music refers to the divergent and convergent thought processes, enacted both in solo and in ensemble, that lead to musical products that are both novel and useful, within specific sociocultural contexts, manifested by way of specific modes of musicianship or combinations of modes that can include but are not limited to the following: improvisation, composition, performance, analysis, and listening.

Theoretical Background

Creativity in music teaching and learning is perhaps the most important area of study for both researchers and practitioners alike in the field of music education at the start of this new millennium. These sentiments can be felt in the area of the general study of creativity as well (Sawyer 2006/2012). Creative thinking in music is at the heart of creativity in music education, as all of the many ways that humans can be creative with music start and end with creative thinking. Researchers have explored this very complex construct in the field of music and music education research over the past 40 years. There are patterns in the foci of such research efforts over that time period that are important to note as this topic will likely continue to be studied in the coming decades. Adding to the complexity of creativity in this domain is the surge of new technologies that are sure to transform both research and practice as they relate to the multiple ways that creativity is manifest in music teaching and learning.

Creative Thinking in Music

Historically, music teachers have considered the word “creativity” to relate to a constellation of abilities of students to produce products related to composition or, in more limited ways, improvisation. Some of the earliest research on creativeness can be traced back to observational research by Pond in 1940s (1981) that noted the ability of children to improvise and to early work by Paynter and Aston (1970) and Schafer (1979) that featured ideas about music composition in the schools. The study of children’s creative ability with composition and improvisation continues today (Kaschub and Smith 2009) and remains a major part of the National Standards for Arts Education (2004) movement in the United States.

Newer conceptions of creativity in music teaching and learning are emerging, inspired in part by a belief that creative thinking in music occurs in many ways in music, not just in composition and improvisation (Reimer 2003; Webster, in press). One way to think about learning activities in music that involve creative thinking as defined above is to consider two broad dimensions. There are creating learning activity types that (1) deal directly with the making of music itself. There are four subgroupings: (a) playing the composed music of others (performing), (b) improvising (either using a style or in free form), (c) composing original music and/or arranging music, and (d) music listening. Each of these four involve an active role in the creation of music as art and involve creative thinking in complex ways that extend traditional views of creativity in relation to just composition and improvisation as defined historically. To this we add a large second dimension: (2) the study of music as art in terms of nonmusical dimensions. This dimension is rarely considered to involve creative thinking, yet there are rich possibilities for researchers and practitioners in considering this dimension in coming years. There are three parts to this: (a) music's technical construction (music theory, aural skills, physical representation in the air) (b) music's relation to other art forms, (c) music's relation to the context in which it is created.

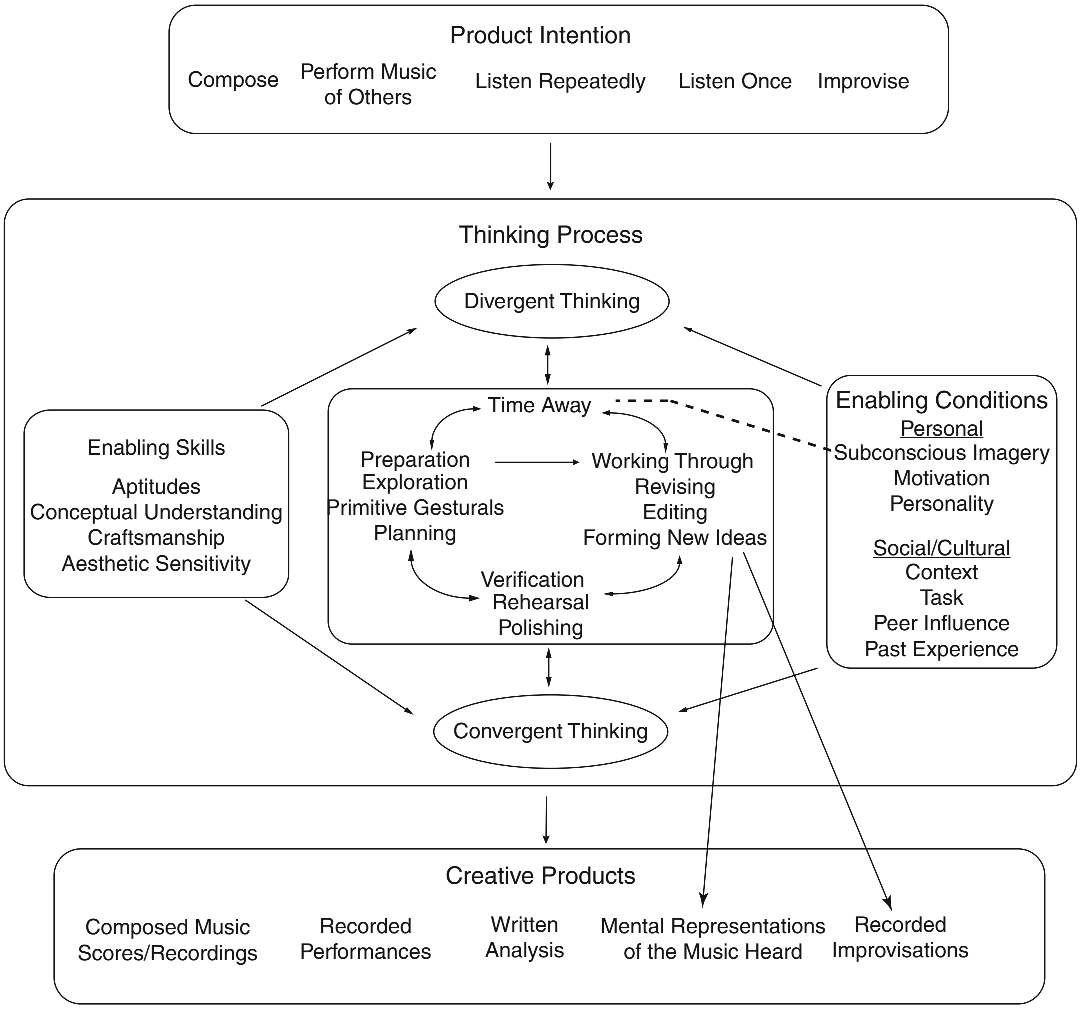
As a conceptual frame for this broader view of creativity, consider the model by Webster (2004) in Fig. 1. This descriptive model is based on a view that "creativity" in music education is best approached by considering the notion of *creative thinking in music*. This model begins with product intentions and ends with a demonstrated product. It has music listening, composition, and improvisation as important parts of the model and accounts for the role of social context.

Finally, an emphasis on the role of collaboration in creativity has emerged in recent years in the general literature on explaining creativity (Sawyer 2012). Individualist theories of creativity that have dominated the popular thinking about creativeness are now tempered with careful consideration for the role of society in framing creative output. This effects how music teachers might address the teaching of creative thinking in classrooms, rehearsal halls, and studios. Such an emphasis works well with constructivist views of music learning (Webster 2011) – an approach that has not been prevalent in music teaching behaviors to date but is growing in interest among younger practitioners. An important part of this developing pedagogy is the use of technology in the music-making enterprise in schools as noted in the *Encyclopedia of the Sciences of Learning* elsewhere online (Webster 2012).

Modes of Musicianship

Theorists in music education have explored the notion that musicality is manifested in multiple ways. Just as there are numerous ways to be intelligent (Gardner 1983/1993/2011), there are numerous ways to be musical. Reimer, based on the work of Gardner, named the different divisions of musicality, "musical intelligences" (2003, p. 219). By aligning his theory closely to Gardner's, Reimer called for a balanced music education curriculum, one that provided students' opportunities to be musical in all of the musical intelligence areas. To not offer adequate instruction in any of the "musical intelligences" would be to under-serve some members of society who might thrive if given the opportunity to exercise their specific musical intelligence strength. These divisions might also be named, "modes of musicianship." This designation places musicianship as the beginning, middle, and end of the matter, something that can be grouped, regrouped, and transformed to account for any "mode" or "modes" that exist or might exist in the future.

Just as there are numerous ways to be musical, there must therefore be numerous ways to be musically creative. Since being creative with music begins at the level of creative thinking, any individual could be musically creative by way of any of the modes of musicianship previously mentioned. Listening, performing, singing, analyzing, improvising, composing, arranging, and describing are all modes of musicianship.



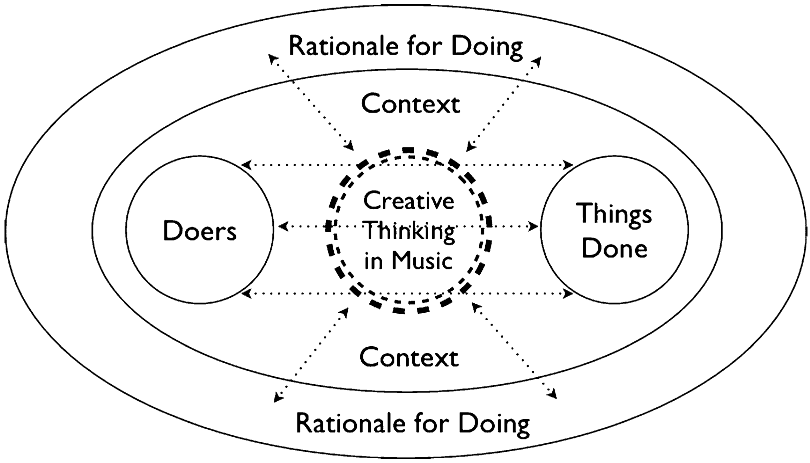
Webster, P.(2002). Creative thinking in music: Advancing a model.
In T. Sullivan, & L.Willingham, (Eds.), Creativity and music education (pp. 16–33).
Edmonton, AB: Canadian Music Educators' Association. (revised 2004)

Creativity in Music Teaching and Learning, Fig. 1 Conceptual model of creative thinking in music

Each mode of musicianship involves doers (people who would like to be musical – the person), some sort of doing (the act of being musical – the process), something done (the result of the musical exchange – the product), and the context in which all of this takes place (some authors call this "press" to keep with the "p" theme). One might think of all of these previously mentioned components of music making as being mediated by the rationale for doing – a philosophy of sorts – that both feeds the desire to make music and is fed by that same desire (see Fig. 2). One's philosophy of music is wrapped up in inter-sonic (musical) as well as delineated (nonmusical) meanings. And, of course, philosophies of music naturally lead to philosophies of music education.

Burnard suggests that the music education profession conceive of musical creativity differently, not as the lone composer, working on creating a masterwork in isolation, as many of the myths surrounding creativity would assume.

Creativity in Music Teaching and Learning, Fig. 2 Conceptual model of creative music making



Rather, she suggests that there are multiple creativities in music that must exist in real-world contexts, in specific practices. The particular creativities that she proposes are: (1) individual creativity, (2) collaborative (or group) creativity, (3) communal creativity, (4) empathic creativity, (5) intercultural creativity, (6) performance creativity in music, (7) symbolic creativity in music, (8) computational creativity, and (9) collective creativity (p. 15–16). She has written a book, titled, *Musical Creativities in Real World Practice*, that details what she means by each of these musical creativities as they exist in the "real world" (2012b).

So, be it different modes of musicianship, or the notion of multiple creativities in music, the domain of music education seems to acknowledge that there must be multiple ways of operationalizing the act of music making, and therefore, there must be multiple ways of being musically creative.

Past, Present, and Future: Research on Creativity in Music Teaching and Learning

Multiple lenses have been employed by researchers in psychology to try to understand the complex construct of creativity. Guilford's Structure of Intellect Model seemed to open the door for researchers to study creativity as a multidimensional construct. In order to better understand this topic, researchers have used multiple methodological lenses to go about their business. In recent years, some methodologies have been used more than others. In order to better understand this topic, researchers have contributed to three primary areas of understanding; these areas are, according to Webster, theoretical, practical application, and empirical (2009). It is possible to think of these three areas as being articulated by way of specific methodologies: psychometric, experimental, biographical, psychodynamic, biological, computational, and contextual. A brief review of the major accomplishments of researchers in music and music education in some of these areas is helpful. The specific areas of psychometric, experimental, biographical, and contextual are detailed here.

Psychometric

Humankind has been exploring the assessment of individual differences from as early as 2200 B.C. (China). This long history must reflect a basic human desire to sort people by differences. Researchers in general psychology in the twentieth century helped to lay the groundwork for all of the research that would follow in music education, by assessing various creative "traits" and personality characteristics of creative individuals. The push, of course, following Guilford's 1950 address to the American Psychological Association (APA), was to identify gifted and talented students so that they could be channeled into careers in math and science, as a way of keeping the United States even with the Soviets in the space race. The major accomplishment of this early psychometric work, however, was the exploration of the notion that there are individual differences, traits, or personality qualities, among all who would desire to be creative. These personal differences were considered independent of context and culture, and were realized to be unique to all individuals. This strand of thought is the "nature" side of the "nature versus nurture" dichotomy. Both contribute to one's potential to be a successful human.

Torrance explored this idea with his *Tests of Creative Thinking* (1974), a measure of general creativity, specifically divergent thinking. Tests takers took both a verbal and figural portion of the test, and were measured on their ability to generate responses to open-ended tasks that demonstrated fluency, flexibility, and originality. The Torrance tests are still widely used today, although some question the construct validity of such assessments. If one takes the position that it is possible to discover benefits to using each of the lenses available to the researcher, then there are potential utilities for such tests as tools for identifying differences in individuals with regard to creativity for the purpose of research.

Personality tests are another manifestation of the psychometric movement to better understand the creative person. These tests have been devised to measure both personality traits and personality types or "temperaments." Traits can be viewed as the "smallest units of individual variation that are consistent, reliable, and valid" (Sawyer 2012, p. 63). Certain personality traits are more or less associated with creative individuals.

Donald MacKinnon founded the Institute for Personality Assessment and Research (IPAR) at the University of California at Berkeley in 1949. MacKinnon (1978) reported that researchers at Berkeley found that various personality traits were common to most highly creative individuals. These traits included the following:

- Above-average intelligence
- Discernment, observance, and alertness
- Openness to experience
- Balanced personalities
- A relative absence of repression and suppression mechanisms that control impulse and imagery
- Pleasant and materially comfortable childhoods, although they recall their childhoods as being not particularly happy
- A preference for complexity

From the beginning, researchers have observed that tests of this nature cannot account for all that influences personality or creativity. MacKinnon writes that creativity must be a "multifaceted phenomenon" (1978, p. 46). There is not a test, neither the ones that MacKinnon and his colleagues at IPAR developed, nor any of the other tests mentioned in this text, that get it "all right," that fully describe all that makes a person creative. The construct is simply too complex to be examined via one particular lens.

Personality types or temperaments, somewhat different constructs than personality traits, are proposed to be a finite number of possible categories that can be used to sort people. The idea of temperaments can be traced back to Hippocrates as early as 370 B.C., and most notably to the work of Carl Jung and his development of archetypes. Jung coined the term "function types" and "psychological types" to describe his idea regarding fundamental differences in people. The two most widely used personality type indicators are the *Myers-Briggs Type Indicator* and the *Revised NEO Personality Inventory* (NEO-PI-R). The *Myers-Briggs Type Indicator* consists of items that have test takers choose from four pairs of alternatives, including: (1) E-Extroverted or I-Introverted, (2) S-Sensory or N-Intuitive, (3) T-Thinking or F-Feeling, and (4) J-Judging or P-Perceiving. In the end, every test taker has a combination of four letters that represent their "personality type" according to the measure. There are a total of 16 different combinations of the letters that comprise the various "personality types." The *Revised NEO Personality Inventory* measured qualities of neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. Scores on the NEO-PI-R were shown to remain constant over a period of 6 years. Developers of the NEO-PI-R believe that it is the only measure of its kind to address all five of the factors identified as contributing to personality.

Vaughan (1977) can be attributed to taking the first step toward developing a musical measure of creative thinking. Vaughan, during the time period of 1969 – 1976, asked children to improvise the following: rhythm patterns in response to both a stimulus and an ostinato, melody patterns in a similar manner, and a musical selection based on how the subject might feel during a thunderstorm. Criterion measures were (1) fluency, (2) rhythmic security, (3) ideation, (4) synthesis, and (5) total. Scoring was based largely on the Torrance tests, which is a strategy that both Gorder (1976) and Webster (1977; 1994) would also utilize in the development of their measures.

Gorder in his *Measure of Musical Divergent Production* (MMDP) (1976; 1980) asked subjects, junior and high school band students, to improvise in four tasks either using their primary instruments, their voice, or by whistling. They were given skeletal versions of melodies to improvise around. Their improvisations were evaluated by using a music content checklist that included identifying qualities of melody, rhythm, tempo, style, dynamics, timbre, expressive devices, and form. Then, the four tasks were scored based on fluency, flexibility, elaboration, originality, and quality. Gorder interpreted the areas of divergent thinking in student improvised phrases as follows: (1) fluency – number of phrases produced, (2) flexibility – the number of shifts of content character employed, (3) elaboration – the extent of the use of content character over that which was necessary to produce a varied phrase, (4) originality – the use of rarely used content items as determined by frequency count, (5) and musical quality (Gorder 1980, p. 36).

Wang's *Measure of Creativity in Sound and Music* has been used by researchers in the tradition of using measures of divergent thinking in music to assess musical creativity. Four musical tasks provided researchers with data regarding musical fluency and musical imagination. Accept for the work of Baltzer, the measure has received little attention in the decades since being developed.

Webster's *Measure of Creative Thinking in Music II* (MCTM-II) marks the most significant attempt to measure divergent thinking in music (1994). Similar to Gorder (1976; 1980), Webster's measure was built, in part, on the work of Guilford, Torrance (1974), Vaughan (1977), and on his dissertation (Webster 1977). The measure was developed for use with children ages 6–10, and includes tasks that involve three sets of instruments, a round ball, approximately 4″ in diameter, that is used for playing tone clusters on a piano, a microphone that is attached to an amplifier and speaker, and a set of five wooden resonator blocks. After a period of warm-up, participants are asked to complete 10 tasks that represent three divisions: (1) exploration, (2) application, and (3) synthesis. All tasks take approximately 25 min to complete, and are scored at a later time on four individual factors: (1) musical extensiveness, (2) musical flexibility, (3) musical originality, and (4) musical syntax. Exploration tasks include the musical parameters of high and low, loud and soft, and fast and slow, and involve images of rain in a water bucket, magical elevators, and the sounds of trucks. These parameters are then employed in the application section, where students engage with the tester in a musical dialogue through the use of each instrument individually. They make "frog" music with the ball on the piano and make the sounds of a robot singing in the shower. In the synthesis section, students are asked to engage all of the instruments in more open-ended tasks that include creating a space story told in sounds and creating a composition that has a beginning, a middle, and an end.

Psychometric studies of creativity in music education seem to have declined in the decades following the development of these measures. This trend seems to have coincided with a shift in the general focus of research in musical creativity from individual perspectives to more sociocultural perspectives. In the decades following this publication, the profession might benefit from a more balanced approach to the study of musical creativity in music and music education that accounts for both individual and sociocultural perspectives.

Experimental

While it is known that musical creativity can be manifest by way of multiple modes of musicianship, compositional and improvisational creativity have received the most attention. These experimental studies in music and music education can be categorized into research on processes and products. Webster's dissertation (1977) was a seminal start to the movement of examining musical creativity empirically in music education. His work led other researchers in music education to take up the cause. The work of Swanwick and Tillman (1986) and Kratus marked the continuation of a period of about 15 years, where the study of children's compositional processes and products seemed to intensify (Hickey 2001; Kratus 1989).

Future work in this area might explore younger ages as they interact with improvisation, and older ages as they interact with both composition and improvisation. Furthermore, the strategies for measuring the various components of compositional processes and products (Kratus 1989; Hickey 2001) might be explored with all of the other various modes of musicianship. For example, music listening on a mobile listening device might be measured over a period of 10 min, as Kratus did in his 1989 study, to explore how students interact creatively with their music. Practicing musicians might be examined over a period of time to determine qualities of their divergent and convergent thinking processes. Musical products might be assessed by way of Amabile's Consensual Assessment Technique (1996), as Hickey (2001) did in her work. The future is promising for work that addresses other modes of musicianship from the perspective of musical creativity as it has been defined in the previous literature in music education.

Biographical

Pam Burnard's latest book, *Musical Creativities in Practice*, includes short biographies of 19 musicians whose creative work exemplifies Burnard's notion of how musical creativities are expressed in the everyday modern world. This work is sure to become important to the music education profession in the next few decades of the twenty-first century.

Contextual

Since this research paradigm started to gain momentum in the 1980s and 1990s, some researchers have chosen to focus more on the study of creativity in real-world educational contexts (Barrett 2006; Burnard 2000, 2002) and specifically on the sociology of musical creativity. This movement seems to have coincided with Csikszentmihalyi's detailing of his *Systems Perspective for the Study of Creativity*, where creativity he says should not be viewed "exclusively as a mental process," but rather as an interplay of psychological and sociological factors (1999, p. 313). Csikszentmihalyi asserts that the momentum for a shift in the research paradigm to include sociological components has been building in the past few decades. There seems to be a growing concern for examining the cultures, including parents, peer groups, and teachers, the individuals that surround students and facilitate their creative work (Wiggins 2011). Ruthmann (2008) discovered through qualitative case study evidence for the existence of a complex interplay among teacher feedback, learner agency, and students' compositional intent, and suggested that teachers take these factors into account when they design opportunities for students to compose. In a related study, Randles (2009a) discovered some evidence to suggest that teachers who compose or arrange music for their ensembles may foster creative cultures where students desire to pursue composition and arranging themselves. In another study, where the creative cultures of participants of an Honors Composition Competition in Michigan, United States, were examined, Randles (2009b) found that teachers played the largest role in students' development of a creative identity, more than parents or peer groups.

At the same time that Ruthmann and Randles were doing their work in the United States, researchers in England and Spain were examining teachers' perceptions of creativity as a way of understanding how to foster creativity in their countries' national curricula (Odena and

Welch 2007; Odena et al. 2005). The results of this work suggest that teachers must have experiences composing and improvising, and engaging with multiple musical genres, if they are to be successful teaching musical creativity in their jobs as future music teachers.

Although much of the work related to the sociocultural side of musical creativity in music education has primarily been qualitative, Randles, in conjunction with Smith and Muhonen has employed various quantitative techniques to compare what he calls creative identity among preservice music teachers in the United States and England (Randles and Smith, in press) and the United States and Finland (Randles and Muhonen, in press). He discovered that future music teachers in England report being able to compose their own original music to a greater extent than their counterparts in the United States, and report significantly higher perceptions of their ability to teach music composition in the schools than future music teachers in the United States (in press). Randles cites primary and secondary socialization as a possible cause for the differences. In another study, Randles used exploratory factor analysis to uncover four latent variables that contribute to what he called "creative identity" (in press). The factors were (1) creative music self-efficacy, (2) value of creative music making in the context of the school curriculum, (3) willingness to allow time for creativity in the curriculum, and (4) value of popular music performing and listening in the school curriculum. He found significant differences favoring the Finnish future music teachers with all factors except Factor 3 (willingness to allow time for creativity in the curriculum). These results suggest that teachers in the United States were willing to include activities that included improvisation and composition, if they were allowed to develop these skills in their socialization as a music teacher, in their experiences in the school music system, as well as in their experiences in music teacher preparation. These findings are supported by the work of Odena and Welch (2007). This branch of the literature is still emerging. Future work in this area is certainly warranted.

Conclusions and Future Directions

Conceptions of creativity in music teaching and learning are changing as music, social contexts, and the students themselves change. Teacher education programs are changing, albeit very slowly, to embrace experiences that better prepare young professionals to teach a wider varieties of music and to do so in ways that engage a more comprehensive set of musical activities. We predict that the older notions of a "general music" teacher that only engages primary school children in singing and movement activities will give way to more specialized music experiences that will engage children at greater depth with performance, composition, improvisation, and music listening using a wider range of traditional and nontraditional musical instruments and with a wider variety of musics. We also predict that the older models of "band," "choral" or "orchestra teacher" will give way in secondary schools to a much richer selection of ensembles drawn from all sorts of musical cultures. What is certainly going to change is that music teachers will be held accountable for a wider music audience at the secondary level and that students will be expected to be far more creative in their exploration of music as an art form that holds deep personal meaning. Our understanding of creativeness will certainly evolve through research and practice and our overall understanding of creative music education will improve as we take advantage of new technologies and new paradigms for learning.

Cross-References

▶ Cognition of Creativity
▶ Convergent Versus Divergent Thinking
▶ Creative Behavior
▶ Creative Mind: Myths and Facts
▶ Creative Personality
▶ Creativity Tests
▶ Creativity, Intelligence, and Culture
▶ Divergent Thinking
▶ Divergent Versus Convergent Thinking
▶ Four Ps of Creativity

- In Search of Cognitive Foundations of Creativity
- Models for Creative Inventions
- Psychology of Creativity
- Research on Creativity
- Social Psychology of Creativity

References

Amabile T. Creativity in context: update to the social psychology of creativity. Boulder: Westview Press; 1996.

Barrett M. 'Creative Collaboration': an 'Eminence' study of teaching and learning in music composition. Psychol Music. 2006;34(2):195–218.

Burnard P. Examining experiential differences between improvisation and composition in children's meaning-making. Br J Music Educ. 2000;17(3):227–45.

Burnard P. Investigating children's meaning making and the emergence of musical interaction in group improvisation. Br J Music Educ. 2002;19(2):157–72.

Burnard P. Musical creativities in real world practice. New York: Oxford University Press; 2012.

Csikszentmihalyi M. Implications of a systems perspective for the study of creativity. In: Sternberg RJ, editor. Handbook of creativity. New York: Cambridge University Press; 1999. p. 313–35.

Gardner H. Frames of mind: the theory of multiple intelligences. New York: Basic Books; 1983/1993/2011.

Gorder W. An investigation of divergent production abilities as constructs of musical creativity [Unpublished doctoral dissertation]. University of Illinois; 1976.

Gorder W. Divergent production abilities as constructs of musical creativity. J Res Music Educ. 1980;28(1):34– 42.

Hickey M. An application of Amabile's consensual assessment technique for rating the creativity of children's musical compositions. J Res Music Educ. 2001;49(3):234–44.

Kaschub M, Smith J. Minds on music; composition for creative and critical thinking. Lanham: Roman and Littlefield; 2009.

Kratus J. A time analysis of the compositional processes used by children ages 7 to 11. J Res Music Educ. 1989;37(1):5–20.

MacKinnon D. What makes a person creative? In: MacKinnon DW, editor. In search of human effectiveness. New York: Universe Books; 1978. p. 178–86.

National Standards for Arts Education. Reston, VA: Music Educators National Conference; 1994.

Odena O, Welch G. The influence of teachers' backgrounds on their perceptions of musical creativity: a qualitative study with secondary school music teachers. Res Stud Music Educ. 2007;28(1):71–81.

Odena O, Plummeridge C, Welch G. Towards an understanding of creativity in music education: a qualitative investigation of data from English secondary schools. Bull Counc Res Music Educ. 2005;163:9–18.

Paynter J, Aston P. Sound and silence: classroom projects in creative music. London: Cambridge University Press; 1970.

Pond D. A composer's study of young children's innate musicality. Counc Res Music Educ Bull. 1981;68:1–12.

Randles C. Student composers' expressed meaning of composition with regard to culture. Music Educ Res Int. 2009a;3:42–53.

Randles C. That's my piece, that's my signature, and it means more: creative identity and the ensemble teacher/arranger. Res Stud Music Educ. 2009b; 31(1):52–68.

Randles C, Muhonen S. Validation and further validation of a measure of creative identity among United States and Finland pre-service music teachers. Br J Music Educ. (in press).

Randles C, Smith GD. A first comparison of pre-service music teachers' identities as creative musicians in the United States and England. Res Stud Music Educ. (in press).

Reimer B. A philosophy of music education: advancing the vision. 3rd ed. Upper Saddle River: Prentice Hall; 2003.

Ruthmann SA. Whose agency matters? Negotiating pedagogical and creative intent during composing experiences. Res Stud Music Educ. 2008;30(1):43–58.

Sawyer K. Explaining creativity: the science of human innovation. New York: Oxford University Press; 2006/2012.

Schafer R. Creative music education. New York: Schirmer; 1979.

Swanwick K, Tillman J. The sequence of musical development: a study of children's composition. Br J Music Educ. 1986;3(3):305–40.

Torrance EP. Torrance tests of creative thinking: norms-technical manual. Princeton: Personnel Press/Ginn; 1974.

Webster P. A factor of intellect approach to creative thinking in music [Unpublished doctoral dissertation]. Rochester, NY: Eastman School of Music, University of Rochester; 1977.

Webster P. Measure of creative thinking in music-II: administrative guidelines [Unpublished manuscript]. Evanston, IL: Northwestern University; 1994.

Webster P. Creative thinking in music: advancing a model. In: Sullivan T, Willingham L, editors. Creativity and music education. Edmonton: Canadian Music Educators' Association; 2002. p. 16–33.

Webster P. Children as creative thinkers in music: focus on composition. In: Hallam L, Cross I, Thaut M, editors. The Oxford handbook of music psychology. New York: Oxford University Press; 2009. p. 421–8.

Webster P. Constructivism and music learning. In: Colwell R, Webster P, editors. MENC handbook of research on music learning, vol. 1. New York: Oxford University Press; 2011. p. 35–83.

Webster P. Technology in music instruction and learning. In: Seel NM. editor. Encyclopedia of the sciences of learning. 2012. Retrieved from http://www.springerlink.com/content/j6qk79t23373w541/fulltext.html

Webster P. Music composition intelligence and creative thinking in music. In: Kaschub M, Smith J, editors. Composing our future: preparing music educators to teach composition. New York: Oxford University Press (in press).

Wiggins J. When the music is theirs: scaffolding young songwriters. In: Barrett M, editor. A cultural psychology for music education. New York: Oxford University Press; 2011. p. 83–113.

Creativity in Neuroscience, Studies

► Creative Brain

Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon

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Synonyms

Design; Expert; Façade design; Frame of reference; Musical composition; Mutilated checkerboard puzzle; Nine-dot puzzle; Novel; Novice; Periodic table of elements; Puzzle; Scientific invention; Sudden mental insights; Valuable; Writing

Introduction

There are many definitions of creativity. Here, one based on commonly held beliefs about creativity and observations from studies designed to unravel its secrets will be used (Akin and Akin 1996): creativity is the act of producing *novel* and *valuable* things. A creative product is different from existing ones on account of one or more *features* and adds exceptional *value* to human purposes. Creativity is readily associated with art. Caravaggio's realism, Van Gogh's impressionism, and Vermeer's depiction of light are just a few examples. In the annals of human civilization, some of the most valued human products include not only artistic but also scientific ones. Hence, developing a unifying theory of the creative process is illusive. This essay will identify a common denominator based on human cognition and its pre- and post conditions that appear to be responsible for the creative act in three domains: puzzles, scientific discoveries, and design.

Understanding Creativity in Puzzles, Scientific Discovery, and Design

Early work on creativity focused on general behavioral tendencies of individuals (MacKinnon 1967). While these point to probable correlations between personality traits and creative people, they offer little about how creativity actually works. What cognitive capabilities underlie the behavior that is commonly known as creativity? How can one measure or predict this behavior?

However limited, research on *expertise* in a number of domains, including chess, music, painting, and poetry, addresses some of these questions. Hayes' work on musical composition (Hayes 1989), linking cognition to expertise and creativity, highlights the importance of cognitive "chunks." He confirms that the *Time at Task* hypothesis that sets the minimum amount of time at one's task of mastery to 10 years holds even for musical prodigies like Mozart and Beethoven and 40 other grand masters of Western classical music. Studies in the areas of painting, poetry, and architecture have also shown how indispensable cognitive chunks are for task mastery.

Some of the most memorable accounts of creativity include statements directly from universally accepted creative individuals, like Tchaikovsky:

> Generally speaking the germ of a future composition comes suddenly and unexpectedly. If the soil is ready – that is to say, if the disposition for work is there – it takes root with extraordinary force and rapidity, and

> shoots up through the earth, puts forth branches, leaves and, finally, blossoms

Tchaikovsky reveals something about that which arrives in the mind and how it reaches fruition. He implies that what arises so suddenly does so due to substantial cognitive preparation that anticipates and evokes the idea in the first place. There is no doubt that the soil upon which Tchaikovsky's sudden realization of a creative idea has blossomed has been properly and painstakingly cultivated. This phenomenon observed in many cognitive task domains is commonly known as the *Aha! response*, *eureka moment*, or *sudden mental insight* (SMI). Puzzles are one of the most elementary forms of complex cognitive activity exhibiting the SMI response.

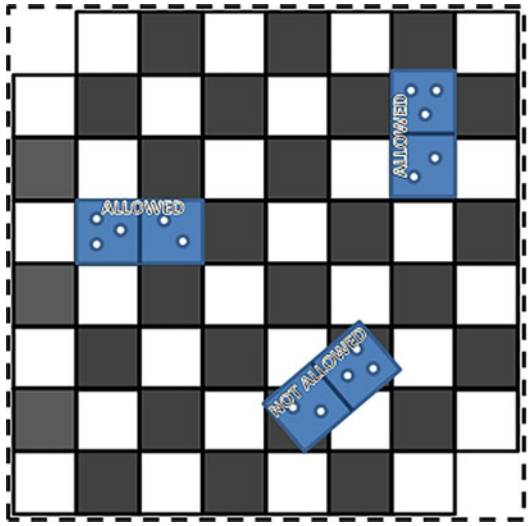
The Creative Nature of the Mutilated Checkerboard Puzzle

The Mutilated Checkerboard Puzzle (MCP) employs a standard 8 × 8 checkerboard (Fig. 1), two of whose diagonally opposite corners have been removed (Kaplan and Simon 1990).

> Imagine placing dominos on the board so that one domino covers two horizontally or vertically (but not diagonally) adjacent squares. The problem is either to show how 31 dominos would cover the 62 remaining squares, or to prove logically that a complete covering is impossible

The MCP is difficult to solve and the solution usually involves the sudden onset of the idea about the proof upon realizing the *Parity Principle*. This principle states that each domino piece needs to cover a pair of black and white squares regardless of where it is placed while the mutilated board has an *un*equal number of black (32) and white (30) squares.

Kaplan and Simon (1990) systematically delineate and classify the *clues* found in the problem context or in the subjects' long-term memory, as well as the *hints* provided by the experimenters, which help induce the recognition of the Parity Principle. They go on to describe the cognitive components needed to develop the solution proof for the puzzle: (1) the sudden onset of the Parity Principle; (2) the three sources of information: puzzle features, relevant knowledge, and hints about the colors of missing squares; (3) the



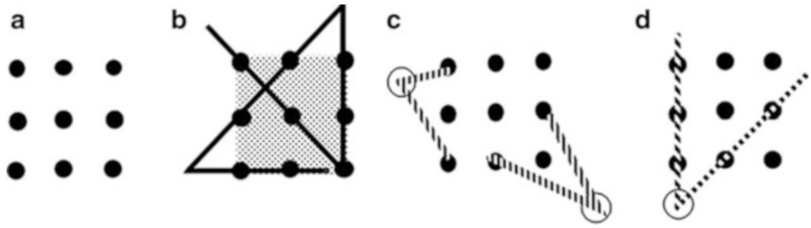
Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon, Fig. 1 The mutilated checkerboard puzzle (Source: Akin 1986)

development of a new problem space; and (4) a new problem space based on the invariant features of the puzzle.

The Creative Nature of the Nine-Dot Puzzle

The Nine-Dot (NDP) is another puzzle identified with the SMI research (Akin and Akin 1996; Newell and Simon 1972). It involves graphic manipulations on a sheet of paper based on nine regularly spaced dots on a 3 × 3 grid (Fig. 2a). The goal is to draw four straight lines that are connected end to end so that each dot has a line going through it (Fig. 2b). In order to successfully solve the problem, subjects must realize that they should extend a line beyond the square-shaped area formed by the nine-dots (i.e., the box; Fig. 2.2, shaded area). This is often the moment when a subject exclaims "Aha!" or experiences the SMI response.

However, most subjects attempting to solve this puzzle restrict themselves to *the box*, which is called the *frame of reference* (FoR) in SMI literature. This makes the solution impossible to attain since two intersection points in the solution lie outside of the box. Typically, subjects solving this puzzle fall into three categories: (1) those who solve it without help (Table 1, Type A); (2) those solve it after assistance is given to help



Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon, Fig. 2 The nine-dot puzzle (Source: Akin 1986)

Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon, Table 1 Cognitive thresholds to solve the nine-dot puzzle (Source: Akin 1986)

Subject category	Operations				
	Removing the FoR (self)	Removing the FoR (by hint)	Drawing lines outside the FoR	Aligning vertices of the lines	Puzzle solved
Type A	√	N.a.	√	√	√
Type B	x	√	√	√	√
Type C	x	√	x	x	x

them lift the FoR – usually in the form of an instruction: "you may go outside of the 'box' of dots, if it aids you in finding the solution" (Table 1, Type B); and (3) those who cannot solve the puzzle even with the instruction to remove the restricting FoR (Table 1, Type C). Hence, solving the NDP requires more than just removing the FoR: operations that enable drawing lines outside of the FoR (Fig. 2c) and aligning the vertices (Fig. 2d). Those who solve puzzle on their own do so by satisfying all three conditions (Table 1, Type A or Type B). Those who are given the hint to go outside of the FoR solve the puzzle by achieving the remaining two conditions after receiving the hint (Table 1, Type B). Those who are not able to solve the puzzle are unable despite the hint proved (Table 1, Type C).

For both puzzles (MCP and NDP), it is possible to solve them only after removing the FoR, and more importantly defining the requisite problem structure for the solution state without the restricting FoR. The development of these new operations is an example of the cognitive dimensions of creative behavior. While these are not at the level of the creativity displayed by, for example, Leonardo da Vinci, Caravaggio, or Vermeer, structurally they serve the same cognitive role in reaching creative results. The obstacle in applying these findings to the larger domain of human creativity is to be able to scale them up to other domains like scientific discovery and design (Akin and Akin 1996; Newell and Simon 1972).

Creative Nature of Scientific Discovery

History of science is full of accounts of brilliant discoveries that have changed the course of society, such as Fleming's discovery of penicillin, Salk's discovery of the polio vaccine, Mendeleev's formulation of the periodic table of elements, Newton's formulation of the general law of gravitation, or Einstein's law of relativity. These novel formulations of knowledge have proven to be of enormous value to mankind, altering the way of dealing with health, science, and technology. There should be little doubt that these are also creative acts of enormous magnitude.

Arguably, the cognitive mechanisms responsible for them are no different than those that assist in more mundane tasks like puzzles or more artistic ones like design. Most anecdotal accounts of scientific discovery are embellished with dramatic events that resemble the SMI moment. Did Newton really think of the law of gravity after an apple fell on his head? Did the periodic table appear to Mendeleev in a dream? Or was Archimedes really taking a bath when he finally figured out the principle of volume measured by a solid displacing liquid, running out into the street yelling "*Eureka*!?" In studying scientific creativity, however, one must look beyond the public exclamation to uncover the hidden SMI moment and the cognitive processes that induce them.

Kedrov's meticulous study of the circumstances around Mendeleev's formulation of the *periodic table of the elements* (Kedrov 1966–1967) helps unravel the conditions that give rise to the SMI in the sciences. In 1868, Mendeleev was busy with constructing the table of contents of the second volume of his new textbooks on chemistry. Having completed the first two chapters of the second volume, Mendeleev was scheduled to go on a long journey the next day and, consequently, was hard pressed to determine the next group of elements to include in the following chapters of the second volume. He had already covered the halogens and the alkaline metals. It was not clear as to which group of elements should be covered next. In the absence of a logical structure to organize the 64 known chemical elements of the day, this was a difficult decision, the exploration of which eventually would lead Mendeleev to the discovery of the periodic table.

Medeleev's exploration began with a search for a pattern that could be applied to all of the known elements. First, he compared the atomic weights of the elements. While this was a good start, there were two big obstacles: the number of comparisons with all pairs of atomic weights was far too numerous to undertake exhaustively, and the chemical elements not yet discovered at the time created gaps and made it difficult to see the global pattern in the data. Next, Mendeleev compared groups of elements based on their atomic *properties* and ordered them according to their atomic *weights*. This reduced the space of comparisons, considerably yielding some consistent patterns. His second breakthrough came when he made a modification in his representation of the elements, motivated by the limited time he had to complete his task. Writing lists of the elements by hand was just too cumbersome. Thus, he decided to use cards to represent elements ordered in a two dimensional matrix space, with one dimension representing the ordering of atomic weights and the other general chemical properties of the elements.

Kedrov speculates that this analogy, marking an SMI moment for Mendeleev, presented itself because he was an avid fan of the card game *Patience* (Kedrov 1966–1967). The cards containing the identities of chemical elements were organized in the same orthogonal fashion as the playing cards of Patience, according to suit and value. Through this, Mendeleev reduced the amount of clutter present in his problem representation. In spite of the unknown elements, the new representation also made clearer the organizational principle that the "properties of elements stand in periodic relationship to atomic weights." It took Mendeleev several days to find the logical basis for organizing the elements, setting aside some elements, which were not yet well calibrated in terms of weights and properties, for future exploration. This future task, turned out to be one of the greatest contributions of the periodic table to the field of chemistry.

The substance of scientific discovery is clearly very different from that of puzzle solving. The domain of knowledge applicable to the former is vast. The time frame and number of scientists that contribute to it are enormous. Commensurately, the impact of its results is far reaching. Nevertheless, there are remarkable similarities between these domains. While the emotional response "Aha!" may mark the moment of triumph for any discovery, it has little to do with explaining the creative process. It turns out, however, that the cognitive steps that must be taken in order to fit data to mathematical functions versus selecting new problem spaces in the MCP are remarkably alike (Newell and Simon 1972). Likewise the creative processes that are necessary for breaking out of the restrictive FoR in a puzzle bear an uncanny resemblance to those of scientific problem solving. In summary, these are:

- *General Criteria*. Creativity is based on the recognition of the novelty and value of its results, in temporal space.
- *Shift in Problem Space*. A shift in the problem space that results from the discovery of a new *principle* (periodicity of elements), a new *representation* (playing cards of the game of patience), or a new *I* (comparing the atomic

weights of the entire set of groups of elements) is needed.

- *Heuristic Search*. Any one of the above effects is the result of a heuristic search process.
- *Knowledge Base*. Owing to the imprecise nature of heuristic search methods, considerable background knowledge and concerted effort are a must.
- *Odds of Success*. Yet, the search space is too vast and the contextual factors too complex to ensure success.

Creative Nature of Design in Writing

Design is a rich concept that has been adopted by many disciplines. The cognitive processes observed in these design disciplines closely resemble processes that play a role in a number of the traditional art fields such as music, writing, painting, and sculpture.

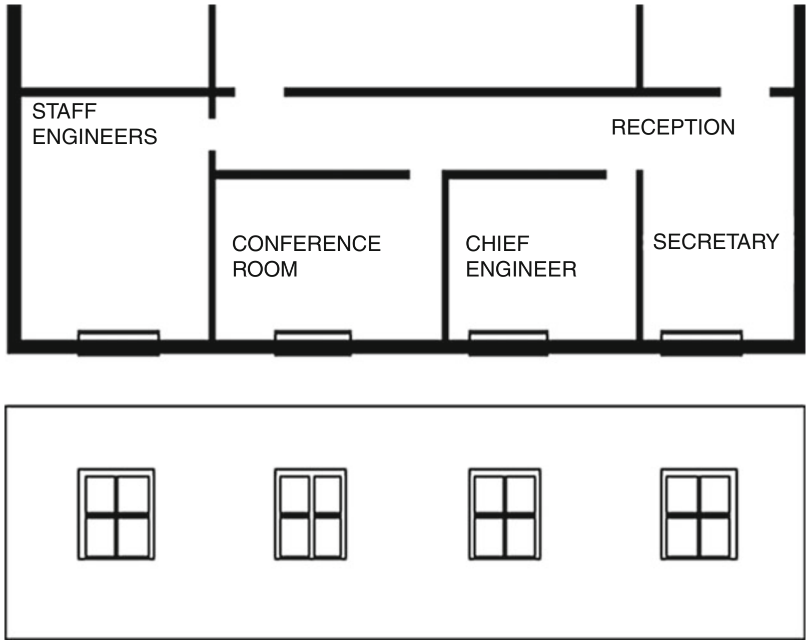
Some argue that human intelligence and creativity have developed to high levels due to their ability to encode ideas in stories and narratives. Cognition in verbal composition has been studied extensively with the goal of improving writing skills. Writers' initial task representations are as important for success, as they would be in puzzles or scientific discoveries. Hayes and Nash (1996) discuss the "nature of the planning activity" in writing. They point out that writers *interleave* planning and writing tasks in an effort to balance their global and local goals. This kind of approach to writing has many practical benefits including the assisting of memory during the execution of complex plans and discovery of new tasks or the consolidation of multiple tasks into one. In calibrating the quality of the writing tasks performed by both experienced and inexperienced writers, Hayes and Nash found that the amount of abstract planning positively correlated with quality. These results from the writing literature converge to make a case for the proper coupling of global and local skills toward creativity, which will be covered next in the context of architectural design.

Creative Nature of Design in Architecture

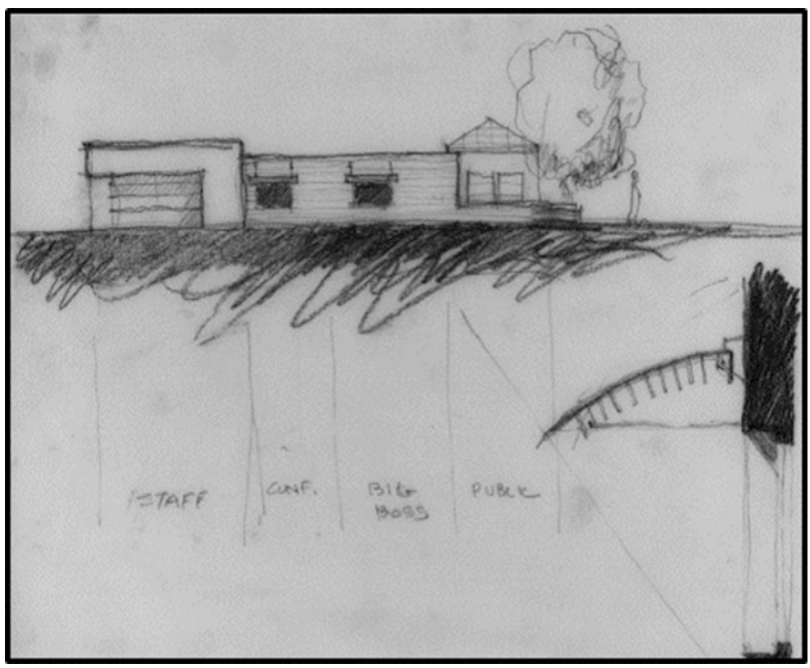
Other fields that have adopted design as a central vehicle for creativity include graphics, industrial products, architecture, landscape architecture, engineering, and urban and regional planning. Attempts at understanding and describing the design process and the underlying structure of the architect's creativity by way of expertise go back to the early 1970s (Eastman 1969). Subsequently direct evidence about the relationship of expertise and creativity in architectural design has been provided by Akin (1986). More recently, important steps have been taken toward modeling creativity in engineering design and assessing the role of metaphors and analogies in inducing the SMI response (Casakin 2007). While these have provided important insights about the nature of the design task and how humans deal with it, no comprehensive theory of creativity has yet emerged.

A study specifically directed at the SMI phenomenon in architectural design compares cognitive processes of expert architects and novices (Akin and Akin 1996). In the architectural design problem, subjects are asked to design a façade for a given floor plan of an office suite containing five rooms: reception, secretary, conference, staff engineers, and chief engineer (Fig. 3). The restricting FoRs in this task are shown in the lower part of the figure and involve five categories: size, proportion-location of windows, number of stories, wall construction, and floor height(s). The expert designer arrives at SMIs following a variety of conditions: exhausting all alternative solutions within the given FoR, trying heuristic rules to leap out of the existing solution cycle (like inverting the orientation and value of design elements, trying an entirely new visual pattern), redefining the FoR based on specific domain knowledge (balancing the elements of a composition), or designing insights resulting from these conditions.

Through this process, the expert designer (Fig. 4) breaks out of six FoRs. The first FoR from which the subject breaks out is the regularity of the windows. This is not surprising since façade design hinges upon the placement and proportions of windows. She refers to the existing window geometry as "repetitive" and "deadening" (Table 2, FR1-1). She also speaks of specific design operations to fix this problem: infusing



Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon, Fig. 3 Plan (*above*) and FoR facade (*below*) (Source: Akin 1986)



Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon, Fig. 4 Façade designs by an expert designer (Source: Akin 1986)

variety, hierarchy, and other grouping strategies. In achieving this breakout, she relies on a well-known principle of composition, *bookends,* that achieves an accentuation of the windows at the extreme ends of a linear façade layout. This principle has the effect of freeing her to experiment with patterns that are not necessarily in conformance with the floor plan (Fig. 4). This effect is also evident in some of the other design features: roof form, materials, and solar shading

Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon, Table 2 Breakout from frames of reference (FoRs) by expert designer (Source: Akin 1986)

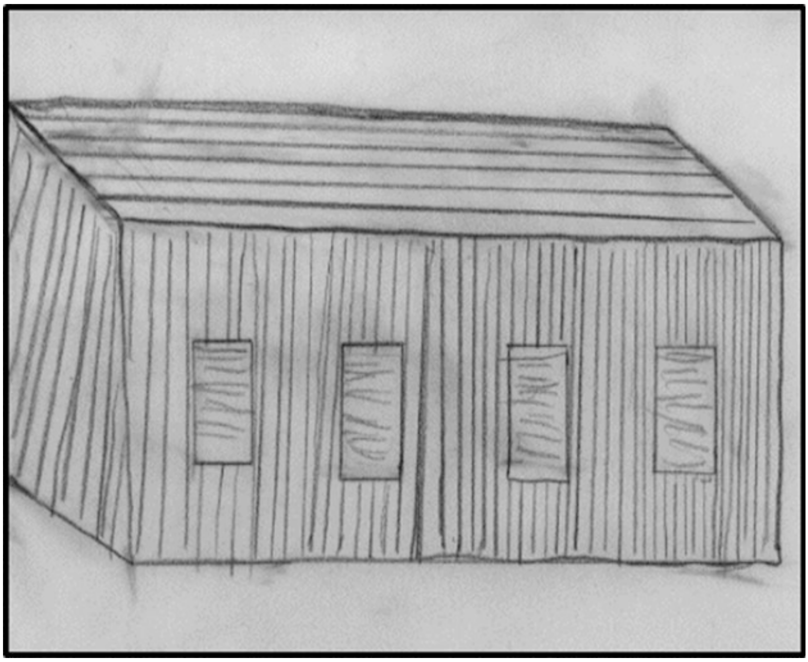
FoR category	FoRs in subject's own words	Source of the FoRs	Breakout from FoR moves	Source of breakout moves
Window geometry	FR1-1: "(these are) repeated windows"	*External*: plan view	Vary end-conditions of façade layout	*Recall*: composition principles
Ceiling height	FR1-2: "(assume) 12' ceiling heights"	*Recall*: building standards	Show functional allocation by ceiling height variation	*Recall*: spatial design principles
Ground floor location	FR1-3.1: "(locate) on ground floor."	*Recall*: general assumption	Assume ground floor location	–
Single story building	FR1-3.2: "(locate) on ground floor."	*Recall*: general assumption	Assume single story building	–
Relief in building façade	FR1-4: ". . .some relief (is needed)"	*External*: plan view	Create projecting shading devices	*Recall*: Subject-1's earlier designs
Façade construct'n	FR1-5: "(give) texture, contrast to materials"	*Recall*: knowledge of construction	Use a variety of building materials	*Recall*: composition & construction in tandem

Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon, Table 3 Breakout from frames of reference (FoRs) by novice designer (Source: Akin 1986)

FoR category	FoRs in subject's own words	Source of the FoRs	Breakout move	Source of breakout move
Window geometry	FR2-1: "want to make (these) window(s) bigger"	*External*: plan view & assumption of normal sill height	Lower the assumed window sill height	*Recall*: general heuristic
Main access	FR2-2: ". . . don't see any doors"	*External*: absence of information	*None*	*Not applicable*
Ceiling form	FR2-3: "nice big curvy ceiling like roof"	*External*: absence of information	Place hipped roof gable	*Recall*: typical "house" image
Construct'n materials	FR2-4: "maybe (the wall) could be brick"	*Recall*: general assumption	Place brick on the façade	*Recall*: typical "house" image

devices. By balancing the asymmetrical roof forms on the opposing ends of the building, the expert designer reemphasizes the two ends of the façade. The "eyebrows" placed above the middle windows as shading devices (Fig. 4, section at the bottom right side) also help balance the differences between middle and end windows. Juxtaposition of the shading devices' metal construction against the heavy, earthy textures of the brick wall presents an attractive material selection decision.

In the case of the novice designer (Table 3), a small number of FoRs are observed and an even smaller number are broken out of. Her solution (Fig. 5) is the same as the normative solution (Fig. 3, facade). The window patterns are the very first FoR from which the novice designer tries to break out. She remarks "I mean if you're looking in, I don't know that I would necessarily see anything. If I stand outside all I pretty much see is windows. . . right?" However, the features used to achieve this breakout are standard features found in *normalized* house images. The roof is a simple gable, the walls are brick, and the windows are regularly proportioned and spaced. The only two pieces missing from the standard image are the entrance (Table 3, FR2.2) and the chimney. The materials (brick and shingles) are selected, once again, in conformance with the idealized house image to which she refers in



Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon, Fig. 5 Façade designs by a novice designer (Source: Akin 1986)

the protocol as part of a childhood model building activity.

These differences between the two subjects point to the same phenomenon observed in puzzles: recognizing the need to break out of FoRs is not sufficient to reach a creative solution. One also needs the procedural knowledge that is necessary to actually implement each breakout. The novice designer, due to a lack of training in design, does not have the technical and experiential background that enables the expert designer with the skills to assemble façade compositions, spatial compositions, sun shading devices, and construction details.

Toward a Unified Theory of Creativity

One of the first things that can be stated regarding the creative process is its kinship to most other cognitive processes. The evidence considered in this entry suggests that cognition of creativity shares a great deal with ordinary cognitive acts such as heuristic search, recognition, and problem solving. In addition, an indispensable factor in the creative process appears to be a shift in the structure of the task at hand, called the SMI. Observations in puzzles, scientific discoveries, and design show that a new construct consisting of both a specific problem representation and operations applicable in the domain of this representation must be created.

The fact that the creative process requires the discovery of a new problem space necessitates that the creative individual must have skills not just for problem solving but also for defining new *problems*. This latter skill has been described in various contexts. Problem seeking, puzzle making, problem restructuring, and problem formulation are some of the related concepts that have recently appeared in expertise and creativity literature.

Conclusion and Future Directions

One of the most important aspects of the process of *searching for new problem spaces* has to do with domain knowledge. As observed in puzzles, inventions, and designs, the knowledge of the creative agent plays a key role in their creative achievements. In the case of the architectural design problem, it is evident that the novice designer does not possess this skill while the expert designer does. Finally, it is important to underscore once again that the SMI or Aha! response is a related but inessential manifestation of creative acts. It seems to be more important for the sociopsychological aspects of discoveries and creative inventions than for the cognitive psychology of creativity.

Several important areas of research that are indicated by this review of research in puzzles, inventions, and design are:

1. Do creative acts always involve the SMI or the “Aha!” response?
2. Is the SMI relevant only in the initial act of creative revelation?
3. If they, or the moment of discovery filled with surprise, are absent in subsequent acts that are identical to the initial act, should they still be considered creative? For example, is Picasso creative when repeating one of his breakthroughs for the *n*th time?
4. Since the differences between novices and experts seem to correlate with the SMI condition, can it (therefore can creativity) be achieved through training?
5. Is expertise a necessary and a sufficient condition for creativity?
6. Since it is culturally regarded as a mysterious process, is there a tautological impediment to uncovering the secrets of creativity? That is, even if one can describe creativity precisely, is it not a forgone conclusion that the culturally accepted notion of what it is would shift?

Cross-References

▶ Analogies and Analogical Reasoning in Invention
▶ Applied Design Thinking Lab and Creative Empowering of Interdisciplinary Teams
▶ Cognition of Creativity
▶ Creative Behavior
▶ Creative Mind: Myths and Facts
▶ Creativity and Innovation: What Is the Difference?
▶ Creativity in Invention, Theories
▶ Creativity from Design and Innovation Perspectives
▶ In Search of Cognitive Foundations of Creativity
▶ Psychology of Creativity
▶ Science of Creativity

References

Akin Ö. Psychology of architectural design. London: Pion Ltd; 1986.

Akin Ö, Akin C. Frames of reference in architectural design: analyzing the hyper- acclamation: “a-h-a-!”. Des Stud. 1996;17(4):341–61.

Casakin H. Metaphors in design problem-solving: implications for creativity. Int J Des. 2007;1(2):23–35.

Eastman C. Cognitive processes and ill-defined problems: a case study of design. In: Walker D, Norton LM, editors. IJCA’’69, International Joint Conference on Artificial Intelligence; San Mateo, CA: Kaufmann; 1969. p 669–90.

MacKinnon DW. Creativity and the expression of possibilities. In: Kagan J, editor. Creativity and learning. Boston: Houghton Miflin; 1967.

Hayes JR. The complete problem solver. 2nd ed. Hillsdale: Lawrence Erlbaum; 1989.

Hayes JR, Nash JG. On the nature of planning in writing. In: Levy CM, Ransdell S, editors. The science of writing: theories, methods, individual differences, and applications. Mahwah: Lawrence Erlbaum; 1996. p. 29–55.

Kaplan CA, Simon HA. In search of insight. Cogn Psychol. 1990;22:374–419.

Kedrov BM. On the question of the psychology of scientific creativity. Soviet Psychol. 1966–1967;5(2):16–37.

Newell A, Simon HA. Human information processing. Englewood Cliffs: Prentice Hall; 1972.

Creativity in Research

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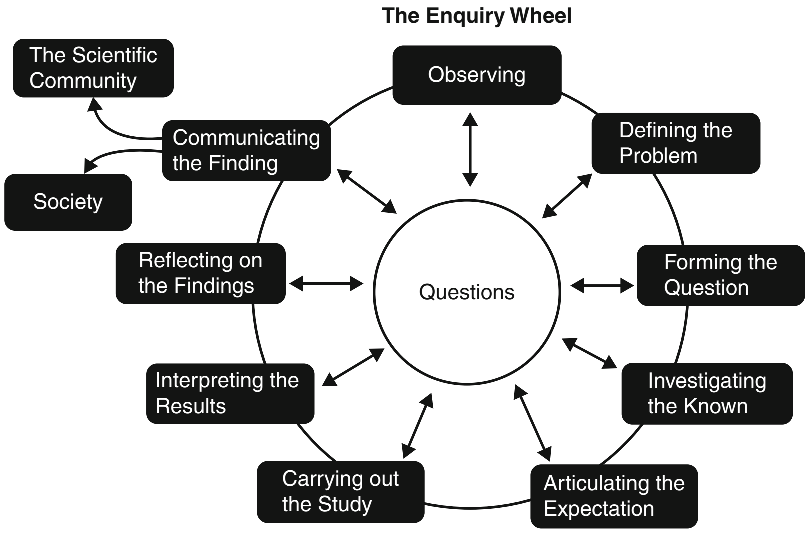
What is Research?

Research is a form of enquiry that aims to find answers to questions that would fill a gap in an existing knowledge base, resolve anomalies in that knowledge base, or add to the existing



Creativity in Research, Fig. 1 The enquiry wheel (Harwood et al. 2004)

stock of the knowledge base. Here the knowledge refers to any subject or discipline or combination thereof.

Depending on the stage of the research enquiry, different types of questions are asked, and answers sought through different actions. Some of these questions require a greater emphasis on the critical appraisal of existing knowledge and observations, and data. Many other questions are speculative and open ended, requiring a more creative approach to address them. All stages however require some measure of both types of thinking (see Appendix 1: Creative Behavior).

The various stages in the research cycle are shown schematically in Fig. 1 below (Harwood et al. 2004). This is based on the views of a number of scientists who were asked how they thought research is conducted. This is a much more pragmatic and flexible view of research than that described by historians and philosophers of science as "The Scientific Method." Some if not all of the stages of Fig. 1 map on to research methods in other disciplines such as the social sciences and humanities.

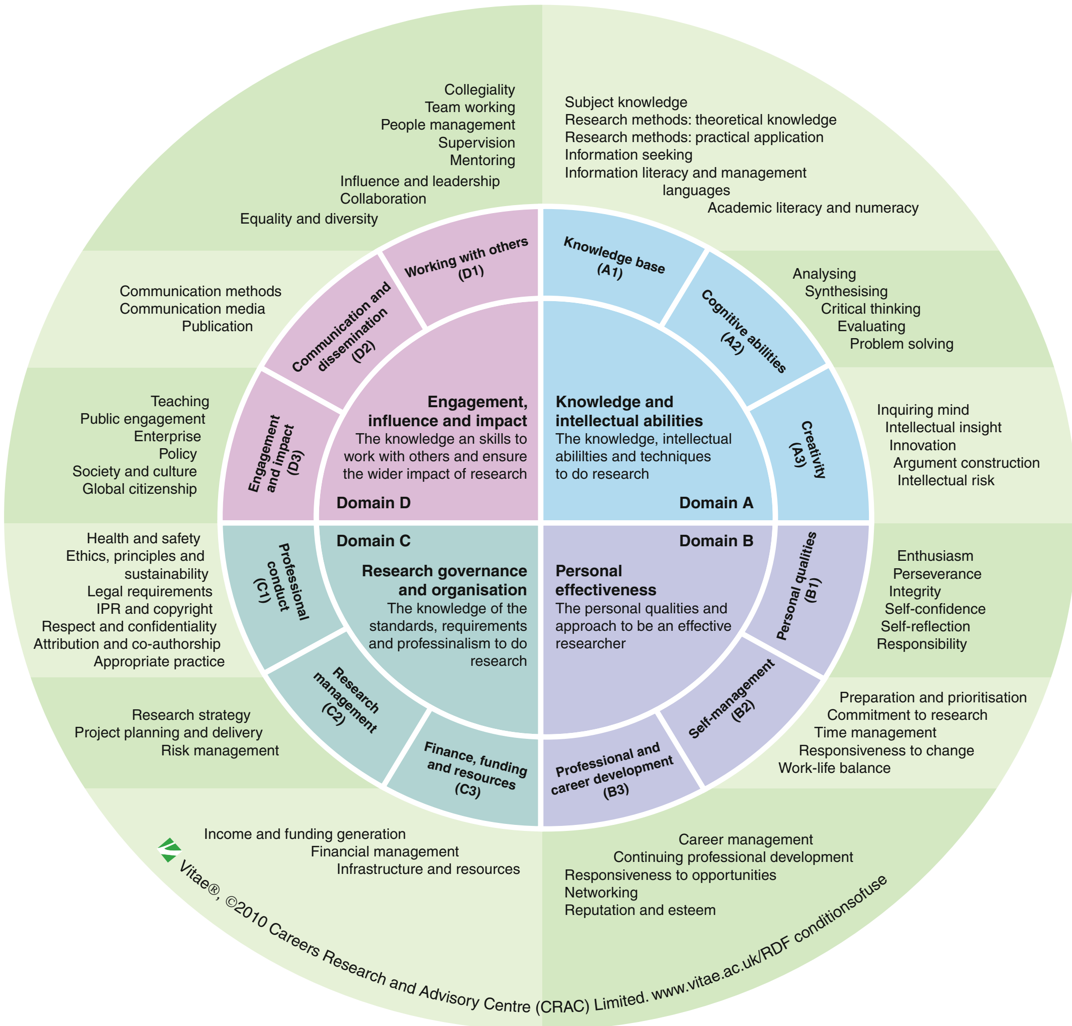
In addition to noting from Fig. 1 that research is not a linear activity, it can start at different points on The Enquiry Wheel, and it may be necessary to jump back across the wheel at times to re-appraise earlier assumptions and hypotheses, redesign the research methods, etc. Questions are at the hub of this wheel and progress can be helped or hindered by the way the questions are framed.

While The Enquiry Wheel describes the main activity of doing research, and creative and critical thinking are at the heart of progress in this framework, it is important to note that being a good researcher requires the development of a much broader range of skills and knowledge. These have been detailed by the organization Vitae in their Researcher Development Framework (RDF) (Vitae 2009) shown in Fig. 2 below.

Where is the Creativity?

Creativity is shown as one of the sub-domains of the "Knowledge and Intellectual abilities" domain in the RDF in Fig. 2. However, in contrast with critical thinking and knowledge, creativity is notoriously difficult to define unambiguously, and the role played by creative thinking in research is not always clear at least in the way it is communicated and perceived by the public.

Most academic research describing new ideas that contribute to knowledge and understanding is reported through publications in the form of papers in journals, monographs, theses, and presentations at conferences. Other forms of research output are patents, installations, designs,



Creativity in Research, Fig. 2 The Vitae researcher development framework (RDF) (Vitae 2009)

and practice-based work, though in common with publications, all such works generally referred to as "intellectual property" are required to be approved by an anonymous peer review process before they can be made publicly available. The main criterion of acceptance in the peer review process is that the research output contains original results or ideas. Given that one of the more enduring definitions of creativity is: "Ideas that are original and of potential value," it is clear that creativity is at the heart of doing research.

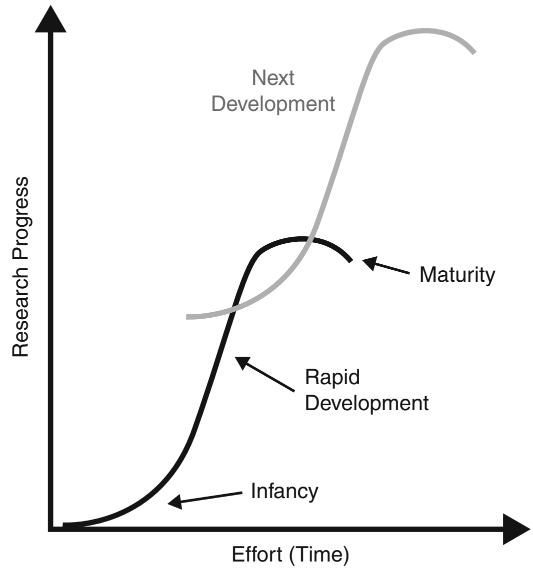
This underpinning of creative thinking in research however is not clear to see to the lay person or research novice (e.g., a PhD student). Reported accounts of research in a particular field over the previous decade or so are summarized in published reviews in academic journals or books. These publications give an impression of seamless and continuous progress in the research field by the researchers who appear to know exactly what they are doing, and where the research is headed. The false-starts, wrong or null hypotheses, unsuccessful experimental design, and all the reworking that is so much a part of doing research are not reported. Given that one of the hallmarks of creative behavior is risk-taking, there is a high probability that many research ideas at various stages of The Enquiry Wheel will not work out when put to the test. If the reader has no sense of these setbacks, it can make research look like it is a very well-structured process that progresses unhindered. A more accurate picture of what it is like doing research (at least some of the time) was offered by the pioneering rocket scientist Wernher von Braun when he said: "Research is what I'm doing, when I don't know what I'm doing."

To add to this earlier impression, researchers are often portrayed in the media as mainly logical thinkers who painstakingly analyze huge amounts of data from which they can infer clear conclusions through the application of critical thinking. This data is often the outcome of months of meticulous, and often, repetitive work. Depending on the discipline, it may be gathered through hundreds of very similar experimental measurements, months of computer modeling time, dozens of interviews with sample populations, months of "field work" or spreadsheets filled with records acquired from volumes of archive material. The problem here is that researchers are often discussing what they did in retrospect, not how they got the ideas to do it in the first place. Another reason that reported research appears to lack creativity is that the discipline of academic writing demands an objective style describing only the facts without any mention of the human drama that is an integral part of any research venture.

How Research Progresses

Support for the aforementioned notion of continuous progression in research can be found in the publication: "The History and Present State of Electricity with Original Experiments published in 1767" written by the scientist and theologian Joseph Priestley (1767). Here he describes the progress of the new electrical technology as follows:

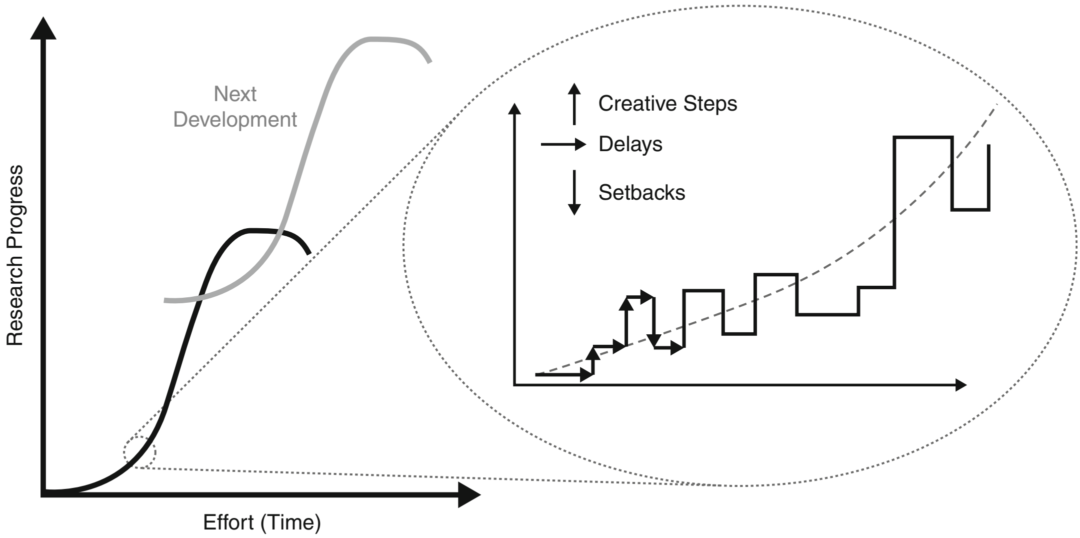
> The History of Electricity is a field full of pleasing objects, …Scenes like these in which we see a gradual rise and progress in things, always exhibit a pleasing spectacle to the human mind… For an object in which we see perpetual progress and improvement is, as it were, continually rising in its magnitude: and moreover, when we see an actual increase in a long period of time past, we cannot help forming idea of an unlimited increase in futurity



Creativity in Research, Fig. 3 The sigmoid curve of research progress

This alleged continuity of research progress can be described with reference to the smoothly rising "sigmoid" (or "S") curve shown in Fig. 3 below (Byron 2009). It is represented as showing a smooth transition through the three stages of growth described below:

1. *Infancy*: This is when a new line of enquiry or field of research opens up. It is often referred to as "basic" or "blue skies" research. Progress is usually slow because the ideas may be speculative, there will be little evidence supporting the theory, and relatively few people will be engaged in the work at this early stage. There is also some inertia to overcome in convincing funding bodies that the research could lead to something useful.
2. *Rapid development*: Here the new ideas, methods, theories etc have started to gain acceptance, similar results have been obtained elsewhere, and as a result of published work, progress accelerates. Funding is now easier to obtain because the chances of success are much



Creativity in Research, Fig. 4 A magnified portion of the sigmoid curve

higher. The territory into which the new underpinning theory, model or methodology can be applied successfully is expanded during this phase, but ultimately because there is no theory of everything, new anomalies will start to appear where the new theory cannot be applied.

3. *Maturity*: At this final stage, these new anomalies or gaps in knowledge start to be more widely recognized. This launches a new trajectory of basic research that aims to accommodate these new anomalies, etc. The older model is no longer driving the new research field. That does not mean to say it or even the earlier theories were wrong, but rather that they cannot be generalized to all situations. An example of this in science would be the transition from classical mechanics to quantum mechanics at the turn of the twentieth century. The classical Newtonian mechanics remains intact where it applies, but it was not able to explain effects at very small scales of size.

During the transition between the previous and the next development curve in many fields of research, there is usually much controversy between competing models or theories. The gap between these two curves represents a large discontinuity that requires researchers make a creative shift in their thinking. These transitions do not have to represent paradigm shifts that signal revolutions in knowledge and understanding, they could represent new research directions. More importantly, these transitions are not the only places where the creativity of the researcher is needed. If just one small part of the alleged smooth curve of Fig. 3 is magnified, many more discontinuities that contribute to progress can be seen as illustrated in Fig. 4 (Byron 2009).

The upward steps in Fig. 4 represent the original contributions to progress. They are discontinuous because such insights or mini-breakthroughs are not predictable from the knowledge available at the time. In patent law used to protect inventions, they are defined as "inventive steps" and this is described as something that would not be obvious to someone "skilled in the art." Without an inventive step, a patent cannot be filed. The other features on the inset portion of the curve in Fig. 4 are also worth discussing here because they do relate to creativity, particularly the horizontal arrow defined as a "delay."

Research is a pretty inefficient business in terms of the time and effort put in, and the aforementioned delays stem from two sources. Firstly, there is the innovation aspect of the research in terms of how well the project is managed. Here delays can be due to various factors such as allocation of resources, equipment, support, development and training time, other demands on the researcher, etc. These are all external factors in terms of the person doing the research, but the other contribution to the delay concerns the researchers' own thinking time. This is partly due to the study necessary to understand the relevant concepts, to keep abreast of the published work, etc., but there is another important delay that is often unaccounted for and this concerns creative insights.

Generally speaking, new ideas do not occur at the time that a research problem or challenge has been identified, and four stages have been identified in the process of creative thinking. These were defined by Graham Wallas in 1926 (Wallas 1926) and are listed below with a brief description of their application in the context of research.

1. *Preparation* – This refers to the assessment and clarification of a research challenge that requires both creative and critical thinking. This is often neglected and can lead to delays when underlying assumptions have not first been identified. Sometimes a challenge can be too ambitious or general and needs to be honed down to a set of smaller challenges that represent specific instances of these larger generalities. For example, the challenge statement in educational research: "How might improvement be made on the evaluation of students' knowledge other than by written examinations?" contains assumptions (e.g., to what extent do written examinations fail to provide an adequate evaluation of students' knowledge?), and is not specific enough. Other questions related to this would need to be answered first, and then included in the challenge statement, (e.g., which group of students are involved? what subjects? when does this occur? and so on).

   On the other hand, if a challenge is too specific, it can inhibit creativity, resulting in solutions that are routine. An example here might be the research challenge: "How might a better website be designed?" The "adaptive" approach would be to look at existing websites, and incorporate ideas that improve the existing website design, and eliminate ideas that are regarded in other websites as bad design. The result would be a step-wise improvement in the design of the website. However, if instead of following this line of enquiry, the challenge is broadened out by abstraction, new creative possibilities arise.

   Abstraction is facilitated by asking "why?" and transforming the answer into a bigger challenge. So in this case this leads to: "Why is it necessary to design a better website?" and the answer to this might be: "In order to communicate the content of the website more effectively." If this is transformed into a new challenge it becomes: "How might the content of the website be communicated more effectively?" and this open up new possibilities that would not be found by looking at existing websites such the use of blogs or Facebook, or perhaps authorship of a booklet or other publication, or maybe an invited meeting of key stakeholders and so on.

   In summary, research can be made more efficient by shaping a challenge first before diving into finding ideas for its current formulation. All too often in research after a particular challenge has been set without examining assumptions or shaping it, a few days later in a casual conversation, someone might be heard saying: "What we are really trying to do is. . .. . .!". When a research challenge has been properly prepared so that it is ready for new creative solutions and no immediate resolution has been reached, the next phase of incubation comes into play.
2. *Incubation* – This is an alleged period of unconscious activity facilitated by conscious disengagement from the challenge.

   See Appendix 1 also.
3. *Insight* – This refers to the "Eureka" moment where a breakthrough idea emerges into conscious awareness. This often occurs away from the place where the challenge was identified and can even occur in a dream.
4. *Elaboration* – The commencement of "Innovation" where the original idea is refined, shaped, communicated, and put into practice.

Apart from the first recorded "Eureka" moment of Archimedes, there are many other examples of other great insight stories in the history of the sciences and the arts. Such famous names as Descartes, Mozart, Wagner, Coleridge, Max Ernst, Poincare, Einstein, Hamilton, Nikolai Tesla, Denis Gabor, Otto Loewi, and Cary Mullis all reported "Eureka" insights at times when they were away from the office, studio, laboratory, workplace, etc. Of course, not all original ideas arise in this way and many do take place while doing research without requiring a long incubation period. These are sometimes precipitated by a timely clue. For example, it took Sir Alex Jeffries only 30 min after examining an X-Ray film of a DNA sample to realize its potential for a unique form of fingerprinting. This is also a good example of someone who makes a creative connection between their highly specialized field and another completely different field (forensics).

Discoveries

It is important to discriminate between original ideas inspired by the researchers themselves, and discoveries which are in some sense independent of the researcher even though they represent originality.

Discoveries appear in different ways and are never planned or predictable from the knowledge available at the time, and as such are not the direct result of any individuals' creative thought or action. However, someone has to witness such events. When Alexander Fleming said: *"Chance favours the prepared mind"* he was referring to certain characteristic of a creative mind, that include curiosity, open-mindedness, a willingness to suspend judgment and challenge assumptions, and an ability to take risks. Given that it is not likely when a discovery is made that the researcher will have previously been looking for what they observed, or what the observation could mean, the requirement for a creative mind-set in doing research is clear.

Nurturing Creativity

Creativity is associated with the appropriate use of the imagination and though it is not difficult to imagine the impossible, research is more concerned with "The art of the soluble" to quote the great zoologist Sir Peter Medawar (Medawar 1967). On the other hand, it was the scientist and writer Arthur C Clarke who said (Clarke 1973): *"Every revolutionary idea evokes the following three stages of reaction":*

> "It's completely impossible — don't waste my time";
> "It's possible, but it's not worth doing";
> "I said it was a good idea all along."

Revolutions apart, creative ideas do sometimes require a certain amount of risk-taking by the person proposing them in that they may appear crazy in the eyes of others. Apart from the risks in dealing with criticism from others, more benignly, this concerns allowing oneself to leave the security of existing habits of thought.

Another way in which creativity can be nurtured is in the development of a tolerance to ambiguity. This concerns the ability to be comfortable with unresolved issues, problems, or challenges for longer periods. It is relatively easy to take the "adaptive" step-by-step approach described earlier to find resolution to such challenges – however, this does not tend to lead to new ideas or open up interesting new lines of enquiry, and is often only a temporary fix.

The more creative approach requires the researcher to be in the mess of an unresolved problem for longer. This can be practiced (provided deadlines are not compromised) by withdrawing from the specific problem at times and trusting in the incubation process described earlier.

Intuition is defined as a form of knowledge or experience unaccompanied by conscious, reasoned thinking. Conscious thought draws on rationality as a guide and deals with tasks in a linear, sequential way. The hidden, intuitive mind has two main influences that determine how it processes thoughts – or rather what become thoughts in the conscious mind. The first process is association which is a pattern-matching process, and the second one is based on heuristics or innate and learned rules of thumb that are shortcuts through repeated association (see, for example, Kahnemann 2012).

Intuition is developed by new knowledge, action, and experience but it is not infallible and shortcuts applied inappropriately can lead to misperceptions or illusory thinking. This is constantly experienced in doing research and many new ideas appear to be counterintuitive until new knowledge is acquired (Byron 2008).

The mismatch between what is sometimes seen to be intuitively correct and what turns out to be true calls again on the need for a more flexible creative attitude to solving problems. This is facilitated by checking assumptions, even reversing them, or trying a number of different approaches and suspending judgment until other options have been explored.

Finding Ideas

New ideas in research can be seen as transforming the existing knowledge base and understanding of the subject, and this is driven much of the time by published work in peer-reviewed journals and conference presentations. A brief look at the history of any area of research will soon reveal that much of the time new ideas simply build on what is already there. This is the basis of what was defined earlier as "adaptive" research. Certain transformations however can also lead to big insights that revolutionize research fields. For example, many of the developments in the early history of microscopy can be seen as adaptive improvements on the first microscope of Anton Van Leeuwenhoek in the seventeenth century (e.g., better lenses, better illumination, better specimen holder, etc). However, when Max Knoll and Ernst Ruska came up with the idea of substituting photons for electrons with the invention of the electron microscope in 1931, this represented a major creative transformation of microscopy (Byron to be published).

When two different disciplines coalesce, another form of transformation takes place where ideas are combined. Examples of this in recent years are bio-informatics, evolutionary psychology, neuro-ethics, social philosophy each of which now has one or more specialized academic journals associated with the new research field.

The study of new ideas in different disciplines reveals that there are only seven kinds of transformation that lead to progress (Byron 2009). It is held that by deliberately applying these transformations to a challenge, many more ideas emerge than would be found by random associative thinking.

The seven kinds of transformation have been summarized in a memorable way with the acronym SCAMPER. This tool was first developed by Bob Eberle in the 1950s and the letters of SCAMPER stand for Substitute, Combine, Adapt, Modify (i.e., Magnify, Minify, Multiply), Put to other uses, Eliminate, and Reverse. Each transformation is prefaced by examining the challenge and asking "What if we……...?" This tool can be applied to any discipline or activity in which there is change. Examples from the world of technology are given below (Byron and Adams 2011).

SUBSTITUTE: Copper cable for Optical fiber – This revolutionized the telecom business.

COMBINE: The telecommunication company "Agilent" Combined planar optical waveguides with an Adaptation of ink jet technology to produce an optical switch.

ADAPT: The microwave oven was an adaptation of magnetrons used in radar systems.

MODIFY (Magnify/Minify): Alastair Pilkington Magnified the phenomenon arising from surface tension of flat oil drops floating on water. He substituted the materials for liquid glass floating on liquid tin and this was how float glass was developed.

PUT TO OTHER USES: Velcro was invented when the attachment mechanism of cockle-burrs was put to another use (after substitution for another material.)

ELIMINATE: The computer industry has been driven by the need to eliminate space on silicon chips by reducing the size of logic elements in order to increase their density and hence their processing power. Wireless technologies eliminate electrical cables.

REVERSE: By creating artificial opals (closely packed silica spheres) and in-filling the gaps then dissolving the spheres we are left with an inverted Opal. This has potential application for photonic circuits (Circuits using light instead of electricity).

Creative tools like SCAMPER enable the researcher not so much to find new ideas, but to ask more questions relating to a particular challenge that could then lead them to finding new ideas. Having available the full range of possible transformative "What If?" questions can also help a researcher to break habitual habits of idea generation and seek more possibilities.

Conclusion and Future Directions

At a time of unprecedented challenges arising from the impact of global warming and population growth on the sustainability of the environment, food supplies, and health provision, the need for productive research and big new ideas has never been greater. To quote the futurist Gaston Berger: *"We must no longer wait for tomorrow, it has to be invented."*

Creativity is the engine that drives progress in research, yet it is largely taken for granted in the recruitment of new researchers that people who have demonstrated a high level of knowledge and understanding of a particular discipline (e.g., achieving a high grade in a bachelors' degree) will be productive researchers. Although, knowledge and understanding are necessary for doing good research, they are not sufficient. Creative skills, unlike critical thinking skills, are less well defined, and in a sense, not directly teachable. Furthermore, the capacity to exercise innate creativity varies considerably from person to person irrespective of their knowledge or indeed intelligence.

The traditional way in which these skills are acquired is through immersion for at least a year or so in doing research, working with other researchers and the research community, and through a great deal of critical study of existing publications. Eventually patterns begin to emerge through these studies that enable a researcher to identify gaps in knowledge, and having familiarized themselves with the entire cycle of research, albeit under guidance, they begin to acquire the confidence to find creative solutions themselves to fill these gaps. From initially being an apprentice, the researcher through hard-earned tacit skills and knowledge eventually becomes an autonomous researcher with barely a mention of the word "creativity." The rate of progress however is very varied, and is highly dependent on the quantity and quality of guidance received from the supervisor or manager through this process.

Transferable skill training programs in research institutes can help researchers acquire these essential skills in a more efficient and effective way. Here the acquisition of slowly learned tacit skills can be accelerated through attendance at specialized workshops focused entirely on these topics (e.g., Creative Problem Solving), and the researchers can gain confidence more quickly through working more closely with their peers.

While creativity cannot be taught directly, it can be "caught" by working in an environment where it is more openly acknowledged and understood as an important part of research activity, rather than being regarded as potential that will make its appearance as a tacit skill over an extended period of time.

In conclusion, it is proposed that to complement the conventional 1:1 supervision process for researchers, the deliberate development of creative skills in new researchers through workshops and courses in research institutes is a key requirement for the next generation of researchers seeking the big ideas needed to address global challenges. To achieve this, considerable effort will be needed by those who develop researchers to fully understand the creative tools and techniques that really work for researchers, and to develop effective development interventions illustrated with relevant subject-specific case studies. In this respect, the transformative idea generation tool described here is one example of a technique that can enable the researcher to find more ideas to meet a research challenge, and to help develop their own creative skills.

Appendix 1: Creative Behavior

In the context of the skills for doing research in any field, it is useful to refer to a spectrum of creative behaviors. At one end of the spectrum is an everyday form of unconscious creative behavior that would include the ability to form the next few words to be expressed verbally. Another example might be when a solution is sought for an existing problem in a routine way by drawing on memories of earlier solutions (e.g., stabilizing a table by placing a folded beer mat under one of the legs). At the other end of the spectrum are the big insights or "Eureka" moments that lead to breakthroughs and possibly progress in research.

The former end of the spectrum may be defined as small "c" creativity and the other as large "C" creativity. "c" creativity in the first example cited earlier is the continuous generation of relatively small ideas (words and phrasing) about something that is required to be communicated, and these ideas are coupled to syntax and other cognitive, noncognitive, and physical mechanisms that make communication possible. All of these small ideas are in themselves unoriginal, but collectively they constitute a unique event in the sense of something being spoken by a certain person at a certain time, and in a certain place.

"C" refers to big ideas or discontinuities in current thinking and the temporal relationship to other measurable processes taking place in parallel is quite different. "C" creativity in the example cited earlier occurs mostly (but not always) at unusual times, and in unusual places often away from the environment (e.g., the laboratory, the studio, the library, the office, etc.) in which the original challenge that led to the insight was first articulated. These "Eureka" moments appear to arise unbidden and without conscious effort, and are a delayed (sometimes after a period of years) response to an earlier unresolved challenge or problem.

Though it has not been verified experimentally, the general consensus is that these ideas arise after a period of prolonged unconscious incubation. That is to say at the time the idea arises in conscious awareness, the person – though not aware of any earlier effort being expended on seeking the idea – is working away on solving it in the background as it were. It is difficult to prove whether or not the incubation process is actually taking place because some random reminder of the problem or challenge may equally have stimulated the idea instantaneously.

Occupying the region in between these two extremes on the spectrum are forms of deliberate creative behavior and examples of this occur on the following occasions:

- When the focus of attention is on a specific problem or challenge, and ideas are sought in real time to solve it
- When working with others to find ideas (e.g., in a group brainstorm or in an academic argument)
- When creative tools and techniques are applied in a deliberate way (e.g., SCAMPER, Forced Connections, TRIZ) to find ideas

Consistent with the extremes of the aforementioned spectrum of creative behavior, deliberate creative thinking (the default process of which is thinking by association) is an unconscious activity but the difference here is that the researcher is consciously aware of the questions that are asked at the same time ideas to answer them are being sought.

With the possible exception of the "Eureka" end of this spectrum, it is important to note that creative thinking does not exist in isolation but has a symbiotic relationship with a cluster of other cognitive abilities generally referred to as critical thinking (e.g., analyzing, rationalizing, synthesizing, evaluating, inferring, judging, deciding, etc.). This symbiosis is driven by a certain degree of emotion that provides the motivation to solve problems in whatever form they take.

Strictly speaking, the processes of critical thinking cannot be separated from creative thinking – ideas emerge from questions posed in both these modes of thought – but there are times when seeking new ideas, it is beneficial to temporarily suspend the critical faculties and let the imagination take the driving seat.

References

Byron KC. Counterintuition. The Institute for Cultural Research. Monograph series No 53. 2008
Byron KC. The creative researcher. 2009. http://www.vitae.ac.uk/policy-practice/1393-189241/The-creative-researcher.html
Byron KC. To be published. Creativity in research. In: Greenfield T, editor. Research methods for postgraduates.
Byron KC, Adams JD. Effective learning in the life sciences: how students can achieve their full potential'. Wiley on-line Library. 2011
Clarke CA. Profiles of the future: an enquiry into the limits of the possible. New York: Harper & Row; 1973.
Harwood WS, Reiff R, Phillipson T. Voices from the frontline: scientists' conceptions of scientific inquiry. J Chem Edu. 2004
Kahnemann D. Thinking, fast and slow. London: Penguin; 2012.
Medawar P. The art of the soluble: creativity and originality in science. London: Methuen; 1967.
Preistley J. The history and present state of electricity with original experiments. 1767.
Vitae is the UK organisation championing the personal, professional and career development of doctoral researchers and research staff in higher education institutions and research institutes. http://www.vitae.ac.uk/policy-practice/1397/About-Vitae.html. More information on the RDF is available at: http://www.vitae.ac.uk/researchers/428241/Researcher-Development-Framework.html
Wallas G. The art of thought. New York: Harcourt, Brace; 1926.

Creativity Machine® Paradigm

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Synonyms

Autonomous bootstrapping of useful information (DABUI), device; Autonomous generation of useful information (DAGUI), device; Imagination engine; Perceptron-imagitron pairs

Introduction

Although the definition of the term "creativity" widely varies, recent developments in the field of artificial neural networks (ANNs) lend a highly comprehensive model to all accounts of this highly prized cognitive process. From this bottom-up, computational perspective, seminal idea formation results from a noise-driven brainstorming session between at least two neural assemblies. In effect, ongoing disturbances both to and within such nets serve to drive a sequence of activation patterns in a process tantamount to stream of consciousness. At sufficiently intense disturbance levels, memories and their interrelationships degrade into false memories or *confabulations*, any of which could be of potential utility or appeal. If another ANN is provided to make this value judgment, we form an inventive neural architecture called a "Creativity Machine" (*US Patents 5,659,666, 7,454,388, and related US divisional and foreign filings).* Within such contemplative computational systems, the latter network may be allowed governance over the statistical placement and magnitudes of such disturbances, so as to induce the highest turnover of potentially useful or meaningful confabulations.

According to this simple, elegant, and working model, creativity may be attributed to the failure of biological neural networks to reconstruct memories of direct experience when exposed to nature's ubiquitous disordering effects, as other "wetware" opportunistically exploits such mistakes and pragmatically perfects the underlying network flaws.

Fundamental Concepts in Creativity Machine Theory

Neural Network

For the purposes of this discussion, the term "neural network" refers to any collection of switching elements, either real or computer-simulated, that wire themselves together so as to write arbitrarily complex input-output programs called *mappings*. In a process called *training*, the wiring strengths between such switches, known as *synapses* or *connection weights*, self-organize so as to decompose the entire body of input patterns into their statistically dominant themes or *features*. Other connection weights within these nets likewise self-organize so as to absorb the inherent statistical interrelationships between such tokenized input space features.

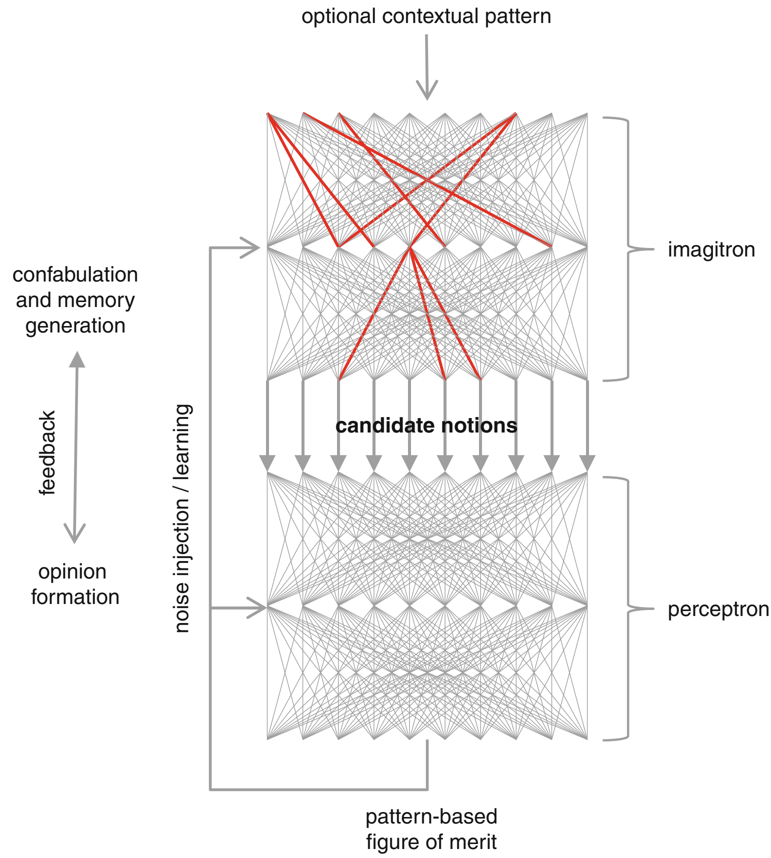
Concepts central to this notion of a neural network are enumerated below, sparing mathematical details and connecting more with introspective analogies to human cognition:

- Artificial neural network – Either a neural network implemented from hardware-based, parallel processing units and physical interconnects, or sequential simulations thereof on digital computers.
- Perceptron – A particular kind of artificial neural network that emulates the non-contemplative and reflexive aspects of perception wherein raw numerical input patterns, tantamount to electromagnetic, acoustic, and contact sensations, are mapped to associated patterns that represent the resultant memories and sensations activated within the brain in response to entities or scenarios observed by it in the external world.
- Exemplars – Raw numerical patterns, typically consisting of input and output components that are presented to a perceptron as it adapts its connection weights to capture the intrinsic mapping between such input-output pattern pairings.
- Environment – In the case of a perceptron, the body of all potential input patterns tantamount to the brain's observable universe.
- Synapse – For an ANN, a numerical value, here synonymous with the term connection weight, used as a mathematical multiplier of raw signals communicated between neurons. Emulating short- and long-term potentiation within the electrochemical synapses of the brain, such connections are responsible for absorbing an understanding of the exemplar patterns through the binding of neurons into colonies that form token representations of the principal features of the external world and then forming connections between such islands that reflect largely spatial and temporal correlations between the represented entities. For all intents and purposes, the *synaptic organization* of a neural network, either biological or simulated, is regarded as the network itself, since connections typically far outnumber neurons, the latter representing the same, repeated mathematical transformation.
- Pattern completion – The neural network process wherein missing components of incomplete or corrupted environmental patterns are filled in based upon learned relationships stored within the network's synaptic connection weights. In effect, this process is tantamount to our staring at clouds and imagining animal or human forms, or reading a misspelled word and perceiving its correct form.
- Associative memory – Usually a perceptron that is trained by example to replicate whatever input patterns are applied to it. By making such *auto-associative* networks recurrent, constantly recycling the generated output patterns back to the input layer, the network is able to accept incomplete data patterns as "clues" to the information sought, thereby enabling the reconstruction of sought knowledge through perfective cycles of pattern completion. Such recursion is tantamount to the time evolution of a biological neural net as it settles into a persistent and stable activation state we regard as a *memory*.

Creativity Machines

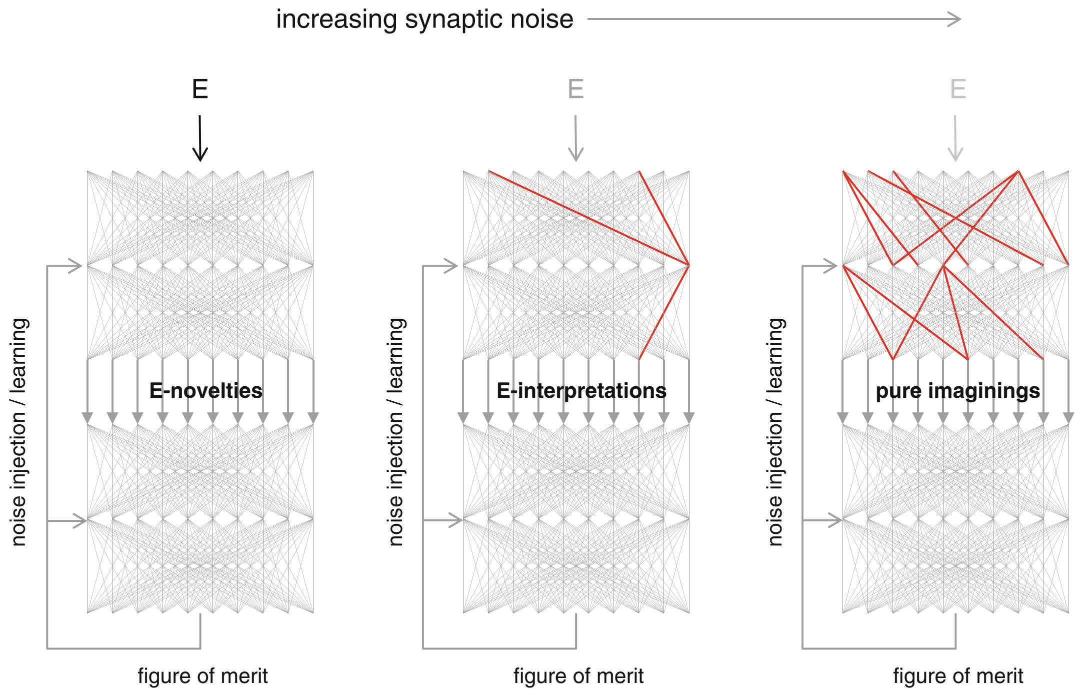
Neural network practitioners often build what are known as *hierarchical cascades* in which one or more preliminary networks accept input patterns from the environment, relaying their output patterns in turn to downstream networks that carry out subsequent pattern-based computations. Similarly, Creativity Machines consist of such cascades (Fig. 1), but the patterns initiating the propagation of information do not necessarily originate in the external environment. Instead, these "seed" patterns have either a complete or partial genesis within the gateway nets of the cascade and are nucleated by all manner of entropic disturbances to these assemblies' neurons and synaptic interconnects. In effect,

Creativity Machine® Paradigm, Fig. 1 *A simple creativity machine, US patents 5,659,666 and 7,454,388*. Transient disturbances within a neural net called an "imagitron" generate confabulatory patterns that are judged for utility or value by a monitoring network traditionally regarded as a "perceptron." Feedback effects between both networks accelerate convergence toward useful solution patterns, oftentimes absorbing them into both networks' cumulative learning (*Red weights* represent those being momentarily perturbed)



such random or chaotic perturbations can drive the turnover of memories as if actual environmental stimuli are being presented to the nets' sensory input layers (Thaler 1995a, b). Appropriately tuned, such disturbances succeed in morphing tokenized entities and relationships collectively stored within such perturbed networks' synapses into plausible to semi-plausible notions the cascade has never directly experienced. The resulting phantom experience within such perturbed networks, coined *imagitrons*, emulates a broad range of virtual, cognitive experiences, ranging from hallucinatory effects to the parade of memories and ideas we commonly regard as contemplation and creative thought. By using downstream networks within these cascades that associate a pattern-based figure of merit with these confabulatory patterns and using such perceived worth to further control the disturbances applied to upstream nets, new and often useful concepts spontaneously emerge.

Figure 2 emphasizes the role of environmental inputs to the Creativity Machine architecture. When both networks of this simple cascade are quiescent (left), the imagitron can serve as a novelty filter that can detect anomalous environmental patterns (E-novelties) through comparison with its stored memories, subsequently recruiting the perceptron to detect any such patterns offering utility or value. As the mean synaptic disturbance level increases (center), the imagitron generates alternative interpretations of any applied environmental pattern (E-interpretations), allowing the perceptron to bias the input pattern's meaning through feedback noise, with the system now fulfilling a sense-making or disambiguation role. Finally, at sufficient levels of perturbation (right), any internal noise swamps out the influence of environmental patterns,



Creativity Machine® Paradigm, Fig. 2 *Growing insensitivity to environmental input, E, with increasing synaptic noise*. As the perceptron injects increasing levels of synaptic noise (*red weights*), the system becomes "attention deficit," first forming alternative interpretations to environmental stimuli and then becoming aloof to the surroundings as it freely imagines, drawing only upon stored memories and derivative confabulations

allowing the system to carry out an "eyes-shut" invention or discovery process.

Creativity Machine accomplishments over the last 23 years have spanned areas of creative interpretation, concept generation, and adaptive control (Table 1). They have often been built from numerous neural modules, so as to combine distinct conceptual spaces into compound discoveries and inventions. The individual neural assemblies therein have automatically recruited each other into complex topologies and recurrencies, subjecting each other to noise levels sufficient to generate a succession of promising juxtapositional concepts or strategies. Equipped with both sensor and actuators suites, such synthetic brains have served as improvisational control systems for various types of military and space flight robots that must often ad-lib behaviors to fit newly arising environmental challenges.

Because of the diversity of Creativity Machine types, objectives, and ties with human cognition, an extensive vocabulary has arisen to prescribe both architecture and function of these systems. Those terms germane to this discussion include:

- Imagitron (a.k.a., Imagination Engine) – Any synaptically connected architecture involving one or more perceptrons that are perturbed by any form of random, semi-random, or systematic disturbances so as to drive the generation of potential ideas.
- Perceptron – In the context of the Creativity Machine, one or more pattern-associating neural nets that link themselves into associative chains and loops in response to the patterns generated by imagitrons. To liken this process to human cognition, a novel pattern issuing from an imagitron can initiate a chain of pleasant associations indicative of the "goodness" perceived. Alternately, notions lacking promise can generate an associative gestalt of negative memories, "badness," that may involve recollections of past physical pain.

Creativity Machine® Paradigm, Table 1 Some creativity machine accomplishments

Accomplishment	Year
Generation of alternative Christmas carols	1989
Generation of 11,000 musical hooks	1995
Design of new personal hygiene products	1996
Prediction of new ultrahard, supermagnetic, and superconducting materials	1996
Invention of novel and useful neural architectures that became patents	1997
Autonomous control of communications satellites	1997
Autonomous generation of hypothetical facial portraits	1997
Autonomous writing of computer code for data compression	1998
Generation of two million new potential English words	1999
Semantic interpretation of web content	2000
Military resource allocation and logistics	2000
Complex hexapod robots invent their own behaviors and ad lib responses to novel scenarios	2001
Creative, communal intelligence for robotic swarms	2002
Autonomous recruitment of neural network modules to grow complex synthetic brains for robotic control	2002
Album of original musical compositions	2006
Growing of brain-like neural pathways for automotive machine vision applications	2006
Autonomous rendezvous and docking of space vehicles	2007
Hardening of spacecraft hull designs to hypervelocity impact	2011

- Perturbation – A mathematically describable disturbance to any element of a connectionist architecture, alternately referred to herein as noise or cavitation.
- Cavitation – A term that has been applied to the perturbations occurring within the "cavity" of a trained neural network, in which random variations are being applied to a dense, quasi-continuous matrix of synaptic connections. The chance aggregation of multiple perturbations among one or more neighboring synapses may be likened to bubble formation within a boiling fluid or "bubbles" of cortical activity observed in functional brain scans.
- Perceptron-imagitron pairs – The permanent or transient combination of a generative imagitron and an evaluating perceptron that forms the basis of a Creativity Machine, with or without the crucial feedback connections. In complex cascades consisting of multiple perceptrons and imagitrons, a subset of the perceptrons may momentarily lock on to notions emerging from some subset of the imagitrons. Transiently, the "resonant" imagitrons and perceptrons form compound Creativity Machines.
- Prosody – The rhythm or temporal distribution of idea generation, characterized herein by its fractal dimension.
- Thalamocortical loop – A representative example of Creativity Machine Paradigm in neurobiology wherein the thalamus is attentive to noise-seeded notions generated within cortex. Putatively, reentrant connections to cortex as well as global neurotransmitter release following an associative gestalt (see perceptron definition) provide the feedback connection depicted in Fig. 1.
- Creativity Machine – A neural architecture involving at least one assembly of nodes and interconnects, subjected to all manner of random or systematic disturbances so as to produce patterns representing potential ideas and/or plans of action, such notions being communicated to an algorithm of any kind that evaluates these candidate concepts for novelty, utility, value, or appeal. In the

preferred embodiment used in scientific discussion (Fig. 1), the cascade takes the form of one synaptically perturbed imagitron that is both monitored and oftentimes controlled by the response of a perceptron.

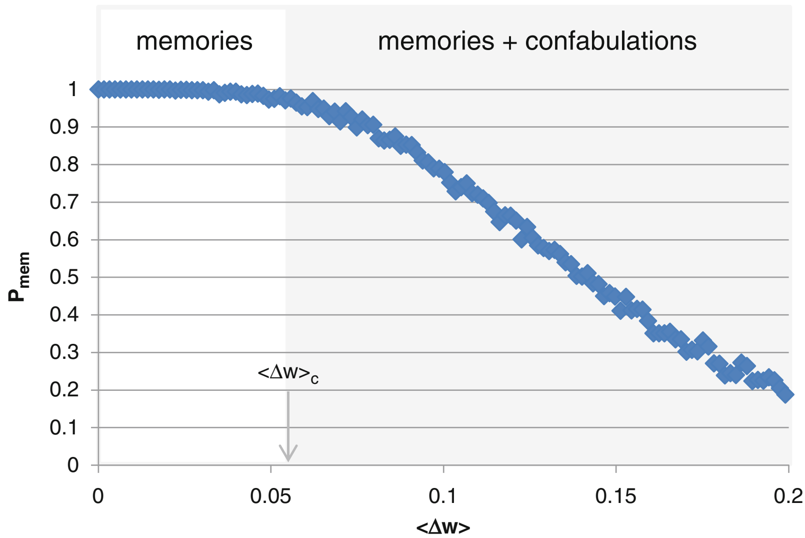
- DAGUI – An acronym standing for "Device for the Autonomous Generation of Useful Information," a non-learning Creativity Machine.
- DABUI – An acronym standing for "Device for the Autonomous Bootstrapping of Useful Information," an adaptive Creativity Machine capable of learning from the effectiveness of any of its generated ideas or strategies.

Historical and Theoretical Background

Early Creativity Machine research (1974–1985) focused primarily upon damage mechanisms within associative memories that generated interesting or unusual notions. The first published work on this subject dealt with near-death simulations using trained artificial neural networks wherein the network degradation involved progressively increasing levels of simulated cell death (apoptosis) that resulted in the nullification of synaptic connection weights (Thaler 1995a). In summary, all NDE simulations generated similar results, no matter how large or complex the synaptic organization of the neural network: In the early stages of network degradation, the net activated into intact memories of its training exemplars in a manner reminiscent of life review. At advanced stages of network destruction, the neural assembly output, whimsical and often plausible patterns, oftentimes creating interesting and useful information, as in one classic experiment in which a perceptron-based associative memory was trained on numerous Christmas carols. At confabulatory levels of destruction, the net output novel lyrics that revealed their pedigree in the training exemplars, such as "In the end all men go to good earth in one eternal silent night," or "Deck the halls with last year's follies." In effect, the network had learned the implicit linguistic rules behind such holiday lyrics, beginning at the granularity of letters and words, and was able to interchange frequently encountered entities in a way that formed coherent statements of potential intrigue to human perception. Early published papers (such as Thaler 1995b) dealt largely with the role of low levels of synaptic damage in generating phantom inputs from the environment. The first mention of the practical use of such confabulatory neural nets monitored by evaluation algorithms appeared in 1997 with both a paper on computational creativity (Thaler 1997) and the relevant patent, US 5,659,666.

Early on, it became quite evident that the same system, namely, a synaptically perturbed neural network, could provide creative possibilities within any conceptual space. Thus, an associative memory that had been cumulatively exposed to valid chemical formulas produced both novel and plausible theoretical chemistries (Thaler 1998). A perturbed perceptron shown numerous design specifications for consumer products generated plausible new merchandise concepts (Plotkin 2009). A cavitating associative memory that had witnessed the kinematics of a complex robot generated totally new and physically realizable movement strategies to improvise new behaviors to deal with unanticipated scenarios (Patrick et al. 2006). In short, in just a few moments, a neural network could quickly absorb a conceptual space and with the addition of synaptic misinformation, if you will, generate a stream of potential ideas applicable to that realm. By attaching a monitoring perceptron, trained by example to recognize useful or appealing confabulations, the extraction of useful information from a perturbed neural net's ideational stream was now automated. To further accelerate the process, the perceptrons were allowed to modulate the statistical average of perturbations applied to the synapses of the imagitrons, allowing the combined networks to self-optimize the turnover rate of useful ideas. As these nets equilibrated, they typically selected cavitation levels near the phase boundary ($<\Delta w>_c$) of Fig. 3, separating memory and confabulation generation within the imagitron. The idea-generating efficiency near this transition is characteristic of what Partridge and Rowe (1993) have called *multi-stage search*, the "holy grail" of computational creativity wherein conceptual

Creativity Machine® Paradigm, Fig. 3 *The phase boundary between cavitation-induced memory and confabulation generation*. The plot depicts the fall off in the probability of rote memory generation, P_{mem}, as mean synaptic perturbation level, $<\Delta w>$, is ramped up within a representative associative memory. Useful confabulatory patterns typically emerge near $<\Delta w>_c$



patterns generated represent a balance between a rigid search as through a preprogrammed decision tree ($<\Delta w> << <\Delta w>_c$, neo-Lamarckian search) and totally unconstrained pattern production ($<\Delta w> >> <\Delta w>_c$, neo-Darwinian search) as in a genetic algorithm.

Research in 1997 (Thaler 1997) not only demonstrated how such brainstorming neural nets could qualitatively emulate the inventive processes inherent to neurobiology but how they could be used to quantitatively model the prosody with which thoughts and ideas were generated in the brain. In summary, these studies strongly suggested that the evolution of human thought, creative or not, could be modeled as the state transition rate of a representative thresholding neuron nested within a network subjected to random synaptic disturbances. Through both empirical and theoretical studies, a revealing relationship emerged between the "microscopic" synaptic perturbation rate of an average neuron and the "macroscopic" pattern turnover of the network as a whole,

$$\rho = \kappa \Delta t^{-D_0} \tag{1}$$

where ρ is the average time rate of change of synaptic weights to this representative neuron, Δt the time required for the overall network to activate into a required number of distinct patterns (ideas), D_0 the fractal dimension of the succession of such patterns, and κ a dimension preserving proportionality constant.

In assessing the validity of Eq. 1, numerous, trained perceptrons were subjected to successive cycles of synaptic perturbation, steadily increasing the mean cavitation level, ρ. Within each such cycle (consisting of multiple experiments at the same cavitation rate), the number of synaptic perturbations, n, and their magnitudes, σ, were randomly varied with their product maintained constant, with the average synaptic perturbation, $<\Delta w>$, evaluating to $n\sigma/N$, where N represented the total number of network synapses. With ρ identified as $n\sigma/N\delta t$, δt was set to 300 ms, the characteristic bubble formation time observed in functional brain scans, thereby bringing fits of Eq. 1 to both human cognition and Creativity Machine function into close agreement. Qualitatively, it was found that sparse and intense synaptic fluctuations (σ or n large) corresponded to novel concept formation (i.e., creativity) while more uniformly distributed perturbations (σ and n small or intermediate) appeared associated with rote memory recall.

Dramatic results were observed in 1998, when adaptive neural nets were used as the building blocks of Creativity Machines, allowing them to test their concepts and strategies on either the environment or themselves through a variety of sensing and actuator schemes, enabling them to reinforce the memories of notions they associated with success, while weakening the recollection of those they deemed non-useful. Through successive cycles of idea generation, evaluation, and reinforcement learning, such self-bootstrapping Creativity Machines (DABUI, US Patent 7,454,388) running on a single personal computer were able to arrive at solution patterns within unprecedentedly large conceptual spaces having tens of millions of attributes, in just minutes.

Correspondence with High-Level Models of Creativity and Innovation

A useful nomenclature for describing not only Creativity Machine architectures but also human creativity (Thaler 1996) appeared in 1996, wherein E represents all potential patterns generated ultimately by the energetics of the environment. Within this descriptive symbolism, the letter O is used to denote perceptron stages, suggesting their roles as observing neural networks. Imagitron stages are labeled by either the letters U, V, or W, depending upon the levels of synaptic noise injected into them:

- U-Mode – Generally, U represents an imagitron into which minimal noise has been introduced ($<\Delta w> \; < \; <\Delta w>_c$, referring to Fig. 3), thus driving it to visit a series of rote memories that have been drawn from the network's previous training experience, its universe, so to speak.
- V-Mode – Imagitrons operating at the critical noise level, near $<\Delta w>_c$, are depicted as V, suggesting that they are producing virtual memories of potential things and scenarios that could be part of the net's external environment, but hitherto have not been directly experienced by it through training.
- W-Mode – Finally, W denotes an imagitron driven by noise levels far in excess of those injected in the critical regime ($<\Delta w> \; > \; <\Delta w>_c$). As a result, most of the constraint relationships characteristic of the conceptual space have been destroyed leading to the generation of predominantly meaningless noise, in a mode reminiscent of the *blind watchman* allegory.

Connecting with this formalism, the process of *incubation*, the temporary break from problem solving that can result in insight (Smith 1991), can be explained on the basis of the general diffusional release of stress-related neurotransmitters and neurohormones within the brain that serve to progressively transition imagitrons from U to V, and possibly W mode, during which time, new concepts are created and learned at a "subconscious" level (outside the purview of perceptrons). Following the hiatus from intense imaginative ideation, the concentration of such perturbative agents recede, leaving the perceptron stage in a more tranquil and lucid state, allowing it to recognize the utility of such freshly created and memorized concepts, as the imagitron's noise levels increase again into the U regime.

A perceptron observing multiple U-mode imagitrons jointly activating into a novel concatenation of memories (a $U_1U_2U_3...U_N$-O process) models the blending of information from multiple conceptual spaces into juxtapositional inventions and discoveries. Similarly, some imagitrons within this juxtapositional string may be operative within the V regime, allowing for the injection of hypothetical entities and scenarios into the composite pattern, leading to $U_1U_2U_3...U_MV_1V_2V_3...V_N$-O discovery. In many respects, such U_iU_j-O and U_iV_j-O discovery modes may very well represent the high-level concept of *bisociation* (Koestler 1964) wherein facts from entirely different frames of reference are combined to provide promising syllogisms, scientific theories, artistic creations, and amusing juxtapositions offering comic import, with the significance of any of these conceptual blends being generated through the perceptron's input-output mapping.

Overall, the Creativity Machine Paradigm falls into correspondence with many high-level, introspective models of seminal cognition, while possibly expanding the definition of creativity itself. If all of cognition may be modeled via the noise-driven brainstorming session between at least two neural networks wherein novel patterns generated by some are recognized as valuable by others, then the definition of what exactly is creative boils down to the perception of what is deemed "novel" or "useful," the province of neurobiological perceptrons. Indeed, the fruits of so-called H-creativity (Boden 2004) are considered novel from a societal perspective wherein many weakly coupled sense-making Creativity Machines (i.e., sundry brains) come to a consensus regarding the originality and usefulness of a given ideational pattern. P-creativity emerges as strongly coupled perceptrons within an individual's brain perceive utility to an anomalous neural activation pattern representing a concept already known to other individuals.

Herein, we have alluded to the fact that much of non-seminal cognition is dominated by the Creativity Machine Paradigm, including the more visceral mental activities occurring outside of conscious awareness, wherein the brain invents, for instance, a succession of eyeball movements to visually examine its environment in the well-known process of *foveation*. Owing to the fact that memories of where we have previously looked are effectively rediscovered through synaptic noise and relearning, we could regard such relatively trivial neural activity as visceral or "V-creativity." Included within this class of minimal creativity may be the process by which we unconsciously attach subjective significance (i.e., pattern associations) to the sum total of neural activity within our brains in a process we call *consciousness*.

Conclusion and Future Directions

The main conceptual barrier to understanding the Creativity Machine principle is that everything in the world may be represented by, and arguably is, a numerical pattern. That the patterns activated within the brain seem so much like the entities and scenarios from the environment, and not like numbers, is that the neural networks therein have habituated to each other, rapidly decrypting and intuitively recognizing these token representations of the world as equivalent to the "real" thing. When damage occurs within these systems, in particular to the synaptic connections, they generate false memories that can either transmogrify these token entities and/or their interrelationships to produce stable patterns of activation previously unknown to the nets therein. These novel, ideational patterns, deemed useful by monitoring nets, span the range of all things considered creative, whether the conceptualization of a sculpture, a concerto, a joke, or the clever interpretation of a painting or book. In the same way, fundamental analogies, bound within neural assemblies, may transiently interconnect themselves into new theories and logical conclusions. These systems may be convergent, stopping when they are satisfied with a given novel pattern, or be divergent, amassing any number of such ideations by converting them into memories. In effect, the Creativity Machine Paradigm could very well serve as a unifying theory of creativity, and perhaps even consciousness, wherein meaning is invented reflexively, not only to what is observed or imagined but to what is intrinsically just the succession of on/off neural activation patterns inexorably taking place within the neurobiological networks of the brain.

Cross-References

▶ Cognition of Creativity
▶ Creative Brain
▶ Creativity in Invention, Theories
▶ Creativity, Experiential Theories
▶ Divergent Thinking
▶ Ideas and Ideation
▶ Imagination
▶ In Search of Cognitive Foundations of Creativity
▶ Models for Creative Inventions
▶ Nature of Creativity

References

Boden MA. The creative mind: myths and mechanisms. New York: Routledge; 2004.

Koestler A. The act of creation. New York: Penguin; 1964.

Patrick MC, Thaler SL, Stevenson-Chavis K. Demonstration of self-training autonomous neural networks in space vehicle docking simulations, 2006, NASA-MSFC. Available at http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20070018815_2007018767.pdf.

Plotkin R. The genie in the machine. Stanford: Stanford University Press; 2009.
Rowe J, Partridge D. Creativity: a survey of AI approaches. Artif Intell Rev. 1993;7(1):43–70.
Smith SM, Blakenship SE. Incubation and the persistence of fixation in problem solving. Am J Psychol. 1991;104(1):61–87.
Thaler SL. Death of a gedanken creature. J Near Death Stud. 1995a;13(3). Spring 1995.
Thaler SL. “Virtual input” phenomena within the death of a simple pattern associator. Neural Networks. 1995b;8(1):55–65.
Thaler SL. Predicting ultra-hard binary compounds via cascaded auto- and hetero- associative neural networks. J Alloys Compd. 1998;279(1998):47–59.
Thaler SL. A proposed symbolism for network-implemented discovery processes. Proceedings of the World Congress on Neural Networks; 1996; Mahwah, NJ: Lawrence Erlbaum & Associates; 1996. p. 1265–68.
Thaler SL. A quantitative model of seminal cognition: the creativity machine paradigm. Mind II Conference, Dublin, Ireland, 1997. Available from http://imagination-engines.com/iei_seminal_cognition.htm

Creativity Management

► Intellectual Property, Creative Industries, and Entrepreneurial Strategies

Creativity Management Optimization

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Synonyms

Creative management; Creativity optimization; Innovation management; Managing creativity

Definition

Creativity management is a system of principles, methods, techniques, practices, and instruments for managing employee creativity in order to get the maximum effect for the organization according to its goals, objectives, employee contingent, and available resources.

Functions and a Special Status of Creativity Management

As a result of increased interest of business in creativity, the management of creativity appeared as a special theoretical and practical discipline in the end of the 1980s. This interdisciplinary movement partially grounds on creativity psychology, HR management, organizational psychology, R&D management, innovation management, and other adjacent disciplines. The term “creativity management” has been used constantly for the last 2 decades, and significant experience has been accumulated in this field, but there is no theoretical or practical consensus on a definite understanding of goals, functions, and methods of creativity management yet.

A definition of creativity management may be specified by allocating its main objectives and functions (Dubina 2006, 2007):

- Development of techniques for the production and evaluation of new ideas
- Support, facilitation, and development of employee creativity
- Encouraging and fostering employee creativity
- Assessment employee creative styles
- Creative team building
- Organizing, monitoring, and directing employee creativity
- Assessment of the effectiveness of different programs for employee creativity development
- Assessment of creative climate in a company
- Construction of an optimal environment for creativity
- Elimination of constraints against creativity

The comparison of the mentioned functions with the main function of R&D management (organizing basic and applied research, inventing and developing inventions into working prototypes, testing and modifying products) demonstrates overlaps in the field of organizing the process of generating and evaluating new ideas. Comparing the major functions of innovation management (facilitating a company's innovative culture, assessing the prospective efficiency of new ideas and inventions, work planning, project scheduling, estimating and assigning resources) delineates the intersection in the field of organizing a supporting climate for generating and developing new ideas. But in general, creativity management, R&D management, and innovation management are complementary management approaches; they have their own status according to their own objects, objectives, and functions. Understanding creativity management only as an initial component of R&D or innovation management narrows down the field of a manager's view on creativity potentials and limits the possibilities of mobilizing employee creativity in all business processes.

Optimally Integrating Approaches to Managing Creativity

The research conducted by Banks et al. (2003) demonstrates significant variations in managers' understanding of creativity management. Based on this research and other works, it is possible to allocate five different approaches to creativity management (or five groups of managers who cultivate such approaches) (Dubina 2006).

The first group rejects and even suppresses creativity as a useless factor in business. Many managers often decry creativity as unpredictable and uncontrollable, like the weather. Therefore, they do not want to invest in creativity development programs; they do not want their employees exhibiting creativity, because, in their opinion, employees must follow instructions to complete their work on time and within budget.

Managers of the second group consider creativity as rather important, but not a crucial factor or a primary determinant of competitive advantages. They also understand creativity as something that cannot be managed; therefore, it demands no special attention or nurturing. The main principle of this approach is nonintervention.

The third group accents creativity facilitation by providing appropriate workplace conditions. The fourth group focuses on intensive fostering and developing creative skills. These two approaches are most popular among managers and are often associated with the whole system of creativity management.

The fifth group emphasizes the need to direct and control employee creativity; this is not, certainly, an overall control and prescriptive procedure but a form of "soft" organizing, focusing, and directing. These managers acknowledge the necessity of creativity harmless for business processes; therefore, it must be monitored and controlled and sometimes even constrained to ensure realization of the company's objectives. This point of view is rarely recognized or acknowledged, because such words as controlling, organizing, and optimizing in conjunction with creativity sound like something of a paradox.

It is an obvious and almost trivial postulate that the efficient development of actual business systems is currently precluded without creativity and change. However, creativity is opposed to the cyclical repetitions and actions in a business system, because creativity presumes the violation of routine repetition and the introduction of new elements; creativity is disruptive in its very nature. In the case of repetitive activity, an employee operates within the rules established by the regulation system, and in the case of creative activity, he or she transforms the existing standards, combines the assigned rules, and creates new ones, thus changing the status and level of the managed system. Uncontrolled creativity of employees may be detrimental for a company, if employee creativity is not adequately engaged in the organizational context. Therefore, the assessment of the level of probable change and, consequently, the evaluation of the level of admissible creativity are required. This is the rationalization behind setting up the questions of searching for the optimal range of employee creativity, as well as an optimal program for creativity development and actualization: What programs for creativity development and creative climate improvement should be carried out, which resources should be invested in that program, and what results will be obtained? Intuitive decisions and qualitative analysis are often not successful, especially for medium and large business structures requiring more reliable and effective tools for decision making in this field.

Managers often consider creativity as an instrument for problem solving. Hence, they often turn to employee creativity when confronted with a problem. De Bono (1993) characterizes such an approach to creativity as "a huge waste of thinking capacity," because "the most progress comes from thinking about things that are not problems." Creativity focused on solving current problems can ensure survival for a company, while creativity focused on searching for new opportunities can ensure successful development. Managers should encourage their employees to think creatively not only to solve a problem but also to seek out new opportunities for the workplace, the department, or the company.

It is not uncommon, as Tan (1998) notes, to find managers working hard to ensure that their organizations have a nurturing environment to encourage creativity. But even if creativity management is carried out in a company, it is often implemented in a nonsystematic way: Managers may occasionally organize some training or workshops on creative decision making for the employees or supervisors, conduct creativity sessions to find a solution for some business problem, make some changes in the reward system to encourage creative suggestions, and so on. Therefore, managers very often pay attention to some single approach, for example, creativity training or creativity motivation system improvement, and fail to take into consideration other aspects and approaches of creativity management, such as creativity evaluation, creativity outcome control, assessing the work environment for creativity, or searching for an optimal strategy for creativity mobilization.

A Conception of Optimally Managing Creativity

The idea of "optimally managing creativity" follows from the conception of a balance between *stability* and *development* (Dubina 2005). It resembles an obvious and almost trivial postulate that the efficient development of actual business systems is currently precluded without creativity and change. However, creativity opposes the cyclical repetitions and actions in a business system, because creativity presumes the violation of routine repetition and the introduction of new elements; creativity is disruptive in its very nature. In the case of repetitive activity, an employee operates within the rules established by the regulation system, and in the case of creative activity, he or she transforms the existing standards, combines the assigned rules, and creates new ones, thus changing the status and level of the managed system. Uncontrolled creativity of employees may be detrimental for a company, if employee creativity is not adequately engaged in the organizational context. Therefore, assessments of the level of probable change and, consequently, the evaluation of the level of admissible creativity are required. This represents the rationale for setting up questions of searching for the optimal range of employee creativity as well as optimal programs for creativity development and actualization: Which program for creativity development and creative climate improvement should be carried out, which resources should be invested in that program, and which results will be obtained?

In practice, such speculations are realized, for instance, in the context of building a balanced creative team which includes people with different *creative styles*, for example, adaptive styles which are targeted at improving the existing paradigm and innovative styles which are disruptive for the paradigm.

So, the first basic idea of optimizing creativity management is based on the statement that the successful and efficient development of actual business systems implies *both* repetitive and creative functions in the working activities of employees. The paradox (and the problem) focuses on the opposition of creativity versus the cyclical repetition of some actions and results in the function of a business system, because creativity displays a disruptive nature and supposes the alteration (violation) of routine repetitions and the introduction of new elements into the system. At the same time, the prolonged development of any business system is not possible without creativity and change.

The second idea of optimally managing creativity associates the costs of creativity development with the obtained results. If an employer implements activities for the employee's creativity development (e.g., tailored training programs, purchasing special software for creative decision support, changing an organizational climate to encourage employees to submit new ideas), he or she may increase the employee's performance with the same wage level, because the employee's creativity is being leveraged. However, this approach requires additional resources, so the problem of the effectiveness of the investment in creativity arises. It is obvious that this investment should be less than performance augmentation to ensure the profitability of the implemented creativity program.

Therefore, the problem of optimally managing creativity may be phrased in the following questions:

- How (in what way) to use and mobilize employees' creativity to ensure the best result for *this* company?
- Which interventions in employees' creativity and organizational climate, and to which extent, are required to maximize the positive effect of these activities for *this* company?
- What is the range and effectiveness of different interventions and programs that can develop creativity and improve creative climate (taking into account the specificity of a company)?
- What is the range of influence of employee creativity and creative climate characteristics on work performance?

It would be naive to expect universal and general answers to these questions. However, the recent amount and quality of research on assessing creativity and creative climate, as well as accumulated management experience in the fields of creativity training and improvement of the work environment, assume that these questions may be solved.

An optimizing creativity management represents not a mechanistic approach to precisely predicting and regulating creative activities. The main principle of optimizing creativity management can be formulated as follows: *Even if it is not possible to predict exact results from interventions for facilitating and fostering creativity, it is possible to select and implement the interventions which provide the best results for a given company in a present situation* (Dubina 2006, 2007).

An approach of optimizing creativity management is an element of the realization of a "total system approach" to the management of creativity as being proclaimed by Tan (1998) for holistically managing creativity in a company. The system approach should ensure that all organizational rules, routines, and procedures, as well as the organization subsystems (organizational culture, workplace environment, management structure, reward system, etc.), mutually support one another in order to develop and use creativity resources most effectively. In practice, the principles of optimizing creativity management are realized in team building, creativity training, and improving organizational climate (Dubina 2007).

Conclusions and Future Directions

Presently, in the sphere of both practical management and management scholarship, there is consensus about creativity as a valuable and inexhaustible business and economic resource.

All business processes of a company should involve creativity, but, at the same time, employee creativity needs to be properly organized and monitored. A too narrow understanding of creativity management (only as an improvement and development) predominates in the management theory and practice, but effective creativity management should not only support, develop, and encourage employee creativity but also assess, organize, and direct it. The management of creativity refers not only to creativity development but addresses also aspects of assessment and optimization.

This entry argues for the necessity of optimizing creativity management in a company/organization in order to mobilize the resource of creativity more effectively. Optimizing creativity management is considered as an evolutionary stage and component of the development of the "total system approach" proclaimed by Tan (1998) to holistically manage creativity in a company. A company needs creativity management optimization in order to mobilize the resources of creativity more effectively. Optimizing creativity management presumes effectively organizing resources and interventions for developing creativity and improving the work environment for creativity.

One of comparatively new approaches to optimally manage creativity is the application of mathematical optimization models to the systems and processes of organizing and stimulating creative and innovative activities. In particular, such a research direction is developed in Dubina (2012) on the methodological basis of game theory.

The approach of optimally managing creativity indicates prospective directions both for theoretical investigations and practical techniques to manage employee creativity more systematically, methodically, and relevantly to the specificity of an organization, its goals, and resources.

Cross-References

▶ Business Creativity
▶ Corporate Creativity
▶ Creative Management
▶ Creative Styles
▶ Creativity and Innovation: What Is the Difference?
▶ Four Ps in Organizational Creativity
▶ Model for Managing Intangibility of Organizational Creativity: Management Innovation Index
▶ Measuring Organizational Climate for Creativity and Innovation
▶ Simplexity Thinking

References

Banks M, Eliott M, Owen J. Managing creativity and competitive advantage in SMEs: examining creative, new media firms. In: Jones O, Tilley F, editors. Competitive advantage in SMEs: organizing for innovation and change. Hoboken: Wiley; 2003. p. 120–34.

De Bono E. Sur/petition: creating value monopolies when everyone else is merely competing. New York: Harper Business; 1993.

Dubina IN. Game-theoretic models and methods of the organization of creative and innovative activities. Dissertation of habil. Dr. of Sci. in Economics. Novosibirsk: Novosibirsk State University; 2012 (in Russian).

Dubina IN. Managing creativity: theoretical approaches to employees' creativity regulation. Int J Manag Concept Philos. 2005;1(4):334–49.

Dubina IN. Optimising creativity management: problems and principles. Int J Manag Decis Mak. 2006;7(6):677–91.

Dubina IN. Optimally managing creativity in organizations. In: Carayannis EG, Chanaron JJ, editors. Managing creative and innovative people: the art, science and craft of fostering creativity, triggering invention and catalyzing innovation. Westport: Praeger; 2007. p. 143–69.

Tan G. Managing creativity in organizations: a total system approach. Creativity Innov Manag. 1998;7(1):23–31.

Creativity Models

▶ Multiple Models of Creativity

Creativity Optimization

▶ Creativity Management Optimization

Creativity Research

▶ Psychology of Creativity
▶ Research on Creativity

Creativity Slump

▶ Decrease in Creativity

Creativity Spillovers

▶ Entrepreneurship in Creative Economy

Creativity Techniques

▶ Creativity in Invention, Theories
▶ Strategic Thinking and Creative Invention

Creativity Techniques: Use of Creativity Techniques in Innovation Processes

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Creative Ideas as a Starting Point for Innovations

Basis of any innovation is a creative thought. It may be that, prior to the creative impulse, reflections and analyses have been made to develop new products or services in a certain customer segment or to solve identified problems or challenges. When a task or even a pressure to develop an innovation is imposed to individuals, very often, concrete ideas are not emerging. A creative idea must arise in a motivated person's brain; then it must be formulated accurately, technically developed, and finally launched as a new product or new service to the market.

A creative concept typically ignores common solutions and structures. Instead, it relies on new approaches. Usually after a creative concept has been generated, laborious work of verification, development, and implementation follows.

Looking at current real innovations, it is obvious that not only one single "brilliant" idea led to the innovation, rather additional, more detailed and complementary ideas compliment the new product development. Thus, multiple creative inputs foster the whole formation process and lead to an innovation. An innovation is of course initiated by a fundamental creative impulse. However, in the course of the development process, numerous other creative inputs are added.

These creative inputs for innovation can come from entrepreneurs, managers, or employees in R&D; they may arise in innovation units or in other departments as a result of personal thinking. These valuable creative contributions are not predictable. As innovation processes in companies nowadays are structured with respect to results and deadlines, specific tools are needed to help generating ideas strategically and within a manageable time frame. Creativity techniques comply with these requirements. They serve as an important tool in addition to the individual creative contributions of employees or proposals from external sources (open innovation).

Creativity Techniques

Basis and Overview

Related to innovation creativity is understood as the human ability to combine elements of knowledge and experience from different areas in an unconventional way, thus triggering new ideas for products or services to solve problems or challenges. Thus, established structures and thought patterns are overcome.

Creativity techniques support the genesis of ideas. They consist of a set of thinking and behavior rules, which stimulate as an overall effect a group or an individual to generate ideas. The most practiced creativity techniques are designed

Creativity Techniques: Use of Creativity Techniques in Innovation Processes, Fig. 1 Grouping of creativity techniques

Techniques of Free Association
- Brainstorming
- Circulating cards technique
- Ring Exchange Technique
- Mindmapping

Techniques of Structured Association
- Walt Disney Method
- Six Hats Method
- Semantic Intuition

Imagination Techniques
- Try to become the problem*
- Take a picture of the problem*
- Fantasy Journeys*

Confrontation Techniques
- Synectics Excursion*
- Stimulating Word Analysis
- Visual-Confrontation-in-the-Group
- Picture Cards Brainwriting
- TRIZ Invention Principles

Configuration Techniques
- Morphological Tableau
- Morphological Matrix
- Attribute Listing*
- SIT (Systematic Inventive Thinking)*

* Techniques that are less suited for application in innovation processes (see sect. "Less suitable Creativity Techniques for Innovation Tasks")

for application in a group; there are only few techniques designed to be applied by just one person. In heterogeneous groups, synergy effects take place, resulting in an extension of the search field, in a deepening of the search quality, and in cross-disciplinary exchange of solution approaches.

Concerning the rules of the individual techniques certain principles are specified, they are usually not recognized as such in the descriptions of the techniques. These principles are primarily:

- Idea-stimulating principles: association, combination, transfer of structures, analogy formation, confrontation
- Keeping individual barriers down: no constraints, no criticism, crazy ideas are welcome, anonymity of ideas written down, no names in the minutes
- Establishing a pleasant session atmosphere: stimulating physical environment, sensitive facilitators, informal behavior, encouragement of intuitive thinking, welcoming humor

Meanwhile, there are many creativity techniques; worldwide one can collect over 100 techniques. Quite often, some listed methods are very similar; they differ only in details or are named differently while following the same approach.

Some creativity techniques can be used in all areas that require creative inputs. On the other hand, there are methods especially suitable for certain applications (e.g., in advertising, for social issues, for technical inventions). Furthermore, in certain regions based on regional, cultural habits, specific creativity techniques are preferred (e.g., brainwriting methods in Japan, visual stimuli in China, less structured methods in the USA, contemplative techniques in Germany).

Creativity techniques can be distinguished according to idea inspiring principles (see Fig. 1). In Fig. 1, techniques are shown which have attained a certain dissemination in Europe. The following brief descriptions are limited to the techniques listed in this figure.

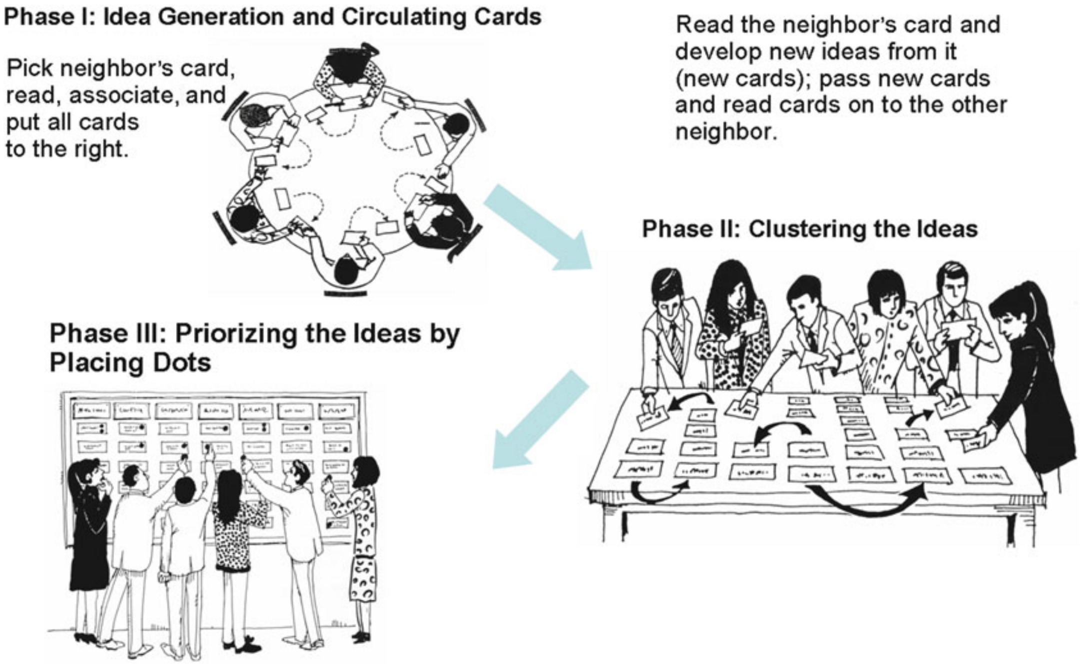
Description of Common Creativity Techniques

The following brief descriptions follow the outline in Fig. 1.

Techniques of Free Association

Idea generation in **brainstorming** sessions is mainly based on reciprocal-free associations of ideas within a group (Osborn 1953). All ideas brought up should be adopted by other participants (cross-fertilization). The following basic rules generally apply to all other creativity techniques:

- No criticism of the ideas is allowed.
- Even crazy ideas coming to one's mind should be expressed: they may stimulate other participants to realistic ideas.



Creativity Techniques: Use of Creativity Techniques in Innovation Processes, Fig. 2 Idea generation with circulating cards technique

- As many ideas as possible should be generated. The more ideas produced, the greater the probability to find a few really good and original ideas.

A brainstorming session is practiced in a group of five to eight participants and should take no longer than half an hour.

Brainstorming is normally considered to be a simple method and is therefore very widely applied. However, experience has shown that the rules are not properly obeyed. The role of the moderator is especially difficult; there is no distinct structure in the process that supports the moderation.

In the **brainwriting techniques**, speaking is replaced by writing; the participants write the ideas on sheets or cards. Apart from that, the basic principles are the same as for brainstorming. The stimulation of the participants is achieved by exchanging the described sheets or cards. The use of different page formats and exchange mechanisms caused in the course of time some brainwriting variants.

In the **ring-exchange technique**, standard stationary sheets are divided into three columns. Each participant writes three ideas in the first line, one in each of the three columns. After about 5 min, the sheets are passed on to the neighbor in a defined direction. The neighbor tries to further develop the ideas written in the first row and notes new ideas in the second line under the respective ideas of its predecessor. If no associations come to their mind, the participants are of course free to write down any idea they have. This procedure is repeated five times. With six participants and all sheets filled in completely, 108 ideas are recorded within about 30 min. Then, these ideas will be screened down and further developed.

The technique was introduced under the name “Method 635” by Rohrbach and further developed by Geschka (1986).

The **circulating cards technique** (see Fig. 2) uses the advantages of pin cards (Geschka et al. 1973). The ideas are written down on cards with thick markers. Each participant writes one idea

Creativity Techniques: Use of Creativity Techniques in Innovation Processes, Fig. 3 Color symbolism of the six hats method

- White Hat: objective information: numbers, data, facts, experience
- Red Hat: emotional and intuitive reactions, feelings
- Black Hat: concerns, difficulties, problems
- Yellow Hat: advantages, positive perspectives
- Green Hat: creative improvements, ideas, alternatives
- Blue Hat: moderation, task management, coordination of the other “hats”

on a separate card and places the cards on the right side to be picked up by the neighbor. The neighbor picks them up when he or she wants further stimuli from others. All participants pass their cards in the same direction. The cards circulate around the table. In this phase, nobody should speak. After about 20 min, idea generation may be stopped. A group of six participants generates normally 50–70 ideas. The idea cards are then clustered on a table; duplicates will be eliminated and the selected idea cards will then be finally pinned on a board. An initial evaluation of the ideas will follow via placing adhesive dots spontaneously on the cards. This approach reveals the most promising suggestions quickly.

To overcome the linear and well-established structures of thinking and writing the concept of **mindmapping** promotes an opening and widening of thinking. All thoughts, ideas, and other relevant issues are recorded in a tree-like structure (Buzan 1986). In the drawn tree structure, ideas and other aspects are characterized by terms, pictures, symbols, and colors. Through this structure and visualization, one receives a new insight of the solution field. Ideas emerge during developing the tree but also hereafter when the designed overall structure is interpreted.

Techniques of Structured Association

Applying the techniques of structured association, idea generation proceeds in defined steps: The problem solvers are guided through several stages of contemplation and the group is led into different lines of thinking – one after the other. This steered parallel thinking is more efficient then controversial discussions. These techniques allow coming up with positive and skeptical remarks as well as with rational and emotional thoughts.

The **Walt Disney method** (Dilts et al. 1991) arose from the Walt Disney’s approach of developing new projects. In a role-play, three thinking attitudes are taken sequentially on different chairs or in different rooms by a person or a group: The dreamers consider future developments and goals with no restrictions; it may be spun dreamed. In the second room, the implementation area and the visionary ideas are reviewed in relation to its implementation, pursuing a positive attitude. In the area of criticism, the suggestions are examined in a constructive manner in order to overcome resistance and obstacles.

The **six hats method** of De Bono (1985) leads systematically to a change of perspective: Symbolized by hats in different colors, different modes of thinking are consecutively conducted in a group (see Fig. 3). All statements are put down under the respective “hat.” A clear separation between the “hats” is important. The reactions to the thinking hats should be spontaneous and quick. The method should take not longer than 30 min.

Many everyday objects and inventions have a descriptive name; they are often composed of two words. Examples are hair curler, heating pad, corkscrew, and ignition key. The method **semantic intuition** (Geschka et al. 1973) turns the parts of the terms around: Any word combination formed suggests a possible device or process; one has to interpret what the new word combination could mean. In this manner, ideas for new products or services arise (e.g., curled cork; pad screw).

How to work through this method? Before starting names of existing products related to a function or subject area are collected, nouns of objects are separated into their components (e.g., corkscrew is divided into cork and screw).

Parameters	Options, alternative solutions					
Drive	Manual	Electric, power cord	Electric, battery driven	Combustion engine		
Cutting unit	Single blade (straight or curved)	Several scissors (like or rotating blades)	Cutting chains (revolving or back-and-forth motion)	one or several saw blades	Cutting or sawing disk	Cutting beam
Carriage unit	Telescope	Folding structure	Stationary carriage	Insert (add-a-unit design)		
Guidance of carriage unit	Manual	Rails	Cross-span adjuster	Optical guide beam	With distance control	Electronic
Range of action of cutting unit (single run)	Part of the hedge fron (not complete height)	Complete hedge front	Top of the hedge	Hedge fron plus top	Allround clipping	

Combination I Combination II

Creativity Techniques: Use of Creativity Techniques in Innovation Processes, Fig. 4 Example of morphological tableau for a hedge clipper

Additionally, one can use object words from another area (e.g., kitchen equipment for the search field gardening equipment).

In small groups, unfamiliar two-word combinations are formed spontaneously and systematically; based upon those combinations, new product ideas are considered. The subgroups will present their ideas to the other groups and develop them together.

Configuration Techniques

Configuration techniques are subsumed as creativity techniques that generate new solutions by compiling solution elements (newly configured) in a new way. This may be either a new combination of elements or omitting or adding elements.

The **morphological tableau** (morphological box) is the most known method of morphology (Zwicky 1966). The underlying concept is to divide a complex problem into subproblems (parameters). These parameters must be independent from each other; a solution for one parameter may not fit to solutions of other parameters. The parameters are put down in the first column of a table. Regardless of the overall problem, possible solutions for each parameter are listed line by line. By combining single solutions of each parameter, solutions for the overall problem are obtained (see Fig. 4).

The identification of the relevant parameters of the overall problem is crucial for the development of a meaningful morphological tableau. One has to sort out requirements, selection criteria, dependent factors, and also parameter suggestions which indicate just modifications. The optimal number of parameters is six to eight.

In **attribute listing**, easily changeable features of a product in sale are chosen as parameters. In a table, the actual states of these features are described and then innovative variations listed in the same line. A combination of the new attributes will result in suggestions for new appearance or functional improvements. Such product variations are an appreciated input for product relaunches.

The **morphological matrix** relates the most important parameters of a problem one to another in a systematic scheme. The matrix suggests establishing a relationship between the two parameter variations for any matrix field. This may be a synergy, a problem, an opportunity, or any other creative interpretation. The **morphological matrix** is particularly useful when there are two important factors that need to be worked on systematically and intensively.

The most important principle of the **SIT** methodology (systematic inventive thinking) (Sickafus 1996) is to develop new solutions, preferably without accessing to external resources within an existing framework (closed world). **SIT** operates with five thinking tools: division, subtraction, multiplication, task unification, and attribute dependency. It begins with an existing product and modifies it according to these specific principles until a new concept with additional benefit is created. Another guideline is always go the paths of greatest resistance, in order to find really original ideas. This technique is especially useful when a company wants to simplify and reduce costs of products.

Confrontation Techniques

Confrontation techniques use functional and structural principles hidden in objects outside the problem field as stimuli for creative idea development. Before this process starts, the problem solvers are led out of the problem area; then, the confrontation takes place by external impulses to be transferred into bold ideas for the given task.

As a first step, a proper clarification of the problem should be done. In all variants of this approach, a short brainstorming on the defined problem follows in order to get rid of familiar resp. known solutions. This methodological step helps to free the participants' minds from preconceived thoughts. Only now the confrontation process starts: The participants are asked to consider presented confrontation objects like pictures, words, or technically principles.

The **synectics excursion** is an element of the synectics problem-solving strategy. To develop innovative solutions, different analogies on the problem are formed in several stages. Confronting them with the problem enables the participants to derive solutions (Gordon 1969).

Stimulating word analysis (Geschka et al. 1973) uses terms of things that are unrelated to the problem as confronting elements; they are compiled randomly. The inherent principles, structures, and functions of these terms are worked out and possibly transferred into solution ideas.

In **visual confrontation**, pictures are presented as confrontation elements (Geschka 1993). The images on cards or picture projections are analyzed and then ideas are derived. There are several variants of this approach.

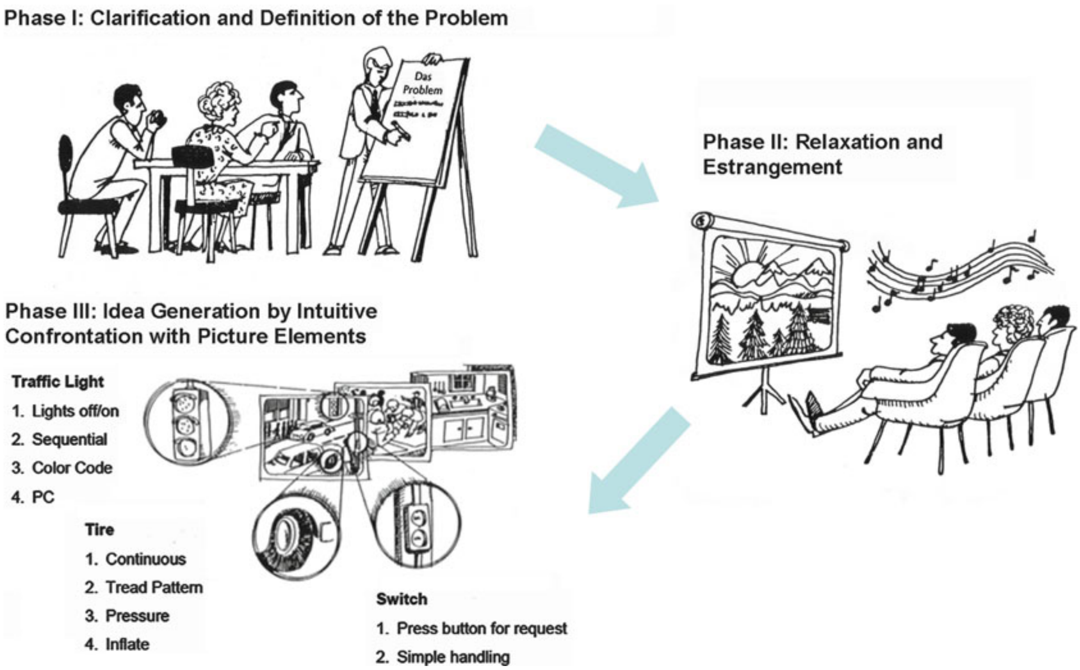
The **visual confrontation in the group** is built on verbal confrontation with pictures and additionally on mutual association by the participants (see Fig. 5). After the phase of purging of known and obvious ideas, five to six soft pictures are projected to the participants for the sole purpose to relax and get away from the problem; this process is supported by relaxation music. The following pictures show tangible situations in different areas of life; the participants are requested to develop solutions from picture elements.

Picture cards brainwriting works with picture cards to stimulate new ideas. The participants work individually with the cards; they should study each picture intensively and try to derive solution ideas from the identified principles in picture elements. The ideas are written down on pin cards. Seven to eight picture cards are worked through in this manner. After about 20 min, the idea cards are passed around the table for further associative idea generation. After all, the ideas are structured and scored.

The 40 **TRIZ invention principles** (Altschuller 1984) can be used as confrontation elements in sessions aiming at innovative technical solutions.

Imagination Techniques

The central elements of imagination techniques are pictorial imaginations occurring in one's mind. These techniques help the problem solver to come up with solutions triggered by purely mental constructs. An intuitive examination of the problem area is assisted by these methods; an in-depth understanding of the problem is arising and giving room for new solutions. The **imagination techniques** are not very common.



Creativity Techniques: Use of Creativity Techniques in Innovation Processes, Fig. 5 Flow of visual confrontation in the group

Applying the method **try to become the problem** (Van Gundy 1981), the problem solver puts himself/herself in the problem situation and simultaneously becomes an element of the problem as follows: "What do I experience in the problem situation?" Solution ideas will result from this "immersion" into the problem.

The technique **take a picture of the problem** analyzes the problem in a way that can be compared with looking through the viewfinder of a camera (Van Gundy 1981). Several problem elements are focused and observed from different perspectives. The problem solver's "observations" sharpen the understanding of the structure and the impacts of the problem situation, thus revealing new approaches.

The **guided fantasy journey** helps to reduce stress, to open up an inner balance, and to promote imagination and creativity. A moderator guides the participants through a stream of consciousness, which inspires them to develop inner stories and images. These images are supposed to stimulate problem-solving thoughts (Martin and Henry 1991).

The Innovation Process

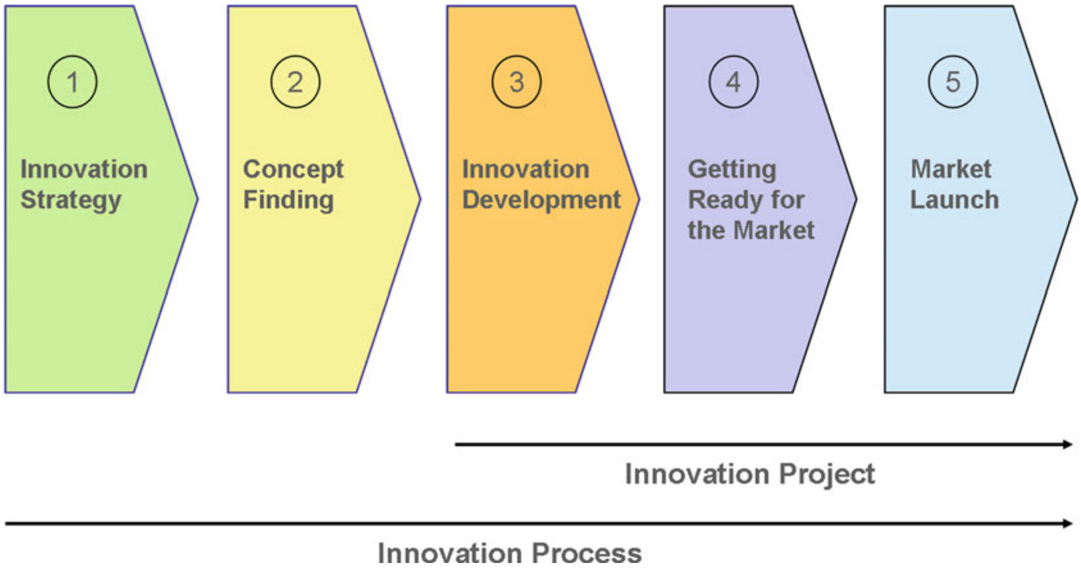
In the following, the question is considered how to utilize creativity techniques in the process of innovation. Therefore, first, the innovation process in companies is outlined.

The process of innovation in firms can be understood as a management process. Taking this into consideration, the process does not begin with a sudden inspiration or an idea finding workshop. Preceding this process is a strategic phase consisting of analyses and considerations in order to determine the direction for the search of innovations. This strategic phase basically exists, but its intensity differs among companies.

Both literature and practice offer different structures of the innovation process. Preferably, a five-phase flow model comes into place, which is based on significantly different blocks of tasks (Geschka and Zirm 2011) (Fig. 6).

The five phases of product innovation can be characterized as follows:

Phase 1: Innovation Strategy. Based on conducted analyses directions, guidelines,



Creativity Techniques: Use of Creativity Techniques in Innovation Processes, Fig. 6 The phases of the product innovation process

search fields, and corridors for innovation search are determined.

Phase 2: Concept Finding. Following the requirements of the first phase, ideas are generated and collected from internal and external sources. Usually, a large number of ideas can be compiled; they need to be evaluated and selected in a process of several stages based on specific criteria. As a result of this idea management, quite a number of innovative concepts are developed. A superior management committee decides which of the concepts should be realized; they are transferred to the R&D department for further evaluation.

Phase 3: Innovation Development. This phase includes product and process development as well as the specification of all other functions or modules that directly or indirectly become part of the new product.

Phase 4: Getting Ready for the Market. In this phase, the new product's manufacturing facilities are set up. Furthermore, all other functions necessary for a market launch have to be conceptualized and prepared: contracting of suppliers, installing of external and internal distribution logistics, implementation, testing and integration of IT systems, training of the marketing staff, and prelaunch activities (print orders, agency contracts, awards to designers, etc.).

Phase 5: Market Launch. The new product is announced to potential customers by using appropriate marketing actions. The logistics have to be installed simultaneously in order to ensure that the new product is available for customers.

Physical products and services are quite different because of their inherent characteristics. Concerning the innovation process itself, however, only the phases 3 and 4 differ clearly. The phases 1, 2, and 5 of the service innovation process basically have equal tasks and goals as those of the product innovation process. Phases 3 and 4 are different; they are described as follows:

Phase 3 (Service Innovation Process): Detailed Concept Development. The proposed new service is analyzed in its sequence and differentiated into all details. The dependencies of the partial steps of performance with each other and the frame conditions are considered. The determined structures and processes are illustrated (often graphically) in a plan (blueprint).

Phase 4 (Service Innovation Process): Getting Ready for Performance. The concept developed in phase 3 is implemented. A set of activities needs to be processed, for example, award of contracts (software, equipment, special technical facilities, etc.), cooperation agreements, internal testing, training of staff, testing with customers, and final adjustments. Particular attention is given to quality assurance since services cannot be made undone, replaced, or repaired.

All five phases require creative inputs for the development and implementation of the product or service as well as for subprocesses, optimization, and speeding up of processes and for marketing and sales measures. Thus, creative techniques can be applied in all phases. However, from the variety of techniques, not all are suitable for enterprises in respect to the creativity-stimulating approach and the frame conditions of application.

Creativity Techniques in the Innovation Process

Less Suitable Creativity Techniques for Innovation Tasks

For the development and implementation of innovations, the skills of internal experts are of high value and importance. Group work leads to synergy effects which promote creative thinking; moreover, participants from different departments provide different knowledge and views on a given problem. Individual techniques or techniques with strong individual parts without communication and exchange are less applicable for a specific problem-solving task. Therefore, the **imagination techniques** are not recommended for innovation processes.

The **synectics excursion** procedure is quite complicated; an experienced moderator is required for this technique. Since it also contains a high proportion of individual thought processes, it is not recommendable for regular application in innovation processes.

Creativity techniques that are intended for a limited application barely come into consideration for innovation activities. The techniques **SIT** and **attribute listing** are not intended to be used in development of innovations, as they focus on product improvement, respectively, on relaunch of products.

Brainstorming is the oldest and most common creativity technique and should be particularly considered. In combination with professional moderation and motivated participants, it is a powerful technique. However, other techniques with special focus in application are superior to it. Concerning most of the tasks within the innovation process, brainstorming can always be viewed as an alternative method when by any reason specific techniques should not be used; however, it is not a preferred technique in the innovation process.

Hence, there remain a comprehensive number of creativity techniques that can be assigned to the phases of the innovation process. In Fig. 1, the less suited creativity techniques are marked with an asterisk (*).

Creativity Techniques in the Phases of the Innovation Process

Creativity Techniques for Strategic Orientation

As discussed in Section ► The Innovation Process in the phase strategic orientation, analyses and perspective considerations are undertaken. Guidelines and search fields for innovations have to be found and set. In order to do so, information about customer needs, market trends, new technologies, etc., and determined goals have to be considered. Identification and formulation of guidelines and search fields, however, require a creative exploration and treatment of this information.

Therefore, techniques aiming at spontaneous creativity are less applicable in this phase compared to structured and contemplative approaches. The **morphological matrix** should preferably be applied in the form of a search field matrix, as shown in Fig. 7. The matrix structure can also be formed with quite different parameters.

Also, the **Walt Disney method** is to be recommended for this phase. It starts with broad visions which of course are of a strategic

Example: Development of innovation fields for a supplier of metal processing

Core capabilities → / Market segments ↓	Mech. solution with little demand on floorspace	Solutions for detachable connections	Solutions for fastening	Mass production of small parts	Die cutting of accurate small parts	Automatic assembling of small parts	Handling and packaging of mass products		Potential new innovation fields
1 Sports		I_1							ΣI_1
2 Domestic home									-
3 Communication	I_3					I_3			ΣI_3
4 Events	I_4					I_4	I_4		ΣI_4
5 Private security									-
6 Do it Yourself	I_6	I_6							ΣI_6
7 Garden									-

Working with the matrix should be line wise (=> line by line)

Creativity Techniques: Use of Creativity Techniques in Innovation Processes, Fig. 7 Morphological matrix for innovation fields

character and proceeds in two further steps of evaluation, concretization and critical analyses to innovation concepts. It is very well a starting method into the innovation process.

Circulating cards technique can be used in this phase, too. It is well suited to collect perspective ideas as well as to combine and to further develop them; this technique offers time to think about business and innovation strategies without distraction.

Creativity Techniques for the Concept-Finding Phase

In the concept-finding phase, ideas for new products or services are to be found based on the guidelines and requirements of the innovation strategy. Workshops are the proper approach for this task. Several (two to three) creativity techniques are applied successively. One should start with a broad collection of ideas; for this step, the **circulating cards technique** is especially suited. After an evaluation and a preselection, certain ideas or solution directions are immersed and further developed by applying confrontation techniques. Especially, **stimulating word analyses, visual confrontation in the group**, and **picture cards brainwriting** may be applied in this stage.

In case of a broad search field with open definitions of functional requirements and technology, **semantic intuition** is an interesting alternative. This technique can be recommended especially when searching for new consumer goods or new personal services.

Part of concept finding is idea selection, which should be done in three to four steps. First, a broad screening is recommended. In the second or third selection step, when there are only few ideas remaining and have already taken shape, a detailed consideration and consolidation is an adequate next step. **Six hats method** is a helpful technique in this situation. It creates revealing insights, extensions and complements are recognized, and the innovation concept gets tuned.

Creativity Techniques for Innovation Development

During the development phase, the designed concept is elaborated functionally and technically and is made ready for production. The approaches within the various industries differ considerably; they are determined by the different technologies and final applications: design methodology in engineering and related industries, software development principles in IT-related companies, and chemical engineering in corresponding sectors. Overall, the creativity techniques **morphological tableau** and the **TRIZ invention principles** can be applied in order to support and complete the development work.

In this phase, usually, discussions in small groups of developers and experts take place to develop solution ideas and concepts which show characteristics of **brainstorming** without being formally named so.

Creativity Techniques for Getting Ready for the Market Resp. Getting Ready for Performance Phase

In focus in this phase is the setup of the production process resp. the final arrangements of the service process (including testing and training). Also, the prerequisites of market introduction have to be established. However, creating design ideas is no longer necessary in this stage, as the entire creative design work was done in the preceding phase of development. Problems occurring due to lack of consideration or unexpected alterations (e.g., suppliers cannot deliver in time, new requirements of important customers, new legislative regulations) may happen in this stage. For these ad hoc problems, it is suitable to carry out **brainstorming** sessions to find solutions. As these problems can be of various kinds, a specific technique is not recommended.

Many activities in this phase run in parallel and are interconnected. To provide an overview and to avoid disruptions, a **mindmap** may be drawn for the entire process of implementation; it should also include alternative and backup solutions. This can be interpreted as a creative preventive contemplation. The created mindmap also helps to guide the processes and to coordinate the activities.

Creativity Techniques for Market Launch

The market launch marks the completion of the innovation process. The conceptual and preparatory activities already begin during the preceding phase. These activities may be considered as one flow of actions up to being effective in the market: A whole bunch of measures is to design with each measure in turn opening a wide range of refinements. In order to obtain creative input, companies make substantially use of external marketing agencies (e.g., communication designer, writers, photographers). These specialists often work individually or in small teams without support of creativity techniques.

In case the concepts and measures are developed by the company itself (partially or entirely), a combined application of the **circulating cards technique** and **visual confrontation in the group** or the **stimulating word analysis** in workshop settings is recommended.

For the development of slogans, the **ring-exchange technique** has evolved as an appropriate method.

Conclusions and Future Directions

A creative idea is the starting point for innovations. The sources for those ideas are diverse. Creativity is a precondition for generating new ideas. Creativity is basically understood as the human ability to combine elements of knowledge and experience from different areas in an unconventional way. Creativity techniques support the genesis of ideas. They consist of a set of thinking and behavior rules, which stimulate as an overall effect a group or an individual to generate ideas. Meanwhile, many creativity techniques have been developed and proven successful in terms of different application. Quite often, some methods are very similar; they differ only in details or are named differently while following the same approach.

Some creativity techniques can be used in all areas that require creative inputs. On the other hand, there are methods which are particularly suitable for specific applications, such as idea generation within an innovation process. This entry comprises on the one hand some basic, most often used and proven successful creativity techniques and on the other hand those techniques which are especially useful for finding solutions within the different phases of the innovation process, for example, to collect ideas in the early stage of an innovation process or later on, that is, during the market launch phase.

As for the future development, a challenge can be seen in finding the appropriate techniques to support the idea generation for value-added services. Additionally, the application for the online use of creativity techniques within the world of social networks needs to be further explored.

Cross-References

▶ Brainstorming and Invention
▶ Corporate Creativity
▶ Creative Behavior
▶ Creativity and Innovation: What Is the Difference?
▶ Creativity from Design and Innovation Perspectives
▶ Divergent Thinking
▶ Divergent Versus Convergent Thinking
▶ Ideas and Ideation
▶ Invention and Innovation as Creative Problem-Solving Activities

References

Altschuller GS. Erfinden – Wege zur Lösung technischer Probleme. Berlin: VEB Verlag Technik; 1984.
Buzan T, Buzan B. Kopftraining. Anleitung zum kreativen Denken. 3rd ed. München; 1986.
De Bono E. Six thinking hats. Toronto: Key Porter; 1985.
Dilts RB, Epstein D, Dilts RW. Tools for dreamers. Strategies for creativity and the structure of innovation. Capitola: Meta Publications; 1991.
Geschka H. Kreativitätstechniken. In: Staudt E, editor. Management von innovationen. Frankfurt: FAZ-Verlag; 1986. p. 147–60.
Geschka H. Visual confrontation. Developing ideas from pictures. In: Geschka H, Moger S, Richards T, editors. Creativity and innovation. The power of synergy. Darmstadt: Geschka & Partner; 1993. p. 151–7.
Geschka H, Zirm A. Kreativitätstechniken. In: Albers S, Gassmann O, editors. Handbuch Technologie- und innovations management. 2nd ed. Wiesbaden: Gabler; 2011. p. 279–302.
Geschka H, Schaude G, Schlicksupp H. Modern techniques for solving problems. Chem Eng. 1973;80(18):15–63.
Gordon WJJ. Synectics. New York: Harper & Row; 1969.
Martin JNT, Henry J. Problem solving by manipulation of imagery. In: Rickards T et al., editors. Creativity and innovation. Learning from practice. Delft: TNO; 1991. p. 183–8.
Osborn AF. Applied imagination. 3rd ed. New York: Charles Scribner's Sons; 1953.
Sickafus EN. Structured inventive thinking. A conceptual approach to real-world problems. Ind Phys. 1996;2(3):18–20.
Van Gundy AB. Techniques of structured problem solving. New York: Van Nostrand Reinhold; 1981.
Zwicky F. Entdecken, Erfinden, Forschen im Morphologischen Weltbild. München: Droemer-Knaur; 1966.

Creativity Testing

▶ Measurement of Creativity

Creativity Tests

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Synonyms

Creative thinking tests; Creativity assessments; Divergent thinking tests

Introduction

Over the past half century, numerous creativity tests have become available and several have earned scholarly confidence in their reliability and validity. Researchers developed these tests because of growing interest in creativity and because of limitations with non-testing methods for judging creativity. There are three main categories of testing for creative potential: (1) Creative Climate Tests, questionnaires that evaluate Creative Climate (the psychological and physical environment and biographical backgrounds of individuals that is conducive to creativity), (2) Creative Attitudes Tests, inventories based on studies of the personalities and attitudes of creative individuals and that evaluate personality, creative motivation, and creative interests, and (3) Creative Thinking Tests, assessments in which participants freely list all of their ideas they can think of in response to open-ended questions.

Creative thinking tests stem largely from the work of J. P. Guilford, who in the 1950s developed tests for what he called this process: divergent thinking and its opposite, convergent thinking (1967). Guilford argued that divergent thinking has three components of divergent thinking: fluency, flexibility, and originality. Torrance (1962) and Meeker (1969) built on the work of Guilford and further developed creativity tests. Today, the Torrance Tests of Creative Thinking (TTCT) is generally considered the best measure for assessing creativity. The TTCT measures creative attitude, creative thinking, and other problem-solving skills. The work of Torrance has received considerable attention in recent years, as its measures, according to Kim (2011), reveal a decline in American creativity since 1990.

Non-testing Approach: Judgment of Actual Products

Creativity can be assessed through non-testing and testing approaches. An example of non-testing approach is judgment of actual products. Identifying creative individuals by actual products encompasses any domains. In order to judge actual products, Amabile's (1982) first developed Consensual Assessment Technique: Expert judges rate the creativity of products in a particular domain, such as stories, essays, collages, poems, research designs, or theories in science, artistic creations, musical compositions, and other artifacts. Each participant is given identical basic instructions and materials for creating a product. Then expert judges working independently assess the creativity of the products, rating the creativity of the products on a 1.0–5.0 scale. The judges do not explain or defend their ratings in any way. Rather, they use only their expert sense of what is creative in the specific domain to rate the creativity of the products in relation to one another. Standard principles of assessment apply. For example, judges use the full scale. The ratings are compared only to the artifacts being judged by a particular panel of judges. This method of assessment compares creativity within a single group of participants (Baer and McKool 2009).

This method of evaluating creativity has some theoretical and practical limitations. Expert judges might have failed to identify the creativity of such eminent individuals such as Albert Einstein, Thomas Edison, and Vincent Van Gogh when they were children. This limitation may stem from judges' vested interests in the status quo or because children often lack production in the domain of their future success. Further current ability may not indicate latent potential. Other limitations are practical. Expert judges can be expensive and are hard to find, especially in rural areas. Therefore, the needs for creativity tests are apparent.

Testing Approach

The testing approach assesses three areas: creative climate, creative attitude, and creative thinking. These areas can be further divided. For example, individuals are exposed to numerous *climates* (family, school/group, etc.). Creative *attitudes* or dispositions toward creativity are viewed differently by different people. Finally, there are many subcategories of thinking that relate to creativity. What follows is a descriptive inventory of the most trusted tests of all three areas of creativity (climate, attitude, and thinking).

Creative Climate Tests

Creative climate tests examine family climate, school/ group climate, and culture climate. Biographical inventories ask about family background, experiences, and activities that are related to creative family climate. Climate questionnaires ask about psychological and physical atmospheres that to creative school/group climate. Cultural questionnaires ask about how much individuals believe in certain cultural norms related to creative culture climate.

Family Climate

The Biographical Inventory Form U

Tests measuring individuals' childhood experiences and activities can show family climate. Based on his studies on scientists in military research centers, NASA, industrial organizations, and universities, Taylor (1959) developed the Biographical Inventory Form U. It consists of 150 multiple-choice items about an individual's characteristics and background including childhood activities and experiences, academic experiences, attitudes, interests, values, self-descriptions, and sources of derived satisfactions and dissatisfactions. Administration of the test takes an hour, and participants use a machine-readable separate answer sheet. The Biographical Inventory Form U has been translated into other languages and is used worldwide. Its results include a measure of relative strengths in the following areas: Academic Performance, Creativity, Leadership and Artistic Potential, plus two bonus scores for Vocational Maturity (indication of how mature a participant is in regard to choosing a vocation) and Educational Orientation (indication of future academic success).

The Biographical Inventory Creativity (BIC)

Schaefer (1967) developed another biographical inventory, the Biographical Inventory Creativity (BIC). It consists of 165 items grouped into five sections (physical characteristics, family history, educational history, leisure-time activities, and others). Research shows that the scores on the biographical inventories are a better predictor of future success than the judgments of the fellowship committee members.

School/Group Climate

The Creativity Climate Questionnaire (CCQ)

Ekvall et al. (1983) developed the Creativity Climate Questionnaire (CCQ), which measures group conditions encouraging or discouraging creativity. The CCQ has 50 questions covering 10 dimensions (five items each). The 10 dimensions can be grouped into three areas of Resources (High Idea Time, Idea Support, and Involvement), Motivation (High Dynamism, Trust, Playfulness, and Low Conflicts), and Exploration (High Freedom, Debate, and Risk-taking). The 10 dimensions that are conducive to creativity are as follow (Ekvall et al. 1983):

1. *High Freedom climate*: The degree to which individuals feel free to express their thoughts, try out ideas, and voice their opinions. A high degree of freedom occurs when individuals have the independence (behavioral autonomy and resources) to define much of their work and considerable discretion in their day-to-day activities. The opposite of high freedom are climates in which people work within strict guidelines and roles and carry out their work in prescribed ways with little room to redefine their tasks.
2. *High Dynamism climate*: The degree to which the climate is dynamic and inspiring so that individuals find joy and meaningfulness in their work. In a high dynamism climate, individuals have opportunities (and take the initiative) to acquire and share information about their work. The opposite of high dynamism are climates in which individuals lack interest in their work, and interpersonal interactions are dull and listless.
3. *High Trust climate*: The degree to which individuals feel that they are emotionally safe and that relationships are open and characterized by honesty and teamwork. People

in these climates trust each other, get on well together, and work toward a common goal. Petty politics and conflicts are absent, and, counting on each other for professional and personal support, individuals sincerely respect one another and give credit where due. In the opposite climate, people struggle to communicate honestly with each other and suspiciously guard their plans and ideas.

4. *High Playfulness climate*: The degree to which individuals display spontaneity, ease, good-natured joking, and laughter. In these environments, individuals work in a professional yet a relaxed atmosphere and laugh and joke in a good-natured way with each other. They have fun at work. The opposite of a High Playfulness climate is where the atmosphere is stiff, serious, gloomy, and cumbrous, and where jokes and laughter are considered as improper and intolerable.
5. *High Idea Time climate*: In these environments, individuals have time: to think things through, to elaborate new ideas, to develop new ideas, and to discuss and test suggestions not included in the task assignment. The climate has flexible timelines so that people can explore new avenues and alternatives. In the opposite climate, every minute is booked and time pressure makes thinking outside the instructions and planned routines impossible.
6. *High Debate climate*: The degree to which expression and consideration of different viewpoints, ideas, and experiences occur. Here, individuals can raise and actively debate issues without fear that certain subjects are *taboo*. Individuals encounter different viewpoints, ideas, experiences, and knowledge. Many voices are heard, and people are keen to put forward their ideas for consideration and review. In the opposite of a High Debate climate, people follow authoritarian patterns without questioning them.
7. *Low-Tension climate*: Climates with little to no personal and emotional tensions. In a low-tension environment, people behave in a mature manner and have psychological insight and control of impulses. People accept and deal effectively with diversity so that there are little personal and emotional tensions. In the opposite climate, people dislike and may even hate each other. Personal differences yield gossip, slander, plots, traps, power, and territory struggles.
8. *High Idea Support climate*: The degree to which new ideas and suggestions are attended to and treated in a kind manner. Individuals actively put forward new ideas, which are received in an attentive and professional way. People listen to each other and encourage initiatives and are constructive and positive about trying out new ideas. The atmosphere emphasizes individual, team, and organizational learning through environment scanning and networking. The opposite of a High Idea Support climate is where idea support is low; “no” is prevailing, and faultfinding and obstacle-raising are responses to ideas.
9. *High Involvement climate*: The degree to which individuals are emotionally involved, committed, and motivated. The climate empowers individuals. With sufficient opportunity to find information, show initiative, and make their own decisions, individuals are involved in the setting and achievement of their daily operations, common long-term goals, and visions. In the opposite climate, individuals are not engaged and feelings alienated and apathetic.
10. *High Risk-Taking climate*: The degree to which individuals are prepared and have the courage to take risks in implementing new ideas. They display spontaneity and ease in actions and tolerance of uncertainty and ambiguity so that bold initiatives can be taken even when the outcomes are unknown. In the opposite climate, individuals are cautious and hesitant. They try to be on the safe side or *to sit on* problem matters. They set up committees and cover themselves.

Culture Climate

The Eastern-Western Perspective Scale (EWPS)

Kim (2004) developed the Eastern-Western Perspective Scale (EWPS) to measure individuals’ degrees of Confucian ideals and to compare them to level of their creativity. The EWPS measures the extent to which individuals' views align with East Asian culture. A total of 49 items are based on the four principles of Confucianism: (1) Importance of education, including devaluing play, drawing a sharp distinction between work and play, and emphasizing heavily education and competition; (2) Family System including filial piety to parents and obedience and loyalty to the authority; (3) Hierarchical Relationships, including gender inequality and gender-role expectations; (4) Benevolence, including conformity, self-effacement, and suppression of expression. Higher total scores indicate a bias toward an Eastern cultural perspective and lower total scores indicate a bias toward a Western cultural perspective. Research shows that higher Eastern culture scores are negatively related to creativity, especially high scores on suppression of expression, gender inequality, gender-role expectations, and filial piety.

Creative Attitude Tests

Creative attitude, interest, affect, and personality are measured by self-reported measures as well as teachers' and others' ratings who have had sufficient opportunities to observe the individual. Parents, teachers, and counselors who are aware of creative attitudes can capitalize on the information to identify creative potential in students. However, although there are many common characteristics that creative individuals share, not all creative individuals will show all creative attitudes, interests, or personalities. In addition, there are problems with teachers' evaluations of students. Some teachers will not recognize characteristics of creativity in students. Research shows that teachers tend to overlook disruptive, overactive, or unconventional creative students; that they prefer students who are low in creativity; that they identify students who are achievers or teacher pleasers as gifted students; that they overlook students who think or dress oddly, ignore rules and conventions, ask too any questions, do poor work when not interested, or be radical or rebellious. Even worse, some energetic and unconventional students are seen as having attention deficit hyperactivity disorder. Some teachers are more likely to recommend consulting a psychologist or psychiatrist than to identify these students as creative. On the other side, there are students who feign creativity by dressing and acting the way they believe eccentric creative people are supposed to dress and act. Thus, using creative attitude tests requires caution.

The Group Inventory for Finding Talent (GIFT)

Rimm (1976) developed the Group Inventory for Finding Talent (GIFT) to measure attitudes and values related to creativity. The items ask about individuals' curiosity, independence, flexibility, perseverance, breadth of interests, and past creative activities. Three levels of Group Inventory for Finding Talent are available: primary for Grades K to 2 (32 items), elementary for Grades 3–4 (34 items), and upper elementary for Grades 5–6 (33 items). Within each of this from, 25 items are common.

The Group Inventory for Finding Interests (GIFFI)

Rimm and Davis (1979) developed the Group Inventory for Finding Interests (GIFFI) to measure individuals' attitudes and interests related to creativity. It consists of 60 items and claims to identify students with attitudes and interests associated with creativity including independence, curiosity, perseverance, flexibility, breadth of interests, risk-taking, sense of humor, and other traits and attitudes. It produces a total creativity score plus five subscale scores including confidence, challenge-inventiveness, imagination, creative arts and writing, and many interests.

The Khatena-Torrance Creative Perception Inventory (KTCPI)

Khatena and Torrance (1998) developed The Khatena-Torrance Creative Perception Inventory (KTCPI), which is a self-reported measure of creativity comprised of two subtests: Something About Myself (SAM) and What Kind of Person Are You? (WKOPAY). The SAM measures artistic inclination, intelligence, individuality, sensitivity, initiative, and self-strength. The WKOPAY covers five factors of acceptance of authority, self-confidence, inquisitiveness, awareness of others, and disciplined imagination.

The Scales of Rating the Behavioral Characteristics of Superior Students-Revised (SRBCSS-R)

Renzulli's (Renzulli et al. 2002) 10-item creativity rating scale is a part of the Scales of rating the original Behavioral Characteristics of Superior Students (SRBCSS, 1976), which is used by teachers to rate students' creativity at any age. Translated into several languages, it is the most widely used teacher-rating instrument. The SRBCSS is designed to measure 10 creative characteristics including curiosity, fluency of idea production, risk-taking, humor and intellectual playfulness, emotional and aesthetic sensitivity, nonconformity, and critical evaluation. There is no composite score (the 10 subscales remain separate), and specific scales may be used independently.

Creative Thinking Tests

Guilford's theories (1967) spawned an array of divergent thinking tests and creative thinking tests, such as the Torrance Tests of Creative Thinking-Figural and Verbal, Thinking Creatively with Action and Movement, Wallach and Kogan Divergent Thinking Tasks, and others. Among these, the TTCT-Figural is the most widely used and is considered to measure creative thinking, and not merely divergent thinking.

Torrance Tests of Creative Thinking (TTCT)

Torrance designed a test to score responses for Guilford's four divergent thinking factors of Fluency, Flexibility, Originality, and Elaboration. The TTCT has two versions: the TTCT-Verbal and the TTCT-Figural. The TTCT can be administered as an individual or group test for any age and development level, beginning with the kindergarten level. The tests require from 30 to 45 minutes working time, so speed is relevant. The tests require some drawing ability, but artistic quality is not required to receive a credit. Torrance recommended the creation of a game-like and *fun* atmosphere to avoid the threatening situation associated with testing. The TTCT has been translated into over 35 languages and is the most widely used test of creativity. Research shows that among all of the creativity tests, the TTCT predicts creative achievement the best. As indicated by Torrance's 40-year longitudinal study, scores on the TTCT are good predictors of adult creative performance.

Torrance Tests of Creative Thinking (TTCT)-Figural

The TTCT-Figural has two parallel forms, A and B, and consists of three activities of picture construction, picture completion, and repeated figures of lines or circles. The TTCT-Figural is comprised of five norm-referenced measures so that the numbers of points earned are relative to the norm group. These measures are Fluency, Originality, Elaboration, Abstractness of Titles, and Resistance to Premature Closure. In addition, there are the 13 criterion-referenced measures of Creative Strengths so that the credit is given depending on whether the criterion appears in the responses. Fluency shows an ability to produce a number of ideas; Originality shows an ability to produce uncommon or unique ideas; Elaboration shows an ability to produce a number of ideas added beyond the minimum details; Abstractness of Titles measures the degree a title is expressed beyond obvious labeling of the pictures drawn; and Resistance to Premature Closure measures the degree of psychological openness. The 13 Creative Strengths measure various creativity personalities including: Emotional Expressiveness, Storytelling Articulateness, Movement or Action, Expressiveness of Titles, Synthesis of Incomplete Figures, Synthesis of Lines or Circles, Unusual Visualization, Internal Visualization, Extending or Breaking Boundaries, Humor, Richness of Imagery, Colorfulness of Imagery, and Fantasy.

Torrance Tests of Creative Thinking (TTCT)-Verbal

The TTCT-Verbal consists of six activities. The stimulus for each task includes a picture to which people respond in writing. Five or 10 minutes are taken for each activity. For Activity 1–3, an ambiguous picture is presented to ask and guess. Activity 1 (Ask Questions) is asking questions about the picture; Activity 2 (Guess Causes) is guessing causes of the action in the picture; and Activity 3 (Guess Consequences) is guessing consequences, immediate or long-term about the picture. For Activity 4 (Product Improvement), the task is to improve a toy so that it is more fun to play with. Activity 5 (Unusual Uses) is a task to think of alternative uses for a common object like a brick. Activity 6 (Just suppose) hypothesizes about an improbable situation. Scoring Components are Fluency (the number of relevant ideas), Originality (the unusualness of the ideas), and Flexibility (Shifts: the variety of different types of ideas).

Thinking Creatively with Action and Movement (TCAM)

Torrance (1979) developed the Thinking Creatively with Action and Movement (TCAM) to measure Fluency, Originality, and Imagination in preschool and primary aged children ranging from ages 3 to 8. It was developed based on the assumption that kinesthetic, rather than verbal, modality is the most appropriate for eliciting the creativity of these age-ranged children. The TCAM is administered individually, and it takes between 10 and 30 minutes, but no time limit is imposed. The examiner is to record all responses made by the child as completely and accurately as possible and to record responses in movement, in words, or in a combination of both. Before an examiner administers the TCAM, warm-up activities and some familiarity are necessary so that children can relax and engage in the activities without restraint. The TCAM is also used with special test subjects including children with emotional impairment and deaf children. The TCAM is also used as a teaching tool using creative movement and creative brainstorming techniques.

The Wallach and Kogan Divergent Thinking Tasks

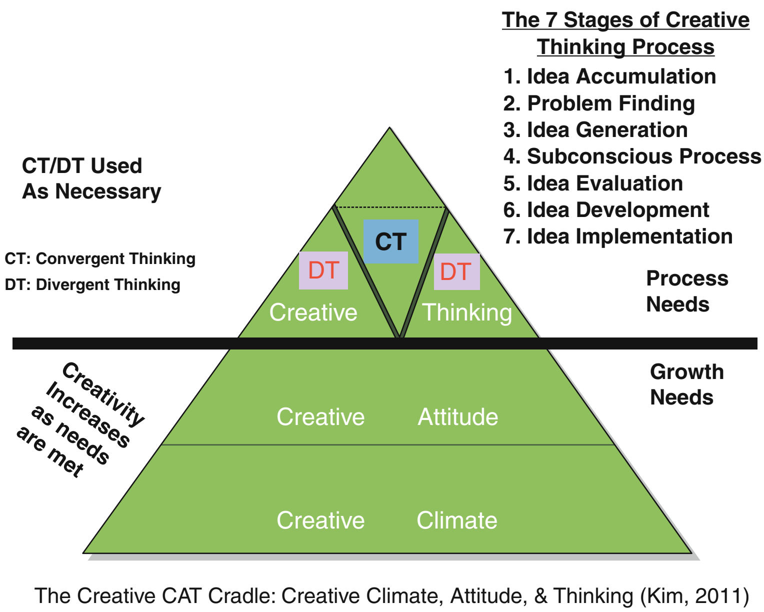
Wallach and Kogan (1965) developed a battery with five tests: three verbal and two figural divergent thinking tests. Each test is scored for Fluency (the total number of ideas listed) and Uniqueness (the number of ideas that are not given by any other individual in the testing group). The Uniqueness score will be dependent on group size with a smaller sample size with a higher Uniqueness score. The entire tests appear in *Modes of Thinking in Young Children* with directions for administration and scoring so that they can be used for free. Verbal divergent thinking tests include (1) the Instances test (Name all the *round* things you can think of; things that make noise; square things; and things that move on wheels), (2) the Alternate Uses test (List the different ways you could use a chair, knife, key, button, newspaper, cork, shoe, and automobile tire), and (3) the Similarities test (Find as many commonalities as possible between two verbally specified objects). Two figural tests use visual materials and include (1) the Pattern Meanings test (Respondents list possible meanings or interpretations of eight abstract visual designs) and (2) the Line Meanings test (it is the same as Pattern Meanings except the stimuli are more abstract and not clear patterns). The administration procedures of the Wallach and Kogan Divergent Thinking Tasks also emphasize a relaxed and game-like atmosphere, and it is an un-timed test. These game-like and un-timed conditions reduce the influence of intelligence on the creativity scores. Research shows that among all of the divergent thinking tests, the Wallach and Kogan tests are found to have the least relationship with IQ.

Conclusion and Future Directions

Creative potential can be assessed using non-testing and testing methods. With testing, there are three different categories of measuring creativity: Creative climate, creative attitude, and creative thinking.

As Fig. 1, the Creative CAT Cradle, shows, Creativity requires three conditions. First, a creative climate must exist. A creative climate refers to an environment characterized by a high degree of freedom, dynamism, trust, and playfulness. In a creative climate, individuals have the time to explore ideas and are free to disagree. Though ideas are debated, new ideas are welcomed and are treated seriously. Individuals in

Creativity Tests, Fig. 1 The creative cat cradle: creative climate, creative attitude, and creative thinking



a creative climate get along, genuinely support one another, are involved, and are willing to take risks.

Creativity also requires a creative attitude, a disposition of individuals within the environment. Creative attitudes include qualities that are sometimes perceived negatively, including high energy, independence, curiosity, perseverance, flexibility, breadth of interests, willingness to take risks, humor, and imagination. These qualities are sometimes perceived negatively. Teachers, for example, often prefer students who sit still, follow rules, and accept authority. Students with creative attitudes, however, often show opposite attributes, which teachers then try to suppress or, at the least, label negatively.

With both creative climate and attitude, more is better. With the final condition of creativity, creative thinking, the key is the right balance and the right timing: There are appropriate stages for divergent thinking and its many facets, but also appropriate stages – not too soon in the process – to begin to evaluate possibilities and bring closure (convergent thinking).

The 7 Stages of Creative Thinking Process shows that:

1. Creative thinking begins with idea accumulation – accumulating a long list of ideas, knowledge, skills, information, experiences, and others on a particular problem or question. Idea accumulation can be speculative or more scientific (cataloging existing ideas on the problem).
2. Once ranges of ideas are accumulated, the thinker then starts to consider or notice problems with the ideas, knowledge, skills, information, experiences, and others: finding weaknesses, flaws, exceptions, and limitations.
3. New ideas then need to be generated in response to those flaws. Ideas generated could include nuances or subtle changes to existing ideas or could include wholly new solutions.
4. Then, time and freedom need to come into play: The ideas must be allowed to percolate subconsciously. Adages such as *sleep on it* or *take time to think about it* ring true to this stage of creative thinking – individuals need time to reflect both consciously and subconsciously.
5. After this roughly hewn, slow process of reflection, individuals must then subject ideas to critical, conscious evaluation and apply rigorous and exacting evaluative processes. Here convergent thinking comes into play, as the thinker starts to move away from the open

phase of accepting ideas but rather to the critical phase of rejecting those of lesser potential.

6. A genuinely creative idea then requires idea development, an iterative divergent-convergent process to figure out how to transform the provisionally best solution (Stage #5) into an idea for a new *solution*. The process plays back-and-forth between how to make the provisionally best solution (convergent thinking) even better (divergent thinking).
7. Finally, the idea must be implemented, which requires wholly new creative processes on a microscale. In implementation, the entire 7 stages of Creative Thinking process may have to be repeated, according to the scale of the problem.

Unlike climate, which draws creative dispositions out of individuals, and creative attitude, the sum of those dispositions, with creative thinking, more is not necessarily better. Individuals must think divergently, generating multiple ideas, and then bring closure through convergent thinking, deciding on the best solution or answer.

Torrance was concerned that because of the lack of availability of creativity detection instruments, creative individuals would be overlooked and even undermined psychologically. For children scoring poorly on IQ or achievement tests, creativity tests open doors. Creativity tests should be used to help find more students whose abilities are not usually found on traditional IQ or achievement tests. Research shows that creativity tests are more culturally neutral than most IQ tests. Creativity tests will yield additional information on many children who do not show their achievement academically. Their creative potential might otherwise go unnoticed, especially in children from culturally diverse and lower socioeconomic backgrounds.

Individuals can be creative in an infinite number of ways. A person may also be highly creative in just one area but less able in others. Other people may be creative in many areas. Identifying creative potential can be difficult and prone to error because of the inherent complexity of creativity and creative people. Motivation and opportunity are two other important factors that influence individuals' creative achievement, in addition to their creative potential. Test conditions can influence creativity test scores by removing the time limits and by preceding the testing with a brief warm-up activity.

No measure of creativity assessment, testing or non-testing, is so reliable and valid that just one measure will produce a highly accurate and dependable estimate of creative potential for invention and innovation. At least two different measures of creativity should be used together. Creative abilities can be assessed, can be nurtured, and their growth can be measured, which should be done, because we cannot know what the future will bring, but we can open our students' minds toward it.

Cross-References

► Convergent Versus Divergent Thinking
► Creativity Across Cultures
► Creativity, Intelligence, and Culture
► Divergent Versus Convergent Thinking

References

Amabile TM. Social psychology of creativity: A consensual assessment technique. J Pers Soc Psychol. 1982;43:997–1013.

Baer J, McKool SS. Assessing creativity using the consensual assessment technique. In: Schreiner C, editor. Handbook of research on assessment technologies, methods, and applications in higher education. Hershey: Information Science Publishing; 2009. p. 65–77.

Ekvall G, Arvonen J, Waldenstrom-Lindblad I. Creative organizational climate: construction and validation of a measuring instrument. Stockholm: Swedish Council for Management and Work Life Issues; 1983.

Guilford JP. The nature of human intelligence. New York: Wiley; 1967.

Khatena J, Torrance EP. Khatena-Torrance creative perception inventory. Bensenville: Scholastic Testing Service; 1976.

Kim KH. The creativity crisis: the decrease in creative thinking scores on the Torrance Tests of Creative Thinking. Creat Res J. 2011;23:285–95.

Kim KH. Cultural influence on creativity: the relationship between creativity and confucianism [doctoral dissertation]. Athens: The University of Georgia; 2004.

Renzulli JS, Smith LH, White AJ, Callahan CM, Hartman RK, Westberg KL. Scales for rating the behavioral

characteristics of superior students-revised edition. Mansfield Center: Creative Learning Press; 2002.
Rimm SB. GIFT: group inventory for finding talent. Watertown: Educational Assessment Service; 1976.
Rimm SB, Davis GA. Group inventory for finding interests. Watertown: Educational Assessment Service; 1979.
Schaefer CE, Anastasi A. A biographical inventory for identifying creativity in adolescent boys. J Appl Psychol. 1968;52:42–8.
Taylor CW. The 1955 and 1957 research conferences: the identification of creative scientific talent. Am Psychol. 1959;14:100–2.
Torrance EP. The torrance tests of creative thinking – norms-technical manual research edition – verbal tests, forms A and B – figural tests, forms A and B. Princeton: Personnel Press; 1966.
Torrance EP. Administration, scoring, and norms manual: thinking creatively in action and movement. 4th ed. Athens: The University of Georgia, Georgia Studies of Creative Behavior; 1979.
Wallach MA, Kogan N. Modes of thinking in young children. New York: Holt, Rinehart & Winston; 1965.

Creativity Training in Design Education

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Synonyms

Creative thinking techniques; Creativity; Design education; Training methods

Theoretical Foundation

Creativity Training Between Design Education and Other Disciplines

The classical creativity training model and approach were established by Alex F. Osborn in the 1950s and Ellis P. Torrance in the 1970s, respectively. Early empirical research suggested that creativity training is effective to help students to produce quantity and quality of creative ideas. Despite the fact that some researchers have questioned the effectiveness of creativity training for enhancing students' creativity, most have highlighted the important role of creativity training in releasing students' creative potential. In view of the creativity training in design education, design students are required to develop strong creative thinking skills, techniques, and methods to solve problems innovatively. Therefore, the underlying principle of creativity training in design education is to equip design students with diverse thinking skills as well as the creative design process in order to release and/or enhance their creative potentials. Furthermore, as Sternberg (2003) pointed out, students are able to develop five underlying learning behaviors through creativity training: (1) willingness to redefine problems, (2) willingness to take risks, (3) willingness to accept criticism, (4) willingness to value others' creative ideas, and (5) believing everyone has potential to be creative.

Creativity training is an essential component of facilitating creative design processes in design education. However, it is important to note that the diversity of interpretations of creativity among design institutes hinders the effective implementation of such pedagogy. Creativity training is, indeed, not concerned with design students' creativity but with helping them to develop their diverse intellectual abilities, such as problem identification skill, critical thinking, risk taking, and curiosity, which eventually lead them to be able to generate creative ideas and solutions to problems.

The Role of Creativity Training in Design Education

A very simple definition for *design* is problem solving, and each solution is indeed unique and creative. Prior research on creative design studies has identified the linkage between design and the development of creative thinking. Design is indeed concerned with creating novelty for people to experience. One of the well-known classifications of creativity is from Margaret Boden in her book called "The creative mind: myths and mechanisms" in 2004. She introduced the categories of H-creativity (historical creativity) and P-creativity (psychological creativity). H-creativity is regarded as creating and/or designing original solutions resulting in new and novel ideas. Comparatively speaking, P-creativity is only regarded as some creative notions for personal satisfaction. In design history, there are numerous original and creative examples that are regarded as classics with timeless qualities. These classic designs are often drawn on as cases for teaching and learning purposes in creativity training in design education. In this case, if the main purpose of design is creative novelty, then studying classical examples in design education may be the "dilemma" of creativity (Kneller 1965). Similarly, some researchers also argued that giving good examples to students can obstruct their motivation to explore new possibilities and creative ideas. In other words, design students will be over-influenced by classical examples if they are keen on researching prior successful design cases. This hinders their creative thinking in particular to seeking new and novel solutions. Of course, designers should continuously doubt, criticize, and evaluate past results scientifically in order to solve problems confidently and foresee future needs of society.

Knowledge and experience are equally essential to enhance students' creativity in design education. Creative thinking is nurtured by the prior internal and external experiences of design students. Therefore, the essence of good design education is a balance between fostering students' creative thinking processes for novelty and guiding them to enrich their experiences. As Green (1974) stated, earlier *design education* needs to develop students' critical minds to understand human needs and human experiences.

Numerous research studies have supported the significant role of design activities in facilitating students' creative thinking skills. Creative learning activities and/or creative thinking techniques should be designed and arranged deliberately in creativity training subjects in design education in order to release the students' creative potential. An effective curriculum design for creativity training should consider six factors: (1) understanding and identifying design students' thinking habits, (2) facilitating and developing their intrinsic motivation by fun activities, (3) encouraging and developing positive and forward thinking, (4) enhancing and building up their self-determination and confidence, (5) acknowledging and managing their emotions, and (6) removing obstacles to their creativity.

Nonetheless, to develop creativity training in design education is not only about giving students classical examples but also providing them with integrated thinking skills, creative thinking techniques, and creative thinking/design processes as well as good learning behaviors consisting of risk taking, having fun, and being open to unexpected solutions.

The Development of Creativity Training in Design Education

To understand the creativity training in design education, it is necessary to review the early developments in art and craft education. This field of education began in the British technical schools in the 1880s. The objectives of these early art and craft subjects emphasized practical training for art careers instead of the development of concepts and creativity. Otto Salmon, one of the pioneers in the early development of design education in the 1890s, listed the objectives of craft education by dividing the learning focus into (1) the formative focus and (2) the utilitarian focus. The formative focus emphasized developing students' independence, sense of forms, and self-reliance in order to develop physical abilities in craftsmanship, while the utilitarian focus aimed to giving students proficiency in the use of tools. This revolutionary concept of developing students' intrinsic competencies in art and craft brought the education into a new era of conceptual development. It was followed later by some craft teachers who developed more intellectual methods of using and exploring the application of materials and tools.

A remarkable early movement of curriculum reform began in the 1960s. The Nuffield Foundation and School Councils in the United Kingdom started to evaluate the existing curriculum and the role of craft education in schools, which caused the development of a new subject domain, *design education*. This great change has raised arguments and discussions about the use of materials in creative problem solving as well as the need to clarify the concept of the design process. Nonetheless, art and craft teachers have put effort into exploring the new knowledge of design education and introduced a new set of theoretical domains in art and design, namely, creativity, initiative, and adaptability. The Design and Craft Education Project, introduced by the University of Keele in the late 1960s and early 1970s, was an influential project providing a clear framework for the further intellectual or creative developments in design education. The emphasis of this framework is that design subjects should be constructed by the combination of intellectual and practical activities. Design education in Britain underwent a tremendous change after this project, from focusing on students' practical skills to intellectual development. This was followed by various British universities making revisions to their design subject curricula, including Goldsmiths' College (1969–1972), Exeter University (1968–1973), Loughborough College of Education (1967–1972), and the Royal College of Art (1973–1975). These actions triggered the entire development of design education in the early 1970s and shaped the skeleton of design education by focusing on the integration of theoretical knowledge and practical skills. Creativity training became one of the key focuses in developing students' theoretical and intellectual knowledge.

Indeed, the creativity training in professional design education (within institutes aiming at training professional designers) was developed even earlier in Europe and America in the 1910s. Some design educators, namely, Moholy-Nagy, Klee, and Kandinsky, insisted that design education should be a combination of artistic exploration and practical function. This notion eventually caused the establishment of the Bauhaus school in Germany in 1919. The curriculum of German Bauhaus school demonstrated a perfect combination of intellectual and practical development for students to balance creativity and skills. This curriculum also provided later design schools with references for pedagogical frameworks and structures. In the 1930s, Moholy-Nagy, with the help of Charles Morris, a philosopher from the University of Chicago, developed a revolutionary curriculum in design education which focused on enriching the design students' sense and knowledge of art, science, and technology. The intellectual development of design education dominated the traditional skill-based art and craft education. All in all, based on the numerous revolutionary reforms in design education since 1880, the curriculum and pedagogical structure of design education had changed from crafts training to design education. Creativity training became a major domain in developing design students' competencies for the design profession.

Furthermore, the Bauhaus school was one of the pioneers encouraging design students to pay attention to the creative thinking and design process instead of the design outcome. Be specific, the Bauhaus emphasized the sound development of the creative and design process leading to develop their concepts of simplicity and purity of forms. Despite the criticism concerning Bauhaus' pedagogical approach, that it was too academic and therefore hindered the students' explorations of fundamental design, the Bauhaus shaped the entire design education from skill-base craft training to a higher intellectual exploration of art and design by enriching the students' creative thinking and design process.

The Creative Design Process and Creativity Training

Numerous studies have been applied to study the design process and creativity of professional designers or design-related professions. Based on these studies, some creativity and design thinking methodologies have been developed. Eggleston (1976) outlined some major features of the design process: (1) the decision-making process emphasizing the development of new ideas and modification of old ones, (2) the interplay of understanding and knowledge by comparing and evaluating ideas, (3) the needs of the social context of human behavior by studying societies, cultures, and clients, and (4) the meaningful way of using various skills in design.

The importance of the design process encourages students to make things in different ways. In this sense, design education emphasizes the creative design process highly in order to generate appropriate design solutions. In other words, design education is a means of teaching the design process for seeking appropriate solutions to problem-solving activities. The creative design process is essential in helping designers to understand the articulation between creative notions and actual design outcomes. This should also be the concern of creativity training in design education. Design students should be able to handle a sound creative design process by preparing problem materials, research, idea development, implementation, and evaluation. These stages are the actual articulation between creative notions and final design outcome.

Further details about the creative thinking process arose from the earlier creativity research. For example, Wallas (1926) structured the creative thinking process into four stages: (1) preparation – identifying the problem and relevant data, (2) incubation – isolating the problem by allowing the individual to sink into his/her unconscious mind, (3) illumination – finding new relationships and generating ideas, and (4) verification – evaluating the possibilities of executing ideas to solve a problem. Similarly, Stein (1967) divided the creative process into three phases: (1) hypothesis formation, (2) hypothesis testing, and (3) communication. These three phases were more or less similar to the four stages described by Wallas. Some similar descriptions of the creative thinking process were proposed by other researchers. By comparing diverse creative thinking processes, Lau and his colleagues (2009) proposed four key stages for arranging the learning process for creativity training in design education: (1) preparation, (2) incubation, (3) evaluation, and (4) implementation. Clearly, in summary, the creative process consists of diverse stages such as problem identification, conceptual combination, and idea generation.

Again, the creative design process is crucial to design education, and creativity training is undoubtedly one of the key components of training design students in sound creative design processes. However, it is important to note that diverse design domains have their own discipline specifics and exclusive design processes in spite of some argument that there must be some similar mechanisms for conducting creative design processes in diverse design disciplines. Indeed, all experts have their own domain specifics, thus continuously creating a diversity of thinking and working processes. Nonetheless, while the design process might be in different forms based on domain specifics, the creative thinking process is the common mechanism throughout all creative disciplines. In other words, the creative thinking process is one of the commonalities in the design process for all design disciplines. In this sense, creativity training in foundation design education should be more or less similar without domain specifics.

Creativity Training Techniques for Design Education

There is hitherto limited research on studying the classification of creativity training techniques for design education. Bulter and Kline's (1998) study was possibly the earliest to categorize creativity techniques for creativity training. They classified various creative thinking techniques into three groups, namely, (1) brainstorming skill, (2) hierarchical techniques, and (3) skills for changing perspectives. Although Bulter and Kline had not intended to study creative thinking techniques for facilitating design education, their research has helped design educators to understand and design their students' creativity training in a systematic manner.

There have been thousands of existing creative thinking skills and procedures applied in diverse educational situations, namely, foundation education, business, product development, and advertising. Whatever the domain is, it is a must to select and arrange appropriate techniques carefully to consolidate comprehensive creativity training in design education. Lau and his colleagues (2009) classified various creative thinking techniques into five main categories: (1) identifying and mapping attributes, (2) making possibilities, (3) changing and shifting perspectives, (4) making associations and analogical thinking, and (5) probing emotions and the subconscious. This categorization was intended neither to compare the various techniques nor to find out the best technique. A systematic classification of various thinking techniques does provide design educators with a framework for course design. The classification facilitates the curriculum design of creativity training for design education by understanding and gathering diverse functions of creative thinking techniques. Table 1 shows the details of this classification of creative thinking techniques.

In addition, currently the Theory of Inventive Problem Solving (in Russian, the acronym for this is TRIZ) has become one of the key thinking tools for facilitating students' creative thinking skills. TRIZ is based on various principles of problem solving such as logic, data, and research. In view of design education, TRIZ helps students to organize creative thoughts and structure their creative thinking processes in a systematic manner.

All in all, creative thinking is a process of thinking instead of having an idea from nowhere. This means, therefore, that creativity training in design education involves a deliberate arrangement of learning activities and creative thinking techniques. Certainly the design educator is always playing an important role in designing teaching and learning strategies.

Measuring Creativity in Design Education

Francis Galton published the "Inquiries into Human Faculty" in 1883, which raised the concerns about assessing human creativity, and this publication has inspired relevant studies in subsequent decades, for instance, the divergent thinking, imagination, and invention tests that were designed by Binet, Henri, and Whipple around the 1900s. The psychometric approach of assessing human creativity became important post 1950. Guilford made a significant distinction in human thinking between convergent and divergent thinking modes. According to Guilford, convergent thinking focuses on finding a single best and correct answer, while divergent thinking seeks novel and unexpected answers. Based on this, some creativity tests such as the Tests of Divergent Production (TDP) and Creative Behavior Inventory (CBI) were introduced between the 1960s and 1970s. However, it is important to note that some subsequent researchers argued that human divergent thinking is not similar to creativity since it can be affected by structural and motivational factors. Some researchers criticized that these tests could only assess human abilities in general but not the diverse abilities that an individual needs to integrate for creative thinking. Nonetheless, any creative and mental test tries to standardize the conditions, and all these standard tests inherently fail to assess human creativity. Creativity has no standard measurement criteria at all. This is true in design education; students from the fashion design domain are more focused on artistic and cultural exploration for generating creative ideas, whereas those from the advertising design domain emphasize strategic and market-driven solutions. Any standardization of assessment tool inherently fails to assess students' creativity in design education.

It is always difficult to develop a generic assessment tool for design students' creativity and problem-solving skills as well as their creative outcomes due to the diverse content specifics in design education. Design education is a form of education rather than pure creativity enhancement. It involves a systemic creative thinking process to generate solutions for problems. Therefore, design education focuses on assessing students' learning processes and outcomes in creativity training subjects instead of human creativity. Criterion-Referenced Assessment (CRA) is one of the useful assessment tools for measuring students' learning outcomes. CRA helps design students to realize their strength and weakness in creativity training subjects.

Conclusion and Future Directions

There is no subjective judgment regarding good or bad taste in design outcomes, since it is always about appropriate or inappropriate solutions to design problems (Green 1974). Therefore, it is essential for a professional designer to use effective design thinking processes to obtain appropriate design solutions to a specific problem. In this case, creativity training in design education is

Creativity Training in Design Education, Table 1 The five categories of creative thinking techniques

Genre	Description	Existing techniques
Identifying and mapping attributes	This type of creative thinking technique works as a cognitive organizational tool for defining the problem nature and relevant factors by either mapping notes or critical analysis	Mind mapping technique
		Concept map
		Hierarchical method
		Algorithm of inventive
		Problem-solving techniques
		Analysis of interactive decision areas
		Attribute listing technique
		Boundary examination technique
		Card storyboards skill
		Critical path diagrams
		Hexagon modeling
		Progressive hurdles technique
		Etc.
Making possibilities	This type of creative thinking technique helps students to generate numerous ideas and possibilities which may or may not result as solutions. This kind of tool is not going to solve a problem directly but can generate more alternatives for further consideration	Brainstorming technique
		Random access technique
		Brain sketching technique
		Brute think technique
		Collective notebook technique
		Heuristic ideation technique
		Ideal final result
		Imaginary brainstorming technique
		Paraphrasing key words technique
		Pictures as idea triggers technique
		Random stimuli technique
		Trigger method
		Think tank technique
		Wishing technique
		Etc.
Changing and shifting perspectives	This type of creative thinking technique seeks diverse perspectives in tackling a problem. Divergent thinking is an essential skill for solving a problem creatively; thus, these tools mainly provide divergent views for students in generating ideas and solutions	Six thinking hats
		Empathizing and dynamization
		Alternative scenarios technique
		Concept fan technique
		False faces technique
		Fresh eye technique
		Help-hinder technique
		RoleStorming Technique
		Etc.
Making association and analogical thinking	This type of creative thinking technique helps students to associate with more possibilities and work for Eureka. Making stimulations from cultural and current issues is also significant in facilitating students' associations and imaginations	SCAMPER procedure
		Lateral thinking technique
		Analogy and speculative imagination
		Circle of opportunity technique
		Escape thinking technique
		Exaggeration technique
		Force-fit game
		Paired comparison technique
		Similarities and differences technique
		Talking pictures technique
		Etc.

(*continued*)

Creativity Training in Design Education, Table 1 (continued)

Genre	Description	Existing techniques
Probing emotions and the subconscious	This type of creative thinking technique makes use of the power of the subconscious and emotions in creating possible ideas as well as making creative decisions	Hunch and intuition
		Doodling technique
		Lucid dreaming technique
		Controlling imagery technique
		Focusing technique
		Keeping a dream diary technique
		Neuro-linguistic programming
		Etc.

crucial in developing students' creative competencies for making sound creative design processes.

Creativity cannot be taught, however creative thinking techniques and process can be. This is the underlying principle of designing creativity training in design education. Creativity training in design education is a systematic arrangement of teaching and learning diverse thinking skills and creative thinking processes as well as developing students' learning behaviors with respect to creative thinking. It is, therefore, quite clear that creativity training is essential in design education.

Cross-References

▶ Brainstorming and Invention
▶ Creative Personality
▶ Creativity in Invention, Theories
▶ Freedom and Constraints in Creativity
▶ Imagination
▶ Invention and Innovation as Creative Problem-Solving Activities
▶ Invention and Modification of New Tool-Use Behavior
▶ Metaphorical Reasoning and Design Creativity: Consequences for Practice and Education

References

Butler DL, Kline MA. Good versus creative solutions: a comparison of brainstorming, hierarchical, and perspective-changing heuristics. Creativity Res J. 1998;11:325–31.
Eggleston J. Developments in design education. London: Open Books; 1976.
Green P. Design education: problem solving and visual experience. London: B T Batsford Ltd.; 1974.
Kneller GF. The art and science of creativity. New York: Holt, Rinehart and Winson; 1965.
Lau KW, Ng MCF, Lee PY. Re-thinking the creativity training in design education: a study of creative thinking tools for facilitating creativity development of design students. Art Design Commun High Educ. 2009;8(1):71–84.
Sternberg RJ. Teaching for successful intelligence: principles, practices, and outcomes. Educ Child Psychol. 2003;20(2):6–18.
Wallas G. The art of thought. New York: Harcourt Brace; 1926.

Creativity Versus Intelligence

▶ Divergent Versus Convergent Thinking

Creativity, Discourses

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Synonyms

Education, discourses; Scientific creativity, discourses

Introduction

The importance of sociocultural influences in contextualizing and contemporizing approaches to creativity is a recurrent theme in all areas of education, enterprise, and research. To understand, and analyze, how sociocultural factors direct and inform our perceptions of what it is, and what it means, to be creative, it is useful to deploy the concept of discourses as ideoethical constructs that we use to identify and articulate our emotional and intellectual relationship to others and other ways of being.

Application of discourse analysis allows identification of four distinct, but overlapping, discourses of creativity that draw upon, and influence, various aspects of teaching, learning, and management theory (Fig. 1).

The Developmental Discourse

Developmental discourses of creativity operate on an assumption that all individuals are capable of at least some form of creative output. This perception draws upon classical, Piagetian notions of cognitive development as a linear process mediated via the complementary functions of accommodation (interpretation of new experiences in relation to existing mental schemata) and assimilation (modifying existing mental schema to include new information). Within this framework, individuals pass through four primary developmental stages: beginning with an ability to coordinate sensory input with motor responses (sensorimotor stage) and culminating in a capacity for extrapolation of concepts and ideas to unfamiliar situations (formal operations stage).

In a developmental discourse, differences in creative ability are primarily attributed to differences in cognitive development, and it is assumed that the capacity for creative output exists in all individuals who reach the formal operations stage.

The developmental discourse is supported by empirical studies that show positive correlations between post-formal cognition and divergent thinking and readily translates to education and training programs based on practices that emphasize personal or individualized learning outcomes (Fig. 1).

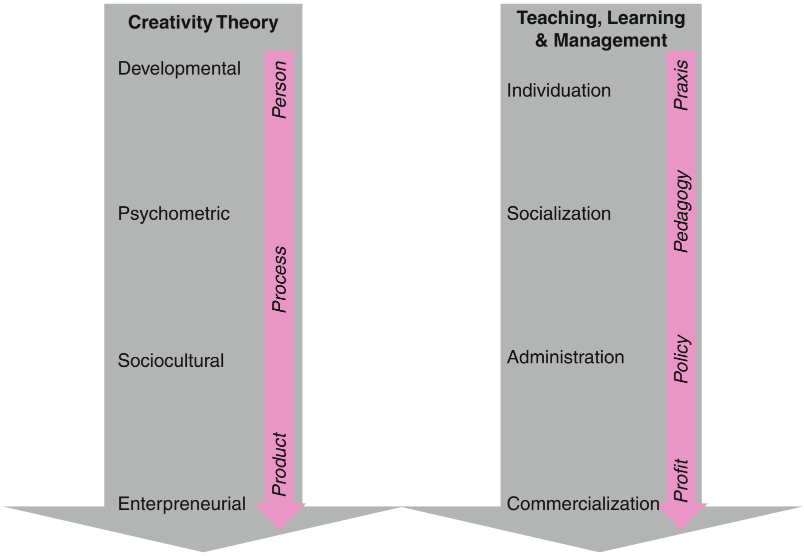
The most significant limitations of developmental approaches discourse arise from evidence that, while the neurobiological structures and processes that determine cognitive capacity (and therefore creativity) are, to at least some extent, genetically determined, individuals who generate creative output also display complex, and highly variable combinations of social, psychological, and intellectual traits/characteristics. A lack of attention to affective and environmental factors therefore means that developmental discourses are unable to adequately account for the subtle, but crucial interplay of personal and social factors that enable or impede creativity in individual cases.

The Psychometric Discourse

Psychometric discourses frame creativity in terms of internal and external networks of traits, characteristics, and events that can be measured, manipulated, or exploited to predict/calculate or control (to a greater or lesser extent) an individual's likelihood of generating creative output. This view of creativity as a function of interactions between social, psychological, and intellectual traits/characteristics tends to dominate in settings where actualization of creativity is dependent on interactions between individuals.

The psychometric approach focuses on interplay of four intrapersonal domains: (a) a genetic domain composed of what one is biologically capable of doing well or poorly; (b) a domain of momentary, sensory memory, or experience; (c) a skillscape, in which the individual interprets and reacts to the events they are experiencing; and (d) a wordscape formed from the ability to articulate and share understanding of events and experiences.

For individuals and organizations wanting to engineer environments that are conducive to creativity, this has practical relevance, but weaknesses of the psychometric approach include a tendency to facilitate output only from individuals that represent extremes of social/intellectual variation and a lack of relevance and/or practicality in creative products.



Creativity, Discourses, Fig. 1 Discourses of creativity (Modified from Schmidt (2011) © SciRes)

The Sociocultural Discourse

Where those operating within developmental and psychometric discourses tend to be motivated by a desire to develop practices and create environments that facilitate creative output of individuals and groups, sociocultural discourses are concerned with the interaction of social, cultural, and economic factors that stimulates, refines, and sustains interest in creativity in the first instance.

This approach is not confined to the field of creativity studies, but extends across all or most fields of human endeavor and offers an important line of defense against policies and practices with the potential to generate or perpetuate social and economic inequity. In an educational context, the movement has its genesis in the early-to-mid twentieth century work of John Dewey, but its relevance and utility is enhanced (rather than diminished) in contemporary societies, where global forces drive recurrent cycles of growth and recession, leaving individuals vulnerable to recurrent periods of unemployment and in need of recurrent retraining.

In terms of practical application, however, sociocultural discourses are generally focused on problematization to such an extent that they rarely give rise to strategies or practices that can facilitate or enable creativity *per se*.

The Entrepreneurial Discourse

Organizations and individuals that operate within entrepreneurial discourses of creativity emphasize the products of creation. The entrepreneurial ideal is establishment and maintenance of policies and practices that identify and reward those that generate the most, or most valuable, creative output.

In purely commercial settings, entrepreneurial systems are self-regulating; in that overt discrimination against any particular sociocultural group is untenable because it constrains market size and limits profit. In these environments, the entrepreneurial approach can be implemented in ways that emphasize constructive, rather than competitive, social interactions.

In other settings, such as education and training, where the value of various products and practices cannot be represented in financial terms, however, an entrepreneurial approach can lead to arbitrary imposition of subjective, rather than objective, measures of creative output. This occurs because emphasis on production rather than creation leads to a focus on competitive attainment, which in turn leads to breakdown of moral and ethical frameworks.

Conclusion and Future Directions

Determining which conceptualization of creativity has greatest relevance and utility in any given setting is not straightforward. Insistence that creativity is an ephemeral, nebulous trait personified in a relatively small subset of élite individuals is dysfunctional at a societal level because there is not, and cannot be, delineation of single creative archetype. Creativity in any domain of human endeavor correlates with a wide range of personal traits and characteristics, and its actualization is the product of complex, dynamic interplay between personal and societal factors. Translation of theories of creativity into praxis in any given domain of human activity should therefore be based upon a dynamic, flexible combination of developmental, psychometric, sociocultural, and entrepreneurial perspectives.

Cross-References

- ▶ Adaptive Creativity and Innovative Creativity
- ▶ Age and Creative Productivity
- ▶ Cognition of Creativity
- ▶ Corporate Creativity
- ▶ Creative Mind: Myths and Facts
- ▶ Creative Pedagogy
- ▶ Creative Personality
- ▶ Creative Potential
- ▶ Creative Process
- ▶ Creativity Definitions, Approaches
- ▶ Creativity from Design and Innovation Perspectives
- ▶ Four Ps of Creativity
- ▶ Psychology of Creativity
- ▶ Research on Creativity
- ▶ Science of Creativity
- ▶ Scientific Creativity as Combinatorial Process

References

Claxton G. Thinking at the edge: developing soft creativity. Camb J Educ. 2006;36(3):351–62.
Clegg P. Creativity and critical thinking in the globalised university. Innov Educ Teach Int. 2008;45(3):219.
Dewey J. Chapter 23: vocational aspects of education. In: Democracy and education. New York: The Free Press; 1916.
Schmidt AL. Creativity in science: tensions between perception and practice. Creat Educ. 2011;2(5):435–45.
Sigelman CK. Life-span human development. 3rd ed. Boston: Brooks/Cole Publishing Company; 1999.
Simonton DK. Scientific creativity as constrained stochastic behavior: the integration of product, person, and process perspectives. Psychol Bull. 2003;129(4):475.
Simonton DK. Creativity as blind-variation and selective-retention: Constrained combinatorial models of exceptional creativity. Phys Life Rev. 2010;7:156–79.

Creativity, Experiential Theories

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Synonyms

Creativity

Introduction

Most theories of creativity focus on the distinctive functional/computational mechanism that accounts for what makes creative mental processes creative. They disagree about what this functional/computational mechanism is supposed to be (whether it is the recombination of old ideas or the transformation of one’s conceptual space, etc.) but they are in agreement about the kind of explanation to be offered – a functional/computational one. Experiential theories of creativity question this assumption that what makes creative mental processes creative is a distinctive functional/computational mechanism. According to these theories, creativity of creative mental processes is to be explained with reference to the way in which this mental process is experienced.

Creativity Versus Originality

Creativity and originality are often used as synonyms. Arguably, this is a mistake. Being original is usually contrasted with being derivative: An idea, for example, is original if it is not derived from someone else's idea. A scientific discovery or an artwork is original if it is not derivative. Whether a scientific discovery or artwork is original says relatively little about the nature of the mental process of the person who produced it. Originality is a property of normally publicly observable entities (not just of physical objects, but also of styles, utterances, and behavior).

Creativity, in contrast, is not normally publicly observable. It is a feature of mental processes. Being creative is not contrasted with being derivative, but with being mechanical (see, for example, Gaut 2003, pp. 150–151). Whether a mental process is creative says nothing about what kind of entities (if any) it produces. Some artists' and scientists' mental processes are creative, but so are many of those who are solving crossword puzzles or killing time at the airport with a difficult sudoku.

There is no simple connection between these two notions. Creativity is neither necessary, nor sufficient for originality. A scientific discovery can be original and still be the product of a purely mechanical mental process, which is, by definition, not creative. Goodyear's often quoted discovery of vulcanization is a possible example. Another example is the following. If you write a letter of recommendation for a student and emphasize how original her work is, you do not thereby also comment on her mental processes. You do not know much about the functional/computational structure of her mental processes, but you do know their outcome: that her research is very original.

Conversely, the products of a creative mental process can be completely banal and derivative. Suppose that you are in high school and you are trying to solve a math problem. There is a mechanical way to solve it: You have to try out all the natural numbers between 1 and 999 one by one, and one of them will be the solution. But there is also a creative way of solving it. If you manage to solve it in the creative manner, your mental process is creative (it is not mechanical), but the product of this mental process is not original at all: All the other students in your class solve the very same math problem, after all.

It is often claimed that novelty is a necessary feature of creativity. The contrast between creativity and originality is supposed to highlight that there may be no need to accept this as an unquestionable assumption. The concept of novelty is indeed very important for characterizing creativity, but in a less straightforward way than it is normally assumed. In contrast, novelty is clearly necessary for originality.

The distinction between creativity and originality could be thought to be a version of Ian Jarvie's distinction between subjective and objective creativity (Jarvie 1981, p. 117). Similarly, Ian Jarvie talks about subjective and objective creativity: subjective creativity, as he puts it, is "a property of persons or their minds," whereas objective creativity is "a property [. . .] of created works" (Jarvie 1981, p. 117). But it is important to note that while Jarvie claims that subjective creativity is "of no interest" in and of itself (Jarvie 1981, p. 117), much of the literature on creativity in the last three decades has been trying to understand the difference between (subjectively) creative and noncreative mental processes.

Creativity, in this sense, is quite a banal phenomenon: It is not to be restricted to the mental processes of a select few: Beethoven, Einstein, and the like. It is something much more common and much less mysterious. Originality, in contrast, is much rarer. There are many fascinating questions about originality that are usually discussed as questions about creativity (Carroll 2003), but for the purposes of this entry, these will be left on the side.

The Experiential Theories

There are two influential strategies to talk about the difference between creative and noncreative mental processes. The first one is to claim that this difference is a functional/computational difference. Say, creative mental processes are those types of mental processes that transform one's conceptual space, whereas noncreative ones are the ones that do not (Boden 1992, 1994 – note that this is Boden's account of radical creativity, not of creativity per se). Or, creative mental processes are bisociative ones and only these mental processes are bisociative (Koestler 1975). It is important to note that these explanations explain a mental process-type (creative mental processes) in terms of a functional/computational process type (bisociation, transformation of conceptual space, recombination, etc.) and this functional/computational process is supposed to be the one that is causally responsible for the emergence of the creative idea/thought.

The second strategy is to deny that any psychological explanation is possible. There are many versions of this claim (Feyerabend 1987; Jarvie 1981). It has been argued that the difference between creativity and noncreative mental processes cannot be explained at all, maybe because creativity is a one-off phenomenon, where every token of creativity is different, and therefore, no mental process type that would be responsible for creativity can be identified (Jarvie 1981). Another, old and influential, version of this view is that although this difference can be explained, it is not a psychological difference: It is not a matter of what the subject does, but either a result of divine intervention (as Plato claims) or of the mysterious subconscious (as Freud does). In other words, even if there is an explanation for creativity (say, divine intervention), this explanation is not a psychological one.

An advantage of, and the main inspiration for, the functional/computational account is that it would make it possible to build creative computers. If creativity is a matter of instantiating a functional/computational process, then computers can do it as much as humans can. And, conversely, some of the claims about the impossibility of a psychological account of creativity are fuelled by doubts about computer creativity.

Experiential theories of creativity claim that the difference between creative and noncreative mental processes is a psychological difference, but not a functional/computational one. In short, this difference is constituted by the way these mental processes are experienced.

Thus, experiential theories of creativity make a negative and a positive claim. The negative claim is that what is distinctive about creativity is unlikely to be a functional/computational process type. The positive claim is that what is distinctive about creativity is still something psychological: the way these mental processes are experienced.

The negative claim of the experiential theories of creativity is that what is distinctive about creativity is unlikely to be a functional/computational process type (Weisberg 1993 argues for a version of this claim). A simple fact to notice is that no functional/computational account proposed so far is without counterexamples. Here are two of the most influential such theories. Margaret Boden's account, according to which (radical) creativity implies the transformation of one's conceptual space, has been criticized for not covering some clear cases of creativity (Novitz 1999, pp. 68–70). Novitz's account, according to which creativity implies the mere recombination of old ideas (Novitz 1999), in turn, also fails to cover all cases of creativity (including the ones Boden was focusing on).

The experiential theories of creativity favor a more pluralist approach. Creative mental processes can be implemented by more than one functional/computational process. Boden is (partly) right: Her functional/computational explanation for the emergence of creative ideas is the right kind of functional/computational in some cases of creative mental processes. But Novitz is also (partly) right: His account identifies the right way to explain some *other* cases of creative mental processes. But neither account is satisfactory as a general account of the difference between creative and noncreative mental processes.

Not all mental phenomena form a functional/computational natural kind. Being in love, for example, is unlikely to be a functional/computational natural kind. The same goes for being happy. The claim is that creativity is also unlikely to be a functional/computational natural kind. What is in common between the diverse mental processes that are taken to be creative is not something functional/computational, but something experiential.

It is important that the experiential theories of creativity are not denying that for each token creative process, there is (or at least can be) a functional/computational process that implements this creative process. What the experiential theories of creativity deny is that there is anything interesting in common between these token processes (besides the fact that they all implement creative processes). Creativity comes in different (functional/computational) forms: Some creative mental processes involve a mere recombination of old ideas. Some others involve a radical transformation of one's conceptual space. The functional/computational level is not the right level of analysis if the aim is to explain the difference between creative and noncreative processes.

Does this make creativity miraculous? Definitely not. Each token creative mental process is realized by a token series of neuron firings. So are token instances of happiness or of being in love. The point is that what is in common between these neural events is unlikely to be captured in functional/computational terms. But, like in the case of happiness and being in love, it can be captured in experiential terms.

A functional/computational and an experiential explanation of a creative mental process are not exclusive of one another. A full explanation of creative mental processes would presumably require both. But the main claim of the experiential theories of creativity is that the experiential description captures something about creative processes in general, whereas the functional/computational description does not. And many important features of creativity can be explained by the experiential explanations (rather than the functional/computational ones).

Many thinkers have toyed with ideas about creativity that could be taken to belong to the experiential approach. Here two such thinkers will be discussed in detail (but note that they by no means exhaust the logical space of the experimental theories of creativity): Robert Musil and Bence Nanay.

Robert Musil's Experiential Theory of Creativity

Robert Musil was not a philosopher, but a novelist, although he did have a Ph.D. in philosophy. This is the account he gives of creative mental processes in his classic and very philosophical novel, *The Man without Qualities*:

> The solution of intellectual problems comes about in a way not very different from what happens when a dog carrying a stick in its mouth tries to get through a narrow door: it will go on turning its head left and right until the stick slips through. We do pretty much the same [. . .] the slipping through comes as a surprise, is something that just suddenly happens; and one can quite distinctly perceive in oneself a faintly nonplussed feeling that one's thoughts have created themselves. (Musil 1930/1979, p. 128)

This is clearly a version of the experiential theory of creativity. What makes creative mental processes creative is the element of surprise – an experience. What makes them creative is not the functional/computational mechanism that underlies these creative mental processes but the way they are experienced. Musil does not elaborate on what this experience is like – besides noting that the experience of surprise, of "a faintly nonplussed feeling" is a crucial element of this experience.

Bence Nanay's Experiential Theory of Creativity

A more recent exploration of the experiential approach to creativity is Bence Nanay's account (Nanay 2012). The starting point of Nanay's version of the experiential theory of creativity is Margaret Boden's concept of radical creativity. Boden argues that an idea is (radically) creative only if "the person in whose mind it arises could not (in the relevant sense of 'could not') have had it before" (Boden 1994, p. 76). There are notable difficulties spelling out what is meant by the "relevant sense of could not" and there may be some questions about whether this account could apply in the case of all instances of (radical) creativity (see Novitz 1999, pp. 68–70). But Nanay rephrases Boden's definition in the following manner: An idea is creative only if the person in whose mind it arises *experiences it* as something she *has* not taken to be possible before.

So the claim is that it is a necessary feature for creative mental processes that their outcome is experienced in a certain way: that one experiences the outcome of the mental process as something one has not taken to be possible before. But what does it mean to say that an experience represents a mental process as something the agent has not taken to be possible before? At time t, the agent considered a number of possibilities. Later, at time t*, she comes up with a possibility that she experiences as something that is different from all the possibilities she considered at time t.

Nanay's aim is to give a necessary condition for creative mental processes. His claim is that the most that can be said about the necessary condition for creative mental processes is that they are experienced as something one have not taken to be possible before. It is important that this is a necessary and not a sufficient condition. But if a couple of further conditions are added, it may be possible to give (or at least come close to giving) a necessary and sufficient condition for creativity.

You can experience an idea as something you have not taken to be possible before, but you may be wrong: Experiences can misrepresent. You may experience an idea as creative: as something you have not taken to be possible before, but maybe you had taken it to be possible before, but you forgot that you had. Thus, if the aim is to give a (close to) sufficient condition for creativity, it would need to be added that the experience that defines creative mental processes has to be veridical: The idea in question really needs to be something you have not taken to be possible before – it is not enough if you experience it as such.

There may be some further conditions that need to be added in order to arrive at a genuine necessary and sufficient condition for creativity. But the aim of the experiential theories of creativity is not to argue for some strict necessary and sufficient condition for creativity. The aim of the experiential theories of creativity is to argue that the right level for the characterization of (and for giving a necessary and sufficient condition for) creativity is not the functional/computational level, but the experiential one.

Experiential Theories Versus Functional/Computational Theories of Creativity

It can be argued that experiential accounts have greater explanatory power in explaining some of the crucial features of creativity than the functional/computational ones – given that the most salient features of creativity are experiential ones, this claim should not come as a surprise.

I will briefly mention three features of creativity that are taken to be important enough so that any comprehensive theory of creativity must be able to explain (or at least say something about) them. There may, of course, be many more such features. But these three have played an important role in shaping the widespread conception of creativity.

(a) A theory of creativity needs to be able to explain why it is a tempting intuition that suggests that creativity is something that happens to us, rather than something that the subject does.
(b) A theory of creativity needs to be able to explain why the experience of the appreciation of other people's creativity can seem similar to the experience of one's own creativity.
(c) A theory of creativity needs to be able to explain why creative actions are taken to be genuine actions and not mere bodily movements.

It can be argued that all these three features of creativity are better explained in the experiential than in the functional/computational framework (see Nanay 2012). If this is so, then there are good reasons to explore the experiential theories of creativity.

Conclusion and Future Directions

It is important to note that the aim of the experiential theories of creativity is not to give a necessary and sufficient condition for creativity – creativity is an ordinary language concept and it may be difficult to capture its meaning with strict necessary and sufficient conditions. The aim of the experiential theories of creativity is to argue that the right kind of analysis for the concept of creativity should be about experiences (rather than functional/computational mechanisms).

Further, even if a necessary and sufficient condition for creativity could be given in terms of experiences, this does not mean that these experiences are causally responsible for the emergence of creative ideas. It is neural processes that are causally responsible for the emergence of creative ideas. The claim is that in order to capture some of the crucial features of creative processes, they need to be analyzed on the experiential level.

One important future direction in research for experiential theories of creativity would be to fill in the details of what these experiences are supposed to be in the same degree of specificity as the functional/computational theories do.

Cross-References

► Cognition of Creativity
► Creativity Definitions, Approaches
► Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon
► In Search of Cognitive Foundations of Creativity
► Mental Models and Creative Invention

References

Boden M. The creative mind: myths and mechanisms. Reading: Cardinal; 1992.
Boden M. What is creativity? In: Boden M, editor. Dimensions of creativity. Cambridge, MA: The MIT Press; 1994. p. 75–118.
Carroll N. Art, creativity, and tradition. In: Gaut B, Livingstone P, editors. The creation of art. New essays in philosophical aesthetics. Cambridge: Cambridge University Press; 2003. p. 208–34.
Feyerabend P. Creativity – a dangerous myth. Crit Inq. 1987;13:700–11.
Gaut B. Creativity and imagination. In: Gaut B, Livingstone P, editors. The creation of art. New essays in philosophical aesthetics. Cambridge: Cambridge University Press; 2003. p. 148–73.
Jarvie IC. The rationality of creativity. In: Dutton D, Krausz M, editors. The concept of creativity in science and art. Dordrecht: Martinus Nijhoff; 1981. p. 109–28.
Koestler A. The act of creation. London: Picador; 1975.
Musil R. The man without qualities (trans. Eithne Wilkins and Ernst Kaiser). London: Picador; 1930/1979.
Nanay B. An experiential account of creativity. In: Paul E, Kaufman SB, editors. The philosophy of creativity. Oxford: Oxford University Press; 2012.
Novitz D. Creativity and constraint. Aust J Philos. 1999;77:67–82.
Weisberg R. Creativity: beyond the myth of genius. New York: Freeman; 1993.

Creativity, Intelligence, and Culture

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Before discussing how creativity and intelligence are impacted by culture, the basic question of how the two constructs are related must be addressed. Sternberg and O'Hara (1999) argued for five possible relationships: Creativity could be a subset of intelligence; intelligence could be a subset of creativity; or the constructs of creativity and intelligence could be overlapping, coincident, or simply disjointed.

Creativity and Intelligence

Most work, however, assumes a connection; as Plucker and Renzulli (1999) concluded, the key question is not *whether* but *how* the two are related. Although creativity and intelligence are clearly related, the exact nature of this relationship is still being explored by research. Scholars have generally found that paper-and-pencil measures of creativity (such as divergent thinking tests) are significantly associated with psychometric measures of intelligence. Traditional wisdom has argued for a "threshold effect," in which creative potential and psychometric intelligence are positively correlated at low levels of IQ and continue to be positively correlated through IQs of approximately 120. Across many of these studies (conducted on both children and adults), in people with higher IQs, the two constructs have been reputed to show little relationship.

More recently, however, this theory has come under fire. Kim (2005) conducted an extensive meta-analysis of 21 studies containing 45,000 participants and using multiple measures of IQ and creativity. She found virtually no support for the threshold theory, showing very small positive correlations (mean correlation of .174) between measures of cognitive ability (designed to measure *g*) and measures of creativity and divergent thinking.

Most of these studies use intelligence measures that primarily have been designed to measure *g*, or a general factor of intelligence. Most theories of intelligence, however, are more complex than simply *g*. One example is crystallized and fluid intelligence, as proposed by Raymond Cattell and John Horn. Fluid intelligence (*Gf*) is the ability to apply a variety of mental operations to solve novel problems, ones that do not benefit from past learning or experience. Crystallized intelligence (*Gc*) is the breadth and depth of a person's accumulated knowledge of a culture and the ability to use that knowledge to solve problems. One study that examined crystallized versus fluid intelligence and creativity, conducted by Sligh, Conners, and Roskos-Ewoldsen (2005), used an individually administered IQ test and a creative invention task (in which people would use shapes to create a possible object, and then name and describe their invention). Sligh et al. found that *Gc* showed the same moderate and positive relationship to creativity as in past studies. In contrast, *Gf* was more related to creativity in people with higher IQs. This finding implies that those who receive high Gf scores may be more likely to be creative than those who receive high Gc scores.

Intelligence and Culture

One notable area where creativity and intelligence diverge is how they are associated with culture. As it is measured, intelligence tends to show significant discrepancies by culture. Within American culture, African Americans and Hispanic Americans tend to receive lower scores of measures of intelligence than do Caucasians and Asian Americans; standardized tests such as the SATs, ACT, Graduate Record Exams (GREs), and Advanced Placement (AP) exams have shown similar patterns of discrepancy among ethnic groups. Although some researchers argue that these measures reflect actual differences, this view is not a commonly accepted one. Some scholars, for example, point to the discrepancy between socioeconomic status and opportunities across ethnicities, whereas others argue that differences are a result of implicit biases in the measures of intelligence that are used. Another perspective is that current ability measures do not incorporate enough aspects of intelligence to truly reflect a person's "global" ability (Kaufman 2010).

Across cultures, Asians and Europeans tend to receive higher scores, whereas Africans receive lower scores; more notable, however, are the different values and implicit beliefs about intelligence. Asians often see effort as a component of intellectual ability, for example, and Africans tend to emphasize practical abilities. It is difficult to draw larger conclusions about intelligence across cultures given that the vast majority of tests used are translated Western tests. Many scholars argue that any differences that emerge are due to test bias (Sternberg and Kaufman 2011).

Creativity, Culture, and Ethnicity

Within creativity, however, such differences by ethnicities and culture are typically slight or nonexistent. As reviewed by Kaufman (2010), most studies of ethnic differences in creativity have used divergent thinking tests; others have used actual creative performance as rated by experts or self-assessments. There tend to be very few differences between African-Americans and Caucasians. Those that have been found favor African-Americans. Hispanic Americans are outperformed by Caucasians on verbal divergent thinking measures (likely because of language discrepancies), but there are no differences on nonverbal measures (or, curiously, verbal measures of creative performance). Some studies have indicated that the bilingual students may have an advantage in creative abilities. Bilinguals have been proposed to be more cognitively flexible, allowing them to see problems from multiple perspectives.

An example of a study that looked at multiple ethnicities and gender is Price-Williams and Ramirez (1977). They found an interesting ethnicity by gender interaction. African-American males and Hispanic American males outperformed Caucasian males on a divergent thinking test. However, the results were reversed for females. Caucasians outperformed African Americans and Hispanic Americans on fluency. There have been few other studies that have found this type of interaction; the vast majority of the studies that examine gender differences either find no significant differences or mixed results.

There are many studies on differences in Asians and Europeans or Asians and Americans. Generally, Asians or Asian Americans outperform Europeans or Caucasians on measures of analytic ability but score lower on measures of divergent thinking. Studies that look at actual creative performance find either no differences or slight differences favoring Americans/Caucasians. In one such study, Rostan, Pariser, and Gruber (2002) studied Chinese American and Caucasian students' artwork, with two groups in each culture: students with additional art training and classes, and students with no such classes. Each group's artwork (one drawing from life and one drawing from imagination) was judged by both Chinese and American judges. There were no significant differences between cultures from either set of judges. The only differences found were that art students (regardless of ethnicity) received higher ratings for their artwork than did non-art students.

Practical Applications

Kaufman (2010) argued that the discrepancy between ethnic differences on creativity measures versus intelligence/achievement tests could offer an opportunity for more equitable admissions criteria. There are two ways that standardized tests are criticized for being potentially biased. A common layperson's approach to criticizing tests as biased is to point to significant differences that occur between males and females and among ethnic groups on various tests of aptitude or ability.

Researchers who advocate psychometric approaches to bias in testing take a more sophisticated view of the problem and do not accept the notion that just because two groups perform differently on a mental test, therefore, the test itself must be in error or biased. Current approaches evaluate content statistically to identify specific items that are inappropriate because they unfairly favor one group over another. Methods are commonly applied as well to determine whether different constructs are measured across nominal groups by the same test; a test may measure verbal ability in Caucasians, for example, but may be measuring something quite different (such as exposure to American culture) in a Hispanic American population. These are only a few of the recent, more sophisticated, methods of considering bias assessment (Reynolds 2000). When a test measures something different from what it was intended to measure for specific groups, then it may be considered a biased instrument against those groups. A measure is fair to the extent that the score only includes (a) variables associated with the construct being measured, and (b) random variance from error. In other words, a measure is fair to the extent that it minimizes systematic error in true score estimation as a function of group membership. If a test systematically assigns certain groups lower scores than their "true" score, then the test should be considered biased.

Creativity assessment can reduce bias from both the layperson and psychometric approaches. If creativity is used to create a fuller picture of an applicant, and if creativity is an unmeasured component of ability, then these measures might also help minimize errors in decision-making regarding such students (many conceptions of intelligence, as mentioned earlier, include creativity as a core component). This possibility for reduction in error can be conceptualized in two very different and complementary ways. Assume one is trying to understand a person's overall cognitive abilities, but only a narrow range of relevant abilities (e.g., those measured by traditional IQ tests) are being assessed. Even if these abilities are being assessed fairly, the ability of the examiner to understand the person's cognitive functioning may be limited. This limitation may be different for different groups. If, for example, some abilities are more relevant in some cultural settings than others, then the unmeasured abilities may have a differential impact on understanding people's abilities based on their culture. Such a discrepancy would create bias in the assessment process. To use a cross-discipline example, imagine a test of visual artistic ability that only looked at sketching. The artistry test would miss many other core components (such as watercoloring or drawing), and would over-reward people who were especially good at sketching. In doing so the test would have an implicit bias against people who were color-blind.

In addition, consider a college admissions program (or a clinical test examiner) trying to assess a limited range of a person's cognitive abilities (e.g., IQ). If the available tests are believed to be biased, it may be possible to correct some of the systematic error present if other cognitive abilities are tested, as long as these abilities are believed to influence scores adversely on other tests in the examination. If, for example, scores on a valid and reliable test of creativity could be shown to correlate with some systematic ethnic bias of IQ tests, then perhaps the creativity test scores could be used to attenuate any systematic error on the IQ tests.

Conclusions and Future Directions

Although there are differences in scores on ability and achievement measures across cultures and ethnicities, these differences are reduced, eliminated, or reversed on most creativity measures. Indeed, including creativity tests as part of a global ability or achievement measure would also likely reduce ethnic differences. Although the psychometric definition of biased assessment is the most relevant for an academic audience, creativity tests can also increase people's perceptions of bias in admission assessments.

Cross-References

► Cognition of Creativity
► Creativity Across Cultures
► Techno-Globalization and Innovation

References

Kaufman JC. Using creativity to reduce ethnic bias in college admissions. Rev Gen Psychol. 2010;14: 189–203.
Kim KH. Can only intelligent people be creative? J Secondary Gifted Edu. 2005;16:57–66.
Plucker JA, Renzulli JS. Psychometric approaches to the study of human creativity. In: Sternberg RJ, editor. Handbook of creativity. New York: Cambridge University Press; 1999. p. 35–60.
Price-Williams DR, Ramirez III M. Divergent thinking, cultural differences, and bilingualism. J Soc Psychol. 1977;103:3–11.
Reynolds CR. Methods for detecting and evaluating cultural bias in neuropsychological tests. In: Fletcher-Janzen E, Strickland TL, Reynolds CR, editors. Handbook of cross-cultural neuropsychology. New York: Plenum; 2000. p. 249–85.
Rostan SM, Pariser D, Gruber HE. A cross-cultural study of the development of artistic talent, creativity, and giftedness. High Abil Stud. 2002;13:125–56.
Sligh AC, Conners FA, Roskos-Ewoldsen B. Relation of creativity to fluid and crystallized intelligence. J Creative Behav. 2005;39:123–36.
Sternberg RJ, Kaufman SB, editors. Cambridge handbook of intelligence. New York: Cambridge University Press; 2011.
Sternberg RJ, O'Hara LA. Creativity and intelligence. In: Sternberg RJ, editor. Handbook of creativity. New York: Cambridge University Press; 1999. p. 251–72.

Creativity, Invention, Innovation and Entrepreneurship, Discourse

► Linguistic Dimension of Creativity, Invention, Innovation, and Entrepreneurship

Creativity: Cultural Capital in Mathematics

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Synonyms

Inventiveness; Originality; Problem solving; Resourcefulness; Social capital

In the realm of education, creativity is not usually associated with mathematics. The average mathematics classroom is dominated with step-by-step directions, algorithms, and logical formulas for problem solving. In the past, this may have been sufficient for problem solving due to the tools available to students. However, access to cultural goods, tools, resources, and technologies has changed dramatically in the past few decades and has radically changed the tools available to students. With this change, creativity has emerged as the new cultural capital of the mathematics classroom. Creativity is needed to address current and future problem-solving challenges of the twenty-first century and beyond.

Key Concepts

Creativity

Emerging technology and innovative access has radically changed the career and lifestyle options of the human race and will continue to change them. The tools and roles of the future are unknown, but preparation for that future occurs daily in classrooms around the globe. Survival in this type of elusive future will require a very fluid/adaptable type of thinking that is closely associated with creativity (Gardner 2009). This type of thinking can be referred to as divergent thinking or "originality, flexibility, and elaboration; and fluency in thinking" and is often thought to be at the core of creativity (Sak and Maker 2006, p. 279). Creativity itself has been defined in hundreds of ways throughout decades. An analysis of 42 definitions of creativity by Kampylis and Valtanen (2010, p. 198) reveals four key components commonly referred to as the four Ps of creativity (person, process, press, and product):

1. Creativity is a key ability of *individual(s).*
2. Creativity presumes an *intentional activity* (process).
3. The creative process occurs *in a specific context* (environment).
4. The creative process entails the generation of *product(s)* (tangible or intangible). Creative product(s) must be novel (original, un*conventional*) and *appropriate* (valuable, useful) to some extent, *at least* for the creative individual(s).

Mathematics

Mathematics can be defined as using number sense, geometry, estimation, measurement, statistics, probability, fractions, decimals, patterns, spatial sense, and relationships to solve problems. Problem solving is defined by the National Council for Teachers of Mathematics (NCTM) as "engaging in a task for which the solution method is not known in advance" (NCTM 2000, p. 52). A critical piece of the NCTM's definition is that the solution method is *not known* in advance. In the past, math has been looked at as a process of solving problems with *known* algorithms. Knowing an algorithm in advance negates a student's mathematical thinking and hinders the development of place value and number sense (Kamii 1988).

Mathematics Education

Contemporary mathematics education relies heavily on the common core state standards initiative.

The common core state standards initiative in the United States recognizes eight main foci:

- Making sense of problems and persevere in solving them
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others

- Model with mathematics
- Use tools strategically
- Attend to precision
- Look for and make use of structure
- Look for and express regularity in repeated reasoning

These core foci of the USA are similar to many other countries, with the exception of how and what is required of students at various grade levels (Kilpatrick 2010). The common theme in these eight foci is problem solving; therefore, "it should be a well-integrated part of the curriculum that supports the development of mathematical understanding" (NCTM 2000, p. 52). Mathematics education relies on centuries of *cultural capital*. "A math textbook, without always acknowledging it, contains wisdom from ancient cultures and the accumulated history of human thinking" (Lonergan 2007, p. 1).

Cultural and Social Capital

The term cultural capital is credited to Pierre Bourdieu in the 1960s. Bourdieu was interested in the noneconomic/material reasons why educational disparity existed between students of lower socioeconomic backgrounds and students of other social classes. He proposed that students bring specific competencies, aesthetic preferences, and dispositions to the classroom that have been instilled and reinforced from a strong cultural perspective and access. Contemporary sociologists view these competencies and dispositions as a "form of currency in the social realm" (Winkle-Wagner 2010, p. 7). A student's cultural capital can have advantages in some settings and disadvantages in others. Cultural capital can be acquired through social origin and education and presents itself within a space where capital is produced and assessed, like a classroom. Social capital manifests itself in relationships. Relationships with family, peers, teachers, and materials have tremendous influence on the learning environment and contribute to cultural capital wealth (Pishgahadam and Zabihi 2011).

Creativity as Cultural Capital

Cultural capital takes into account the dispositions, values, traditions, preferences, arts, skills, advantages, and intergenerational equity of specific groups of people. Cultural capital can be used as leverage to elevate or lower social status which influences all other aspects of life. When creativity is infused into the definition of cultural capital, the uniqueness and skills of different cultures are valued and respected. This leads to an appreciation of divergent thinking and an encouragement of creative problem solving. In the mathematics classroom, creativity has been traditionally devalued and narrowly focused on specific skills and strategies. Creativity was not seen as valuable cultural capital, but as playful distraction, nonsense, and/or inattentiveness. This ultimately leads to standardized thinking and reserved reactions. Embracing creativity as cultural capital in the mathematics classroom revitalizes the problem-solving process, expands the boundaries of the math field, and invites competitiveness and innovation into the classroom and ultimately into the global workplace.

Current Trends in Mathematics Education and Their Link to Global Competitiveness

The National Center for Education Statistics (NCES) monitors and reports how US students perform in specific subject areas, such as mathematics. The NCES gathers its data from state standardized test scores and international standardized mathematics assessments. Mathematics achievement is typically assessed and compared internationally through the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA). Results from the TIMSS and PISA are frequently cited as reasons for improving mathematics education and are motivators for international competition. Despite the heavy reliance on the results of these standardized assessments, questions regarding the fallout of high test scores have emerged. A comprehensive 40-year study of countries' TIMSS scores demonstrates unexpected findings (Baker 2007). The higher a country's TIMSS scores were 40 years ago, the lower the country's economic health and national wealth today. Economic growth in countries improved as test scores dropped. Quality of life, as measured on the quality-of-life index, improved as test scores decreased. The Economist Intelligence Unit's Index of Democracy showed that countries with the highest test scores had lower levels of democracy. The number of creative patents was much higher in countries with lower test scores. Yong Zhao highlights Baker's work in his PowerPoint presentation to the Pennsylvania Association for Supervision and Curriculum Development and be accessed at the following website:

http://zhaolearning.com/wp-content/uploads/2011/11/PASCD.pdf

The trend to rely on standardized assessment results has resulted in a one-size-fits-all math education classroom that replaces creativity and problem solving with skills, drills, and memorization. This may raise international test scores, but lower international market competitiveness by negating creativity, innovativeness, and originality in careers rooted in mathematics, engineering, and technology. Creativity is valuable cultural capital, unique to cultures that value independence, creative thought, and divergent thinking. The social and educational origins of cultural capital provide a unique opportunity for creativity in the mathematics classroom. Creativity allows one to value the social capital contributions of individuals and add the importance and value of creativity to the cultural capital repertoire. In the mathematics classroom, it is pertinent to specifically focus on the cultural capital acquired through interaction and create social acceptance and importance of creativity in problem solving.

Sir Ken Robinson, a proponent of creativity in the classroom, eloquently explains the evolutionary need for creativity in schools and highlights the current trends and disvalue of creativity as cultural capital in the following TED Talk.

http://www.youtube.com/watch?v=hkPvSCq5ZXk&feature=related

Policy and Practice

Science, technology, engineering, and math (STEM) initiatives are specifically designed to increase science and math skills in children and build awareness for science, math, technology, and engineering careers. Judith Ramaley, the former director of the National Science Foundation's education and human resources division, began the STEM initiative in 2001. Her idea was to abandon the isolated teacher-directed content areas of the sciences and mathematics and teach them as interdisciplinary, collaborative inquiry-based explorations and problem-solving experiences that transcended gender and class boundaries. STEM has recognized that valued skill sets have changed from solitary isolated skill sets to collaborative innovative application. As the STEM initiative grew momentum in schools, the exclusion of a very necessary component was glaringly apparent. The foundational skills for math and science are there, but the ingenuity to create, solve problems, and invent is lacking. Creativity is missing. In 2011, STEM responded to the creativity crisis in the STEM program through the introduction of an A for arts. STEM is now STEAM – science, technology, engineering, arts, and mathematics. STEAM recognizes that:

- Arts education is a key to creativity.
- Creativity is an essential component of, and spurs, innovation.
- Innovation is agreed to be necessary to create new industries in the future.
- New industries, with their jobs, are the basis of our future economic well-being.

The trend in STEM corroborating Albert Einstien's thinking of "We can't solve problems with the same kind of thinking we used when we created them."

Core math initiatives of the USA and other countries need to be grounded in an understanding of the cultural capital contemporary students possess and be cognizant of the elusive tools and roles of the future. Math standards, math practices, and math classrooms need to recognize the importance of divergent thinking, encourage creative problem solving, and nurture and respect creativity.

Conclusion and Future Directions

As educators prepare students for the twenty-first century and beyond, a renewed emphasis in divergent thinking is taking place and is necessary for the future global society. To keep creativity alive in the classroom, educators need to keep in mind the four Cs – content, connection, choices, and coauthorship (Longergan 2007). The fluidity of creative thought has distinct implications for the role content knowledge plays in the development of creativity. "Knowledge can provide the foundation for creative work: however, too much knowledge may preclude the thinker from going beyond stereotyped responding or bring about negative transfer to new problem situations" (Sak and Maker 2006, p. 281). The content presented to students should be integrated into interdisciplinary projects that require contextual math to complete the project. Creativity also involves connection to *real-world* disciplines. The connection can happen through the arts, technology, engineering, or science and is reinforced through the STEAM initiatives. Choice is something seldom seen in education, but extremely important not only to creativity but to initiative, industry, and problem solving. Too often, education is presented in a linear fashion with one right answer. Students need questions that invite a multitude of answers and pathways. This is critical as students face a future where the roles and tools of the society will look quite different from present day. Coauthorship refers to the student's role in problem identification and formulation. Involving them in the task of identifying a problem increases motivation, encourages them to look at the world more critically, and helps them to identify the need to solve the problem. This process encourages creativity as students began posing their own problems to solve.

Cross-References

▶ Convergent Versus Divergent Thinking
▶ Creativity and Innovation: What Is the Difference?
▶ Creativity Definitions, Approaches
▶ Divergent Thinking

References

Baker K. Are international tests worth anything? Phi Delta Kappan. 2007;89(2):101–4. http://www.pdkintl.org/kappan/kappan.htm

Gardner H. Five minds for the future. Boston: Harvard Business School Press; 2009.

Kampylis PG, Valtanen J. Redefining creativity: analyzing definitions, collocations, and consequences. J Creat Behav. 2010;44(3):191–214.

Kilpatrick J. A comparison of proposed US common core math standards to standards of selected Asian countries. Education News. 2010 July 9. http://www.educationnews.org/ed_reports/94979.html

Longergan M. The case for creativity in math education. Horace. 2007;23(2). http://www.essentialschools.org/resources/386

National Council of Teachers of Mathematics. Principles and standards for school mathematics. Reston: National Council of Teachers of Mathematics; 2000.

Pishgahadam R, Zabihi R. Social and cultural capital in creativity. Can Social Sci. 2011;7(2):32–8. www.cscanada.org

Sak U, Maker CJ. Developmental variation in children's creative mathematical thinking as a function of schooling, age, and knowledge. Creat Res J. 2006;18(3):279–91.

Winkle-Wagner R. Cultural capital: the promises and pitfalls in education research. ASHE High Educ Rep. 2010;36(1):1–144. doi:10.1002/aehe.3601.

Creatology

▶ Science of Creativity

Cross-Cultural Creativity

▶ Creativity Across Cultures

Cross-Cultural Entrepreneurship and Business

▶ Entrepreneurship and National Culture (According to Hofstede's Model)

Cross-Disciplinarity

► Interdisciplinary Research (Interdisciplinarity)

Cross-Employment

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Synonyms

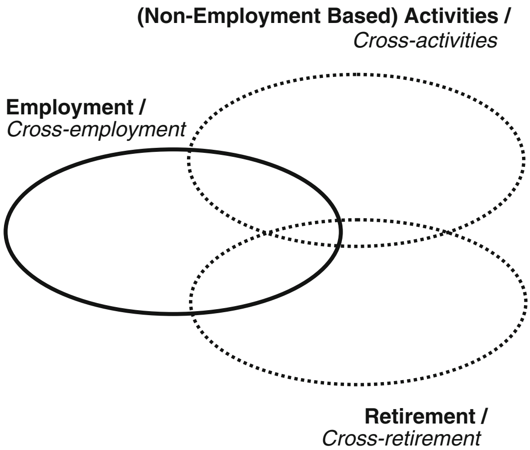
Cross-employment and cross-retirement; Multi-employment; Network-based arrangement of work; Organizational arrangement of nonlinear research (knowledge production) and nonlinear innovation (knowledge application); Tenure track and cross-employment

Concept of Cross-Employment

Cross-employment represents a type of multi-employment, where a person is being employed simultaneously by more than one organization (institution). The emphasis here is placed on employment by at least two organizations, and it must be simultaneous (and not a sequential first-then) form of employment. The opposite concept to cross-employment would be the single employment by only one organization (or institution) at a time. Employment implies that the person is involved in social and tacit learning of the different organizations that also behave as organizational environments. When employment is in reference to knowledge production and knowledge application, then cross-employment should also be understood as an expression of and as a form for organizing, optimizing, and excelling research and innovation. Cross-employment already exists as an empirical phenomenon. How common or uncommon currently cross-employment is, is difficult to assess. This topic has not been sufficiently researched, so far. Beyond the empirical aspects of cross-employment, also the question could be raised, whether cross-employment has also the qualities of a normative and ideal-typical category: Should work, also in association with knowledge production, research, and innovation, be organized in a way of allowing for more (or even encouraging) arrangements that follow the logic of cross-employment?

Cross-employment as a specific term and concept was first introduced by Campbell (2011). In Carayannis and Campbell (2012, p. 24), the following comprehensive description for cross-employment is being presented: "*Cross-employment* (multi-employment) may be regarded as one (organizational) strategy for realizing creative knowledge environments. Cross-employment (multi-employment) refers to a knowledge worker, employee, who is being simultaneously employed by more than one organization, possibly being located in different sectors (e.g., a higher education and a non-higher education institution, e.g., a university and a firm). *This supports the direct network-style coupling of very different organizations in knowledge production and innovation application*, expressing, therefore, what nonlinear innovation could mean in practical terms . . . Cross-employment makes possible 'parallel careers' for individuals (knowledge workers) across a diversity of organizations and sectors, thus also a simultaneous operating in parallel in organizations with different rationales and innovation cultures." The creative knowledge environments (CKEs), as a concept and term, were introduced by Hemlin et al. (2004).

Cross-employment (employment) has a hybrid overlapping or can be combined with other forms of activities that are nonemployment based (such as self-employment) or also with partial (part-time) retirement, then being called cross-retirement in connection with employment



Cross-Employment, Fig. 1 The hybrid overlapping of employment and cross-employment with activities and retirement [Source: Author's own conceptualization]

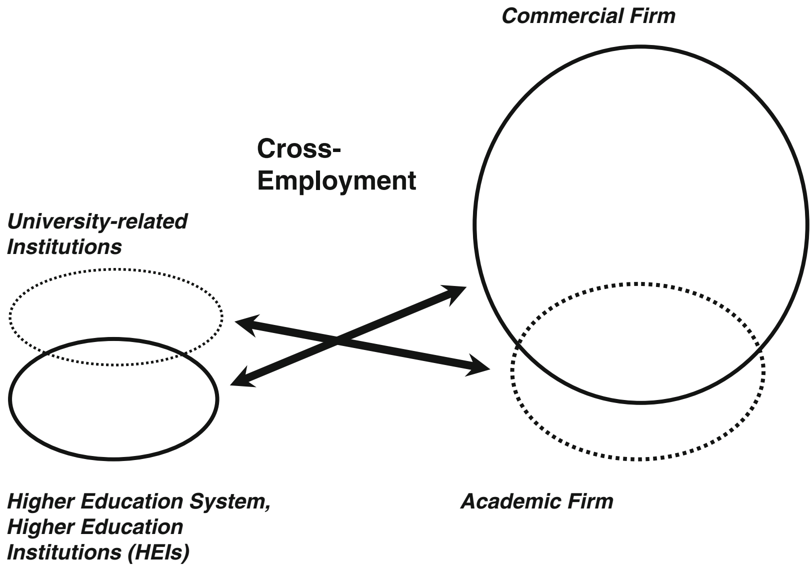
or cross-employment (Fig. 1). Ramifications of cross-employment, therefore, are not only limited to types of employment.

Characteristics and Opportunities of the Concept of Cross-Employment

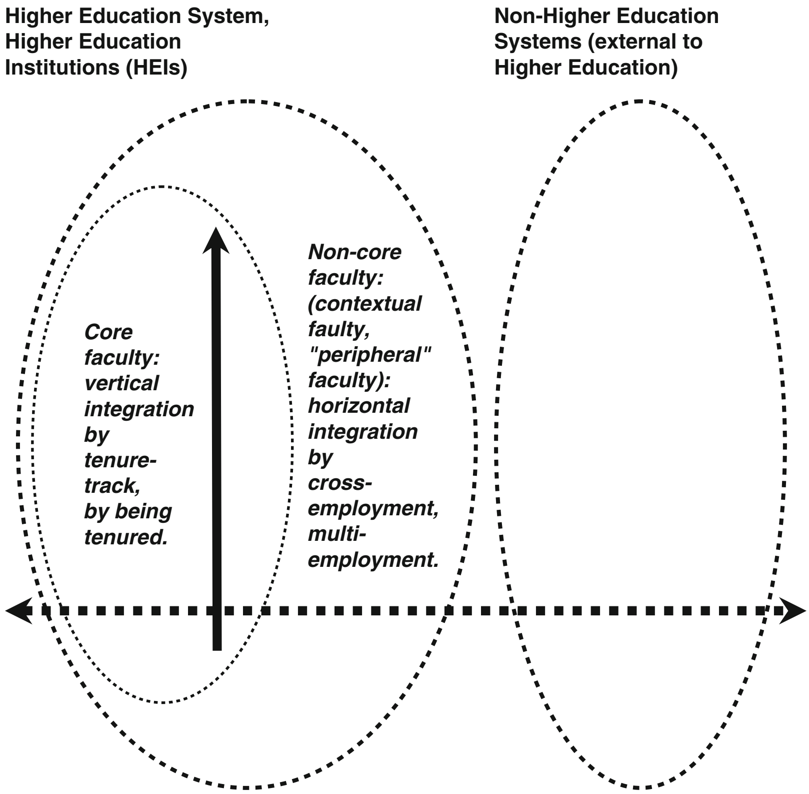
Cross-employment does not only have advantages, when compared with single employment. However, in the following, those characteristics of cross-employment should be elaborated in more detail, which offer opportunities and potentially also benefits to (individual) persons as well as the organization. The context for cross-employment to be discussed here is an organization (institution) that is engaged in knowledge production and knowledge application, or research and innovation:

1. *Creative development of complementary competences, diversification, and pluralization of the competence base of organizations:* Persons that can base their activities of knowledge production and knowledge application on working relations of cross-employment are in a position of creatively (and innovatively) developing further complementary competences that also refer to practical experiences and tacit knowledge. For the organization, this has the potential benefit that the spectrum of competences of their employees is being diversified and pluralized to a crucial extent. This supplies evidence how cross-employment represents one approach for helping to develop "creative knowledge environments" within organizations. The combination of complementary competences also nurtures the creation of new competences. Organizations (institutions), therefore, should regard cross-employment also as an organizational opportunity for themselves.
2. *Network-style formation of linkages (and bridges) across organizations and sectors:* Cross-employment supports the formation and advancement of networks and network linkages between organizations (institutions). In fact, cross-employment represents a crucial form of organizational manifestation for the development and promotion of networks. For example, there can be cross-employment between two or more universities (higher education institutions), where in one case the employee may focus on academic research, and in the other case on organizational quality enhancement. In such a scenario, the cross-employment would unfold still within one sector, the higher education system. Cross-employment, however, can also create network-style connections between organizations in different sectors, for example, the higher education sector and the economy (the business enterprise sector): In such a scenario, the cross-employment would act and behave trans-sectorally and would perform a trans-sectoral building of linkages and bridges. Multiple forms, networks, and combinations of trans-sectoral cross-employment between universities (higher education institutions), university-related institutions, firms (commercial firms, academic firms), and other organizations (e.g., of the civil society) are possible, feasible, and even recommendable (see Fig. 2). Cross-employed persons, across different organization and sectors, create (or at least have the potential of creating) a multitude or heterogeneity of cross-organizational and cross-sectoral networks.

Cross-Employment, Fig. 2 Possible network linkages of cross-employment between higher education and other organizations (sectors) [Source: Author's own conceptualization based on Campbell and Carayannis (2013), p. 29]



3. *Cross-employment as one organizational expression for nonlinear innovation:* The model of linear innovation is often being referred to Vannevar Bush (1945). One core understanding of that model is that first there is basic research in a university context, which later develops further to an innovation application in context of a firm. This linear framing of innovation is being challenged by the notions of an evolving nonlinear innovation. In practice, there often will be a hybrid overlapping of forms and processes of linear and nonlinear innovation. This may mean that an organization (firm) engages simultaneously in different technology life cycles at different degrees (levels) of technology maturity (closer to basic research, or closer to application and market commercialization). Cross-employment represents another crucial manifestation and organizational representation of and for nonlinear innovation. For example, a cross-employed person (knowledge worker) can participate in basic research at a university, and, at the same time, may be involved in innovation application and knowledge practice in a firm or another organization outside of university. Such a person works simultaneously at both ends of the whole spectrum of knowledge production and knowledge application.
4. *The balancing of tenure track and cross-employment within universities and other higher education institutions (academic institutions):* The traditional understanding of an academic career at a university follows the tenure track logic. Tenure track implies: At the beginning there is a competitive entry, and the performance of the tenure-track-based academic (junior) faculty member is being regularly evaluated. If being positively evaluated, the faculty member finally will be tenured, otherwise is being dismissed by the institution. Tenured academic faculty certainly enjoys substantial privileges, for example, allowing (and being encouraged) to focus more independently on basic research. However, the one main problem of this tenure-track-based model of careers is that it runs the risk of developing into a "minority model" for academic faculty. Numbers of tertiary-education-graduates increasingly exceed the available positions in higher education institutions. So what should happen to the rest (the "silent majority") of academic faculty or potential academic faculty? There are serious concerns of a diffusion and a



Cross-Employment, Fig. 3 Vertical integration by tenure-track and horizontal integration by cross-employment (multi-employment): only within higher education or within and outside of higher education [Source: Author's own conceptualization based on Campbell and Carayannis (2013), p. 68]

spreading of depriving working and living conditions of numerous faculty members at higher education institutions. Cross-employment may offer here one solution for the non-core academic faculty, allowing to balance risk of academic careers, employment statuses, competence development, and a more stable and enduring pooling of different financial resources and funding schemes for academic faculty members that are either not tenured or also not on a tenure track. Here, the tenure track logic would provide a "vertical integration" of the core faculty, and cross-employment a "horizontal integration" of the non-core or peripheral academic faculty either within the higher education system or across higher education and non-higher education (Campbell and Carayannis, 2013, pp. 67–68). This, furthermore, would offer the option and opportunity of "parallel careers" to individuals. Cross-employment, however, should not only be regarded as an option of balancing risk for those who did not make it to enter and to complete successfully a tenure track, but has also the distinct characteristics of a career scheme of itself (see Fig. 3). Cross-employed academic faculty demonstrates also qualities of a new, a novel, and of an innovative and creative academic entrepreneurship.

Conclusion and Future Directions

Of course, there are problems and risks associated also with cross-employment. For the individual person, this may be the stress of becoming overburdened by heavy loads of multi-tasking. For the individual person (e.g., being engaged in knowledge production and knowledge application), this defines a need to search for potential synergies and knowledge and competence surpluses that again pay off positively. Organizations, network connected by cross-employed, also should learn, how to translate this into mutual benefits and opportunities for all of the involved institutions. For organizations (e.g., firms), who are mutual competitors, cross-employment-based connections may not be feasible. Speaking more generally, this, of course, refers to the following challenge: How to balance and to organize cross-employment, networks, and competition? The concept of "Co-Opetition" (Brandenburger and Nalebuff, 1997) tries to capture these complex patterns of interaction or of potential interaction. In other cases and scenarios, however, organizations may benefit from mutually connecting networks of cross-employment. In contemporary context, there is (perhaps) not too much, but (probably) not enough cross-employment. *Cross-employment has all the potentials and capabilities of adding to the creative transformation of how knowledge production (research) and knowledge application (innovation) are being processed and performed. Cross-employment represents one form of organizational expression and manifestation, what networks and nonlinear innovation can mean in organizational terms*. Cross-employment, however, creates also a need for adapting and improving regulations of governance (network governance) and legal regulations, so that the potential dynamics can also unfold in reality, to the advantage of the knowledge economy, knowledge society, and knowledge democracy. Further empirical investigation and research on the topic of cross-employment and the involved ramifications appears furthermore to be necessary. Virtualization (Pfeffer 2012) and the use of advanced technological means could also imply of exploring ways of integrating or linking the global with the local through and by cross-employment.

In the analysis, being presented here, no distinction was drawn between cross-employment and multi-employment, they were treated as interchangeable terms and concepts. Should there be an interest in finding and emphasizing nuances of a different meaning, then an analogy could be drawn (or at least suggested) to the concept of "academic disciplines." Multi-employment would be closer to multi-disciplinary, where competences (disciplines) continue to be independent. Cross-employment, however, would have more similarity with interdisciplinary and transdisciplinary: On the one hand, those different network-connected competences should also help forming new competences (perhaps at a meta-level); on the other hand, new (creative) opportunities are being created for combining and linking basic research with application and innovation application (or exploration and exploitation in firm context).

In conclusion, the following quote of Campbell and Carayannis (2013, p. 36) summarizes crucial key aspects of the whole complex of cross-employment: "Several forms and variations of cross-employment are thinkable and reasonable. Cross-employment can stretch (in network-style arrangements) across different higher education institutions or can link universities with non-universities, i.e. organizations outside of higher education (for example, firms or organizations of the civil society). Cross-employment should foster the creativity of and in knowledge production and knowledge creation. The cross-employed academic profession or cross-employed academic faculty involves itself and engages in a much broader spectrum of knowledge production."

Cross-References

- ▶ Academic Entrepreneur, Academic Entrepreneurship
- ▶ Academic Firm
- ▶ Ambidexterity
- ▶ Creative Knowledge Environments
- ▶ Cross-Retirement (Cross-Employed Cross-Retired) and Innovation
- ▶ Global University System in World Society
- ▶ Higher Education and Innovation
- ▶ Interdisciplinary Research (Interdisciplinarity)
- ▶ Mode 3 Knowledge Production in Quadruple Helix Innovation Systems: Quintuple Helix and Social Ecology
- ▶ Nonlinear Innovations
- ▶ Palliative Care and Hospice - Innovation at End of Life

▶ Transdisciplinary Research (Transdisciplinarity)
▶ University Research and Innovation

References

Brandenburger AM, Nalebuff BJ. Co-opetition. New York: Doubleday; 1997.
Bush V. Science: the endless frontier. Washington: United States Government Printing Office; 1945. http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm#transmittal.
Campbell DFJ. Wissenschaftliche "Parallelkarrieren" als Chance. Wenn Wissenschaft immer öfter zur Halbtagsbeschäftigung wird, könnte eine Lösung im "Cross-Employment" liegen. Guest Commentary for DIE PRESSE (February 2, 2011). 2011. (http://diepresse.com/home/bildung/meinung/635781/Wissenschaftliche-Parallelkarrieren-als-Chance?direct=635777&_vl_backlink=/home/bildung/index.do&selChannel=500).
Campbell DFJ, Carayannis EG. Epistemic governance in higher education. Quality enhancement of universities for development. New York: SpringerBriefs in Business, Springer; 2013. http://www.springer.com/business+%26+management/organization/book/978-1-4614-4417-6.
Carayannis EG, Campbell DFJ. Mode 3 knowledge production in quadruple helix innovation systems. 21st-century democracy, innovation, and entrepreneurship for development. New York: SpringerBriefs in Business, Springer; 2012. http://www.springer.com/business+%26+management/book/978-1-4614-2061-3.
Hemlin S, Allwood CA, Martin BR. Creative knowledge environments. The influences on creativity in research and innovation. Cheltenham: Edward Elgar; 2004.
Pfeffer T. Virtualization of universities. Digital media and the organization of higher education institutions. New York: Springer; 2012. http://www.springer.com/business+%26+management/media+management/book/978-1-4614-2064-4.

Cross-Employment and Cross-Retirement

▶ Cross-Employment

Cross-Employment and Multi-Employment

▶ Mode 3 Knowledge Production in Quadruple Helix Innovation Systems: Quintuple Helix and Social Ecology

Cross-Retirement (Cross-Employed Cross-Retired) and Innovation

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Synonyms

Cross-employment; Flexible retirement; Partial retirement; Phased retirement; Semi-retirement

The Concept of Cross-Retirement

Phased or partial retirement describes retirement schemes allowing employees approaching retirement age to gradually reduce the number of working hours. Reasons may be a greater need for recovery from work, health problems, or a desire for more leisure time to gradually adapt to full-scale retirement. Thus, phased retirement enables older employees to remain in the labor market, but with less work pressure and more time for recreation. In these schemes, the potential loss of income may or may not be compensated by social transfer benefits. Cross-retirement (i.e., cross-employed and cross-retired) likewise aims at allowing the individual to combine the benefits of retirement and those of work in a similar way, but with some important distinctions. Cross-retirement (a) does not constitute a transition period but rather an additional phase of life without any predetermined endpoint, and (b) the ratio of work and free time should be self-determined and flexibly adjustable to the individual's needs. Cross-retirement thus should enable the individual to continue to contribute to society while limiting the restraints of regular employment. Cross-retirement represents a status where a person is retired and works at the same time. More precisely defined, this means that a person works (full-time, but probably more likely part-time), however also earns retirement payments, to which he or she is eligible and entitled. Cross-employment, as a complementary term and concept (Campbell 2011; Campbell and Carayannis 2013; Carayannis and Campbell 2012), refers to a person with two or more simultaneous employment statuses. In practice, several (creative and innovation-inspiring) combinations, arrangements, and network configurations between cross-retirement and cross-employment appear possible, plausible, and feasible.

Financial Considerations

In several of the advanced economies and OECD (Organization for Economic Co-Operation and Development) countries, raising the (legal and/or de facto) age (minimum age) for retirement represents a hot topic that is being intensively, and politically controversially, discussed. Arguments in favor of a continuous increase of the retirement age assert that otherwise the pensions systems cannot be financed by public means adequately, because there is also a general tendency of an increased life expectancy. Not raising the retirement age may have the consequence that retirement payments are not sufficient anymore for covering the costs of a good life in higher age in the long run. Cross-retirement may bring in here a perspective additionally important for the public debates, and should therefore be treated as a serious political issue to be considered. Retirement, in the context of cross-retirement, may shift some of the underlying financial fundamentals in support of a betterment of the long-term financing (public financing) of pension systems.

Theoretical and Empirical Background

Life Expectance, Socio-Demographic Factors, and Retirement Age

Life expectancy has been increasing especially in industrialized counties at a rate of roughly 2.5 years per decade for the last one and a half centuries, and so far, there is no indication that this trend will change in the near future, despite new potential health threats such as obesity (Oeppen and Vaupel 2002). In 1840, life expectancy for Swedish women was 45 years; currently, in 2011, life expectancy for an Austrian woman is 83.3 years. Irrespective of this trend, the labor force participation of older individuals has considerably declined in the past 60 years (Guillemard and Rein 1993). In the first half of the twentieth century, approximately 70 % of the men over the age of 65 were actively working. By 1970, the rate of employment in men over 65 had declined sharply to barely 20 % in most industrialized countries. Similarly, the employments rates, e.g., of men aged 55–64 in the Netherlands declined from 80 % in 1970 to 45 % in 1990. Several factors can be held responsible for this trend, such as the policy of companies and governments to encourage older employees to enter retirement, a change in work status with less self-employed individuals in the work force, a decrease in the satisfaction with and the quality of work conditions, and a change in the individuals' perception regarding life and work. However, these changes have created an ever-growing number of individuals claiming retirement benefits and thus a substantial financial burden for industrialized countries. In several European countries, governments are striving to change this development with a mix of policies (Cooke 2006). These include outlawing mandatory retirement at a certain age as well as age discrimination, increasing pension eligibility ages, closing other paths of early retirement, and introducing flexible and part-time retirement policies. So far, e.g., the Netherlands has been successful in increasing labor participation in those over 55 from an all-time low in 1996 of 20 % to above 30 % in 2006. In Austria, efforts are underway to increase retirement age by e.g., investing in medical rehabilitation and by discouraging individuals from entering early retirement due to health problems. Recently, the European Commission has suggested increasing retirement age to 70 years in the next decades to meet the increases of life expectancy.

Benefits and Costs of Work on Psychosocial Well-Being and Health

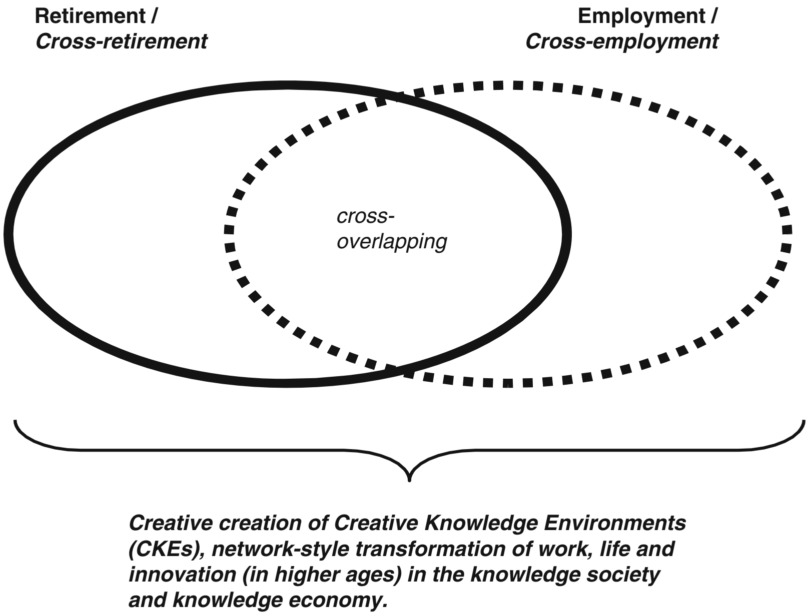
Next to the obvious benefit of employment in gaining an income, work also has several psychosocial benefits for the individual that are of importance for the well-being and health of the individual. This fact becomes obvious when considering the dramatic negative impact of unemployment on health, even when those unemployed receive social security benefits. Of all psychosocial factors, unemployment is generally found to be the leading cause of ill health. In her seminal book, Marie Jahoda, the pioneer in research on unemployment, named five pathways through which employment positively affects health and well-being (Jahoda 1982). Work provides a meaningful daily and weekly time structure, provides supportive and challenging social contact, fosters meaningful individual activity, enables the feeling of having a collective purpose or common goal, and provides a work-related identity and a societally relevant status. Though studies on the positive effects of work on health and well-being are scarce, recent studies show, e.g., that volunteering improves mental health, especially in those beyond the age of 65 (Musick and Wilson 2003). However, whether work is good for the individuals' health and well-being depends strongly on the psychosocial quality of work. Though employment generally is associated with better mental health, work associated with high job demands, low job control, job insecurity, and unfair pay tends to be associated with *worse* well-being than unemployment (Butterworth et al. 2011). Thus, in some instances, it is better not to work.

Health and Productivity of Elderly Employees

As individuals age, relevant physical and cognitive faculties decline. Typically, these are seeing and hearing, processing complex stimuli, holding multiple items in working memory, reaction time, muscular strength, coordination of movement, and overall physical capacity. However, in most jobs, these changes are more than compensated by experience and a resulting greater efficiency, thus leading to stable productivity. Exceptions are jobs where cognitive or physical requirements exceed capacities and experience provides little advantage, such as unskilled manual work, fast data processing, or generally high levels of work demands (Silverstein 2008). Cognitive and physical capacities, in addition, decline at different speeds for each individual, resulting in greater differences between older individuals than between younger individuals. Indeed, it can be observed that older cohorts of employees, typically beyond the age of 60, show stable or even improved rates of productivity and fitness when those less able have left the workforce (and thus the cohort) due to retirement. Another feature of elderly employees is their greater physical disability in terms of higher rates of chronic disease and chronic pain disorders as well as a slower recovery from illness or injury. Elderly working individuals also show higher levels of work-related fatigue and need more time to recover from work and thus more leisure time (Mohren et al. 2010). Flexible work arrangements and more time for restoration can compensate for these needs.

Benefits and Costs of Retirement on Health and Well-Being

Retirement undoubtedly has positive effects on several psychosocial variables. Retirement is characterized by an increase in the availability of free leisure time, a removal of potentially adverse working conditions such as insufficient appreciation, time pressure, and social conflict and usually with a removal of financial insecurity. Among the most prominent effects of retirement is a reduction of prolonged fatigue, a reduction in depressiveness, and an improvement of general well-being. However, the prevalence of, e.g., cardiovascular or respiratory diseases does not change, nor does the number of musculoskeletal problems (Westerlund et al. 2010). Thus, despite its positive effects on mental health and well-being, retirement does not improve physical health. On the contrary, evidence is accumulating showing that earlier compared to later retirement may even be associated with a slightly greater mortality and thus earlier



Cross-Retirement (Cross-Employed Cross-Retired) and Innovation, Fig. 1 Heterogeneity and diversity in cross-retirement for knowledge production and innovation

death (Quaade et al. 2002). Though conclusions are premature, those retired may lack the positive psychosocial factors associated with work described above such as a feeling of purpose and a meaningful daily time structure. Thus, retirement improves mental health possibly by increasing opportunities for leisure time and by removing adverse psychosocial factors potentially associated with the previous job. However, retirement does not improve physical health.

Benefits of Flexibility and Freedom of Choice

Controllability is the major factor defining stress. The individual who has no control over an adverse situation will show a large and enduring stress response. In the occupational realm, low job discretion, together with high work demands, constitutes high strain jobs and is associated with a wide array of health problems (Theorell 1997). It is obvious that jobs which do not allow the employee to decide how to approach a task, how to solve a problem, what tools to use, when to take a break, when to start and end work, when to take a vacation, and so forth will be associated with more strain and discomfort. On the other hand, recent reviews point to the fact that flexible working conditions which provide workers with control and choice (such as self-scheduling or gradual/partial retirement) have a positive effect on health and well-being (Joyce et al. 2010). Thus, the more elderly employees are able to decide when and how and how much to work, the greater are the chances that work will not only not be disabling, but on the contrary have a positive impact on health and well-being. However, obviously and regretfully, not all jobs will qualify and allow this flexibility.

Conclusion and Future Directions

Implications for Theory, Policy, and Practice

The concept of cross-retirement opens up a whole new spectrum of perspectives, so far undervalued in the public debates and political issue discourses. As cross-retirement a status is being defined, where a person receives retirement payments on the one hand, but still is benefiting from a paid employment (self-employment) status on the other hand. Cross-retirement can be combined with full-time employment, but also with various forms of part-time employment. Particularly combinations and network-style arrangements of and between cross-retirement and cross-employment offer opportunities and promise potentials for work, life, and innovation capabilities of persons in higher ages and their contributions to the knowledge society and knowledge economy (see Fig. 1). Cross-retirement, in combination with cross-employment (or without cross-employment), has the potential of transforming work, life, and the knowledge production, as they are being currently still understood in a conventional setting. Persons, benefiting from cross-retirement payments, can engage more freely and independently, and with more freely available time, in processes of knowledge production and innovation in society and economy. This extra free time could have an effect on pushing and encouraging creativity and innovation that is based on unconventional thinking or on practices parallel (outside) to the established working life. Cross-retirement, also (but not only) when linked to networks of cross-employment, adds to diversity and heterogeneity in organizations; therefore it supports the formation and development of "creative knowledge environments" (Hemlin et al. 2004). The current research and literature suggests that creative knowledge environments, within organizations, promote organizations in their efforts of knowledge production and innovation application (see again Hemlin et al. 2004). Employers, organizations, and institutions should realize more openly that cross-retirement represents one approach for expanding and complementing a diverse and heterogeneous knowledge and competence base that underlies organizations and that adds to the capabilities of organizations in their creative knowledge production and innovation application ambitions and strategies. Cross-retirement may also imply the need for "social innovations" within organizations, so that organizations (also economic organizations) benefit from cross-retirement.

One further implication of cross-retirement is that the hard line ("deadline" of beginning) of retirement is being switched into a gradual process of an interesting transformation with a positive prospect and perspective. Cross-retirement is being carried by the effort to integrate (to keep integrated) the elderly persons (those who want and can) into processes of knowledge production and innovation in the knowledge society and economy. Cross-retirement certainly will not solve all issues and problems in association with aging. But it is important that the potentials and opportunities of cross-retirement (also when combined with cross-employment) should enter the public discourses and political debates more straightforward. Cross-retirement would have to be coupled with a redesigning of society and the economy, at least to some extent.

Cross-References

- ▶ Citizen Science in Health Domain
- ▶ Creative Knowledge Environments
- ▶ Cross-Employment
- ▶ Healthcare and Innovation
- ▶ Palliative Care and Hospice - Innovation at End of Life

References

Butterworth P, Leach LS, Strazdins L, Olesen SC, Rodgers B, Broom DH. The psychosocial quality of work determines whether employment has benefits for mental health: results from a longitudinal national household panel survey. Occup Environ Med. 2011;68:806–12.

Campbell DFJ, Caryannis EG. Epistemic governance in higher education. Quality enhancement of universities for development. New York: Springer; 2013. http://www.springer.com/business+%26+management/organization/book/978-1-4614-4417-6

Campbell DFJ. Wissenschaftliche "Parallelkarrieren" als Chance. Wenn Wissenschaft immer öfter zur Halbtagsbeschäftigung wird, könnte eine Lösung im "Cross-Employment" liegen. Guest Commentary for DIE PRESSE. 2011. http://diepresse.com/home/bildung/meinung/635781/Wissenschaftliche-Parallelkarrieren-als-Chance?direct=635777&_vl_backlink=/home/bildung/index.do&selChannel=500. 2 Feb 2011.

Carayannis EG, Campbell DFJ. Mode 3 knowledge production in quadruple helix innovation systems. 21st-century democracy, innovation, and entrepreneurship for development. New York: Springer; 2012. http://www.springer.com/business+%26+management/book/978-1-4614-2061-3

Cooke M. Policy changes and the labour force participation of older workers: evidence from six countries. Can J Aging. 2006;25:387–400.
Guillemard AM, Rein M. Comparative patterns of retirement: recent trends in developed societies. Ann Rev Sociol. 1993;19:469–503.
Hemlin S, Allwood CM, Martin BR. Creative knowledge environments. The influences on creativity in research and innovation. Cheltenham: Edward Elgar; 2004.
Jahoda M. Employment and unemployment: a social-psychological analysis. Cambridge Cambridgeshire/New York: Cambridge University Press; 1982.
Joyce K, Pabayo R, Critchley JA, Bambra C. Flexible working conditions and their effects on employee health and wellbeing. Cochrane Database of Syst Rev. 2010;2: CD008009.
Mohren DC, Jansen NW, Kant I. Need for recovery from work in relation to age: a prospective cohort study. Int Arch Occup Environ Health. 2010;83:553–61.
Musick MA, Wilson J. Volunteering and depression: the role of psychological and social resources in different age groups. Soc Sci Med. 2003;56:259–69.
Oeppen J, Vaupel JW. Demography. Broken limits to life expectancy. Science. 2002;296:1029–31.
Quaade T, Engholm G, Johansen AMT, Moller H. Mortality in relation to early retirement in Denmark: a population-based study. Scand J Public Health. 2002;30:216–22.
Silverstein M. Meeting the challenges of an aging workforce. Am J Ind Med. 2008;51:269–80.
Theorell T. Fighting for and losing or gaining control in life. Acta Physiol Scand Suppl. 1997;640:107–11.
Westerlund H, Vahtera J, Ferrie JE, Singh-Manoux A, Pentti J, Melchior M, Leineweber C, Jokela M, Siegrist J, Goldberg M, Zins M, Kivimaki M. Effect of retirement on major chronic conditions and fatigue: French GAZEL occupational cohort study. BMJ. 2010;341:c6149.

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▶ Small Businesses and Sustainable Development

Cultural Cities

▶ Entrepreneurship in Creative Economy

Cultural Dimensions

▶ Entrepreneurship and National Culture (According to Hofstede's Model)

Cultural Diversity

▶ Diversity and Entrepreneurship

Cultural Entrepreneurship

▶ Entrepreneurship in Creative Economy

Cultural Policy

▶ Entrepreneurship in Creative Economy

Culture

▶ Creativity and Confucianism

Cumulative Advantage

▶ Networks and Scientific Innovation

Cyber Entrepreneurship

▶ Microfirms

Cyberentrepreneurship and Proximity Relationships

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Synonyms

Corporate management; Digital economy; Regional economy; Technologies; Territorial management

Notions of Cyberentrepreneurship and Proximity Relationships

Context and Presentation of the Subject

For over half century, information technologies have deeply impacted economy landscape and company ecosystem: data, production, management, work organization, entrepreneurship. We identify a new profile emerging: "the cyberentrepreneur." These transformations driven by IT technologies have also finally affected regional environments, contents, authorities. Immaterialization overcomes some of the historical constraints of production, such as "distance-time, distance-cost, access speed . . . . . . the ease of travel" (Cattan 2011; Duranton 2008). These changes, already significant, appear to be only the beginning of a much longer cycle, where the intangible and conceptual elements will take a stronger and stronger dominant position.

Definitions

Electronics Physical science for formatting and management of electrical signals to, among other things, allow high-speed transmission and the mass storage of information.

Computers Techniques for the automatic processing of information through electronic machines, mobile phones, and others, equipped with specific programs, software.

Cyberentrepreneur Kind of entrepreneurship using information and communication technologies in different business functions: management, marketing, recruitment, finances, relations with the innovative environments, local resources etc.

Internet Multi-connection system of computer networks for horizontal exchange of information between individuals.

Social Networks Free association of individuals and organizations can exchange information directly with each other through information and communication technologies.

Ubiquity Computer system embedded in hardware and miscellaneous items and linked.

Teleworking Pattern of organization of the production function where the work activities of certain employees are periodically physically separated.

Collaborative Organization of the work activity of a group of people connected by functional links and making an indivisible product.

Cyberentrepreneurship and Proximity Relationships: Close and Necessary Links

The Cyberentrepreneur, À New Entrepreneur Profile

The cyberentrepreneur generates the following new dimensions of capitalism:

Social capital: a shift from personal and family environment to social networks (see Jeremy Rifkin 2011, of the strategic importance of the ability to access relevant information/persons)

Financial capital: a shift from local venture capitalists to global financial markets

Cultural capital: a shift from silo framework to knowledge management (Bouwman and Hulsink 2002; Carrier et al. 2004)

Elevation of quality level of intervention of entrepreneur may strengthen, in the territorial environment of the firm, exclusion effects, such as digital illiteracy, unemployability, networks access shadow zones, constrained immobility, etc. The expansion of social, financial, and cultural functions of the cyberentrepreneur, compared to its predecessor, not "cyber," transforms its relations to the territories:

Management of production becomes ubiquitous (in synchronous or asynchronous modes); it can act on several areas simultaneously.

Research skills are expanded (by the use of teleworking, for example); they bring together geographically dispersed knowledge in a unified process.

The assembly is the product of agile and collaborative methods, raising levels of quality and quantity of human and technical interventions (on the place of production, for marketing).

Cyberentrepreneur and Management of the Firm

Since the emergence of computers, in the decades post-second world war, it was soon realized that innovation is great and generic. Of course, the inertia of traditional Taylorist patterns of work organization has been strong (strong enough to last until now) but managerial innovations (e.g., quality circles) reached to enter, to seek to renew the relations within the firm. New waves of innovations (microcomputer, Internet, and social networks) will make obsolete these first attempts to renovate.

More than half a century after the emergence of what some call "the scientific and technological revolution," the social innovation path traveled is still quite insignificant, evidenced by the following:

- The small progress of participative management in companies
- The strong resistance to implementing remote working solutions
- The difficulty of integrating young people into existing organizations
- The light interactions between firms and territories
- The limited distribution of collaborative work tools
- The gap between the cultural level and practices of organizations
- Under-use of creative potential of employees, etc.

The cyberentrepreneur still remains, essentially, a mythical concept, who does experience only partially new ways of working and organizing production. These psychological, cultural, and behavioral delays are disadvantageous for involved firms, individuals, territories; they generate unnecessary costs and are the source of waste of resources. If the new models of both economic and territorial management are strengthened in the theoretical research, they are not widely present in actual practice.

Cyberentrepreneur and Homogenization of the Territories

Among the current developments in the territories, academics (Aubert et al. 2011) report the existence of the integration process, "The constitution of homogeneous environments on micro-spaces. From a social point of view, the search for the inter-se prevails; from an economic point of view, specialization prevails; from a political point of view, the club effects are predominant" (Aubert 2011).

In social terms, the action of cyberentrepreneur can accentuate the effects of connection between individuals, for example, by stimulating the need to develop social networks, but the action of this new form of firm can also worsen the isolation of people who are outside the ways of accessing these networks, by quartering the society and causing discharges, ghettoization, and social relegation.

On the economic front, the trend identified by experts on territorial dynamics (the fragmentation of settlements and erratic aspects that contain many strategies of location) the cyberentrepreneur can oppose another form of structuring of space, based on cross-linking the organization of production, itself made possible by the use of teleworking (distanciation of internalities, marginalization of physical moves) and subcontracting (outsourcing, globalized research skills).

On the political front, the rise of clubbing behaviors may be overcome or circumvented, thanks to the effects of the economic work of cyberentrepreneur, with the wide use of practices of e-learning, strengthening specialized networks, etc.

The Cyberentrepreneur, Dynamisor of the Residential Economy

In terms of the economy of a territory, the distinction between economics called "production" ("Turned to external markets, this model spreads competitive positions in order to catch the revenue streams necessary for regional growth" – Aubert 2011) and the so-called residential ("Centered on the local market, this model can satisfy the needs of residents" – Aubert 2011) is important in terms of development potential in all the meanings related to local area (more or less prosperous, the number and quality of services to the population, value of the equipment, treatment of disparities, etc.).

Cyberentrepreneur action may contribute to change in relationship between these two forms of economic activity, in that it consumes or produces or sells goods and intangible services (in fact, today, every "good" or "service" comes in the form of an arrangement of various material elements, in decreasing proportion, and especially and increasingly intangible elements). It allows the creation of gateways between the two types of economies:

- Cyberentrepreneur may provide local activities access to foreign markets, and enable local staff to have additional income ("production") as a form of endogenous local economy.
- Cyberentrepreneur may also pull into territory services related to production economy at very low costs that previously would have severely strained the budgets of local staff.
- Cyberentrepreneur may finally through teleworking enable local officials to have a job in a firm located in the economic system of the territory (see Appendix).

Teleworking, Coproduction of the Firm and the Territory

The network logic implemented by the cyberentrepreneur should lead to the emergence of a new type of space, cross-fertilizing product of the firm and the territory.

This new system will be economic and territorial:

- No rural, in the meaning "very survivals artificially maintained" (Lussault 2011) that is to say beyond the traditional model of self-sufficiency and developing a new vision based on self-productive and reticulate autonomy and an emerging right to sedentarity.
- Neither urban in the meaning of submission to the working environment and living imposed by the firm, that is to say based on finding a balanced framework, consistent with the desired lifestyle, connected to the company but with a loose connection, not tense.
- Not quite neo-rural or suburban, in the meaning of "space formerly rural, escheated, (which) urbanizing with the introduction of spatial forms, practices, values and references that come from urbanization" (Lussault 2011) that is to say to a sustainable and distanced position, initiating a new model for economic and territorial:
  - Reconstructed with elements of the urban and rural;
  - Co-produced by the firm and the territory;

  and constituting an early clarification in the chaotic environment of proliferating, moving, uncontrollable space-time between individuals (see also Aurigi 2005).

The territory of usual reference for decision makers is defined by the limits of the administrative district (this one of the local elections, the definition of budgetary resources, the map of public facilities, etc.). In terms of economic activity, public policies aim to traditionally attract production units, brick and mortar, in the territory.

With digital technology, teleworking is possible. It implies a redefinition of local and regional strategies: The goal is less filling preinstalled industrial estates as the attraction of jobs in the territory of reference, that is to say people coming to live and telework on this territory, their employers may be located in places far removed from that territory, creating a "connectivity between remote locations . . . a growing interweaving of the positions of centrality and situations peripherals, blurring some of the notions of inside and outside, of dominant and dependent" (Cattan and Frétigny 2011; Malecki and Moriset 2008).

Explanation: Travel time between home and workplace does not assume much importance, this shift takes place once or twice a week and can be achieved outside the peak hours.

Benefit to the employee: In addition to the gain resulting from the removal of daily commuting, he built a "right to physical sedentarity" can keep his home even if he changes jobs.

Advantage for the firm: In addition to gains in productivity and lower management costs, the company can expand its recruitment area and retain employees, even when changing their place of residence.

Conclusions and Future Directions

Two possible directions of developments, in the case where labor practices geographically separated from the place of assembly productions would be populated: either to strengthen the trend toward metropolization (as was demonstrated by Jacques Levy as "diffusion phenomenon of urban, growing indistinctness between two socio-spatial orders that, until recently, all opposed" – Pinson and Rousseau 2011), either to introduce a new model of territorial organization, "re-personalization" of space (and the role of cyberentrepreneur to find a research field to develop its potential and give strength to the adage, "without the digital immateriality, no possible") (Lussault 2011).

Cross-References

▶ Digital Economy and Business Creation
▶ New Forms of Entrepreneurship in a Sustainable Knowledge-based Service Economy
▶ Proximity Relationships and Entrepreneurship
▶ Territory and Entrepreneurship

References

Aubert F, Georges-Marcepoil E, Larmagnac C. Les satellites interconnectés. Territoires. 2011;2040, n° 4, pp. 121–127
Aurigi A. Making the digital city: the early shaping of urban internet space. Aldershot: Ashgate; 2005.
Bouwman H, Hulsink W. A dynamic model of cyber-entrepreneurship and cluster formation: applications in the United States and in the low countries. Telemat Inform. 2002;19:291–313.
Carrier C, Raymond L, Eltaief A. Cyberentrepreneurship: a multiple case study. Int J Entrep Behav Res. 2004;10:349–63.
Cattan N, Frétigny JB. Les portes d'entrée de la France et les systèmes territoriaux des flux, Territoires. 2011;2040, n° 3, pp. 61–77.
Duranton G. Distance, land and proximity: economics analysis and the evolution of the cities. Environ Plan A. 2008;31:2169–88.
Lussault M. L'ultra-urbain mobilisé dans la mondialisation, Territoires. 2011;2040, n° 3, pp. 11–26.
Malecki EJ, Moriset B. The digital economy: business organization, production processes and regional development. London: Routledge; 2008.
Pinson G, Rousseau M. Les systèmes métropolitains intégrés. Territoires. 2011;2040, n° 3, pp. 29–58.
Rifkin J. The third industrial revolution: how lateral power is transforming energy, the economy, and the world. London: Palgrave Macmillan; 2011.