Probing a myth: does the younger generation of scientists have it easier?

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There is a common assumption that younger generations have it easier than their predecessors. Is this myth true or false? The television program “MythBusters” examines scientific myths and, after careful analysis, scientists design experiments aimed to dispel or support the myth in question.

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Often, they find that the myths are unfounded. Scientific discoveries can lead to exponential advances that certainly help the next generation generate breakthroughs. This is a fact, not a myth, as long as we ensure that there is an environment to foster creativity and facilitate research performance. This was true in the United States and Europe for the best part of the twentieth century. Proof of this lies in the incredible discoveries made by young scientists on their own or as co-investigators with more established researchers. A notable example includes that of Dr. Yuan Lee, a 1986 Nobel Laureate in Chemistry, who shared the prize, along with Dr. John Polanyi, with his former postdoctoral advisor Dr. Dudley Herschbach. Many such examples exist where young investigators showed their promise in science early on and were recognized, if not immediately then later in life, for their early achievements. Although this was not uncommon in the 1900s, the current scientific climate does not seem to produce such early achievers. A recent study showed that the age at which investigators reported their most important work had dramatically shifted to older ages [1]. In trying to understand the reason for this disparity, we need to examine the economic environment, which, undoubtedly, affects the ability to support discoveries in science.

The last decade has been one of reduced research expenditure in the private sector and in funds allotted to government-sponsored research. This has resulted in fewer open positions, both in industry and academia, and affected the ability of recent graduates to find jobs. As a result, young scientists are choosing to accept longer postdoctoral stints and non-tenured research positions while they become more competitive for the precious permanent industrial and governmental jobs and tenure-track openings in academic institutions. A recent study performed by the National Institutes of Health (NIH) showed that the average age for first-

Fig. 1 Graph showing age at first NIH R01 award over the last two decades

Fig. 2 Percentage of NIH R01 Principal Investigators from two different age groups (66 years old and older and 36 years old and younger)

time investigators was close to 43 years of age, similar to results from 2001 (just below 42 years old), but quite different from results from 1991 when the average age was 38.5, see Fig. 1 [2]. These statistics are interesting when one examines recent data reported by the NIH of a survey that showed the age progression of faculty members with NIH funding over the last 30 years shifting toward senior investigators continuing to hold NIH awards later in life. This shift is rather dramatic and shows that the percentage of investigators under the age of 36 was 3 % in 2010, whereas in 1983 this group reached a peak comprised of a much larger 18 %, which started to decline to 10 % in 1990 and 5 % in 2000. In contrast, the age at the other end of the scale has also shifted, showing active researchers beyond 80 years old. Interestingly, about 7 % of current investigators are 66 or older, whereas in 1983 this group was negligible at 0.02 %; this steadily increased to 2 % in 1990 and 4 % in 2000, as seen in Fig. 2 [3]. It is great for science that so many senior investigators choose to continue having active research groups in their golden age, and reflects upon advancements in medicine, often due to the work of these very same researchers. However, at the same time, it is worrisome that not enough new positions are being created to accommodate the younger generations, causing a trend that materializes as a delayed onset of their independent careers. The current economic situation, where the funding of federal agencies has dramatically decreased, has had an impact on the funding of all scientists, junior and senior alike, in the USA. Why is this happening? Is there a real need for longer training before striking it solo because of a lack of sufficient knowledge or is it simply because there are no jobs available for recent graduates? The fact that reports for new academic tenure-track positions has declined in the

last 10 years and that the average age of NIH first awards is 43 years old indicates the latter, meaning that the economy has restricted the number of available positions for younger scientists in research and development and shifted their emancipation to a time when they are already in their fourth decade. Perhaps the only positive news is that the NIH reports that 30 % of all investigators awarded R01 grants in 2010 were first-time investigators.

In Europe, the picture is similar. The average age of investigators receiving a Starting Grant Award from the European Research Council (ERC) is 37 years of age and the success rate is 12 % overall, with a 35 % success rate for invited (pre-selected) applicants in life sciences and 46 % in physical sciences and engineering [4]. These rates indicate that the picture for young investigators is also bleak on the European scene. This Starting Grant Award program was established as an effort to counteract the lack of sufficient opportunities for young investigators to develop independent careers. Its goal is to facilitate the transition from working under a senior investigator to establishing their own research program to prevent the waste of research talent in Europe due to a lack of resources for younger generations. Furthermore, another goal of the Starting Grant Award program is to speed up the establishment of the next generation of creative and energetic research leaders within Europe. The ERC was created in 2007 as an arm of the EU's Seventh Framework Programme (FP7), and was the first pan-European funding body for frontier research. ERC funds account for 15 % of the FP7 budget and total €7.5 billion for the 5-year period from 2007 to 2013. It is anticipated that by 2013 the ERC will have supported around 5,000 grants. While this number appears to be high, in reality these funds are not sufficient when considering the number of countries and investigators in the European Union countries.

Although still insufficient, the ERC has been consistent in taking a stand to promote the careers of young scientists. We cannot ignore, however, the impact of the economic crisis on countries that had been on a scientific upswing in the last 20 years. Such an example is that of Spain where investment in research has decreased dramatically in recent years. Funding has gone from €8.5 billion last year to €6.4 billion in 2012 [5]. This represents an overall 25.5 % reduction in governmentally sponsored research and development in Spain. This serious setback in investment has brought levels of funding to those of 2005, creating the impression that research enterprise is not a priority within the government. It is worrisome that this decrease in research investment may negatively impact growth in science

and technology to a point of stalling the momentum that fields such as nanotechnology and medical research were experiencing in Spain. One can only hope that we can ride out the wave without causing a debacle in the infrastructure and human capital built through long-term investment.

A major concern is how all of the above trends will impact on the number of young people pursuing studies in the physical and life sciences, which ultimately will determine the number of scientists working in industrial, governmental, and academic outfits in the future. There is no question that being unable to tap into the creativity of younger generations would be detrimental for the advancement of science. Going back to our initial myth regarding younger generations of scientists having it easier than older ones, I believe that we can safely conclude that this myth is untrue. No doubt, our current young scientists have it tougher than ever to pursue their dreams, despite the beneficial wealth of knowledge that has been amassed by older generations. It is the creativity of the younger generations that needs to be nurtured and supported, so that their ideas result in scientific breakthroughs. Forgetting this would be a tragedy.

On a brighter note, and despite all the challenges, we can currently still count on an abundance of fabulous young scientific minds devoted to research. A testament to this is the current special issue of *Analytical and Bioanalytical Chemistry* in which the work of young researchers from the Americas, Europe, Asia, and Australia is being highlighted. It is with joy that we share their contributions with you, our readers. We would also like to thank our young investigators for following their career dreams despite the significant challenges that they have to overcome to establish themselves in the academic field.

To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science.

-Albert Einstein

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