

What does it mean to be ‘virtual’?

Colin Beardon

University of Plymouth, Earl Richards Road North

Exeter EX2 6AS, UK

Tel/Fax: +44 1392 475028

Email: c.beardon@plym.ac.uk

Abstract

The role of language in thinking and reasoning about technology and society is examined with respect to the naming of new technologies.

The paper first describes the evolution of the word ‘artificial’ through its use in ‘artificial intelligence’ and argues that a common interpretation of the latter term was made possible by an ambiguity in its constituent terms. Emphasis is then placed upon the word ‘virtual’, arguing that its traditional use was first adapted to meet the general needs of computing, and then a more specialized meaning has emerged associated with the concept of ‘virtual reality’. This new sense is roughly synonymous with ‘potential’.

Empirical evidence is provided of the use of the word, based upon various dictionary definitions, quantitative research using electronic corpuses (the British National Corpus, INSPEC database of scientific and technological abstracts, and three newspapers) and a discussion of definitions given by practitioners and theoreticians in the field.

INTRODUCTION

When we think about the future of a new technology we usually do so in words - through written reports, at conferences, in articles, etc. - and whilst most of our time is spent looking at particular technologies in detail it is important, from time to time, to look at the words we use for words are also a form of tool and used incorrectly they can result in misleading conclusions. This paper will look at one particular word which has come to be used widely in debates about the future of computing, and that word is ‘virtual’. It has had quite a long history, being used to describe ‘virtual addressing’ in the 1970s, but it has achieved spectacular notice since the term ‘virtual reality’ became popular around 1990.

It will be shown that there is a process whereby the words we use to describe technology originate from ordinary usage, but then grow to produce new senses of the word which gain wider currency in debates about society in general. The ambiguity of sense that naming a technology introduces means that the names themselves are often ideologically loaded. To put it simply, these terms can be persuasive, providing obstacles to certain ways of thinking about the future, giving quasi-scientific legitimacy to some aspects of the relationship of technologies to human life, and introducing a sense of inevitability concerning certain technological developments.

It may be thought that little hangs on a name but the choice of words can be very significant. Words are an important aspect of the way we understand and negotiate the wider significance of new knowledge and they are part of the raw material for projections into the future. A technology gains meaning through the words used to express it and these are rarely chosen capriciously. Technological projects often have a number of competing names during the early stages: for example, the technique now known as 'virtual addressing' was first called 'paging'.

Naming (especially where it involves complex names containing more than one term) is a poorly understood process and until recently there has been little linguistic research into the topic. The juxtaposition of names has no fixed interpretation and there can be numerous implied relationships between the terms, possibly as many as the relationships expressible in language in general. For example, relations between the terms can involve modalities: a 'bus stop' is where a bus is *supposed* to stop, not necessarily where it *does* stop. Compound names are rarely simple devices and the brevity that is their appeal leaves them open to wide ambiguity of interpretation.

So, when it comes to giving a technology a name there is nearly always an ideological content. The word 'computer' itself emerged from a field of contenders. In 1945 it was used exclusively to refer to human beings who performed complex calculations. Its extension to describe an electromechanical device was compatible to views, expressed by Turing (and Babbage before him), that the work of the machine was comparable to the work of well-ordered human beings working at desks with pen and paper. Not everyone agreed with this and Norbert Wiener, for one, articulated a more humanistic role for the technology which he expressed through an alternative name for the device: a 'cybernetic' machine.

With terms such as 'artificial intelligence' and 'virtual reality', the constituent words are so powerful that their juxtaposition is overloaded with potential meaning. Through their technological development there is an accompanying process of lexicalization (whereby they become recognized as a single linguistic unit with a definite meaning) by means of which new refinements or interpretations of their constituent terms are produced. Benjamin Woolley refers to this when he says,

'Virtual' was and remains a much grander word, scandalously underused, a huge vessel of semantic vacuity waiting to have meaning poured into it. Computing has provided some of that meaning ... (Woolley, 1993, p. 58)

If computing has provided new meaning to words like 'artificial' and 'virtual', then how does this take place, and what are the implications for rational public discourses about technology?

THE 'ARTIFICIAL'

Before tackling the contemporary phenomenon surrounding the word 'virtual', it is advisable to establish a theoretical model based upon a past example. For this reason, the evolution of the word 'artificial' with respect to 'artificial intelligence' will first be briefly examined.

Words are not static referents with a meaning fixed for all time. While the word 'artificial' indicates today an opposition to nature or what is natural, this is a fairly recent development. In the seventeenth century it was used to mean something like 'clever' (i.e. 'displaying special art or skill') and by the nineteenth century it was a synonym for 'deceived', 'cunning' and 'affected' and associated with terms such as 'untrue', 'counterfeit', 'illegitimate', 'skilful', 'sly' and 'insincere' (Roget, 1852). But it is in the sense of 'unnatural' that it is commonly used today.

The Concise Oxford Dictionary (1982) lists various senses in which the 'artificial' is opposed to the 'natural':

1. made by art; not natural ... (i.e. concerned with the process of making)
2. not real (artificial flowers, limb) ... (i.e. concerned with the product)
3. affected, insincere, factitious, not arising naturally ... (i.e. concerned with the intention)

The application of the term 'artificial' to early computers (when it was referred to as 'an artificial brain', for example), raises the question of which of these senses was being used. Computers had a clear claim to be considered 'artificial (1)' in that they were without a doubt manufactured objects. The introduction of the novel compound term 'artificial intelligence', however, introduced an element of ambiguity and they soon became portrayed as 'artificial (2)' in that they were being proposed as products capable of imitating human intelligence (Turing, 1950).

Figure 1. Types of definitions of 'artificial intelligence' (Author's analysis of answers given in Negrotti, 1991)

Model or simulate human intelligence	27%
Develop a theory of human intelligence	16%
Produce behaviour which would be considered intelligent in a human	15%
Extend human intelligence or capabilities	7%
Develop human attributes in computers	6%
Extend the powers of computers	6%
Provide an intellectual challenge	4%
Other definitions	19%

By 1983 it would appear that this process was well established, at least within the scientific community. At the 8th International Joint Conference on Artificial Intelligence (IJCAI), held in Karlsruhe in that year, one hundred artificial intelligence (AI) researchers and developers were asked to provide short definitions of artificial intelligence. Their answers (summarized in Figure 1) indicate a strong

view (68%) that building computers that imitate human behaviour is central to the discipline of AI.

The strong connection between 'artificial' and 'imitation' (and hence its connection to artificial (2) rather than artificial (1) in the Oxford English Dictionary (OED)) is reflected in the definitions provided for the lexicalized term 'artificial intelligence' in many present day dictionaries. In these entries there is no implied opposition of 'artificial' to 'natural' but instead frequent comparisons are drawn with human behaviour.

- *artificial intelligence*: Study of how to make computers do things that people can do, such as make decisions, see things etc. (Longmans Dictionary of Contemporary English, 1995).
- *artificial intelligence*: The study of how to produce mechanisms that have some of the qualities that the human mind has, such as the ability to understand language, recognize pictures, solve problems and learn (Cambridge International Dictionary of English, 1995).
- *artificial intelligence*: The development and use of computer programs to copy intelligent human behaviour (Oxford Advanced Learners' Dictionary, 1995).
- *artificial intelligence*: A type of computer technology which is concerned with making machines work in an intelligent way, similar to the way the human mind works (Collins COBUILD English Dictionary, 1995).
- *artificial intelligence*: The computational reproduction of intelligent action (Macmillan Dictionary of Information Technology, 1989).
- *artificial intelligence*: The property of a machine capable of reason by which it can learn functions normally associated with human intelligence (McGraw-Hill Dictionary of Computers, 1984).

There is at least a *prima facie* argument here that the development of 'artificial intelligence' in its technological and popular sense was made possible through the exploitation of an ambiguity in the meaning of the word 'artificial'. While no one could argue that computers were manufactured, and were thus properly described as being 'artificial (1)', proponents of AI, and particularly 'Strong AI' as defined by Searle (1980), went on to assume that they were also 'artificial (2)', which is to say that computers could potentially imitate aspects of human behaviour. It has been argued elsewhere that this conception of the status of computers in our societies was dominant in the 1960s and 1970s and had a number of unfortunate implications (Beardon, 1994).

THE VIRTUAL

Traditional definitions of 'virtual'

The word 'virtual' is seen today as roughly meaning 'almost', but it is not without its own history. It was derived from the same root as 'virtue' and originally meant 'morally virtuous'. By the nineteenth century it was synonymous with 'nonexistence' and 'intrinsicity', and associated with terms such as 'unreal', 'potential', 'subjective' and 'instinctive' (Roget, 1852).

Its current meaning was expressed in the Oxford English Dictionary (1933),

virtual

4. That is so in essence or effect, although not formally or actually; admitting of being called by name so far as the effect or result is concerned.

To be a 'virtual X', according to this definition, is to be 'almost an X'. Contemporary dictionaries have concentrated exclusively upon this sense of the word.

virtual almost, even if not exactly or in every way (Cambridge International Dictionary of English, 1995).

virtual almost or nearly the thing described, but not completely (Oxford Advanced Learners' Dictionary, 1995).

Longmans Dictionary of Contemporary English (1995) identifies two such senses,

virtual

1. virtual peace/darkness/destruction etc. something that is so nearly complete peace etc. that any difference is unimportant.

2. virtual leader/prisoner etc. someone who is in fact a leader, prisoner, etc. but not officially one.

There seems very little disagreement of substance between these different definitions and, with respect to general usage of the word, there seems to be unanimity that a 'virtual X' is not an X but it is almost an X.

Uses of 'virtual' within computing

The adjective 'virtual' has been used in computing at least since the 1960s and has been applied to many objects (see Figure 2). An examination of the terms in this list reveals some unusual senses of the word 'virtual'.

Figure 2. Uses of 'virtual' as a premodifier in computing terminology (derived from various computing dictionaries)

virtual access method	virtual facility	virtual private network
virtual address	virtual input/output	virtual reality
virtual button	virtual interface	virtual service
virtual call	virtual machine	virtual space
virtual cathode	virtual manager	virtual storage
virtual circuit	virtual memory	virtual support
virtual device	virtual network	virtual system
virtual disk	virtual password	virtual terminal

For example, the following definition of 'virtual address' is based upon the distinction between a syntactically valid location and something else which is referred to (unproblematically) as an 'actual location'.

virtual address: A symbol that can be used as a valid address part but does not necessarily designate an actual location (McGraw-Hill Dictionary of Computers, 1984).

It could be claimed that a virtual address has the same effect or result as an actual address for the programmer, though it is not the same kind of thing for the operating system designer, but this is an argument about relativities. It can be argued that a virtual address is still an address, and the operating system designer cannot legitimately claim to represent 'actuality' whereas the programmer does not. Rather, the point is that a virtual address is an indirect, rather than a direct, address or, to be more precise, it is more indirect than some other forms of address. The term 'virtual' in this case seems to be used to indicate a level of indirection (i.e. what is thought of as a real address to one group of people is not thought of in that way by another).

In another example, the following definition of 'virtual machine' introduces the notion of a simulation:

virtual machine: In computing, a simulation of a computer and its associated devices by another computer system (Macmillan Dictionary of Information Technology, 1989).

Whilst this is a similar use to that in 'virtual address', in this case the computer system that is doing the simulating and the machine that is being simulated might exist in exactly the same sense (theoretically, they could be the same machine). An appeal cannot be made to some underlying 'actuality' in this case but, rather, it is the process of simulation (or indirection) which makes the use of the word 'virtual' appropriate.

The majority of cases in computing seem to imply a degree of simulation or indirection, whereby one group of users appears to be further away from some supposed 'reality' than another group. The Macmillan Dictionary of Information Technology provides a definition for 'virtual' as an adjective within computing that is formulated largely along these lines.

virtual In computing and data communications, pertaining to a facility that is offered to a user, or system, as if it were a physical reality (Macmillan, 1989).

With the exception of one term on this list, which we shall return to later, it does appear that the use of the word 'virtual' in computing prior to the emergence of the term 'virtual reality' has introduced a new sense of the word, rejecting the traditional sense in which it is synonymous with 'almost' and developing a new sense which is roughly synonymous with 'simulated'.

USAGE

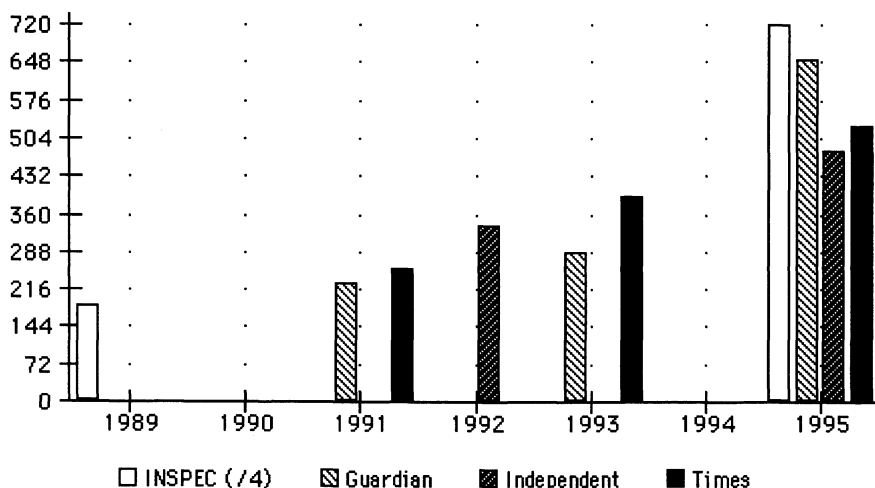
Usage of the word 'virtual'

So far it has been assumed that the phenomena described in this paper are not only real but are significant. In this section it will be shown that the word 'virtual' is being used much more than it used to be, that the term 'virtual reality' has brought about a quantum increase in its usage, and there is some evidence that the word is being used in new ways. We will do this by studying sizeable bodies of real language usage, as captured in various electronic forms.

For several years, the usage of the word 'virtual' has been increasing at an average rate of about 30% per annum and this rate has itself been increasing. These findings are drawn from INSPEC (an annual CD-ROM database of scientific and

technical abstracts); and the CD-ROM full-text versions of three United Kingdom newspapers (*The Guardian*, *The Independent* and *The Times*). The results are summarized in Figure 3.

Figure 3. Number of occurrences of the word 'virtual'



In order to determine which nouns were usually modified by the adjective 'virtual' a search was made of the British National Corpus, an electronic corpus containing approximately 200 million words of contemporary English usage. The 883 sentences retrieved yielded a total of 888 simple noun phrases, which in turn yielded 300 different head nouns. The most common of these are shown in Fig. 4.

Figure 4. Most common head nouns pre-modified by 'virtual' in BNC

virtual reality	116	virtual disappearance	13	virtual store	8
virtual monopoly	45	virtual collapse	12	virtual computing	6
virtual networks	29	virtual certainty	11	virtual demise	6
virtual memory	26	virtual eliminators	11	virtual destruction	6
virtual machines	25	virtual prisoners	11	virtual dictatorship	6
virtual particles	24	virtual standstill	11	virtual impossibility	6
virtual processors	21	virtual circuits	9	virtual library	6
virtual absence	15	virtual exclusion	9	virtual persons	6
virtual strangers	14	virtual freeze	8	virtual war	6
virtual worlds	14	virtual silence	8		

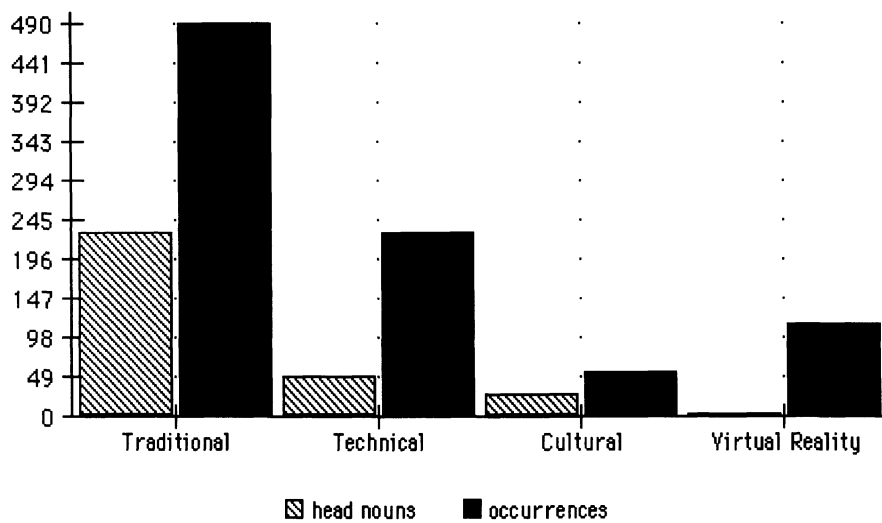
An initial attempt was made to divide the occurrences into two classes of use: 'technical' which refers to a specific technical or scientific discipline and includes pairs such as 'virtual memory' (computing), 'virtual image' (optics) and 'virtual subject' (linguistics); and 'traditional' which is unrelated to any particular

technical sub-language and includes such pairs as 'virtual monopoly', 'virtual absence' and 'virtual strangers'.

It was found that, while a large number of cases could be classified in this way, certain examples did not fit either group. These could be described as cultural extensions of technical usage, e.g. 'virtual worlds', 'virtual library' and 'virtual touch'. By admitting a third, 'cultural' category it was possible to classify all instances, with the exception of 'virtual reality' which was deliberately not classified at this point. The distribution of different head nouns and number of occurrences by class is shown in Figure 5.

It was noticed that the most common examples of traditional use ('virtual monopoly', 'virtual absence', 'virtual stranger', 'virtual disappearance' and 'virtual collapse') all have negative connotations. An analysis of the entire sample found this to be a general trend (70% negative; 16% neutral; 14% positive). A tentative conclusion could therefore be drawn when the word 'virtual' is used as a synonym for 'almost' it is more likely to qualify a head noun with negative connotations. No such trend could be found with other classes of usage.

Figure 5. Use of 'virtual' by class in BNC

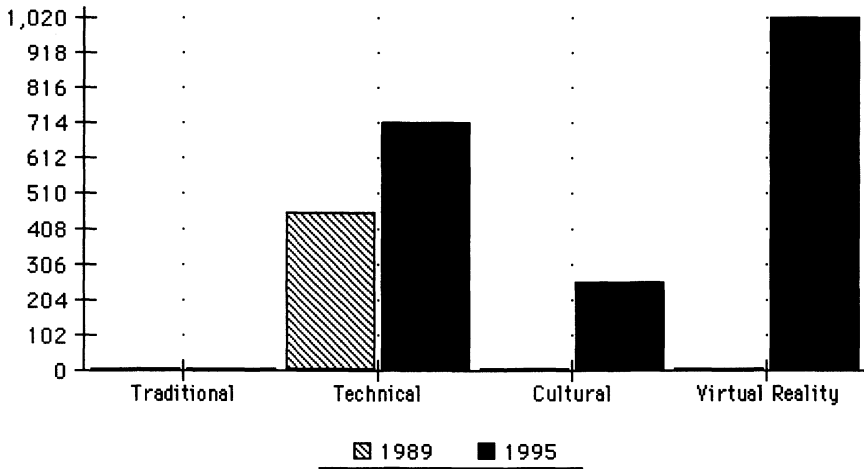


Growth of usage of the word 'virtual'

Examples from four CD-ROM series were searched in order to quantify the change of usage of the word 'virtual' over time. The INSPEC database of scientific and technical abstracts for 1989 and 1995 gave an indication of change over a 6 year period, though as it is not a full-text database it cannot be considered to be a representative sample of usage. Nevertheless, the extent of the time range was

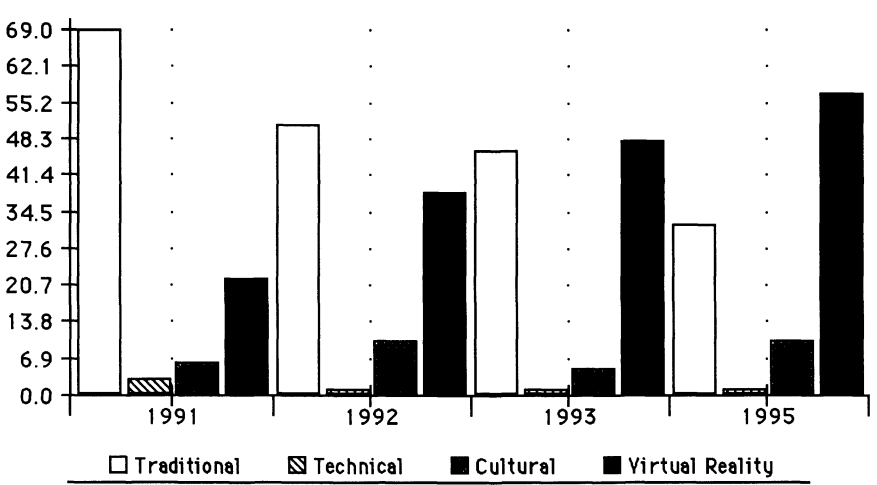
considered useful. Searches were conducted for all the head nouns appearing in Figure 1, and the results are shown in Figure 6.

Figure 6. Use of 'virtual' by class in INSPEC



As we may expect from technical abstracts, the sample was heavily skewed towards technical usage and against traditional usage, but what is of particular interest is the growth in 'cultural' usage from practically no examples in 1989 to 9% of the total in 1995.

Figure 7. Percentage distribution of 'virtual' by class in newspapers



A second search was undertaken using the full-text of *The Guardian*, *The Independent* and *The Times* newspapers for various years between 1991 and 1995. The combined results are shown in Figure 7 and clearly indicate a massive growth in the use of the term 'virtual reality', a significant growth in 'cultural' usage (given the increasing size of the samples, and a decline in technical and traditional usage).

These findings show that there has been a spectacular growth in the use of the word 'virtual', spearheaded by its use in the term 'virtual reality' since about 1989, but also supported by an increase in the extensions of the word into 'cultural' domains.

The use of 'virtual' in 'virtual reality'

If the word 'virtual' has traditionally been synonymous with 'almost' (with a tendency towards negative connotations), and it has come to be applied in computing synonymously with 'simulated' (without negative connotations), then which sense is being used when we talk of 'virtual reality'?

The definitions of virtual reality given by practitioners involve several key components. These are: that virtual reality is produced by computational machinery of some kind; that it is based upon images and sounds produced by this equipment; and that it has the effect upon the person experiencing virtual reality that they are immersed within it and can interact with it or the objects within it. The following four quotations illustrate all these points.

- Virtual reality is the use of computers and human-computer interfaces to create the effect of a three-dimensional world containing interactive objects with a strong sense of three dimensional presence (Bryson, 1996, pp. 62-63).
- VR refers to interaction with computer generated spatial environments constructed to include and immerse those who enter them (Bricken, 1994, p. 163).
- Virtual reality (VR) immerses the user in a three-dimensional (3D) environment that can be actively interacted with and explored (Green and Halliday, 1996, p. 46).
- Virtual Reality (VR) systems ... are distinguished by using real-time updates of the user's head orientation and position to redraw (often in stereo) 3D images in real-time (Deering, 1996, p. 54).

However, the term 'virtual reality' has become lexicalized and in the definitions that now appear in dictionaries we find a divergence from what the technologists are saying. While the technologists stress the technology involved, all the dictionary definitions describe virtual reality from the subjective standpoint of the person experiencing it (using words like 'seems' and 'looks like'). Only one of the dictionaries taken for this study mentioned interaction.

- *virtual reality* is an environment which is produced by a computer and seems very like reality to the person experiencing it (Collins COBUILD English Dictionary, 1995).
- *virtual reality* an image produced by a computer that surrounds the person looking at it and seems almost real (Longmans Dictionary of Contemporary English, 1995).

- *virtual reality* a system in which images that look like real objects are created by computer and appear to surround a person wearing special equipment (Oxford Advanced Learners' Dictionary, 1995).
- *virtual reality* is a set of images and sounds produced by a computer which seem to represent a place or a situation in which a person experiencing it can take part (Cambridge International Dictionary of English, 1995).

This shift of emphasis, from technical description to subjective experience, is significant. Virtual reality, in technical discourse, is about levels of representation and abstraction. In general discourse, it is about appearance, belief and reality, that is to say it is presented as an ontological issue.

What is 'virtual' in 'virtual reality'?

To some people virtual reality is an ontological issue and, echoing Neil Postman's (1992) double-negative, 'We believe, because there is no reason not to believe', they argue that virtual reality can be defined as 'the suspension of disbelief'.

William Bricken appears to argue this way when he uses the concept of 'presence' to address the subjective aspects of virtual reality.

Presence is the impression of being within the virtual environment. It is the suspension of disbelief which permits us to share the digital manifestation of fantasy (Bricken, 1994, p. 167).

For Bricken virtuality is founded upon a contrast with physical reality, Broadly, virtual reality is that aspect of reality which people construct from information, a reality which is potentially orthogonal to the reality of mass. ... Physical reality is built of mass while virtual reality is built of bits (Bricken, 1994, p. 163).

In a previous section it was mentioned that one example of the use of the word 'virtual' in computing pre-dated virtual reality yet did not function as a synonym for either 'almost' or 'simulated'. In the definition of a 'virtual terminal' it is clearly implied that it is used to refer to an ideal type and not necessarily a real terminal.

virtual terminal: In peripherals, an ideal terminal that is defined as a standard for the purpose of uniform handling of a variety of actual terminals. A terminal processor thereafter converts the signals of the real terminal to conform to the standards of the virtual terminal (Macmillan Dictionary of Information Technology, 1989).

Woolley expresses a similar notion with respect to the notion of 'virtual machine',

A computer is a 'virtual' machine - a virtual Turing machine, to be precise. It is an abstract entity or process that has found physical expression, that has been 'realized'. It is a simulation, only not necessarily a simulation of anything actual (Woolley, 1993, pp. 68-9).

Woolley points to a new sense of the word 'virtual' that is not opposed to 'actual' or 'physical', but is opposed to 'realized'. A similar point is made, and expanded, by Pierre Levy who makes essentially the same distinction but uses the opposite words to Woolley when he writes,

I would like to draw an important philosophic distinction between two dialectic couples, the possible/real one and the virtual/actual one. Following

some suggestions of Gilles Deleuze, I would say that the possible is a ghost reality: already completely defined, it only lacks existence. The realisation is not a creative process, it is just a selection among determined entities.

and later says,

... virtuality, indeed, does not mean imaginary. Strictly speaking, the virtual is not the opposite of the real but the opposite of the actual (Levy, 1997).

Despite their confusing use of terminology, both Woolley and Levy are saying the same thing. 'Virtual' is no longer being used in opposition to 'physically real' but is used as a rough synonym for 'potential' (a concept not unrelated to Aristotle's concept of *entelechy*). Levy makes this clear by showing how a virtualization can have a physical existence,

Virtualization is not necessarily a disappearance. On the contrary, it is often a materialization process. This can easily be shown from the example of technology. The design of a new tool is a virtualization of many actions. When someone designs a tool, instead of focusing on the action, he makes the focus on something much more general, on a type of problem. The tool is not an answer to such or such particular situation but the materialization of a general function.

and

... the image is virtual on the hard disk and actual on the screen. Virtualization is digitisation and actualisation is display. The image is even more virtual when its digital description is not a stable deposit in the computer memory, but when it is calculated in real time by a program from a model and a flow of input data (Levy, 1997).

This type of 'virtuality' is roughly synonymous with 'potential' in the sense that it manifests itself as a stored general function which can be activated in order to produce a specific output depending upon the context of use. This is a long way from being a simple synonym for 'almost' and, on the way, it has turned into a term that will admit of degrees (Levy, 1997).

CONCLUSION

When we try to think about the future of a particular technology, or to think about new technologies in general, we are forced to use words as our tools. In this paper it has been demonstrated how those tools may be first borrowed but then, through their interaction with the technology itself, they become changed. Ambiguities are exploited and new senses of words are formed which can have a currency outside of the technical domain within which they were created.

This was shown in the first instance with the term 'artificial' which has always been ambiguous and which was interpreted ambiguously by some of those who speculated about the capabilities of computers to imitate human beings within what was a strictly modernist paradigm. The term 'virtual' did not contain such ambiguity but its use within the same modernist paradigm of computing produced a new sense of the word, roughly synonymous with 'simulated'. More recently, the postmodernist concept of 'virtuality', as embodied in the term 'virtual reality' has yielded yet another sense of the word, roughly synonymous with 'potential'.

It may appear that words as tools are therefore unreliable, selected to do one job they become transformed into something else; but we should remember that rigid, inflexible tools are also unreliable as they are soon broken and discarded. It is better to see language as an important arena in which culture and technology come to terms with each other and the output from which, in the form of new terms and new word senses, provides the parameters within which our thoughts about the future are frequently trapped.

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