The impact of cognitive technologies

Towards a pragmatic approach

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Technological advances have been an integral part of human development throughout history. In recent decades such advances have been dramatic in that many of the new technologies have quickly penetrated into activities in the daily life of ordinary people. In contrast to very specific technologies (such as in the medical domain, which are used by highly specialized experts and directly affect only those people who suffer from specific syndromes) new technologies are now deeply embedded in many everyday activities of virtually everyone.

With the accelerated pace of technological innovation, predictions were made on how they may affect us. Past forecasts focused mainly on the *external* and technical impact of technology — e.g., how technology will take over many human activities. The concern was how we would cope with the increase in free leisure time as we were served more and more by technological devices that would do what we had previously done and that would be subservient to us and our needs (e.g., Dumazedier 1967), as well as with the reduced offer of employment (a perspective still on the agenda today; e.g., Rifkin 2004). However, such forecasts not only did not materialise, but in many respects, it is we who ended up subservient to technology, rather than it to us.

What we propose to consider is technology's impact not so much in terms of the 'quantity' of work and time employed in a given activity, but rather in terms of the 'quality' or kind of the activity. For example, the routine tasks of a worker in a car assembly line now have transformed to operating, maintaining, and contributing to improve robotic systems that assemble the cars, and more workers are perhaps involved in design, marketing and administrative tasks.

Viewed from this perspective, we think that technological innovations have not necessarily reduced the amount of 'work' but rather significantly changed the type of work performed by humans. In this respect, these innovations did not *replace* human labour, but introduced deep changes in its *environment*,

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which led to the requirement and development of new *cognitive competencies* (Dror 2005). Hence we suggest moving from the *external* effects of technology to emphasising its *internal* implications. Technology, in this view, becomes the *contextual* drive responsible for the evolution of new human capacities and their use — a role that requires its study within the framework of a *pragmatic* theory of cognition.

Our claim goes well beyond the misattribution of technological impact to the quantity rather than the quality of the work performed. Technology has had, and will have, a much greater and deeper impact. As technology penetrates more and more into the realm of the ordinary person and is more and more used in everyday life, its impact increases, for it changes the nature of one's 'form of life'.[1] That is to say, technology's impact consists not only in a shift to different types of activities, but in its encompassing effect on human life, which can only be gauged in terms of a much deeper sense of 'quality'.

At this deeper level, we submit, technology goes beyond contributing to the improvement of our 'quality of life' by offering more comfort and opportunities, as well as by increasing the smoothness, user-friendliness, and efficacy in the performance of a wide range of activities. In many fields technology's contribution has already undergone a radical transformation: from aiding and assisting humans in their tasks to actually taking part in human activities. Thereby, technology, in addition to improving the quality of human life, is eventually changing its very scope and nature. We propose to envisage an emerging set of cognition-related technologies as belonging to this category.

Cognitive technologies, in this sense, can be characterised as those systematic means created by humans and used by them for the achievement of cognitive aims, including either cognitive states or cognitive processes that lead to such states or help significantly to reach them.[2] As these technologies are used in our cognitive processes, as they cognize with us and for us, they influence and impact the very way we think and affect the very nature of cognition. As cognitive technologies advance, they shift from being mere tools that aid cognition to having constitutive roles in shaping cognitive processes themselves. Through them, our mind becomes "bio-technological" and "hybrid", and our brains "plastic" — in the suggestive terminology of Andy Clark (2003, 2004).

Cognitive technologies have far reaching implications in human development. As cognitive technologies advance, the earlier visions of technology 'freeing' humans are still not in sight. Time and again a cognitive technology starts as an aid, a tool to assist humans in their work, to help them cope with vast amount of data. After success in this initial role, the technology is believed

to be able to replace the human altogether; to put the human out of the equation and have the technology — "with relatively simple improvements" — take his/her place. But time and again the "simple improvements" are far from simple and the ambitious jump fails, optimism (or fear) gives place to pessimism (or reassurance), and utopian dreams fade away. The investigation of the new kinds of links between cognition and technology oscillates along in this cycle — but it is too important to be left to marketing imagination and deserves a more stable and sober frame of mind and forum.

One of the most common reasons for this oscillation is the lack of integration between what we actually know about human cognitive processes and the cognitive technologies themselves. As a result, designers and developers are often well off the mark regarding what desiderata a cognitive technology is supposed to fulfil in order to either replace or interact with a given (human) cognitive task (Dror 2005). Under these conditions, setbacks — especially of the most ambitious projects — are virtually inevitable. But they should not lead — as they often do — to abandoning the search for the relevant and appropriate cognitive technology. The moral should rather be that in order to be able to develop and use technologies that function in cooperation with human cognition (and even replace it in some cases), it is necessary to view both of them from a comparative and interactional viewpoint. Only in this way it will be possible to take advantage of the strengths and weaknesses of cognitive technologies relative to the strengths and weaknesses of human cognition, and find how they are best intertwined. This way they do not compete with one another, but rather merge and complement each other, giving rise to new and more powerful capabilities.

Furthermore, such an approach will not only lead to more realistic cognitive technologies, but also to a different, pragmatically oriented methodology for the investigation of human cognition in the light of its (successful or unsuccessful) interactions with cognitive technologies. Unlike the Cartesian mind, whose cognitive activity was allegedly performed in isolation from the external world, we view cognition as being *embodied* and *embedded* in the surrounding context, of which the technological environment is a major component. While the intense and intimate interaction with some cognitive technologies can be viewed as a mere augmentation of natural cognition's accuracy or range, i.e., as a 'quantitative' effect, others may have — as argued above — a 'qualitative' impact on cognition, affecting its very nature.

It is this pragmatic perspective for the investigation of the relationships between cognition and technology that we wish to foster in our Special Is-

sues on Cognition and Technology. They have been designed as a systematic exploration of topics in which particular types of cognitive phenomena are investigated in direct connection with the new cognitive technologies that bring them to the fore under a new light. The new cognitive possibilities and modes of interaction between technology and humans thus created are not only worth investigating on their own merits, but they raise new theoretical questions and opens new vistas regarding the nature and scope of human cognition.

Consider, for example, distributed cognition. Cognition used to be thought of as largely individual-based, but with the advent of the web and other new technologies it is becoming clear that cognition can also be distributed across different agents, both human and virtual. Not only has the web provided the medium for distributed communication, collaboration, and coding on a scale undreamt of a few decades ago, but it has added autonomous software processes to the interaction, as agents that hold their own alongside the human ones. What are the effects of this new mode of cognition on cognition itself?

A particularly important use of the possibilities afforded by distributed cognition is e-learning and e-training. In addition to adaptive, dynamic, and individually tailored instruction, other opportunities are opening up with new learning technologies — including the future possibility of bio-electronic brain implants. Some of the e-learning technologies are already widely used, but their full effect is still barely understood, whereas in those more speculative future technologies it is hardly conceivable. Both hold promises and dangers, the investigation of which, in their technological context, may prove to be groundbreaking for the understanding of the crucial cognitive process of acquiring and using knowledge.

In fact, to date, the available e-learning technology, popular as it is, is far from being fully exploited. For example, much of e-learning's so called 'development and design' consists in transcription of existing paper methodologies. Further progress in e-learning requires the comprehension and exploitation of its inherent potential as a cognitive technology compatible with and complementary to human cognition. Furthermore, the successes and failures of implementations of such technologies can be viewed as an empirical input for a better understanding of the architecture and characteristics of human cognition — including its capacity to evolve through the use of such cognitive technologies and eventually merge with them in a single and coherent system.

Due to recent developments in robotics, *actual embodiment* of cognition can be explored and its consequences better understood. How far do the new insights require substantive modifications of traditional conceptions of robots

as externally programmed and controlled — hence, not really autonomous — and of humans as the privileged seat of autonomy, agency, and free will, due to their presumed superior cognitive capacities?

Human cognition is itself variable in the course of an individual's life. Ageing and impairment can bring about changes in resources and how they are used, both cognitive and behavioural. These changes range from cognitive processing capacity and speed to mobility. Within the biological-neuronal system such changes give rise to a variety of compensation mechanisms, which deeply affect and change cognition. At present, technological intervention may overcome, supplement, and counter damage that causes decrease in cognitive and other capacities. As such, cognitive technologies in this area not only fills gaps, but also may change cognition altogether.

The science of studying cognition has undergone major changes as a result of technological developments. Computers, the web, super-sensitive optical, tactile and acoustic devices, now allow cognition researchers to conduct experimentation with greater ease and in new ways. Brain scanning machinery and functional imaging along with many other technological innovations yield new kinds of knowledge and possibilities and have already led to the emergence of new fields of research — such as cognitive neuroscience (Dror and Thomas 2005). The range of possibilities and modes for experimentation design, data collection, cognitive phenomena investigated, and modalities of analysis will keep changing in an accelerated pace thanks to ever more sophisticated and ambitious tools. That these contributions to our capacity of research belong to the field of cognitive technology is clear. But are they also on the verge of revealing kinds or aspects of cognition hitherto undreamt of? And if so, what does this imply regarding the nature of the mind and its relation to the brain?

These and other fundamental theoretical and meta-theoretical questions inevitably arise when one considers cognitive technologies, and they gain in resolution and in their ability of yielding new insights by being considered in the context of cognitive technologies. This is a further illustration — if at all needed — of the benefits of a pragmatically oriented, *theoria cum praxis* approach. We hope to embark with the readers and the contributing authors in a fruitful and original journey of exploration of these issues. We hope to examine a variety of directions, some of which we have post marked in this paper, and to look at radically new conceptual frameworks, fundamental epistemological shifts, alternative paradigms — all directly linked to and motivated by the need to understand, assess, and sometimes forecast the impact of the rapidly changing cognitive technological environment upon human cognition.

Notes

1. See Wittgenstein (1953) for a discussion of 'form of life'; and Dror and Dascal (1997) for a discussion of Wittgenstein in reference to the foundations of human cognition.

2. For a more elaborated definition, as well as for a set of criteria for a typology of cognitive technologies, see Dascal (2004: 38ff.)

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