Preface
Cognitive Technology: Instruments of Mind

Cognitive Technology is the study of the impact of technology on human cognition, the externalization of technology from the human mind, and the pragmatics of tools. It promotes the view that human beings should develop methods to predict, analyse, and optimize aspects of human-tool relationship in a manner that respects human wholeness. In particular the development of new tools such as virtual environments, new computer devices and software tools has been too little concerned with the impacts these technologies will have on human cognitive and social capacities. Our tools change what we are and how we relate to the world around us. They need to be developed in a manner that both extends human capabilities while ensuring an appropriate cognitive fit between organism and instrument. The principal theme of the CT2001 conference and volume is declared in its title: Instruments of Mind.

Cognitive Technology is concerned with the interaction between two worlds: that of the mind and that of the machine. In science and engineering, this interaction is often explored by posing the question: how can technology be best tailored to human cognition? But as the history of technological developments has consistently shown, cognition is also fashioned by technology. Technologies as diverse as writing, electricity generation and the silicon chip all illustrate the profound and dynamic impact of technology upon ourselves and our conceptions of the world. The instruments afforded by these technologies continue to evolve and to shape the minds that first conceived them.

The technologies of the third millennium promise mind-machine interactions of unprecedented intimacy and subtlety. These interactions embrace radically new kinds of experience that force us to re-examine fundamental concepts of embodiment and consciousness which frame our understanding of the relationship between minds and machines. The implications of these interactions will hinge on the ways in which humans make meanings out of these new experiences. The conference and these proceedings address this issue using the diverse perspectives afforded by a wide range of disciplines, and evidence drawn from both contemporary developments and the history of technology. Its aim is to deepen our insight into the potential influence of current and future technologies over people and society.

1   The Making of Meaning

The CT2001 conference focuses on the core question of how technology contributes to the making of meaning. 'The making of meaning' is to be broadly

interpreted as referring to all the activities by which significance is attached to the actions of people and machines engaging with a technology. For a new technology, meaning is in the first instance associated with intended and pre-conceived applications. The pioneers of the motor car are first preoccupied with refining the car engine, supplying the primary driver controls, building basic roads. As a technology matures, new meanings typically emerge, as skills are acquired, and unforeseen functionality is identified. Driving skills and protocols evolve, the car becomes a status symbol, the drivers are subject to road rage. A new technology typically establishes a pattern of usage, and an associated social organization. Driving regulations are introduced, and the organization of families, industries and cities comes to reflect greater mobility and autonomy. This in turn spawns languages and conventions that are universally understood by proficient users of the technology. New features and classifications of road are created, and resources to provide services, information and training about cars and driving are developed. Established technologies supply the metaphors that influence the ways in which we interpret and communicate our experience. Access to autonomous travel is perceived as a norm, neighbouring cities converge, metaphors such as "giving a proposal the green light" and "stepping on the gas" invade our language.

The contribution of technology to the making of meaning through these processes has been analyzed in many ways: in the design and creation of technologies and artifacts themselves; in the psychological, sociological and historical analysis of their individual and corporate use; and in the philosophical implications for our modes of thought and ways of communicating. A proper understanding of the processes of mutual co-evolution and adaptation which shape our interaction with the technology of the computer age will ultimately require a holistic rather than a reductionist approach. Given our current understanding of these matters, an integrative and holistic account is inevitably a long term ambition, but it is an ambition which must not be forgotten. With this in mind, CT2001 addresses the core question of how technology affects the making of meaning from the following perspectives taking both empirical and more analytical or philosophical approaches.

2   The Personal and Experiential

The impact of technology upon individuals is central to our understanding of the making of meaning. Technologies such as writing and number systems have provided us for a long time with the ability to extend our cognitive and conceptual operations, and various new technologies take this further by offering enhanced representational and perceptual capacities which change the nature of human experience as an embodied condition. This raises very difficult questions about the role of embodiment, affect and consciousness in the making of meaning, as individuals begin to operate with altered or novel perceptual capacities in virtual or real environments which are seemingly unconstrained in the relationships

they permit between self and world, and self and other. It also has implications relating to ethics and aesthetics, and thus to psychological well-being.

3   The Social

The persons who are affected by a technology will not only change their role in the constitution of their social world, but are also affected by how that technology is embedded in and changes their social order. Consequently, any proper understanding of the conference theme must turn to macrosociological accounts of the impact of technology. We are already witnessing how new technology is rapidly changing the temporal and spatial dimensions of communication and decision making, and how this is having a differential impact on sections of society. It can isolate those who do not have access to it, but it can also bring together those who were previously separated by custom, prejudice or geography. These changes are potentially of great significance for the structuring of society and the access to political power and economic resources of different persons and groups. This raises important questions concerning the access to and organization and regulation of these technologies.

4   The History of Technology

Whilst we live in times of great technological change, technologies which have a major impact are not novel. Studies of Cognitive Technology have, for the most part, been focused upon contemporary and emerging computer-based technology, but there is no reason why studies of earlier technologies cannot yield important lessons. Indeed it would be foolish to ignore what can be learned from an analysis, comparative or otherwise, of technologies which have gone the full cycle from invention and introduction, to acceptance and maturity, to the point where they become a seemingly natural part of the world for all. This analysis would necessarily focus on the co-evolution of technologies, societies and persons as each adapts to the changing circumstances.

5   Education and Individual Development

Any newly born child faces the challenges provided by the technologies of the society into which he or she is born, and must develop in some appropriate fashion if he or she is to prosper. The sense and meaning which they find in a technology may differ from that which their parents found in it in an earlier stage of its introduction or development. This has consequences for both the individual and social perspectives mentioned above, and it is important to understand how each new generation comes to understand and respond to the meanings of a technology for itself. Technologies are also significant in individual development in the ways in which they offer differing kinds of educational engagement and experience. Constructivist approaches to learning highlight a potentially key role for technology

in education. Understanding the current role and future scope of educational technology is intimately bound up with understanding how it is implicated in the making of meaning. This motivates a re-evaluation of traditional theories of knowledge representation and of educational development in the light of - for example - new advances in web-based learning and mind-computer interfaces.

6   Creating, Designing and Engineering

Ultimately, each of these perspectives is only of more than academic interest if it can be translated into understandings which can affect the processes of invention and design. Consequently, CT2001 considers such translations in the light of particular engineering practices, both successful and unsuccessful. The contemporary context for design highlights the need for a more holistic approach to design such as Cognitive Technology commends. Key issues include: the need to take account of requirements that cannot be preconceived, but evolve through feedback and adaptation in use; the problems of devising abstract models of mind and machine to support the design of applications that use new technologies (such as virtual reality, robotics and brain-mediated interaction); and the paradoxical way in which the social and technical infrastructures that enfranchize particular technologies can obstruct alternative creative developments.

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The Fourth International Conference on Cognitive Technology: Instruments of Mind held Monday 6th - Thursday 9th August, 2001 at the University of Warwick, United Kingdom, is hosted by the Empirical Modelling Laboratory, Department of Computer Science, University of Warwick.

CT2001 is supported by the Computer Science Department of the University of Warwick, U.K.; the Adaptive Systems Research Group of the University of Herfordshire, U.K.; the Cognitive Technology Society (CTS); the Media Interface and Network Design (MIND) Labs of Michigan State University, U.S.A., host of CT'99; the University of Aizu, Japan, host of CT'97; the City University of Hong Kong, host of CT'95; and also by Springer Verlag, publisher of these proceedings, and by John Benjamins Publishing, publisher of CTS's *International Journal of Cognition and Technology*.

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