

Towards the Design of Electronic Cognitive Prostheses

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Abstract

Technological systems can function as cognitive prostheses. For example, existing cell phone and PDA software helps manage and access addresses, phone numbers, and appointments, but has only limited and rigid functionality. The goal of our research project is to envision, prototype, design, construct, and evaluate more powerful and flexible electronic cognitive aids. These should help people, including individuals who are aging and who have cognitive impairments, carry out activities of daily living; remember and use names, faces, and appointments; find objects of importance, such as glasses, wallets, and keys; understand and remember procedural instructions, such as taking medications; reminisce about meaningful aspects of their lives; and communicate with distant loved ones.

We shall motivate this work in terms of need and opportunity. Demographers forecast significant increases in the percentage of senior citizens and in the prevalence of cognitive impairments caused by afflictions such as Alzheimer's disease (AD). Information technology, and in particular advances in mobile, ubiquitous, and multimedia computing, allow us to create powerful new aids to cognition.

We shall develop a seven-dimensional framework for our research encompassing the kind of cognitive function to be supported, such as aspects of memory or executive functioning; the "disease" category for which it is intended, including AD, mild cognitive impairment (MCI), and normal aging; the stakeholders for whom the system is intended, which may include caregivers and family members; whether the user will work with the prosthesis by himself or with assistance; the kind of technology to be used; and the design process that is employed, such as user-centred design and participatory design. Of greatest importance is whether the technology is intended as a *prosthesis*, or to function as an aid to *rehabilitation*, or most ambitiously as a mechanism for *prevention*, e.g., helping to delay cognitive decline.

We shall illustrate the framework with projects that are completed or well underway:

- The participatory design of orientation aids for individuals with amnesia (MSc student Mike Wu, in collaboration with Dr. Brian Richards of the Baycrest Centre for Geriatric Care in Toronto, completed), followed by an investigation of cognitive aids as collaboration technology among amnesics and members of their families (PhD student Mike Wu, together with Dr. Richards)
- The participatory design of DVD-based multimedia biographies for AD and MCI individuals and their families (together with Dr. Elsa Marziali at Baycrest, also previously Tira Cohene, Simona Mindy, and Kristin Ramdeen, and now Sarah Chatland, Kante Easley, Martin Yeung, and Masashi Nishihata, supported by the Alzheimer's Association)
- The participatory design of cell phone software for normally aging seniors (MSc student Mike Massimi, completed).

The talk will conclude with introductions to several other projects that have just begun.

Biographical Sketch of Ron Baecker

Ronald Baecker is Professor of Computer Science, Bell University Laboratories Chair in Human-Computer Interaction, and founder and Chief Scientist of the Knowledge Media Design Institute at the University of Toronto. He is Affiliate Scientist with the Kunin-Lunenfeld Applied Research Unit of Baycrest, and was during the first half of 2006 on academic leave as Visiting Professor, Cognitive Neuroscience, Columbia University College of Physicians & Surgeons. Baecker is also Principal Investigator of the CDN\$5.5M Canada-wide NSERC Network for Effective Collaboration Technologies through Advanced Research (NECTAR), has been named one of the 60 Pioneers of Computer Graphics by ACM SIGGRAPH, has been elected to the CHI (Computers and Human Interaction) Academy by ACM SIGCHI, and has been awarded the Canadian Human Computer Communications Society Achievement Award. He has published over 125 papers and articles, is author or co-author of four books and co-holder of 2 patents, and has founded and run two software companies. His current entrepreneurial venture is a virtual non-profit foundation within the University of Toronto to distribute and support the open source ePresence Interactive Media system (<http://epresence.tv>). His B.Sc., M.Sc., and Ph.D. are from M.I.T.