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Participatory Design in Computer-Based Cognitive Prosthetics

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The effectiveness of a Computer-Based Cognitive Prosthetics (CBCP) increases as its design better fits the patient's 1) residual abilities and, 2) cognitive disabilities 3) in the context of target daily activities; the better the fit, the greater the restoration of function. Elsewhere we have reported that context is prosthetic software design, as some abilities appear in some context but not others. Thus, CBCP's software has an exceeding large design space. A critical problem then is to develop a methodology for identifying design parameters for prosthetic software.

Our work on CBCPs is based on applying computer science concepts to brain injury rehabilitation. First, a patient with cognitive disabilities can work cooperatively with custom designed software and perform a wide variety of activities which are part of everyday life,— household, community, and vocational. Secondly, the performance of the patient-computer system is a function of user characteristics, activity characteristics, and designed computing characteristics. When designing for the general population, user characteristics are treated as robust, overcoming design limitations in computing system as well as misunderstandings of the activity characteristics. However, our work with brain injury patients has shown that patient-system performance is extremely sensitive to what are considered relatively minor design parameters; furthermore, that the brain injury survivor needs to be viewed as the least robust component, while the computer system design needs to be the most flexible.

In pilot studies, clinical data were considered to be the most logical source of design parameters. Several clinical methods were available as inputs to design. Data which was useful in determining a diagnosis was found to be too general for the design of prosthetic software. Treatment plans – both those focusing on cognitive skills and those focusing on functional activities – were also found to be too general for design parameters.

This study adapted software design methods for personal productivity tools. The design methods include participatory design, having the brain injury survivor play a key role in the initial design, and on-going redesign of the prosthetic software.

One-of-a-kind software systems were designed by a team consisting of a computer scientist, the patient, and a cognitive remediation therapist who was learning CBCP techniques. Three TBI outpatients participated in the study to design and use CBCP software to perform relevant activities at home, in the community, and at work. Data showed that patients were the source of the greatest number of suggestions of modifying their prosthetic systems, both for the interface components as well as the underlying functionality (software features). The contributions of these TBI subjects are consistent with findings in the area end-user computing in corporations.

Subjects performed as efficient and effective "meters" for some design components in computer-based cognitive prosthetics. Performance measures included learning time, number of errors committed, and evidence of confusion in CBCP use. It is likely that for at least some of the design parameters, no method than patient participation would have uncovered the design modification. Other parameters, -- particularly text for commands and instructions – seem to require patient involvement to increase CBCP performance, particularly in greatly reducing training time. It should be noted that some patient contributions to design took place during the testing process. However, other design changes came from the patient's experience with the CBCP during actual use.