



Participatory Design for Sensitive Interface Parameters: Contributions of Traumatic Brain Injury Patients to Their Prosthetic Software

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Abstract: Interface design is important in the design of prosthetic software for brain injury patients. Personal productivity modules demonstrated their ability to help patients when other rehabilitation methods had failed. However, the software was typically very sensitive to what are considered relatively minor design parameters. Patients were able to guide designers and their therapists in constructing highly effective interfaces. In some instances, the dimension which the patient was optimizing was not readily apparent, and consequently could not be achieved by other means. The research and poster has relevance the broader area of learning disabilities.

Interface design plays a major role in the effectiveness of a new intervention for enduring cognitive deficits from brain injury. Highly customized personal productivity modules have shown an ability to assist brain injury patients in restoring performance of everyday activities when other forms of rehabilitation have failed. This poster will show examples of interface features and specifications which were designed by several brain injury patients and which optimized some dimension which was significant to them.

The research objective of this NIH-funded study was to deliver a system to each subject that will satisfy critical needs and would require only minutes of training. 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. The iterative nature of our approach required the delivery of multiple systems to ensure the success of the prosthesis. Over the course of 4 months 23 versions of the different systems were delivered to patients: to gradually increase functional enhancements, to improve interface, and to remove errors. The final applications delivered were: Daily Schedule, Daily To Do List, Priority List, Rolodex, Word Processor, Case Tracking, and External Activity Calls.

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 a relatively sensitive component, while the computer system design needs to be the most flexible.

A critical problem is collecting data sufficient to develop a user requirement. In pilot studies, medical and 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

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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.

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.

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.

Interface components were originally designed by ICP's interface designer with clinical input. Interface characteristics of all three systems changed before system delivery. During design session with clinicians and during testing with subjects, changes were identified and implemented in the delivered system. This was an iterative process, until clinicians considered the system appropriate for subjects' private use.

When this research was completed, a total of 304 interface components were specified for all three subjects. The first version delivered to subjects included a total of 254 interface specifications (84%). To design the initial systems, many decisions had to be made as to what components should be included and how they should be specified. A total of 91 unique interface components were identified as details of 24 unique objects. For example, for a menu object we specified details of menu colors, number of options in menus, and menu styles. Examples of other higher level objects were menus, sound, cursor, and commands. Each change to an interface component affected various lines of code in the underlying programs.

Throughout the study, 66% of these original components had to be changed one or more times during the study to better accommodate subjects. For example, the color of the appointment highlighter for subject one's To Do List changed from the original design and changed when editing was added. This was to draw his attention to the function at hand. The rest of the interface components (33%) were not changed during the study. For example, borders around boxes were determined at the onset to be single or double lines depending on their content. Neither the clinicians nor the subjects requested them to be changed.

Almost two thirds of the interface object changes were requested by either the patients or clinician. Almost three-quarters of the functionality was requested by the patients or clinicians. It is clear that at least some of the interface and functional changes would not have been suggested by those with systems expertise because those changes were either counter-intuitive or violated accepted guidelines. Also, the impact on both patient and therapist of the opportunity to have their ideas implemented cannot be understated.

While the brain injury population is quite small, this poster may provide insight into design considerations for users in the broader area of learning disabilities.