Software for Assessing Computer Usage Skills

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Abstract
The goal of this project is to improve interventions in the area of computer use for people with disabilities through the development of functional assessment software. Current efforts are focused on developing an easy-to-use tool for measuring users' skills in using the keyboard and mouse, as well as emulators of these devices.

Background
Accurate functional assessment of a user's abilities is a key component of successful interventions in computer access and other computer-based assistive technologies. A good assessment tool can help diagnose difficulties with an existing interface; evaluate and compare the expected performance with candidate access systems; plan training interventions; track changes in an individual's abilities over time; and measure the overall effectiveness of an intervention.

There is a wide variety of methods currently employed in assessments for computer access, including informal clinical observation, concep-tual models, manual data collection, and com-puterized assessment tools. Computer-based tools have tremendous potential because they can be more efficient, repeatable, and accurate than other methods. Computerization can provide functions unavailable with paper-and-pencil methods, such as showing multiple views of the data, recording raw data for optional in-depth analysis, adapting testing to the client, and tracking performance over time [1].

One computerized approach to assessment is to support the evaluator through all stages of the assessment process and recommend the most appropriate assistive device [2,3,4,5]. Developers stress the need for accurate functional assessment data in making these recommendations, yet most systems provide little or no explicit support for gathering it [2,3,4]. And by focusing primarily on device prescription, assessment data are treated only as a means to that end, which tends to limit the main use for these systems to "one-time" major evaluations lasting several hours or more. They are not easily applicable to performance assessments that take place in a single therapy session and are not designed to track performance across multiple assessments.

A second type of computer-based assessment tool includes programs designed to test only one or two fundamental skills [e.g., 6]. These programs have the appeal of being relatively easy to use, and they provide valuable information about the skills they assess. However, in focusing on one or two specific skills, they lack comprehensiveness, and particularly in the older programs, the data management and display capabilities could be greatly enhanced.

Statement of the Problem
While the approaches reviewed above have advanced assessment methods in computer access, none meets the need for a quantitative tool that fully exploits the possibilities of computerization and focuses specifically on measuring the full range of computer input skills easily and efficiently. Our goal is to develop an inexpensive software tool that will allow an evaluator to validly assess an individual's computer input skills and compare performance across different devices and time periods.

Design criteria for the evaluator interface include: ease of use with little training, greater efficiency than alternative methods, support for multiple views of the data, and management of data collected over time. Design criteria for the tests themselves include: broad coverage of computer input skills, sensitivity to different levels of client impairment, and compatibility with commercial computer access devices.

The first phase of this project involves the design, development, and evaluation of a prototype for the computerized assessment of keyboard and pointing input skills. The intended user population includes professionals in either educational or clinical settings who perform computer access evaluations and implement interventions based on these evaluations. The client population includes children and adults whose physical disabilities may affect their ability to use the standard computer keyboard and mouse.

Design
A user-centered design process is being employed throughout the project to identify user needs and evaluate potential ways to meet those needs. Structured methods of obtaining user feedback have been used from the initial stages of the design process, including written

scenarios of use to get feedback on user goals and desirable system features, and walkthroughs of hypertext mockups of the design to gain feedback prior to actually coding the design [7]. The major components in the system will include the evaluator interface, client interface, and report component.

Evaluator Interface. Used by the professional performing the assessment, this allows the evaluator to configure and perform new client assessments and review the results of previous assessments. Structured support is provided for evaluations that are the most common, in order to efficiently guide the evaluator through the process. One way to accomplish this is through the liberal use of default settings at all levels of the interface. At the top level, entire assessment protocols may be selected to allow, for example, comparisons in performance between two candidate input devices. At a lower level, parameters defining the details of specific tests (e.g., number of trials, type of stimuli, etc.) are set by default to provide simplicity and consistency in the evaluations. The evaluator can override these default values as desired.

Client Interface. Used by the client who is being assessed, the client interface presents the actual assessment tests and collects the performance data resulting from them. The client interface for the prototype system will test the skill families of keyboarding and pointing skills. These skills are assessed through a hierarchy of tasks which tap into successively more complex aspects of the overall skill. For example, keyboarding tasks, in order of complexity, include matching single keys, key combinations, single words, and sentences.

A hierarchy of complexity helps accommodate differing client abilities. For example, matching single letters of the alphabet or color-coded keys may be a more appropriate assessment of keyboarding skill in a young elementary student than transcription of full sentences. The hierarchy also provides a way to isolate the physical component of the task from its perceptual and cognitive aspects. As one moves up the hierarchy, tasks incorporate more perceptual and cognitive skills. Performance on higher level tasks may be compared to that at the lower level of the hierarchy to reveal how perceptual and cognitive issues affect keyboarding for a particular client [8].

Report Component. This presents a variety of views of the assessment data to help the evaluator and client understand and interpret the results. The evaluator is the primary person who interacts with this component, although the resulting output will be useful to a variety of individuals, including clients and their families, insurance companies, and physicians. The view/report component supports multiple views of the data. For example, performance may be examined across time, to show how a skill is changing with experience, or across different task configurations, to show how skill depends on the type of configuration being used.

Development

The current prototype is being developed for the Macintosh platform, as it is very common in schools and assistive technology clinics. We are using HyperCard because it allows very efficient implementation of complex prototypes.

As of January 1997, development has focused on prototyping different variants of the evaluator interface and obtaining feedback from potential users. The basic framework for the evaluator interface is now complete. Tests have also been developed for two keyboarding tasks: single letter matching and sentence transcription. By June 1997, we expect to have at least preliminary versions of all keyboarding and pointing tests. Final refinements will be completed by September 1997.

Evaluation

In addition to the user-centered design process described above, which provides for continuous evaluation during design and development, two formal evaluation phases are planned. The first is bench testing, to assess the prototype's technical feasibility. This includes measures of correctness, cost, reliability, and speed. Bench testing will measure response time for all functions in the system and allow us to identify components that need to be made more efficient.

The second evaluation phase is clinical testing, to assess the extent to which the prototype is functional and usable from the perspective of actual target users, including both evaluators and clients. Clinical testing will occur at two sites: the New Horizon School in Ypsilanti, MI and the University of Michigan Medical Center in Ann Arbor, MI. Four evaluators from each site, including rehabilitation engineers, occupational therapists, and special educators, will test the prototype with a total of sixteen clients.

In the first stage of clinical testing, evaluators will use the system with non-disabled individuals to ensure that it incorporates the desired functions and to rate its usability. They will be asked to assess a colleague's keyboard and pointing skills, using each of the tests

supported in the system, and generate a summary report of the results that matches a supplied sample report. Evaluator-colleague pairs will be observed by an investigator, and the session will be videotaped to record the evaluator's behavior in interacting with the system. Following the mock assessment, evaluators will complete a survey which asks for interface feature requests, bugs, the time required for the assessment, and judgment of the system's usability and usefulness. The assessed colleagues will fill out their own survey regarding the clarity of the assessment tasks, their level of interest in performing them, and any sources of confusion in the tasks.

In the second stage of clinical testing, the evaluators will perform assessments with actual clients. The testing and analysis protocol to be followed will be identical to the first stage testing, except that evaluators will be free to select the assessment tests and reports that are most appropriate to the particular client.

Discussion

Although it is still quite early in the project, we have been encouraged by the feedback we have received so far. The primary challenge in meeting our design criteria is to find an appropriate balance between power and simplicity. We hope that by working with users throughout the project, we'll strongly enhance our chances of providing relevant features while maintaining ease-of-use.

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