AN EMPIRICALLY DEVELOPED SYSTEM FOR THE SELECTION OF COMPUTER INPUT DEVICES FOR USERS WITH PHYSICAL DISABILITIES

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Information-oriented jobs are particularly well suited for persons with disabilities, requiring far less physical capability than many other jobs. However, computers themselves may present barriers to workers with physical limitations through poorly designed features and poorly selected adaptive aids. Current methods of input device selection for users with disabilities are unsystematic and rarely result in the selection of a device which allows maximum productivity of the user.

The current research has developed and evaluated a physical skills assessment test which can be used to predict performance with various computer input devices. Subjects, consisting of individuals with various degrees of functional limitations of their upper extremities, underwent the physical skills assessment test designed to measure the individual's capability to perform the actions required in using various pointing devices. In addition, each also performed a computer-based target acquisition task with five pointing devices: a mouse, trackball, directional arrow keys, graphics tablet, and joystick. The task itself was a target acquisition task with the independent variables of target size, target distance, mode (i.e. point vs. drag moves), and trial block. Dependent measures include the time necessary to acquire the target, number of crossings of the target boundaries before selection, number of selections occurring outside the target boundaries, distance of erroneous selections from target center, and subjective evaluations of each device. Scores from the assessment test and the computer-based tests were used to derive rules relating performance with each of the computer input devices to performance on the physical skills assessment test. With such rules established, the results of a new client's score on the assessment test will allow a therapist to immediately eliminate from consideration those devices which require physical actions not possible by the client. Furthermore, the results will indicate specific areas where device modification may lead to improved performance, as well as which of the remaining devices would likely lead to optimal performance by the client.

In addition to the guidelines concerning the five devices selected for use in this study, the results also serve to demonstrate the feasibility and utility of an accommodative aid selection system based on a functional assessment of the client's residual abilities. The system may easily be expanded to include other commercially available input aids and can then be used by clinicians in choosing an optimal input aid, which will increase a disabled user's productivity and hence increase his/her competitiveness in the workplace. In addition, this research provides information critical to manufacturers regarding characteristics of device control and software design which are particularly helpful and/or harmful to the performance of persons with disabilities.

PERCEPTUAL-MOTOR CONTROL IN HUMAN-COMPUTER INTERACTION

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Three experiments compared the speed and accuracy of item selection from two types of hierarchical pop-up menus (click-open & walking). These menus are perceptually equivalent, but require very different action sequences to make selections from them. Two ways in which the action sequences differ involve (1) the amount of spatial constraint in the movement path, and (2) the position of the mouse button during the movement. The present results show that selection from click-open menus is faster and less error-prone than selection from walking menus. This disagrees with the Keystroke-Level Model of Card, Moran, and Newell (1983).

The difference in selection times for the two menu styles stems from the position of the mouse button during movement. In particular, moving with the mouse button depressed (walking menus) is slower than moving with the mouse button released (click-open menus). It appears that this difference is caused by the postural awkwardness of moving with the button depressed throughout the primary phase of movement. The difference is not caused by (1) greater working-memory load, (2) greater friction between the mouse and the mouse pad, or (3) greater difficulty in coordinating the end of the movement phase with the terminal button release in walking menus.

With numerically-ordered menus, selection time is dominated by motor factors and is well modeled by Fitts' law for both click-open and walking menus. With randomly organized menus, selection time is dominated by a systematic, top-to-bottom search process. Visual search and mouse movement are parallel rather than serial processes.

Present results indicate the need for a process model of human-computer interaction that accommodates both serial and parallel processes. A start is made toward specifying such a model through the critical-path scheduling used by