Head and Eye-Pointing Technology for AAC Access: Accuracy & Performance

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INTRODUCTION

- Head and eye movement technology to control access to Augmentative and Alternate Communication (AAC) systems has improved significantly over the past several years. While improvements have been made, particularly related to set-up, calibration, and ease of use, limitations still exist for functional application of these technologies by persons with disabilities.
- Head-based and eye-based pointing interfaces are used to enable access to technology in a similar manner as that of the standard handheld desktop mouse; a person simply uses head or eye movements to emulate the hand on a mouse by moving a computer cursor to specified points on the display and clicking (Bates & Istance, 2003).
- Head pointing (e.g., TrackIR, HeadMouse Extreme, TRACKER) continues to be a practical access option for persons who use AAC for a number of reasons. The most obvious of these reasons is that these individuals are unable to functionally control their hands as a result of physical impairments (Fager, Beukelman, Ball, & Jakobs, 2006).
- The purpose of this study is to examine accuracy and timing of the two technologies on typical communication-related tasks (e.g., spelling out words and messages) while accessing a standard onscreen keyboard interface.
- The goal of this is to develop a more complete knowledge base regarding these technologies for both persons who use AAC and individuals who provide them. This information may be used to establish a foundation from which to make recommendations for the best option pertaining to the specific needs of each individual.

METHOD

- Ten non-disabled participants (5 males, 5 females) ages 19 to 43 were introduced to and instructed in basic use of the two technologies for approximately 15 minutes prior to engagement in the research tasks. None of the participants had used either type of access technology prior to this session.
- To control for variations in equipment, one device from each of the technology categories was selected for evaluation. The eye-pointing technology was represented by the ERICA eye-gaze system (Eye Response Technologies, Inc.) and the head pointing technology was represented by the HeadMouse Extreme (Origin Instruments, Inc.). The tasks were presented for use by connecting the HeadMouse device to the ERICA system so that the software interface would be identical. Figure 1 illustrates the arrangement of deivces with a participant.
- Each participant was provided 10 minutes to acquaint themselves with the device prior to completing the tasks. Following this familiarization time, each participant was asked to complete the following tasks:
  - Point to & select single letters from an onscreen alphabet keyboard as they were verbally presented by the researcher.
  - Point to & select letters to form words from an onscreen alphabet keyboard as they were verbally presented by the researcher.

RESULTS

- Measures included target accuracy upon initial attempt and efficiency across tasks. In addition, time required to complete each task was noted.
- Participants achieved success with both HeadMouse and ERICA access technologies on all accuracy (letter, word, & sentence) tasks.
- No significant difference was observed on initial accuracy scores for the letter task between ERICA and HM ($\chi^2 = 6.44$, $N = 10$, $p = .32$). Likewise, no significant difference was observed on initial accuracy scores for the word task ($\chi^2 = 6.19$, $N = 10$, $p = .29$) nor for the sentence task ($\chi^2 = 0.83$, $N = 10$, $p = .44$).
- Wixon Signed Ranks Test indicated significant differences for timing on two tasks: Letter ($T = 2.55$, $p = .01$, $M = 2.27$ ERICA, $M = 0.47$ HM), Sentences ($T = 2.70$, $p = .01$, $M = 11.32$ ERICA, $M = 5.06$ HM). The Word task was not found to be significantly different ($T = 0.00$, $p = .10$, $M = 1.54$ ERICA, $M = 1.54$ HM) between ERICA and HM.
- Figure 2 illustrates participants’ accuracy on spelling single words.
  - ERICA accuracy on the first attempt is indicated by the solid blue bar, and ERICA accuracy when self correcting strategies were employed is indicated by the patterned blue bar.
  - HM accuracy on the first attempt is indicated by the solid purple bar, and HM accuracy when self correcting strategies were employed is indicated by the patterned purple bar.
- As noted in Figure 2, participants achieved greatest accuracy when allowed to make self corrections to complete each task when using the ERICA. Participants achieved greatest accuracy on first attempt when using HeadMouse.

DISCUSSION

Although there were no significant correlations, and measures were taken to standardize the study, multiple factors should be taken into account for possible attribution to the differences, especially the ERICA.
- Light sensitivity
- Movement (calibration across trial)

**Figure 1.** Arrangement of HeadMouse and ERICA camera for participants.