Visual/Cognitive Processing Demands of Keyboard Layouts for Individuals With & Without TBI

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Purpose/Rationale: After severe traumatic brain injury (TBI), some literate individuals who require augmentative and alternative communication (AAC) to support communication, use onscreen keyboards to generate text (Beukelman & Mirenda, 2013; Britton & Baarslag-Benson, 2007; Fager Hux, Beukelman, & Karantounis, 2006). A range of layouts are available in specialized communication software. However, limited objective information is available on the visual-cognitive processing demands of these layouts to guide clinical decision-making for keyboard selection. Individuals who have had a TBI often experience changes in their visual and cognitive capabilities which can affect their ability to use different keyboard layouts (Fager, Doyle, & Karantounis, 2007). Eye tracking analysis can provide insight into the visual-cognitive processing requirements of AAC interface layouts and content (Thiessen, Beukelman, Ullman, Longenecker, 2014; Wilkinson & Light, 2014; Light & McNaughton, 2014; Brady, Anderson, Hahn, Obermeier, & Kapa, 2014; Gillespie-Smith & Fletcher-Watson, 2014).

Research Question: Is there a difference in the visual-cognitive processing demands between an QWERTY and ABC (alphabet) onscreen keyboard for individuals who have a TBI and for typical individuals?

Methods:

Participants:

- 10 individuals with TBI ranging from Ranchos Los Amigos Levels 8-10 (Hagan, 1997);
- 10 typical (neurologically intact) individuals

Hardware/Software:

- Tobii X2-60 eye tracker
- Tobii Studio analysis software
- Tobii/Dynavox Compass keyboard layouts

Procedures:

- Participants calibrated using Tobii X2-60 and controlled cursor with standard mouse
- Participants typed sentences using mouse with ABC or QWERTY keyboard layout (10 sentences for each onscreen keyboard layout randomized per participant)
- Data collected regarding keyboard type preference, and prior experiences using onscreen keyboards.

Analysis:

- Keyboard = area of interest (AOI)
- Eye gaze metrics:
    - Fixation Count (number of fixations within an AOI)
    - Total Fixation Duration (the sum of the duration for all fixations within an AOI)
- Means/standard deviations, t-test=between group, paired t-tests=within group between keyboard type

Results:

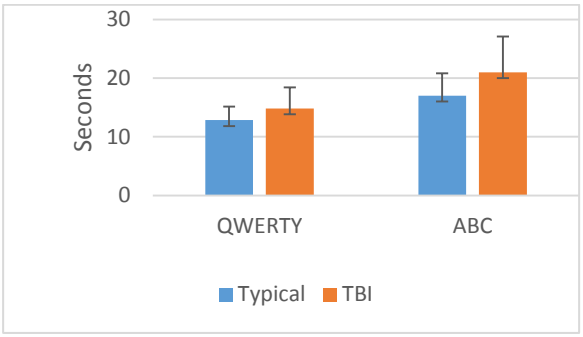
Total Fixation Duration

Typical: QWERTY: 12.83 (SD = 2.29)

ABC: 17.02 (SD = 3.80)

TBI: QWERTY: 14.81 (SD = 3.59)

ABC: 21.01 (SD = 6.09)



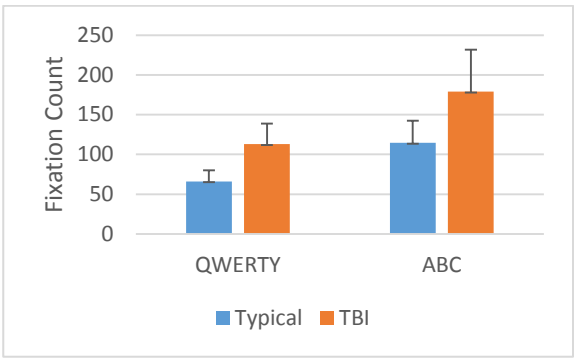
Fixation Count

Typical: QWERTY: 66 (SD = 16)

ABC: 115 (SD = 26)

TBI: QWERTY: 112 (SD = 28)

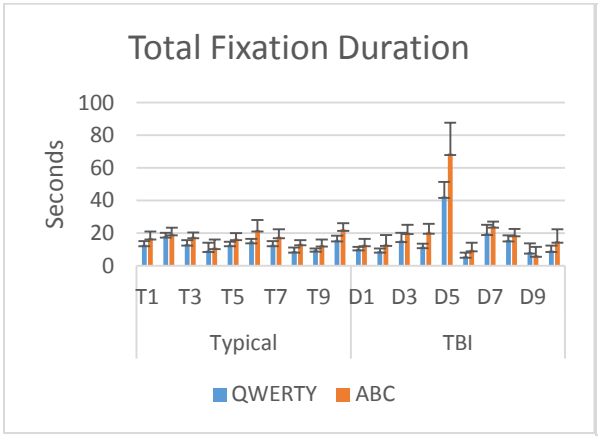
ABC: 179 (SD = 53)

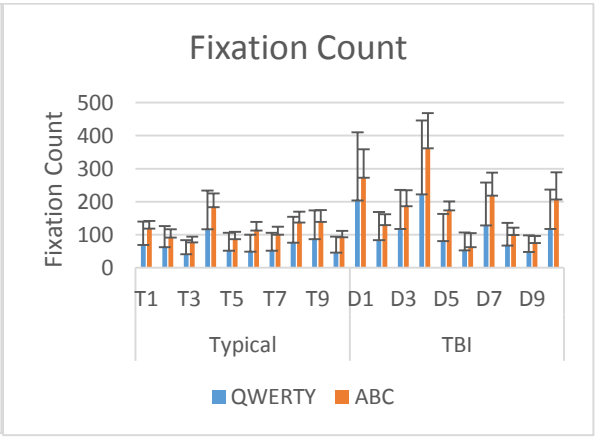


***no significant difference between participant groups**

***significant differences for keyboard type for both groups at p <0.05**

Individual Differences across Participants with TBI





Discussion:

QWERTY keyboard use resulted in fewer fixation counts and shorter total fixation durations
Performance matched participants' perceptions and preferences for QWERTY over ABC layout
Prior experiences using different technology interfaces may be a useful guide for layout selection
TBI participants- more variability in performance across participants compared to typical participants

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