VALIDATING VISUAL EYE TRACKING TECHNOLOGY TO ASSESS ACCOMMODATIVE TECHNOLOGY FOR STUDENTS WITH DISABILITIES IN UNDERGRADUATE EDUCATION

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INTRODUCTION

- The National Center for Education Statistics (NCES) data from 2011-2012, reported that 11% of undergraduate students are identified as having a disability.

- Nearly, 38% of students with disabilities are enrolled in 2-year as compared to 9.8% at 4-year institutions.

- Students with disabilities require support services, some of which are accommodative technologies.
5 MAIN CATEGORIES DESCRIBING STUDENTS WITH DISABILITIES

- Learning Disabilities (LD)
- Emotional or Psychiatric Conditions (EPC)
- Orthopedic or Mobility Impairments (EMI)
- Attention Deficit/Hyperactivity Disorder (AD/HD)
- Health Impairments (HI)
PROBLEM STATEMENT

- Little data exists on whether or not such technologies are sensitive to accommodating individual needs, that is tailored to support people with a specific or having multiple disabilities.

- The literature lacks studies:
  - 1) investigating the cognitive processing in people with multiple disabilities
  - 2) whether technologies given to these students are beneficial
  - 3) what are the educational outcomes in using such technologies

- The aim of the study was to determine whether assessing students’ visual processing abilities (i.e., eye gaze) through a 10-minute Flanker Task could be used as a predictive diagnostic tool to screen students with disabilities.
We hypothesized the following:

**Null Hypothesis # 1:**
\[ H_0 = \text{That eye gaze could not detect attentional differences between a controlled and a noisy environment.} \]

**Alternative Hypothesis # 1:**
\[ H_1 = \text{That eye gaze could detect attentional differences between a controlled and a noisy environment.} \]

**Null Hypothesis # 2:**
\[ H_0 = \text{That eye gaze could not detect attentional differences between a triple blinded Non-OSSD and OSSD student groups.} \]

**Alternative Hypothesis # 2:**
\[ H_1 = \text{That eye gaze could detect attentional differences between a triple blinded Non-OSSD and OSSD student groups.} \]

**Null Hypothesis # 3:**
\[ H_0 = \text{That eye gaze could not be used as a predictive diagnostic tool to screen students with disabilities.} \]

**Alternative Hypothesis # 3:**
\[ H_1 = \text{That eye gaze could be used as a predictive diagnostic tool to screen students with disabilities.} \]
**Method:**

**Sample Population**

- Students from SUNY Old Westbury were randomly sampled by convenience

- **Experiment 1: Assessed the Sensitivity of Eye Gaze in Distracting Conditions**
  - Males $N = 11$ (i.e., Control Environment $n = 4$ & Noisy Environment $n = 7$)
  - Females $N = 50$ (i.e., Control Environment $n = 26$ & Noisy Environment $n = 24$)

- **Experiment 2: Assessed the Sensitivity of Eye Gaze between students**
  - Males $N = 6$ (i.e., Non-OSSD $n = 4$ & OSSD $n = 2$)
  - Females $N = 34$ (i.e., Non-OSSD $n = 26$ & OSSD $n = 8$)
Students were presented with outer arrows that were congruent (i.e., arrows facing the same direction) and flanked the middle arrow. Or Incongruent (i.e., arrows facing in the opposite direction). Participants were given 12 practice trials before starting the experiment to familiarize themselves with what was expected. The test presented 50 trials (i.e., 10 trials of control, left congruent, left incongruent, right congruent, and right incongruent arrows) randomly within a 10-minute time period. Participants % accuracy and reaction time (RT measured in microseconds) were recorded to infer cognitive attentional processing.
EYE TRACKING EXPERIMENTAL METHODS: GAZEPART POINT UX EDITION

Visual Flaker Task Stimuli

Eye Tracking Heat Map

Eye Tracking Heat Map Superimposed Over Test Stimuli

Participant Eye Tracking
DATA ANALYSIS:

- Data were analyzed using an ANOVA with a level of significance set at $\alpha = 0.05$ and a 95% confidence interval. Data are presented as $\pm$ SEM.

- Experiment # 1: evaluated the effects of Gender, Environment, and Flanker Test Condition and the interaction between Gender X Environment X Flanker Test Condition.

- Experiment # 2: evaluated the effects of Gender, Student Group, and Flanker Test Condition and the interaction between Gender X Student Group X Flanker Test Condition.
EXPERIMENT # 1 RESULTS:

Fig. 1. Male Control vs. Noisy Environmental accuracy differences. The data revealed a significant effect of Environment $F_{(1)} = 8.784$, $p = 0.005$, but no significant effect of Condition $F_{(3)} = 0.089$, $p = 0.966$, nor a significant Environment X Condition interaction $F_{(1,3)} = 0.089$, $p = 0.966$

Fig. 2. Male Control vs. Noisy Environmental RT differences. The data revealed no significant effect of Environment $F_{(1)} = 0.018$, $p = 0.895$, Condition $F_{(3)} = 0.012$, $p = 0.998$, nor a significant Environment X Condition interaction $F_{(1,3)} = 0.187$, $p = 0.904$.
**Fig. 3.** Female Control vs. Noisy Environmental accuracy differences. The data revealed a significant effect of Environment $F_{(1)} = 20.660$, $p = 0.001$, but no significant effect of Condition $F_{(3)} = 0.750$, $p = 0.524$, nor a significant Environment $X$ Condition interaction $F_{(1,3)} = 0.268$, $p = 0.849$.

**Fig. 4.** Female Control vs. Noisy Environmental RT differences. The data revealed no significant effect of Environment $F_{(1)} = 2.140$, $p = 0.145$, Condition $F_{(3)} = 0.290$, $p = 0.832$, nor a significant Environment $X$ Condition interaction $F_{(1,3)} = 0.192$, $p = 0.902$.
**EXPERIMENT # 2 RESULTS:**

**Fig. 5.** Male Non-OSSD vs. OSSD accuracy differences. The data revealed a significant effect of *Group F*\(_{(1)}\) = 122.909, \(p = 0.001\), but no significant effect of *Condition F*\(_{(3)}\) = 1.805, \(p = 0.187\), nor a significant *Group X Condition* interaction *F*\(_{(1,3)}\) = 1.805, \(p = 0.187\)

**Fig. 6.** Male Non-OSSD vs. OSSD RT differences. The data revealed no significant effect of *Group F*\(_{(1)}\) = 4.142, \(p = 0.059\), *Condition F*\(_{(3)}\) = 0.092, \(p = 0.964\), nor a significant *Group X Condition* interaction *F*\(_{(1,3)}\) = 0.074, \(p = 0.973\)
**EXPERIMENT # 2 RESULTS:**

**Females: Visual Attention Eye Tracking Sensitivity**

![Flanker Test Conditions](image)

**Fig. 7.** Female Non-OSSD vs. OSSD accuracy differences. The data revealed a significant effect of Group $F_{(1)} = 84.145, \ p = 0.001$ and Condition $F_{(3)} = 2.647, \ p = 0.052$, but no significant Group X Condition interaction $F_{(1,3)} = 0.774, \ p = 0.511$

**Females: Visual Attention Eye Tracking Sensitivity**

![Flanker Test Conditions](image)

**Fig. 8.** Female Non-OSSD vs. OSSD RT differences. The data revealed a significant effect of Group $F_{(1)} = 6.765, \ p = 0.010$, but no significant effect of Condition $F_{(3)} = 0.077, \ p = 0.972$, nor a significant Group X Condition interaction $F_{(1,3)} = 0.219, \ p = 0.883$
DISCUSSION:

- Our experimental methods employing Eye Gaze Technology was sensitive in detecting attentional differences in participants when tested in Controlled vs. Noisy environments. Results showed that both genders exhibited reduced accuracy in Noisy environments when compared to Controlled environments. However, RT was unaffected by environment.

  - We reject the Null Hypothesis, and accept the Alternative Hypothesis that eye gaze technology could detect attentional differences between a controlled and a noisy environment.

- Additionally, our experimental methods employing Eye Gaze Technology was sensitive in detecting attentional differences in participants who were grouped after following a triple blind procedure as Non-OSSD vs. OSSD. Results showed that both genders exhibited reduced accuracy in OSSD students when compared to Non-OSSD students. However, RT was unaffected by Student Group.

  - We reject the Null Hypothesis, and accept the Alternative Hypothesis that eye gaze technology could detect attentional differences between a triple blinded Non-OSSD and OSSD student groups.

  - We reject the Null Hypothesis, and accept the Alternative Hypothesis that eye gaze could be used as a predictive diagnostic tool to screen students with disabilities.
Conclusion & Limitations:

Our study indicates that we are able to control for environmental conditions and our methods are sensitive enough to detect changes between Non-OSSD and OSSD students.

Eye Gaze Technology is sensitive enough to detect accuracy and reaction time changes in real time of individuals with disabilities, even while being triple blinded to the participants.

Our study is limited due to small sample sizes.

Future Outlooks:

We are now being triple blinded to the subtype of OSSD student disabilities (i.e., LD, EPC, EMI, AD/HD, HI) to determine whether differences exist.

Future analysis of OSSD student attentional differences will help us to develop an evidenced-based approach to determine which visual aid and/or accommodative technologies match our OSSD students needs.

Such databased/evidenced-based supports will help our OSSD department advocate for an increased budget for accommodative resources that match student needs and, in turn, will promote academic achievement for OSSD student in college.
REFERENCES:


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