

Development and Feasibility Test of a Computerized ADHD Screener for Children

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Introduction

- ADHD impacts 9.4% of children in the U.S. with many children going undiagnosed until later in life, when it becomes clear that there are attentional issues at home and in school through either externalizing behaviors or low grades (Danielson, et al., 2018).
- There are significant gender differences in diagnosis, which has been contributed to a difference in how symptoms present themselves across genders, internalized vs. externalized (Gershon et al., 2002).
- Recent research has shown that the regulation of eye movement, blink timing, and response timing are associated with a diagnosis of ADHD (Fried, et al. 2014).
- This study intended to develop a quick screening tool that did not rely on adult perception of children's behavior and used biometric data instead.

Methods

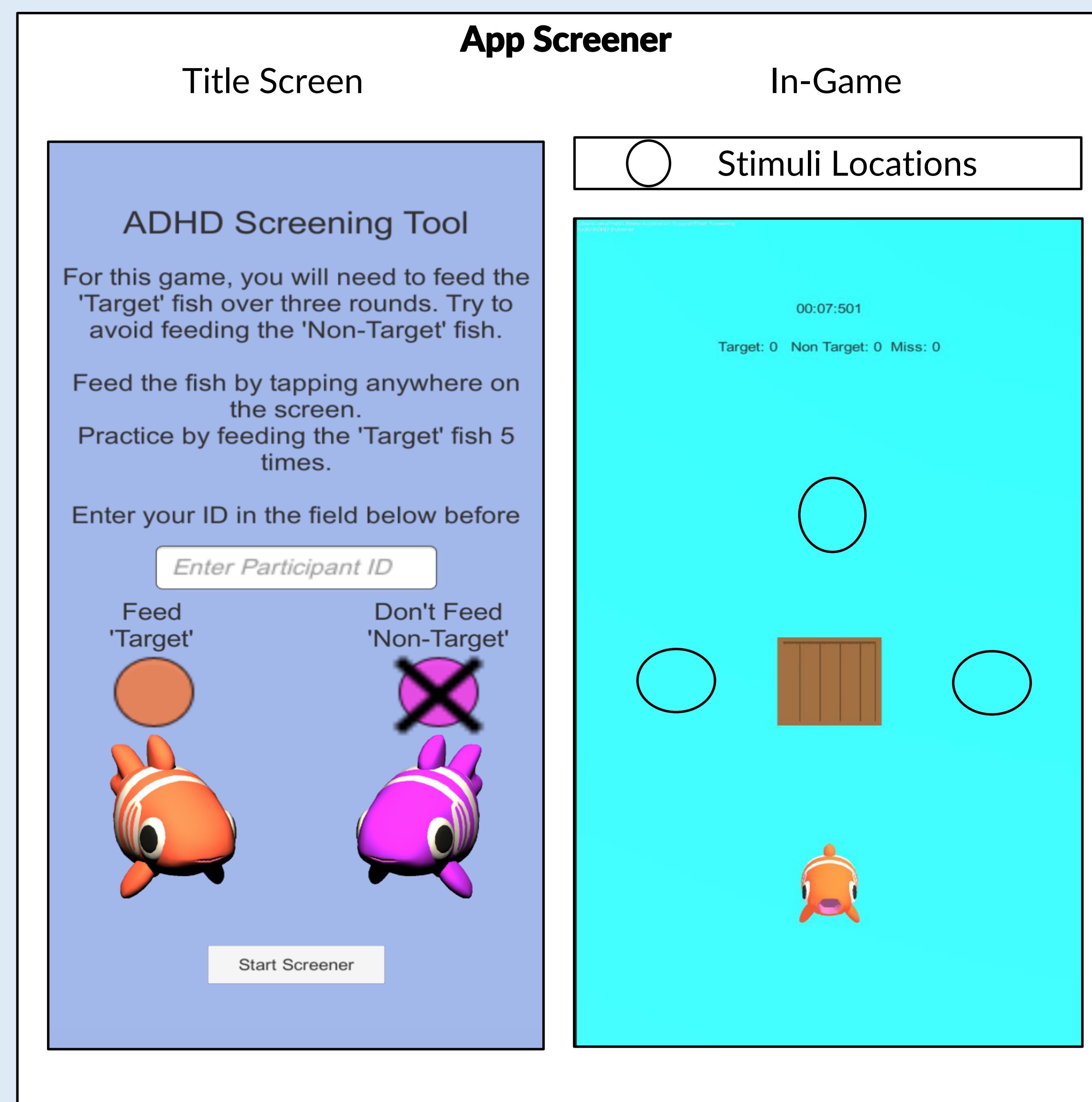
- Participants were recruited through online message boards and forums. The parents completed a questionnaire to determine if they were eligible and a brief ADHD screener, the NICHQ Vanderbilt.
- A total of 40 participants between the ages of 6 and 12 were recruited, with 19 having a previous diagnosis of ADHD and/or showing a score above cutoff on the Vanderbilt. Twenty-one participants did not have a diagnosis of ADHD and did not have a score above cutoff on the Vanderbilt.
- Participants then downloaded the screening tool onto their iPhone or iPad and completed the 9-minute screener while in a zoom session with the researcher. Once complete, both parents and child completed a debriefing questionnaire to assess their experience with the screener.

Screener Development

- Unity3D was used to develop the screening app for the iPhone and iPad.
- The front facing camera was utilized during the screener to complete the eye tracking and facial tracking data collection.
- The software was developed by the researcher and utilized the Unity3D ARkit and ARFoundation SDK's.
- The game required the participants to press the screen whenever they saw the target fish (stimuli) come above the water, which then fed the fish (reaction timing).
- The screener was composed of 3 rounds, 3 minutes each, with each participant receiving 1 of 2 pseudorandom order of fish location and target vs non-target.
- The 3D rendering for the fish and dock were commissioned through POLYDACTYL: Omabuarts Studio.

Results

- An ANOVA showed significant differences between the control and ADHD groups in both Response and Blink Timing during the first 2 round, $F=25.2, p<.001$; $F=.26, p<.01$.
- A binomial Regression was conducted to determine test validity for predicting a diagnosis of ADHD.
- Both Response and Blink timing were found to be significant, $p<.005$ & $p<.05$.
- Overall predictive validity was 82.5%, with an 81% true positive and 84.2% true negative rates.
- The NICHQ Vanderbilt has an overall predictive validity of 77.5%, with an 80% true positive and 75% true negative rates.
- The Connors Comprehensive Behavior Rating Scale, a commonly used ADHD assessment tool has an overall predictive Validity of 78% across all test components.
- No meaningful differences were found between genders or if the participant played video games or not.



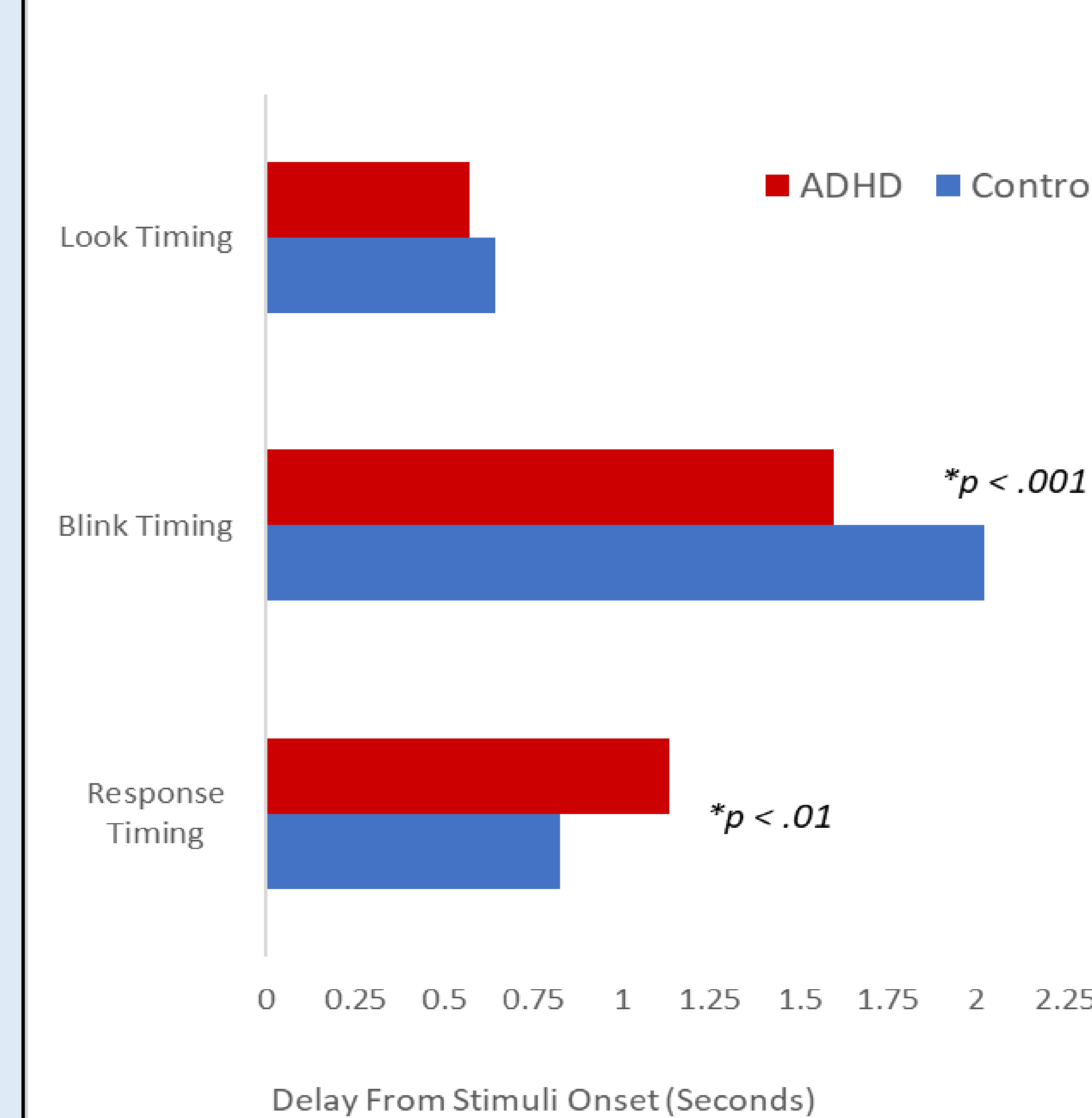
Timing Delay of Blinking, Responding, and Looking Towards the Stimuli for Participants with ADHD and Without During All Three Rounds and The First Two Rounds of the App Screener

Outcome Measures	3 Rounds		2 Rounds		ANOVA							
	Control (N=21)	ADHD (N=19)	Control (N=21)	ADHD (N=19)	3 Rounds	2 Rounds	F_a	p				
Response Timing	.847	.181	1.181	.220	.827	.163	1.133	.222	27.826	<.001	25.2	<.001
Blink Timing	2.090	.441	1.793	.533	2.021	.500	1.597	.446	3.696	.062	.26	.008
Look Timing	.683	.264	.630	.153	.642	.423	.572	.146	.591	.447	.19	.497

Values for timing are in seconds.

^aOne-Way ANOVA, ($df = 1,38$)

Mean Timing Across the First Two Rounds



Binomial Regression of Response and Blink Timing During the First Two Rounds

	B	S.E.	Sig	Exp(B)
Response Timing	9.289	3.033	.002	10823.744
Blink Timing	-2.119	1.028	.039	.120
Constant	-5.025	2.902	.083	.007

Test of Predictive Validity

Observed	ADHD	No ADHD	Percentage Correct
ADHD	17	4	81.0
No ADHD	3	16	84.2
Overall Percentage			82.5

Discussion

Conclusions

- Children with ADHD, on average, have slower reaction times and blink quicker when responding to stimuli than those without ADHD.
- These findings are in line with the previous research on eye movement and reaction timing in individuals with ADHD.
- Finding no meaningful differences across genders corroborates previous meta-analyses that there is under diagnosing of girls occurring.

Caveats

- Limitations of the researchers programming knowledge led to some loss of data accuracy for look timing and response accuracy (not shown).
- The small sample size of 40 participants and the limitation to those with access to an iPhone or iPad was a major restriction.
- A wider range of demographics is needed, as the current study was primarily "white" identifying individuals.

Future Directions

- To further develop the accuracy and validity of the screener, a significantly larger sample size is needed.
- Updating the software to more accurately measure participants eye movements and response accuracy is key to improving the app.
- Focused research on the differences between demographic identifiers as well as diagnoses that are commonly misdiagnosed as ADHD, such as Anxiety and Trauma.
- Investigating the potential for early screening of other disabilities that may impact early learning through videogame-based apps using biometric data.

Acknowledgments

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