

The Acute Effect of a Sensory Integration Therapy Intervention on Postural Stability and Gaze Patterns of Children with Autism Spectrum Disorder: A Feasibility Trial

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Study Background

- Individuals with Autism Spectrum Disorder (ASD) often struggle with sensory organization and processing [1]
- Sensory Integration (SI) therapy is a therapy designed to address this impairment. Behavioral research regarding its effectiveness, however, has been inconclusive [2]
- Postural stability and gaze are physical systems that are dependent on sensory processing [3, 4]. Evaluating how these systems are influenced by a SI therapy may prove beneficial for measuring the potential effects of this therapy.
- The development of new methodologies to measure the effect of SI therapy could be used to better understand what is occurring during this therapy and to bridge the current research gap concerning therapeutic efficacy

Research Objective and Hypothesis

Research Objective: It was the objective of this feasibility study to determine whether posturography and gaze tracking could be used to measure the effect of a common SI intervention.

Hypothesis: Subjects will demonstrate changes in postural stability and socially relevant gaze fixations post-intervention

Methodology

Test set- up

- Pre-test/Post-test Format
 - Evaluate acute effects of an SI intervention
- SI Intervention: Swing Therapy
 - Provides intense vestibular input
- Therapy protocol
 - 10 minutes
 - While swinging, subjects performed physical, social, and cognitive activities



Methodology

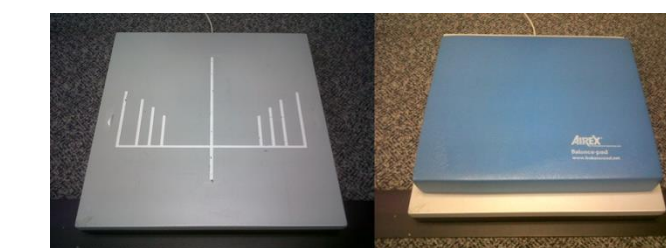
Posturography

Subject Demographics

- 5 children diagnosed with ASD (age: $9.2 \pm .45$ years, height: 54.8 ± 2.36 inches, weight: 81.76 ± 21.0 lbs.)
- 5 typically developing (TD) children (7.4 ± 2.06 years, height: 50.4 ± 5.89 inches, weight: 61.72 ± 20.76 lbs.)

Test Equipment and Methodology

- Bertec Balance Plate (BP 5050)
- Modified mCTSIB
- 20 second trials, 1000 Hz



Analysis

- Data downsampled to 100 Hz, filtered with a 4th order low-pass Butterworth filter (5 Hz. cut-off)
- From the COP data collected, calculated parameters:
 - Linear: A/P Sway Range, M/L Sway Range, Mean Sway Velocity, and RMS COP Displacement
 - Nonlinear: Sample Entropy

Gaze tracking

Subject Demographics

- 3 children diagnosed with ASD (age: $8.67 \pm .58$ years, height: 53.5 ± 1.5 inches, weight: 65.47 ± 9.82 lbs.)
- 4 typically developing (TD) children (7.0 ± 1.83 years, height: 52.4 ± 2.56 inches, weight: 70.3 ± 12.16 lbs.)

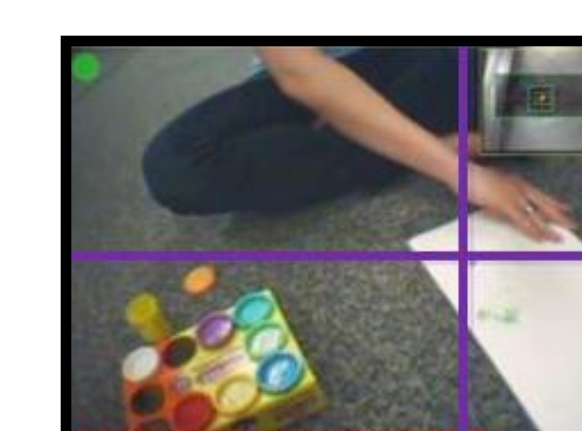
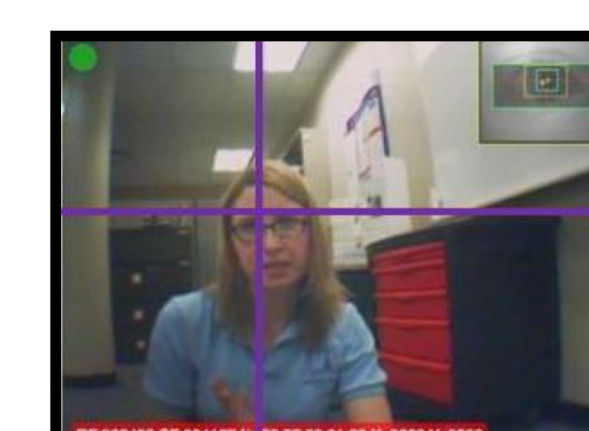
Test Equipment and Methodology

- Mobile Eye Tracking Unit with eye camera and scene camera
- Subject plays gross and fine motor games



Analysis

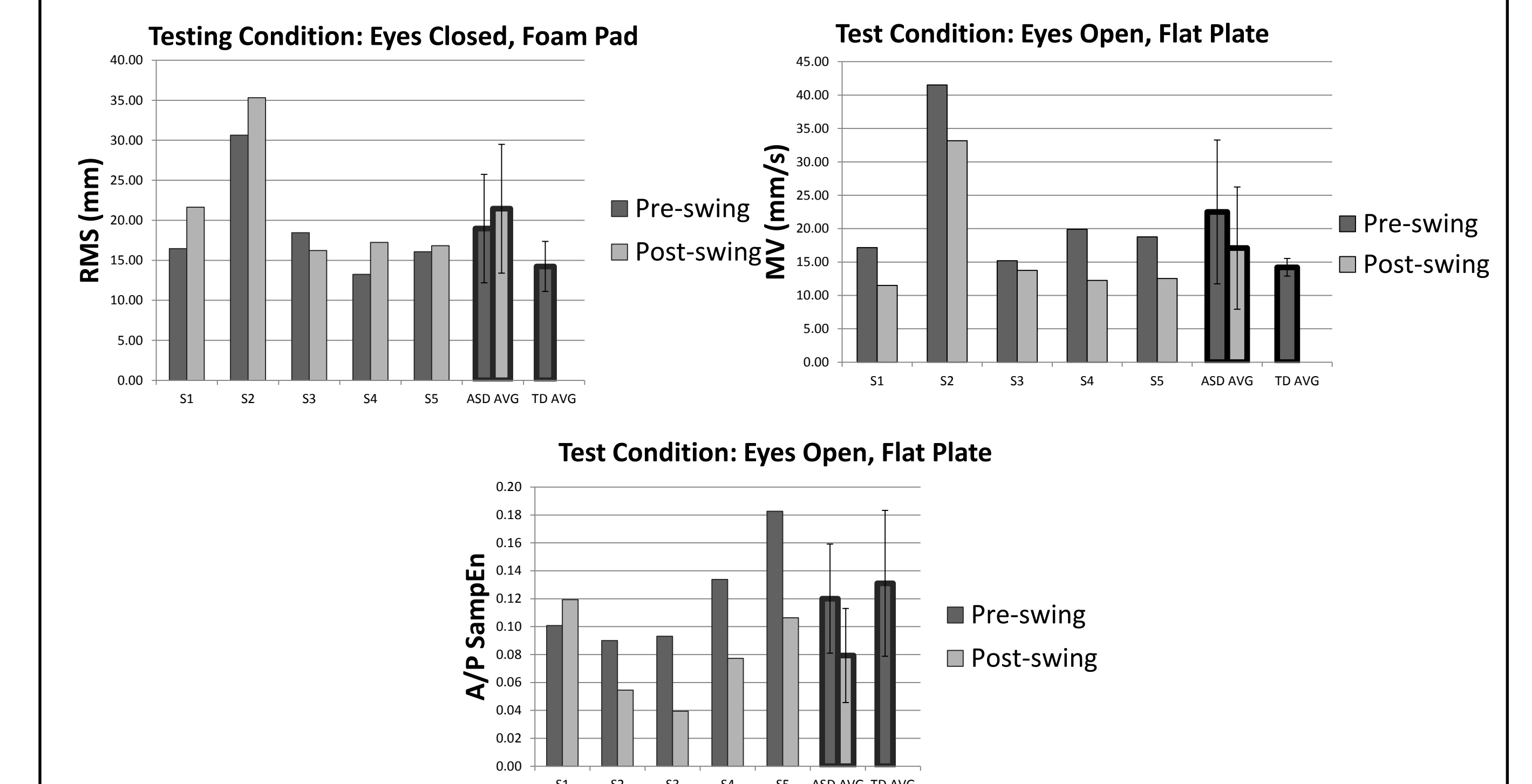
- Eye and scene camera videos synchronize, calibrate, and rendered to obtain video with gaze overlay and text file with gaze coordinates
- Semanticcode software used to identify gaze fixations (eye contact, face, task)



Results and Discussion

Posturography

- Several parameters depicted consistent post-intervention changes for the children with ASD



Post-intervention, all subjects with ASD demonstrated decreased MV in the Eyes Open/Flat Plate condition with an average decrease of 5.87 ± 2.69 mm/s, and 4 out of 5 subjects with ASD demonstrated an increase in Sway RMS and A/P Sample Entropy in the Eyes Closed, Foam Pad condition and Eyes Open, Flat Plate condition respectively

Gaze tracking

- Did not capture consistent post-intervention changes
- Potential explanations:
 - Vestibular nature of therapy
 - Gaze, although affected by sensory processing, is still much more a characteristic of social function
 - Experimental protocol (trial spacing, fine motor game played on the ground, which could have biased results)

Future Work

The findings support posturography as a feasible and informative tool, so future work could focus on using posturography methods to evaluate acute and long term effects and optimal dosing of various SI therapy modalities

References

- [1] Ashburner, J., et al. (2008). Sensory processing and classroom emotional, behavioral, and educational outcomes in children with autism spectrum disorder. *Amer J of Occu Ther*
- [2] Pollock, N. (2009). Sensory integration: A review of the current state of the evidence. *Occu Ther Now*
- [3] Peterka, R. J. (2002). Sensory integration in human postural control. *Journal of Neurophysiology*,
- [4] Takarae, Y., et al. (2004). "Pursuit Eye Movement Deficits in Autism," *Brain*