Potential Movement Biomarkers for Autism in children and adolescents

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Introduction

Background:

- Autism spectrum disorder (ASD) is one of the most common childhood disabilities, it occurs in all racial/ethnic groups, presents early in development and continues across the lifespan[1]
- Clinically, ASD is defined by impairments in social communication and social actions, repetitive behaviors, and restricted interests[2,3]
- While social communication deficits are the hallmark of autism spectrum disorders (ASD), motor deficits are known to be common in this population as well.
- Members of our research team recently showed that kinematic markers collected by playing a tablet game may be a promising biomarker for identification of ASD as compared to a typically developing population (TD) in children ages 3-6 years old[4]
- To our knowledge, no one has replicated this finding in an older population.

Purpose:

- To replicate and extend previous findings of kinematic differences in children with ASD to an older population of children (9-12 years old).

Methods

Participants

- 9 males, 4 TD, and 5 ASD
- Age 9-12
  - TD (M=10.8, SD= 1.4)
  - ASD (M=10, SD=0.88)
- IQ
  - TD (M= 116.2, SD= 1.4)
  - ASD (M= 107.2, SD= 22.9)

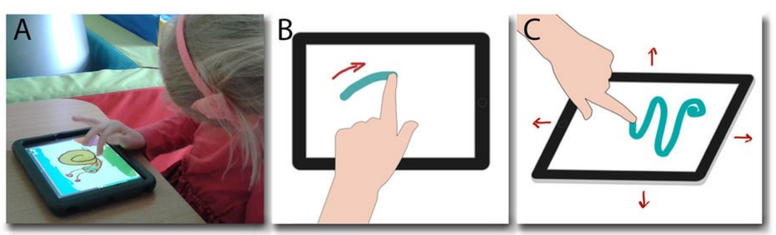
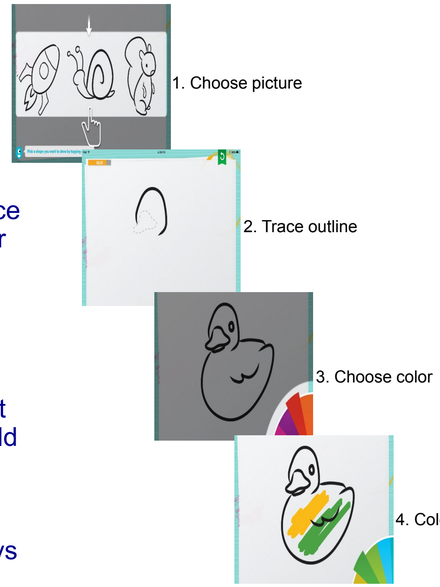


Figure taken from Anzulewicz, Sobota, & Delafield-Butt (2016). [4]

Methods

Data Acquisition

- Participants played an iPad drawing game.[4]
- After a 2 minute drawing training the child is asked to trace and color images for a 5 minute self-guided trial without any experimenter involvement.
- Table was aligned at rib height on the child
- iPad is placed 2cm away from the edge of the table and stays flat throughout the task.



Analysis:

- The game measured gesture kinematics and gesture force using inertial sensors and touch screen touch displacements.
- 212 features were calculated from the inertial sensor and touch screen data[4]. A Kolmogorov-Smirnov (K-S) test was run to identify motor features distinct between ASD and TD children
- These features are all derived from the inertial movement sensors and are first order time derivatives of acceleration (Jerk) or are metrics of displacement of the iPad during gestures (Attitude, Rotation).

Results:

- K-S test identified seven significantly different features between ASD and TD groups that represented differences in acceleration of finger movements and the displacement of the iPad during movements.

Results:

Feature	ASD group		TD group		P value
	mean	SD	mean	SD	p < 0.02
Jerk Magnitude Maximum	8.33	6.06	1.78	0.86	0.015
Jerk Minimum, y-axis	-5.44	4.03	-0.73	0.69	0.015
Jerk Range, y-axis	9.39	5.28	1.49	1.42	0.015
Attitude Range, y-axis	0.03	0.03	0.004	0.001	0.015
Rotation Root Mean Square, x-axis	0.01	0.01	0.005	8.63	0.015
Rotation Standard Deviation, x-axis	0.01	0.01	0.005	8.64	0.015

Conclusions

- Results demonstrated inertial movement sensor parameter differences are key identifiers between 9-12 year old ASD and TD children, common to children 3-6 years old.
- Contact forces and the distribution of forces during coloring may serve as important identifiers of ASD irrespective of age during childhood, while other parameters may be age-dependent.
- Such features are consistent with over-shoot phenomena common to brainstem-cerebellar pathology, and are in agreement with similar features reported in other paradigms[5,6].

References / Acknowledgments

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