

# ARE RESTRICTED, REPETITIVE BEHAVIORS AND POSTURAL CONTROL LINKED IN AUTISM SPECTRUM DISORDERS?

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## INTRODUCTION

Restricted interests and repetitive stereotyped behaviors (RRBs) encompass one of the core diagnostic areas of autism spectrum disorders (ASD). RRBs are believed to be a heterogeneous group of behaviors that may vary according to both age and level of functioning<sup>[1]</sup>. Motor clumsiness has been reported to be predictor of repetitive behavior in individuals with pervasive developmental disorders; however the relationship between motor control and repetitive behaviors remains to be fully defined<sup>[2]</sup>.

In an effort to help further define this relationship, we compared motor control and RRBs in children with ASD and typically developing children (TD). Using measures previously used in the literature to assess motor control<sup>[3]</sup> and RRBs<sup>[4]</sup>, we compared the center of pressure (COP) sway area during quiet stance with intensity and frequency scores on the Revised Repetitive Behaviors scale (RBS-R)<sup>[5]</sup>.

## METHODS

The presence of repetitive behaviors was determined in 30 children diagnosed with ASD (3.7 to 15.7 yrs) and 29 TD children (2.4 to 15.9 yrs). The RBS-R is an empirical rating scale used to assess the presence and severity of repetitive behaviors (Stereotyped Behavior, Self-Injurious Behavior, Compulsive Behavior, Ritualistic Behavior, Sameness Behavior and Restricted Behavior). The scale provides 2 separate scores for each of the 6 subscales and overall total. One score is an *intensity* score, a sum the ratings for each item and the other score is a *frequency* score, a sum of the number of items endorsed or scored as present.

In addition, children performed quiet stance trials where they were asked to stand as still as possible with their feet comfortably apart (a self-selected

stance width) and with their arms comfortably at their side for 15 seconds. Foot positioning was marked on the initial trial and used for all subsequent trials. Children performed four experimental trials.

Ground reaction forces (GRF) were recorded (360 Hz) from a forceplate (Type 4060–10, Bertec Corp., Columbus, OH) embedded level with the floor. Ground reaction forces and moments collected from the forceplate were processed and the location of the COP was calculated. Once the COP was calculated, the sway area was determined by multiplying the peak displacements in the mediolateral and anteroposterior directions. An individual's data from the four experimental trials were averaged to provide one representative datum for Sway Area which was then submitted for statistical analyses.

We had three primary questions of interest: 1. Is the magnitude of postural sway greater in children and adolescents with ASD compared to those typically developing? 2. Are RBS-R scores related to the magnitude of postural sway?; and 3. Is this relationship more pronounced in ASD.

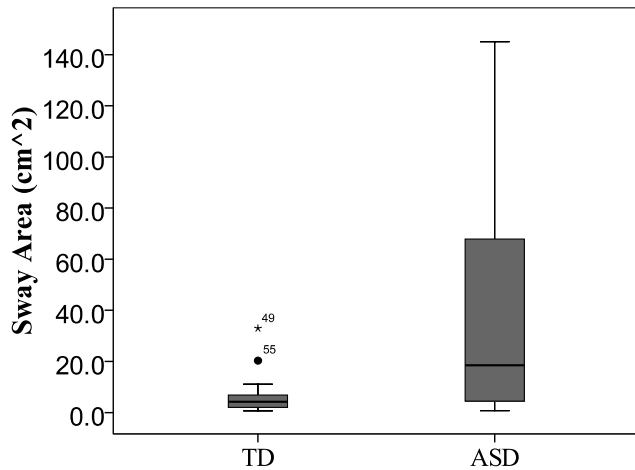
## RESULTS

Children and adolescents with ASD consistently produced greater postural sway in both the antero posterior and mediolateral direction leading to greater sway area ( $P < 0.05$ ) compared to their age matched peers (Figure 1). Not surprisingly, children and adolescents with ASD exhibit significantly greater frequencies and intensities of repetitive and restricted behaviors (Table 1).

Overall in the population of 59 children and adolescents, our measure of postural control (sway area) was significantly correlated with the both the overall RBS-R frequency and intensity scores

( $r=.52, p<0.001$  and  $r=.54, p<0.001$ ) as well as 5 out of the 6 subscale scores ( $r$  range of .37 to .65, all  $p<0.01$ ). The magnitude of sway was not related to the scores related to self injurious behavior.

However, when you look at these relationships within groups, it appears that RBS-R scores are only related to postural control in the group with ASD. In ASD, sway area was significantly correlated with the frequency and intensity of stereotyped behavior ( $r=.56; r=.39$ ), compulsive behaviors ( $r=.31; r=.45$ ), and RBS-R overall ( $r=.31; r=.37$ ); intensity of ritualistic behavior ( $r=.4$ ) and intensity of restricted behavior ( $r=.55$ ). Conversely, in typically developing children, the magnitude of postural sway was only related to the frequency and intensity of self injurious behavior ( $r=.71, p<0.001$  and  $r=.70, p<0.001$ ) RBS-R scores.



**Figure 1.** Box plot for COP sway area.

## DISCUSSION

Our results support previous reports that RRBs are related to gross motor performance. However, we are the first to show a relationship between these

behaviors and postural control. Both the overall intensity and frequency scores were significant predictors of COP sway areas in ASD. Of interest are the significant individual intensity and frequency subscore predictors. RRBs can be loosely classified into lower-level (more repetitive motor behaviors) and higher-level behaviors (circumscribed interests, resistance to change, rigid routines and rituals) suggesting different neuropsychological mechanisms. It seems the intensity of both higher-level and lower-level behaviors are significantly related to deficits in postural control, whereas only the frequency of lower-level behaviors seem to be related to deficits in postural control.

## CONCLUSIONS

The increased postural sway and the apparent link between RRB's, a core feature of ASD, and postural control suggests future research is warranted in this area. Intervention trials aimed at improving postural control are underway in attempt to improve treatment of ASD.

## REFERENCES

1. Esbensen, A. et al. (2009). *Journal of Autism and Developmental Disorders*, **39**, 57-66.
2. Carcani-Rathwell, I. et al. (2006). *Journal of Child Psychology and Psychiatry* **47**, 573-81.
3. Minshew, N. J. (2004). *Neurology*, **63**, 2056-61.
4. Cuccaro, M. et al. (2007). *Child Psychiatry and Human Development* **37**, 347-60.
5. Bodfish, J. et al. (2000). *Journal of Autism and Developmental Disorders*, **30**, 237-43.

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**Table 1.** Group scores ( $M \pm SD$ ) for the RBS-R intensity and frequency scale scores.

RBS-R Scales	Intensity		Frequency	
	TD (n=29)	ASD (n=30)	TD(n=29)	ASD (n=30)
<b>1 Stereotyped</b>	0.6 ± 1.3	6.1 ± 3.7	0.4 ± 0.8	3.7 ± 1.7
<b>2 Self-Injurious</b>	0.1 ± 0.4	2.9 ± 3.2	0.1 ± 0.4	2.1 ± 2.1
<b>3 Compulsive</b>	1.0 ± 2.9	5.6 ± 3.8	0.7 ± 1.4	3.4 ± 1.9
<b>4 Ritualistic</b>	0.9 ± 2.2	6.7 ± 4.0	0.7 ± 1.2	3.7 ± 1.8
<b>5 Sameness</b>	0.8 ± 2.0	9.1 ± 6.5	0.6 ± 1.3	5.5 ± 2.6
<b>6 Restricted Interest</b>	0.3 ± 1.1	4.5 ± 3.3	0.2 ± 0.5	2.5 ± 1.3
<b>Total Score</b>	3.8 ± 9.0	34.9 ± 17.4	2.7 ± 4.7	20.9 ± 7.4