Development of Graphomotor Fluency in Adults with and without ADHD: A Kinematic Analysis

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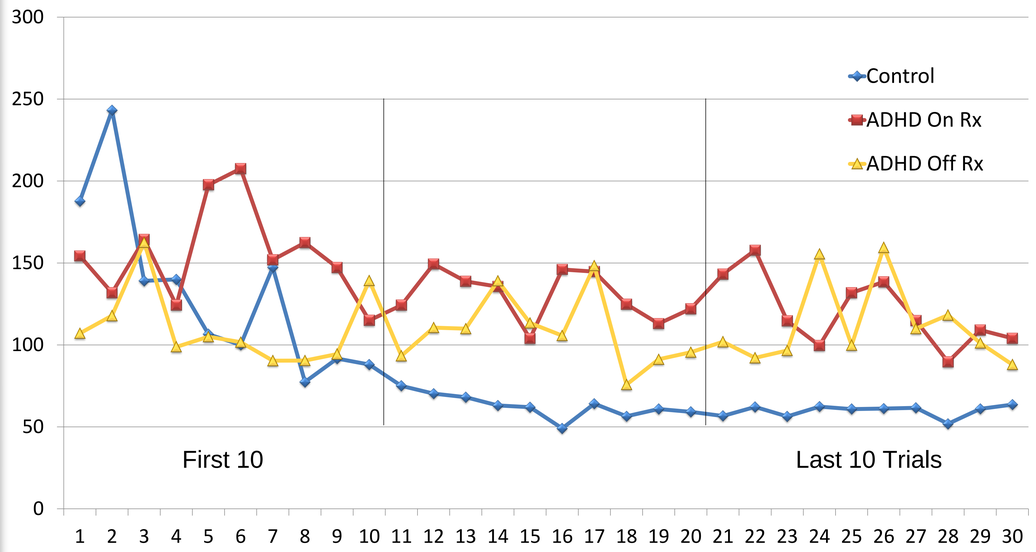
Introduction

- ADHD is a neurodevelopmental disorder characterized by symptoms of inattention and/or a combination of hyperactivity and impulsivity (Barkley, 2006)
- Motor problems, including poor graphomotor skills, are frequently found in those with ADHD and are noted to be undertreated (Fliers et al., 2009)
- Kinematic analysis using digitizing technology has indicated differences in the handwriting fluency of children with ADHD, but not adults (Langmaid et al., 2012; Tucha & Lange 2001, 2004)
- To date, no studies have investigated the development of graphomotor fluency from a kinematic perspective in adults with ADHD

Methods

- 30 adult control participants and 12 adult participants diagnosed with ADHD were recruited from a larger study
- 12 control participants were randomly selected as part of this analysis and data from 11 ADHD participants were used after removal of outliers
- All participants wrote a novel symbol 30 times on a digitizing tablet, with ADHD participants counterbalanced to perform this task twice: once on and once off stimulant medication
- Kinematic graphomotor fluency was operationalized using the variable Normalized Jerk, with higher values indicating a more dysfluent, less automatized graphomotor program and lower values indicating a more fluent, more automatized graphomotor program

Mean Graphomotor Fluency of a Novel Symbol Over 30 Trials



Novel Writing Fluency (Normalized Jerk) – Summary Table

Source	*M*	*SD*	*F*	*p*	$\omega^2_{Partial}$
Controls	-	-	10.39	.008*	.439
First 10	133.57	101.14	-	-	-
Last 10	60.90	39.46	-	-	-
ADHD On Rx	-	-	2.63	.136	.129
First 10	155.40	125.28	-	-	-
Last 10	120.32	118.27	-	-	-
ADHD Off Rx	-	-	0.28	.870	.000
First 10	137.44	104.89	-	-	-
Last 10	128.45	79.66	-	-	-

Note. * = statistically significant difference (α = .02). On Rx = ADHD/Clinical participants on ADHD medication; Off Rx = ADHD/Clinical participants off ADHD medication. M = mean of normalized jerk (NJ) value; SD = standard deviation of normalized jerk value; First 10 = Average NJ of first 10 trials; Last 10 = Average NJ of last 10 trials

Results

- A repeated measures One-Way ANOVA was used to compare the average normalized jerk of the first 10 versus the last 10 trials for control participants and ADHD participants both on and off stimulant medication.
- A Bonferroni correction used due to multiple comparisons (α = .02)
- A statistically significant decrease in normalized jerk was observed in control participants, but not in ADHD participants on or off stimulant medication
- Large, medium, and negligible effect sizes were observed comparing the first 10 versus the last 10 trials for controls, ADHD participants on medication, and ADHD participants off medication, respectively

Discussion & Conclusions

- Over the course of 30 trials, the graphomotor fluency of adults without ADHD was significantly improved. This statistically significant improvement, however, was not observed in participants with ADHD, regardless of medication status
- The data suggest that given similar practice, adults with ADHD did not develop graphomotor fluency as quickly as adults without ADHD
- Noting that attentional abilities are significantly improved with stimulant medication treatment, data suggest concomitant dysfunction within the motor system

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