
COMMENT

Stimulant Treatment of ADHD: Effects on Creativity and Flexibility in Problem Solving

Michie O. Swartwood and Jeffery N. Swartwood

State University of New York, Cortland

Jamie Farrell

University of New Orleans

ABSTRACT: The objective of this study was to determine whether Ritalin (methylphenidate, MPH) affects cognitive flexibility and creativity in children with Attention Deficit Hyperactivity Disorder (ADHD). Measures administered included the Wisconsin Card Sorting Test–Revised (WCST–R), the Test of Divergent Thinking (TDT), and the Conners’ ADHD rating scale, for both on and off MPH conditions. Comparison of on and off MPH data indicated that MPH administration significantly decreased symptoms of ADHD, as rated by parents on the Conners’. No significant differences were found on the WCST–R as a function of MPH administration. The Elaboration subscale of the TDT was the only scale to show a significant decrease in scores with MPH administration.

Methylphenidate (MPH) administration is the most commonly used treatment for Attention Deficit Hyperactivity Disorder (ADHD; Barkley, 1998); it has been estimated that 2.8% of the school age population may be currently taking this drug (Safer, Zito, & Fine, 1996). The effects of this drug on the behavior problems associated with ADHD have been well documented, but the relation between dosage, behavioral response, and cognitive functioning is quite complex. Empirical investigations document that MPH positively affects attention span, impulse control, and motor activity in children with ADHD (Barkley, 1998). While most children show these improvements, approximately 30% of children do not respond positively

to the medication (Barkley, 1998). Some studies have shown that MPH may actually detract from cognitive processing abilities in some children, by leading to “overfocusing” or cognitive perseveration, particularly at higher dosages (Solanto & Wender, 1989; Tannock & Schacher, 1992). Research also indicates that estimated proportions of favorable and unfavorable responders may depend largely on the type of response measure used by the researcher. Subtle effects of the drug on cognitive processing may be missed, if outcome data alone are used as dependent measures (Ashman & Shroeder, 1986).

Although we know that some children may be favorable behavioral responders and unfavorable cognitive responders (DuPaul & Rapport, 1993), subtle cognitive processing such as strategy generation and flexibility in problem solving are rarely measured in children given a trial of MPH. This raises a serious question regarding possible bias in clinical research toward exploring effects on the problems that lead to referral (behavioral), without consideration of possible subtle changes in cognitive functioning. This could help explain the research findings that children who receive MPH treatment for ADHD actually do more

Correspondence and requests for reprints should be sent to Michie O. Swartwood, Ph.D., Department of Psychology, State University of New York, Cortland, NY 13045. E-mail: swartwoodm@cortland.edu

school work accurately, yet do not differ from nontreated children with ADHD on measures of long-term academic achievement (Swanson et al., 1993).

The objective of this study is to determine whether MPH administration negatively affects performance on standardized tests of subtle cognitive functions, namely flexibility in problem solving and divergent thinking. Results may suggest directions for future research on the complex relation among dosage, behavioral response, and cognitive response in MPH treatment of ADHD.

Method

Participants in the study were 8 children, ages 8 to 11 years, diagnosed with ADHD (by either a psychologist or physician) and no other psychiatric or learning disorder. All participants were being treated with MPH. Dosage levels were individualized, as determined by the participants' individual physicians. Participants received permission from their individual physicians to abstain from taking MPH for 12 hr prior to the off-MPH testing condition.

Participants were tested twice, once having received MPH 1 hr prior to testing and once having abstained from taking MPH for 12 hr prior to testing. Parents were asked to rate participant behavior on the Conners' Rating Scale-Revised for both on and off medication conditions. The Wisconsin Card Sorting Test-Revised (WCST-R) was administered to assess abstract reasoning and the ability to shift cognitive strategies. The Test of Divergent Thinking (TDT) was administered to assess cognitive fluency, flexibility, originality, and elaboration. Counterbalancing for medication status was undertaken. Scoring of the TDT was conducted according to standard criteria and blind to medication status. Each subscale of the TDT was scored as follows: Fluency was scored based on quantity of drawings completed, Flexibility was scored based on the number of times the picture shifted from the category of the first drawing (living, mechanical, symbol, view, or utility), Originality was scored based on whether the participants drew in and around the stimulus form or were restricted by the form, and Elaboration was scored based on symmetry of the drawing, with drawings having asymmetrical details given higher scores.

Results

Data were analyzed using a Wilcoxon Signed Ranks Test to determine whether medication status significantly influenced performance on the dependent measures. Participants' DSM-IV Total score on the Conners' Rating Scale was significantly higher for the off MPH condition ($M = 77.29$, $SD = 4.57$) than for the on MPH condition ($M = 62.60$, $SD = 10.97$), $z = -1.83$, $p = .04$ (one-tailed). There were no significant differences in participant performance on the WCST-R between on and off MPH conditions, and no trends in the WCST-R data were evident. On the TDT, MPH administration resulted in decreased scores on the Elaboration subscale ($M = 4.75$, $SD = 3.77$) compared to the off MPH condition ($M = 6.63$, $SD = 4.24$), $z = -1.70$, $p = .05$ (one-tailed). Scores on the Fluency, Flexibility, and Originality subscales of the TDT were not affected significantly. Plotting of individual data revealed that 7 of 8 subjects had lower scores on the Elaboration subscale with MPH administration.

Discussion

The significantly higher parent ratings of ADHD symptoms on the Conners' Rating Scale for the off MPH condition is consistent with empirical investigations documenting that MPH positively affects attention span, impulse control, and motor activity level in children with ADHD (Barkley, 1998). This finding indicates that participants in the study were judged by parents to be favorable responders to MPH, at least on a behavioral level.

MPH administration did not affect performance on the WCST-R. In fact, scores on the WCST-R were nearly identical across conditions for all participants. The WCST-R is commonly viewed as a measure of "executive function," requiring planning, shifting cognitive sets, and engaging in goal directed behavior (Chelune & Baer, 1986). This pilot data suggests that MPH does not disrupt these higher order, executive processes in children with ADHD.

A significant effect on creative thinking was found using the TDT. The four subscales measured by this instrument (Fluency, Flexibility, Originality, and Elaboration) are derived from Guilford's factor analytic research on intelligence and are reported to be highly related to creativity (Williams, 1993). Elaboration is de-

scribed as the ability to add to or embellish an existing idea, or to stretch or expand upon things or ideas (Williams, 1993). The TDT measures this ability through a nonverbal drawing task, where a subject is required to add to an existing drawing. More complex, asymmetrical embellishments of the existing drawing are given higher scores. Participants in this study provided more symmetrical, less complex embellishments while under the influence of MPH, indicating that creative thinking may be subtly influenced with stimulant treatment.

In conclusion, although these data do not suggest robust effects of MPH on flexibility in problem solving or higher order thinking skills, a significant effect on elaborative thinking was found, suggesting that the effects of stimulant treatment on creativity should be further explored. It is possible that impairment in some aspects of creative thinking may contribute to the cognitive nonresponse reported in an estimated 30% of children treated with stimulants. Further exploration of subtle effects of stimulants on creative processes may yield higher numbers of nonfavorable responders in this important domain of human functioning, a possibility that could have ramifications for treatment practices for ADHD.

References

- Ashman, A., & Schroeder, S. R. (1986). Hyperactivity, methylphenidate, and complex human cognition. *Advances in Learning and Behavioral Disabilities*, 5, 295–316.
- Barkley, R. A. (1998). *Attention Deficit Hyperactivity Disorder: A handbook for diagnosis and treatment*. New York: Guilford Press.
- Chelune, G. J., & Baer, R. L. (1986). Developmental norms for the Wisconsin Card Sorting Test. *Journal of Clinical and Experimental Neuropsychology*, 8, 219–228.
- Conners, C. K. (1997). *Conners' Rating Scales—Revised technical manual*. North Tonawanda, NY: Multi-Health Systems, Inc.
- DuPaul, G. J., & Rapport, M. D. (1993). Does methylphenidate normalize the classroom performance of children with Attention Deficit Disorder? *Journal of the American Academy of Child and Adolescent Psychiatry*, 32, 190–198.
- Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtiss, G. (1993). *Wisconsin Card Sorting Test manual revised and expanded*. Odessa, FL: Psychological Assessment Resources, Inc.
- Safer, D. J., Zito, J. M., & Fine, E. M. (1996). Increased methylphenidate usage for attention deficit disorder in the 1990s. *Pediatrics*, 98(6), 1084–1088.
- Solanto, M. V., & Wender, E. H. (1989). Does methylphenidate constrict cognitive functioning? *Journal of the American Academy of Child Adolescent Psychiatry*, 28, 897–902.
- Swanson, J. M., McBurnett, K., Wigal, T., Pfiffner, L. J., Lerner, M. A., Williams, L., et al. (1993). Effect of stimulant medication on children with Attention Deficit Disorder: A review of reviews. *Exceptional Children*, 60, 154–162.
- Tannock, R., & Schacher, R. (1992). Methylphenidate and cognitive perseveration in hyperactive children. *Journal of Child Psychology and Psychiatry*, 33(7), 1217–1228.
- Williams, F. (1993). *Creativity Assessment Packet, technical manual*. Austin, TX: Pro.Ed.