**Title:** **Improving Executive Functions in Adolescents with ADHD: Evaluating the Impact of the Advanced Tools for Organization Management (ATOM) Intervention Program**

 **Authors**: Qinxin Shi1, Ph.D., Dvorsky Melissa 1, Ph.D

1Department of Psychiatry and Behavioral Sciences, Children’s National Hospital, Washington, DC

**Introduction:** Attention-deficit/hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders affecting adolescents (Castellanos et al., 2002). Executive functions (EFs) are crucial mechanisms for adolescents with ADHD, and deficits in these functions are linked to significant challenges in daily life, including impaired academic performance (Martel et al., 2007). EFs refer to a set of higher-order cognitive processes—such as working memory, inhibitory control, and cognitive flexibility—that enable individuals to engage in intentional, goal-directed behavior (Crone et al., 2009). Teaching students how to learn and to effectively manage responsibilities are important skills that can predict success in their education and adulthood.

The Advanced Tools for Organization Management (ATOM) program is a technology-enhanced and research-supported intervention for improving executive function skills, homework completion, and motivation for middle school students with ADHD (Dvorsky et al., 2018). The ATOM program is developed with school partners, parents, and students to best support students with ADHD. In ATOM, students learn to organize materials, record assignments, plan ahead, and manage their time effectively (Qi et al., 2023). Students use the online tool between check-ins to practice organization skills, monitor progress, and earn points toward rewards. The goal of this study is to evaluate whether students with ADHD had their EFs improved after participating in the ATOM.

**Methods:** The ATOM intervention targets middle school students in grades 6–8 who experience difficulties with attention, organization, and consistently turning in assignments, regardless of whether they have a formal ADHD diagnosis or an Individualized Education Program (IEP) or 504 Plan. To implement ATOM, schools will identify up to six students fitting these criteria, with referrals made by school staff. ATOM staff from Children’s National will then conduct student screenings and obtain family consent. Designated school staff will act as interventionists, provided with all materials, initial training, and ongoing technical support. These interventionists will be compensated $400 for delivering the intervention and sharing feedback on their experience. The program consists of 15–20-minute sessions held 1–2 times per week over 11 weeks, with two sessions involving parents to help reinforce skills at home. School providers and students set up personalized goals, checklists, and electronic planners focusing on material organization, homework recording, homework completion, time management/planning, and self-regulation. Students can earn immediate points for doing the behavior and collect earned points for tangible rewards.

Before and after receiving the ATOM intervention, parents filled out the Behavior Rating Inventory of Executive Functioning (BRIEF-2) (Gioia et al., 2015). BRIEF-2 is a parent-report questionnaire of EF in children and adolescents. Items on this measure are rated from 0 = Never, 1 = Sometimes, or 2 = Often, and loaded onto eight theoretically and empirically derived subscales, including Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor subscales. A General Executive Composite score, Behavioral Regulation Index, Cognitive Regulation Index, and Emotion Regulation Index are also derived.

The study sample consisted of 50 participants (22 male and 28 female), primarily middle school students aged 11 to 15 years (*M* = 12.64, *SD* = 1.05). The grade-level distribution indicated that most participants were in 6th grade (28%), 7th grade (26%), and 8th grade (32%), with smaller proportions in 9th grade (10%) and 10th grade (4%). The sample was predominantly White (50.7%) and Black or African American (37.7%), with smaller representations of Asian (2.9%) and Biracial/Multiracial (5.8%). Ethnicity data showed that 84.1% of participants identified as Not Hispanic or Latino, while 14.5% identified as Hispanic or Latino.

**Results:** A series of paired simple T-tests were performed to examine the changes in EFs before and after the ATOM intervention. The paired samples test revealed several significant improvements in parent-reported executive functioning from baseline to follow-up. Specifically, raw scores showed significant gains in Inhibition (INH), *t*(45) = 3.66, *p* = .001; Initiate (INIT), *t*(45) = 4.28, *p* < .001; Working Memory (WM), *t*(45) = 4.29, *p* < .001; Plan/Organize (PO), *t*(45) = 3.74, *p* = .001; Task Monitor (TM), *t*(45) = 4.34, *p* < .001; Organization of Materials (OM), *t*(45) = 4.04, *p* < .001; Behavioral Regulation Index (BRI), *t*(45) = 2.74, *p* = .009; Cognitive Regulation Index (CRI), *t*(45) = 4.87, *p* < .001; and Global Executive Composite (GEC), *t*(45) = 4.01, *p* < .001. Similarly, significant improvements were observed in T scores for INH, *t*(45) = 3.59, *p* = .001; INIT, *t*(45) = 4.15, *p* < .001; WM, *t*(45) = 4.00, *p* < .001; PO, *t*(45) = 3.68, *p* = .001; TM, *t*(45) = 4.06, *p* < .001; OM, *t*(45) = 3.63, *p* = .001; BRI, *t*(45) = 2.61, *p* = .012; CRI, *t*(45) = 4.92, *p* < .001; and GEC, *t*(45) = 3.97, *p* < .001. Additionally, a significant decrease was noted in the Negativity Score, *t*(45) = 2.30, *p* = .026, indicating reduced negativity over time. These results suggest substantial developmental improvements in cognitive and behavioral regulation domains.

**Discussion:** The findings from our evaluation of the Advanced Tools for Organization Management (ATOM) program provide compelling evidence that targeted, technology-enhanced interventions can yield significant improvements in executive functions (EFs) for middle school students with attention difficulties, including those with ADHD. The improvements observed in various domains of EF, as reported by parents using BRIEF-2, highlight the potential of structured organizational skills programs in supporting adolescents who experience challenges with self-regulation and task management.

Our results demonstrated improvement in key areas of EFs, which are critical for effective daily functioning. Improvements in Inhibition and Behavioral Regulation suggest that students participating in ATOM were better able to control impulsive responses, a crucial skill for adapting to classroom and social environments. Improvement in Working Memory and planning/Organizing underscore the intervention's effectiveness in helping students hold and manipulate information while planning and finishing tasks. Gains in Task Monitoring and Organization of Materials indicate that students became more aware of their work quality and better equipped to keep materials in order, reflecting a meaningful increase in self-monitoring and organizational habits.

The significant progress in the Cognitive Regulation Index and Global Executive Composite points to overarching improvements in EFs, suggesting that ATOM successfully fosters both targeted and generalized EF skills. The significant reduction in the Negativity Score also merits discussion. This finding indicates not only improved cognitive and behavioral regulation but also a positive shift in emotional responses, suggesting that the ATOM program contributed to better emotional control or reduced frustration associated with academic tasks. Such emotional improvements are crucial, given that ADHD often co-occurs with emotional dysregulation, which can exacerbate everyday challenges. Overall, this study highlights the ATOM program's promise in enhancing executive functioning for adolescents struggling with attention and organizational difficulties. Continued partnerships with schools and families will be crucial for optimizing program delivery and maximizing student outcomes.

**References:**

Castellanos, F. X., & Tannock, R. (2002). Neuroscience of attention-deficit/hyperactivity disorder: the search for endophenotypes. *Nature Reviews Neuroscience*, *3*(8), 617-628.

Crone, E. A. (2009). Executive functions in adolescence: inferences from brain and behavior. *Developmental science*, *12*(6), 825-830.

Dvorsky, M., Steinberg, B. S., Harlan, M., & Pfffner, L. (2018). Evidence-Based Digital Interventions for Adolescents with ADHD: Stakeholder-Generated Solutions to Optimize Engagement and Implementation in School Settings. *WILLIAM H. BEAUMONT RESEARCH PRIZE WINNERS*, *86*(1), 79.

Gioia G. A., Isquith P. K., Guy S. C., Kenworthy L. (2015). *Behavior Rating Inventory of Executive Function®, Second Edition (BRIEF-2*). Lutz, FL: PAR Inc.

Martel, M., Nikolas, M., & Nigg, J. T. (2007). Executive function in adolescents with ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry*, *46*(11), 1437-1444.

Qi, L., Dvorsky, M., Steinberg, A., Harlan, M., Chronis-Tuscano, A., & Pfiffner, L. (2023). Evidence-Based Digital Interventions for Adolescents with ADHD: StakeholderGenerated Solutions to Optimize Engagement and Implementation in School Settings.