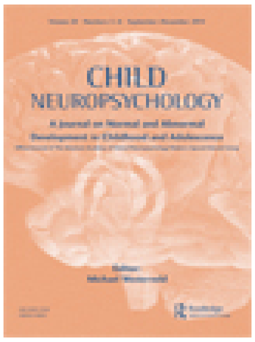

Child Neuropsychology

A Journal on Normal and Abnormal Development in Childhood and Adolescence

ISSN: 0929-7049 (Print) 1744-4136 (Online) Journal homepage: https://www.tandfonline.com/loi/ncny20

Targeting self-regulation and academic functioning among preschoolers with behavior problems: Are there incremental benefits to including cognitive training as part of a classroom curriculum?

Taylor D. Landis, Katie C. Hart & Paulo A. Graziano

CHILD NEUROPSYCHOLOGY
https://doi.org/10.1080/09297049.2018.1526271

Routledge
Taylor & Francis Group

Check for updates

Targeting self-regulation and academic functioning among preschoolers with behavior problems: Are there incremental benefits to including cognitive training as part of a classroom curriculum?

Taylor D. Landis, Katie C. Hart and Paulo A. Graziano

Center for Children and Families, Department of Psychology, Florida International University, Miami, FL, United States

ABSTRACT

The purpose of this study was to examine the additional benefit of an adaptive Cogmed working memory training (CWMT) to a social-emotional/self-regulation classroom curriculum for preschoolers with externalizing behavior problems (EBP). Participants for this study included 49 children (71% boys, M_{age} = 4.52) with at-risk or clinically elevated levels of EBP. Children participated in an 8-week summer treatment program for Pre-Kindergarteners (STP-PreK), where they were randomly assigned to either adaptive CWMT (n = 24), or nonadaptive CWMT (n = 25). Multiple repeated measures analyses were conducted to examine the impact of adaptive versus nonadaptive CWMT on pre and posttreatment parent-/teacher-reported behavioral functioning, parent-/teacher reported and child task performance of executive functioning, and standardized academic achievement measures. Repeated measures analyses found that children in both groups improved on all measures (d's = .23-.86). However, there were no significant time X condition effects for parent or teacher-reported behavior, reported or observed executive functioning, or standardized academic measures. These findings suggest that CWMT does not appear to provide any incremental benefits to children's executive functioning, behavior, or academics when implemented within a comprehensive behavioral modification intervention.

ARTICLE HISTORY
Received 29 March 2018
Accepted 12 September 2018

KEYWORDS
Preschool; externalizing behavior problems; cognitive training; executive function; self-regulation; intervention

Executive functioning (EF) is an important self-regulatory process involved in the planning and control of goal-directed behavior, emotion, and cognition (Calkins, 2007, Ponitz et al., 2008). EF includes processes such as working memory, inhibition, set shifting, planning, contextual memory, and fluency (Pennington and Ozonoff, 1996, Welsh, 2002). Prior research has highlighted the importance of self-regulation processes in many functional domains, including school readiness and academic success (Blair and Diamond, 2008, Graziano, Reavis, Keane, & Calkins, 2007). A meta-analysis by Schoemaker et al(2013) demonstrated that preschoolers with externalizing behavior problems (EBP; i.e., hyperactivity, impulsivity, inattention, defiance, aggression;

CONTACT Paulo A. Graziano pgrazian@fiu.edu Center for Children and Families, Department of Psychology, Florida International University, 11200 SW 8th Street, AHC 4 Rm. 459, Miami, Florida 33199

Wichstrom et al., 2012) exhibit moderate deficits in EF, especially inhibition (Schoemaker et al., 2013). Hence, emerging research has focused on the malleability of EF and EF interventions.

One of the most researched interventions targeting EF in children is cognitive training (Diamond and Lee, 2011, Douglas, 2005). Cognitive training programs (e.g., CogMed, Pay attention!, Jungle Memory) are theoretically based in neuroscience, proposing that through computerized technology, both anatomical and functional neural modification can occur through repeated performance (Vinogradov, Fisher, & de Villers-Sidani, 2012). More specifically, cognitive training programs utilize learning-dependent brain plasticity in the prefrontal cortex, associated with cognition (Vinogradov et al., 2012). Given the development of the frontal lobe and changes in cognitive functioning during early childhood, theoretically, young children may especially benefit from cognitive training (Peijnenborgh, Hurks, Aldenkamp, Vles, & Hendriksen, 2016). Alternatively, older children who have the ability to recognize their cognitive deficits, and the need to improve them, may benefit more from cognitive training (Peijnenborgh et al., 2016). Consistent with transfer of learning theories, repeated practice improves performance; such that playing computer games, may in turn reflect cognitive and affective improvements (Simons et al., 2016). However, it is important to note that most cognitive training programs focus on working memory, which is only one component of EF.

Over the past 5 years, many meta-analyses have examined the effects of cognitive training. In a review of studies sampling healthy adults, cognitive training (i.e., N-back tasks) produced task-specific improvements on nontrained N-back tasks, as well as some other working memory tasks (e.g., digit span; Soveri, Antfolk, Karlsson, Salo, & Laine, 2017). However, these effects did not transfer to other, nontrained tasks of cognitive control (e.g., Stroop task; Soveri et al., 2017). Similarly, in typically developing children, cognitive training improved task-related working memory (e.g., Automated Working Memory Assessment [AWMA], number span, and digit span), with maintenance (Sala and Gobet, 2017). However, this review found that these effects did not transfer to fluid intelligence (e.g., block design), academic achievement (e.g., reading fluency), or cognitive control (e.g., go/no-go task; Sala and Gobet, 2017).

Given the cognitive impairments associated with a variety of clinical populations, a large body of literature has also examined the effects of cognitive training in atypical samples. Cortese et al. (2015) examined the effects of a variety of cognitive training programs targeting components of EF, such as working memory, attentional control, and inhibition in children/adolescents with Attention-Deficit/Hyperactivity Disorder (ADHD). Cognitive training demonstrated moderate to large near-transfer effects on working memory improvement (e.g., AWMA, digit span, and dot matrix; Cortese et al., 2015). However, cognitive training was not associated with improvements in academic achievement (e.g., word reading fluency), or reduction in ADHD symptoms (Cortese et al., 2015, van der Donk, Hiemstra-Beernink, Tjeenk-Kalff, Van Der Leij, & Lindauer, 2015). Furthermore, in children with learning disabilities, cognitive training has demonstrated improvement in verbal and visuospatial working memory that sustained for up to eight months (Peijnenborgh et al., 2016). Lastly, Melby-Lervåg, Redick, and Hulme (2016) found that cognitive training yielded improvements across verbal and visuospatial working memory tasks. Consistently across meta-analyses of samples with both adults and children, with and without behavioral and learning impairments, cognitive training has yielded some context and content dependent, near-transfer effects for working memory improvements, but no far-transfer effects to other cognitive domains, or intelligence.

Despite the immense amount of research conducted recently, less work has examined the effectiveness of cognitive training in preschoolers, a crucial developmental period for self-regulation processes, such as EF (Garon, Bryson, & Smith, 2008). One of the only studies with a younger sample demonstrated some effectiveness for cognitive training improving working memory task performance compared to a control group, though these findings were not robust across measures of EF, nor did they examine behavioral or academic functioning (Thorell, Lindqvist, Bergman Nutley, Bohlin, & Klingberg, 2009). One of the other studies with preschoolers found that cognitive training improved symptoms of parent and clinician, but not the teacher, rated inattention, but they also did not examine academic outcomes (Tamm, Nakonezny, & Hughes, 2014).

The impact of cognitive training is mostly limited to near-transfer improvements in similar cognitive tasks (i.e., working memory tasks), but not necessarily enhancements in core cognitive mechanisms, as evidenced by lack of academic or behavioral improvements (Melby-Lervåg et al., 2016, Sala and Gobet, 2017, Soveri et al., 2017). On the other hand, more traditional and evidence-based behavioral parent training programs demonstrate significant reductions in EBP (Kaminski, Valle, Filene, & Boyle, 2008). However, as reviewed by Chronis, Chacko, Fabiano, Wymbs, and Pelham (2004), there are some challenges to employing parent training models within school settings. Additionally, behavioral parent training programs do not specifically address EF deficits that are theoretically associated with EBP. Not surprisingly, an array of preschool curricula have been developed to promote self-regulation skills as a means of improving academic success. Broadly, these curricula aim to improve social-emotional skills, behavioral regulation, problem-solving, and classroom engagement (see Domitrovich, Durlak, Goren, & Weissberg, 2013 for a list of programs; Ursache, Blair, & Raver, 2012). One easily transportable self-regulation classroom curriculum includes the use of 30-min circle time EF games that require attention, working memory, inhibitory control, and behavioral regulation (Tominey and McClelland, 2011). Across several studies, these circle time EF games have been shown to improve preschoolers' self-regulation and academic achievement (Schmitt, McClelland, Tominey, & Acock, 2015, Tominey and McClelland, 2011). While such classroom curricula have empirical support for improving self-regulation and academics, they typically target children without behavior problems.

Adapted from the summer treatment program (STP; Pelham et al., 2010), the STP-PreK (Graziano, Slavec, Hart, Garcia, & Pelham, 2014) is a multimodal intervention which includes a parent training program along with an 8-week daily camp component that utilizes behavioral modification strategies to facilitate the transition to kindergarten for children with behavior problems. Compared to universal programs, such as the preschool curricula mentioned previously, the STP-PreK is unique in targeting children with elevated levels of EBP, who have greater EF deficits, at a critical time in development. Rimm-Kaufman and Pianta's Ecological and Dynamic Model of Transition (2000) highlights the importance of self-regulation during the transition from preschool to kindergarten especially for academic trajectories. Self-regulation plays a large role in adjusting to the increasing demands of independence and responsibility in kindergarten, making intervention during the transition period critically important (Rimm-Kaufman and Pianta, 2000). A previous open trial (Graziano et al., 2014) and randomized control trial (Graziano and Hart, 2016) demonstrated the initial efficacy of the STP-PreK in improving children's EBP and EF. However, it is important to note that the randomized control trial included a comprehensive social-emotional/self-regulation classroom curriculum, which included daily social skills lessons through the use of puppets, vignettes, and videos; a 30-minute self-regulation period consisting of various EF games adapted from Tominey and McClelland (2011) and most relevant to the current study, a computer period in which children participated in Cogmed JM working memory training (CWMT; http://cogmed.com; Graziano and Hart, 2016). Thus, it remains unclear which active social-emotional/self-regulation component contributed to improvements in EBP and EF. When implementing a classroom curriculum, it is important to examine which treatment components are actively providing benefits. Isolating the effect of working memory training is particularly important given emerging commercialization of computerized cognitive training programs and marketing to parents and academic personnel (Hambrick, 2014, Simons et al., 2016).

Current study

Interest in technology interventions and cognitive training programs with high transportability targeting children's EF have received a great deal of attention over the last decade (Cortese et al., 2015). Despite some promising results as it relates to near transfer effects (i.e., EF), these programs have generally not yielded results relating to academic benefits or symptom/impairment reduction (Cortese et al., 2015, Rapport, Orban, Kofler, & Friedman, 2013). It may be the case that cognitive training programs are more effective if delivered during the preschool period, a crucial developmental period for EF (Garon et al., 2008). After an extensive literature review using the following keywords, few studies to our knowledge have examined such programs within a preschool population, and despite some promising results, none of the studies examined academic outcomes, and only one examined symptom reduction: [cognitive training, preschool, social-emotional curriculum, behavioral intervention] (Rueda, Checa, & Cómbita, 2012, Tamm et al., 2014, Thorell et al., 2009). Additionally, no study to our knowledge has examined the extent to which such computerized cognitive training programs provide incremental benefits to children above and beyond a classroom-based behavioral and social-emotional/self-regulation curriculum. Using a randomized trial design, the current study assigned preschoolers with elevated EBP to receive the STP-PreK's behavioral and social-emotional/self-regulation classroom curriculum along with either (a) the nonadaptive or (b) the adaptive version of CWMT. We expected that children receiving the adaptive CWMT would outperform those receiving the nonadaptive version on EF measures. However, we hypothesized that there would be no additional benefits for the adaptive cognitive training over the nonadaptive group in terms of academic or behavioral functioning improvements.

Method

Participants and recruitment

This study took place in a large urban university in the Southeastern United States with a large Hispanic/Latino population. Children and their families were recruited from local preschools and mental health agencies via brochures, radio advertisements, and open house/parent workshops. Participants were eligible if they (a) had an externalizing problems composite t-score of 60 or above on parent (M = 63.71, SD = 13.84) or teacher (M = 67.09, SD = 17.20) BASC-2 (Reynolds and Kamphaus, 1992), (b) were enrolled in preschool the previous year, (c) had an estimated IQ of 70 or above (M = 85.57, SD = 12.74), (d) had no reported Autism Spectrum or Psychotic Disorder, and (e) were able to participate in the 8-week STP Pre-K (Graziano et al., 2014).

The final sample consisted of 49 children (M_{age} = 4.52, SD = 0.63, 71% male), whose parents provided consent to participate in the study. In terms of ethnic makeup, 76% of the participants were Hispanic/Latino. All children's primary language was English, with 58% also being proficient in Spanish. All child assessments were administered in English. According to the C-DISC (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), 33% of children met DSM-IV criteria for both ADHD and Oppositional Defiant Disorder (ODD), an additional 29% met criteria for ADHD alone, 20% met the criteria for ODD alone, and 18% did not meet any diagnosis.

Study design and procedure

The university's Institutional Review Board approved this study. All families participated in a pre-treatment assessment prior to the start of the STP-PreK. As part of the pre-treatment assessment, children were individually administered the Wechsler Preschool and Primary Scale of Intelligence- 4th edition (WPPSI-IV; Wechsler, 2012) and six subtests of the Woodcock-Johnson Test of Achievement-Third Edition (WJ-III; Woodcock, McGrew, & Mather, 2001) while parents completed a diagnostic interview (C-DISC; Shaffer et al., 2000) in their preferred language (83% English). Parents and teachers also completed questionnaires about the child's behavior and self-regulation skills. Eligible participants were invited to attend a second laboratory visit, where children completed an EF battery which consisted of the Head-Toes-Knees-Shoulders (HTKS) Task (McClelland et al., 2014, Ponitz, McClelland, Matthews, & Morrison, 2009) and the AWMA (Alloway, Gathercole, & Pickering, 2004). The same EF battery and academic achievement assessment were completed 1–2 weeks following the intervention.

Intervention

The STP-PreK (Graziano at al., 2014) is a multimodal intervention for preschoolers with ADHD and other behavior problems. Children in the STP-PreK receive an intensive academic, behavioral, social-emotional, and self-regulation training throughout the camp day (M-F 8 am to 5 pm) across a variety of classroom and recreational enrichment activities. Embedded across activities is the use of a behavior modification program. Parents also attended a weekly school readiness parenting program (Graziano, Ros, Hart, & Slavec, 2018). A previous randomized trial showed that the addition of a social-emotional/self-regulation curriculum to the STP-PreK provided enhanced academic and self-regulation outcomes (Graziano and Hart, 2016). The social-emotional/self-regulation curriculum included an EF game period (30 min), adapted from Tominey and McClelland (2011), and CWMT (15 min; http://www.cogmed.com).

Given the current study's interest in examining the incremental benefits of computerized cognitive training, children in this study all received the same behavioral modification program and social-emotional curriculum from the STP-PreK, but were additionally randomized to receive either (a) an adaptive version of CWMT (n = 24), or (b) a nonadaptive version of CWMT (n = 25). CWMT is a computer program designed to improve working memory and behavior in preschoolers through a game-like interface with a theme park design (Roche and Johnson, 2014). The program consists of 10–15 min sessions, five days a week across the course of 5 weeks (http://www.cogmed.com). The adaptive version is designed to increase in difficulty dependent on children's game performance. On the other hand, children in the nonadaptive version remain in the same easy introductory level they start out at regardless of performance. Consistent with prior research, children participated in the cognitive intervention for a maximum of 25 days. (Rapport et al., 2013). The two intervention groups were compared on all demographic (e.g., child age, child sex, SES, ethnicity) and screening variables (e.g., initial EBP symptom severity, ADHD diagnosis). Ethnicity was significantly associated with the condition (r = -.30, p < .05), such that there were less Hispanic/Latino children in the nonadaptive condition than in the adaptive condition. As seen in Table 1, there were no significant differences between the groups on any other demographic or screening measures.

Table 1. Baseline variables by condition.

	Total sample (n = 49)	Adaptive (n = 24)	Nonadaptive (n = 25)
Demographic variables			
Child sex (% male)	71	63	80
Child age (Mean)	4.52 (0.63)	4.56 (0.62)	4.48 (0.66)
Hollingshead SES	39.81 (13.15)	40.13 (12.87)	39.50 (13.67)
Child ethnicity (% Hispanic/Latino)	76	**63***	**88***
Child IQ	85.57 (12.74)	84.04 (13.51)	87.04 (12.05)
BASC-2 (P)	63.71 (13.84)	63.67 (17.26)	63.75 (9.66)
BASC-2 (T)	67.09 (17.20)	65.67 (16.25)	68.80 (19.01)
ADHD only diagnosis (%)	29	29	28
ODD only diagnosis (%)	20	25	16
ADHD + ODD diagnosis (%)	33	21	44
Cogmed JM variables			
Days trained	20.08 (5.37)	18.75 (6.04)	21.36 (4.38)
Active minutes played per day	15.80 (2.57)	15.69 (2.23)	15.91 (2.91)
Paused minutes per day	15.14 (10.75)	17.18 (12.28)	13.18 (8.84)
Start-max index	6.69 (9.63)	**13.67 (9.70)*** **	**0.00 (0.00)*** **

Note. Values in parenthesis represent standard deviations. SES = socioeconomic status, BASC-2 = Behavior assessment system for children, 2nd edition, ADHD = attention-deficit/hyperactivity disorder, ODD = oppositional defiant disorder, P = parent report, T = teacher report. Paused minutes per day = number of minutes per day not engaged in the activity. Start-max index = difference between the maximum and the start index. *p < .05 significant group differences, ***p < .001 significant group differences.

Measures

Behavioral functioning

ADHD symptoms. Parents and teachers completed the Disruptive Behavior Disorder (DBD) Rating scale (Pelham, Gnagy, Greenslade, & Milich, 1992). Each symptom of ADHD on the DBD Rating Scale is rated on a 4-point frequency scale (*not at all, just a little, pretty much, or very much*). The DBD Rating Scale was adapted to reflect the newest edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; American Psychiatric Association, 2013). For this study, the mean severity of ADHD symptoms (hyperactivity/impulsivity and inattention) were used for parent (α = .91, α = .95 pre and post, respectively) and teacher (α = .94, α = .96 pre and post, respectively).

Externalizing behavior problems. Parents and teachers completed the Behavior Assessment System for Children-Second Edition (BASC-2; Reynolds and Kamphaus, 1992). The BASC-2 is a widely utilized tool that assesses emotional and behavioral domains. The scales include internalizing, externalizing, and behavior symptom domains, and adaptive/social functioning skills. The externalizing problems scale was used for the current study for parent (α = .90, α = .91 pre and post, respectively) and teacher (α = .97,α = .97 pre and post, respectively).

Executive functioning

AWMA. Children were administered four subtests of the AWMA (Alloway et al., 2004). Subtests included (a) Word Recall (auditory short-term memory); (b) Listening Recall (auditory working memory); (c) Dot Matrix (visuospatial short-term memory); and (d) Mister X (visuospatial working memory). In the Word Recall task, children are required to remember a sequence of words and repeat them back to the examiner. The Listening Recall subtest requires children to indicate if a sentence is "true" or "false," then recall the last word of the sentence with increasing difficulty. In the Dot Matrix task, children must recall in order the location of a series of dots presented on a 4 × 5 grid. In the Mister X task, two similar figures are next to each other, each holding a ball in its hand. One of the figures is rotated between 45 and 315 degrees. The child is required to determine the spatial orientation (i.e., "Are they holding the ball in the same hand or different hands?"), and recall the location of the ball from six different possibilities. Raw scores from the subtests are converted to standard scores according to gender and age norms. Scores from the AWMA show adequate test–retest reliability and has established convergent validity (Alloway et al., 2008). Due to the moderate to high correlation among the four subtests (*rs* = .31-.78), an average standardized score of the subtests was calculated and used for the analyses in the current study.

HTKS. Children were administered the head–toes–knees–shoulders task (HTKS; Ponitz et al., 2008). The HTKS is a widely used task used with preschoolers to assess EF. The HTKS has well-established internal consistency, reliability and concurrent/ predictive validity (Ponitz et al., 2009). During HTKS, children are required to follow a set of behavioral rules paired with conflicting behavioral responses. There are three parts to the task with 10 trials each. Prior to each part, children are presented with a set of rules (i.e., head and toes) such that the child is required to do the opposite/different move from what is stated aloud. For example, when the examiner says, "touch your toes" the correct behavioral response would require the child to touch their head. In the second part, a new set of paired rules is added, touching shoulders and knees. In the third part, the examiner switches the rules, such that head pairs with knees, and shoulders pairs with toes. The child receives 0 points for an incorrect response, 2 points for an immediate correct response, and 1 point for self-corrections with a total possible score of 60. The current study used this total score with higher scores indicating better EF.

BRIEF. Parents and teachers completed the Behavior Rating Inventory of Executive Function Preschool Version (BRIEF-P; Gioia, Isquith, Guy, & Kenworthy, 2000). The BRIEF-P yields 5 nonoverlapping scales clinical scales (inhibit, shift, emotional control, working memory, and plan-organize). Scores on these individual scales can be summed up to form composites of inhibitory self-control (inhibit + emotional control), flexibility (shift + emotional control), emergent metacognition (working memory + plan/organize), and an overall global executive composite. Higher scores on clinical scales/composites are indicative of poorer EF capacity. The emergent metacognition composite t-score was used as a measure of EF for parents (α = .92, α = .94 pre and post, respectively) and teachers (α = .94, α = .98 pre and post, respectively).

Academic functioning

WJ-III. Children were administered six subsets of the Woodcock-Johnson Test of Achievement-Third Edition (WJ-III; Woodcock et al., 2001), a widely used, norm-referenced measure of academic achievement with excellent psychometric properties. The subsets administered were Applied Problems, Calculation, Writing Samples, Letter-Word Identification, Passage Comprehension, and Spelling. This study examined derived composite scores: Brief Reading (Letter-Word Identification, Passage Comprehension), Brief Math (Applied Problems, Calculation), and Brief Writing (Spelling, Writing Samples). Given the high correlations among the brief scores, (r's = .56-.58 pre, and r's = .63-.67 post), a composite score was created for an overall academic achievement score at both assessment points.

Data analytic plan

All analyses were conducted using the Statistical Package for the Social Sciences, version 20 (SPSS 20). There was less than 6% missing data for all child measures. Missing data for parent and teacher report ranged from 2–18% and 12–63% at pre and posttreatment, respectively. According to Little's Missing Completely at Random test, the missing data were missing completely at random (X^2 (605) = 17.2, p > .05). There were no significant differences between children with complete versus partial data in terms of any demographic variables or any outcomes examined in the current study. The full dataset is available from the authors upon request. Multiple imputations were conducted with five imputation, which is a sufficient estimate for the given sample size (Rubin, 1987). Preliminary analyses were conducted to examine the differences between adaptive (n = 24) and nonadaptive (n = 25) conditions, as well as associations between demographic variables and the study variables. Our sample size is above the minimum of 20 per group, and sufficient for detecting significant time effects for working memory training (Redick, Shipstead, Wiemers, Melby-Lervåg, & Hulme, 2015). Multiple repeated measures ANOVAs were conducted to compared children in the STP-PreK who were randomized to adaptive versus nonadaptive CWMT in terms of behavioral, academic, and EF outcomes. Bonferroni corrections to minimize Type 1 error were utilized while Cohen's *d* effect sizes were provided for all analyses.

Results

Preliminary analyses

Preliminary analyses examined potential associations between demographic variables and the study's outcome variables. Ethnicity was significantly associated with pre-treatment scores of academic achievement ($r = .29$, $p < .05$), such that nonHispanic/Latino children scored higher than Hispanic/Latino children. Children's age and IQ were significantly associated with HTKS ($r = .43$, $p < .001$; $r = .14$, $p < .05$ respectively) and AWMA ($r = .18$, $p < .01$; $r = .48$, $p < .001$ respectively) performance, indicating that older children, and children with higher IQs performed better on EF tasks. Additionally, IQ was significantly associated with WJ performance ($r = .63$, $p < .001$), such that children with higher IQs performed better academically. Given that IQ shares variance with EF and academic performance, and consistent with prior work (Rapport et al., 2009), IQ was not used as a covariate. Rather, a residual IQ score was derived by parceling out variance not accounted for by the outcome variable of interest on IQ. No other demographic variables were significantly associated with the study's variables of interest. Therefore, subsequent analyses included age, ethnicity, and residual IQ scores as covariates.

Intervention outcomes

CWMT

As seen in Table 1, there were no significant differences between the adaptive to the nonadaptive condition in terms of number of days trained, $F(1, 47) = 3.02$, $p = .09$, active number of minutes played, $F(1, 47) = 0.09$, $p = .77$, or number of minutes not engaged in the activity, $F(1, 47) = 1.73$, $p = .20$. On the other hand, there were significant differences between the two conditions between the start index and maximum index, $F(1, 47) = 49.71$, $p < .001$. Thus, as expected children who received the adaptive condition experienced an increase in the level of difficulty of the training modules.

Behavioral functioning

As seen in Table 2, even after accounting for age, ethnicity, and residual IQ, there was a significant time effect such that children across both groups experienced a significant improvement in their ADHD symptoms as rated by both parents and teachers, $F(1, 44) = 32.96$, $p < .001$, $d = -.55$; $F(1, 44) = 11.58$, $p < .01$, $d = -.41$, respectively. However, there was no significant time X condition effect for parent-rated ADHD symptoms, $F(1, 44) = 0.63$, $p = .43$, or teacher-rated ADHD symptoms,

Table 2. Behavioral functioning outcomes.

	Pre *M* (*SE*)	Post *M* (*SE*)	Time x Group *F*	Time effect *F*
Behavioral functioning				
DBD – ADHD (P)			0.63	**32.96*****
Adaptive	1.53 (.13)	0.92 (.17)	–	–
Nonadaptive	1.34 (.13)	0.87 (.13)	–	–
DBD – ADHD (T)			0.63	**11.58****
Adaptive	1.31 (0.17)	0.80 (0.17)	–	–
Non-adaptive	1.59 (0.18)	1.07 (0.18)	–	–
BASC – Externalizing (P)			0.09	**32.14*****
Adaptive	63.24 (3.03)	52.19 (2.11)	–	–
Nonadaptive	64.62 (3.24)	53.22 (2.08)	–	–
BASC – Externalizing (T)			0.64	**46.03*****
Adaptive	66.52 (2.50)	51.68 (1.86)	–	–
Nonadaptive	68.04 (2.45)	56.57 (1.87)	–	–

Note. Means and SEs are marginal estimates after controlling for age and ethnicity. *p < .05, **p < .01, ***p < .001. P = Parent report, T = teacher report, DBD – ADHD = Disruptive Behavior Disorder Rating Scale mean attention-deficit/hyperactivity disorder symptom severity, BASC Externalizing = Behavior Assessment System for Children, 2nd edition externalizing problems T-score.

$F(1, 44) = 0.41$, $p = .53$, suggesting that children across both groups experienced similar improvements in ADHD symptoms.

Additionally, there was a significant time effect for EBP such that children across both groups decreased in their behavior problems as rated by both parents and teachers on the BASC-2, $F(1, 44) = 32.14$, $p < .001$, d = -.60; $F(1, 44) = 46.03$, $p < .001$, d = -.86, respectively. There was no significant time X condition effect for parent, $F(1, 44) = 0.09$, $p = .76$, or teacher, $F(1, 44) = 0.64$, $p = .43$, rated behavior problems. These findings suggest that children in both the adaptive and nonadaptive conditions improved their behavior problems at a similar rate.

Executive functioning

Similarly and as seen in Table 3, there was a significant time effect for both observed EF measures, $F(1, 44) = 43.46$, $p < .001$, $d = .49$; $F(1, 44) = 51.93$, $p < .001$, $d = .60$, AWMA and HTKS respectively. However, there was no significant time X condition effect on either observed EF measure, $F(1, 44) = 0.70$, $p = .41$; $F(1, 44) = 0.10$, $p = .75$, AWMA and HTKS respectively. Additionally, there was a significant time effect for both parents and teachers reported EF deficits, $F(1, 44) = 72.69$, $p < .001$, d = -.62; $F(1, 44) = 7.17$, $p < .05$, d = -.27, respectively. However, there was no significant time X condition effect for either parent nor teacher rated impairment of EF, $F(1, 44) = 2.47$, $p = .12$; $F(1, 44) = 0.05$, $p = .82$ respectively. These results indicated that children across both groups improved similarly in terms of observed and parent/teacher reported EF.

Academic functioning

As seen in Table 3, there was a significant time effect for the WJ-III, $F(1, 44) = 11.06$, $p < .01$, $d = .23$. However, there was no significant time X condition effect, $F(1, 44) = 0.32$, $p = .57$. Regardless of condition, all children improved academically.

Table 3. Academic and executive functioning outcomes.

	Pre *M* (*SE*)	Post *M* (*SE*)	Time x Group *F*	Time effect *F*
Executive functioning				
AWMA – average			0.70	**43.46*****
Adaptive	82.60 (2.99)	91.35 (2.22)	–	–
Nonadaptive	85.06 (2.17)	92.85 (2.18)	–	–
HTKS – total			0.10	**51.93*****
Adaptive	3.24 (1.32)	9.81 (2.57)	–	–
Non-adaptive	6.41 (1.29)	16.68 (2.52)	–	–
BRIEF – EMC (P)			2.47	**72.69*****
Adaptive	74.18 (2.87)	55.40 (2.45)	–	–
Nonadaptive	69.88 (2.97)	58.55 (2.39)	–	–
BRIEF – EMC (T)			0.05	**7.17***
Adaptive	65.54 (2.90)	58.65 (2.50)	–	–
Nonadaptive	65.44 (2.83)	62.12 (2.42)	–	–
Academic functioning				
WJ-III – average			0.32	**11.06****
Adaptive	91.36 (3.19)	95.53 (3.25)	–	–
Nonadaptive	97.07 (3.12)	103.28 (3.20)	–	–

Note. Means and SEs are marginal estimates after controlling for age and ethnicity. *$p < .05$, **$p < .01$, ***$p < .001$. P = Parent report, T = Teacher report, AWMA – average = automated working memory assessment average standard score, HTKS – total = Head-toes-knees-shoulders total score, BRIEF – EMC = Behavior rating inventory of executive Function Preschool version Emergent Metacognition T-score, WJ-III = Woodcock-Johnson test of achievement-third edition average standard score.

Discussion

This study was among the first to examine the extent to which CWMT provided incremental benefits to a classroom-based EF curriculum for young children with EBP. The results from the current study demonstrated that children that were randomized to receive the nonadaptive cognitive training improved similarly across all domains (behavioral, academic, and EF) compared to children assigned to the adaptive cognitive training. However, all children who participated in the STP-PreK improved their behavioral, academic, and executive functioning as evident by parent, teacher, and observed/standardized measures. Implications of these findings are discussed below.

Prior research examining the efficacy of cognitive training programs in older children and adolescents have yielded mixed results (Rapport et al., 2009). Our findings with a younger sample were more consistent with emerging meta-analyses and reviews (Cortese et al., 2015, Simons et al., 2016), such that the effects of cognitive training did not generalize to academic or behavioral improvements (van der Donk et al., 2015). Furthermore, we did not even find near transfer effects of CWMT to working memory, or other aspects of EF. Transfer of learning theories, such as formal discipline, suggest that repeated practice generally improves performance, which is the guiding principle for cognitive training (Simons et al., 2016). However, transfer effects are largely content and context dependent, so the specificity of cognitive training limits generalizability to more complex processes such as EF (Stine-Morrow and Basak, 2011).

This study was among the first to systematically examine the potential for cognitive training to improve EF in a preschool sample with EBP. Our null near-transfer effects are consistent with Sala and Gobet (2017), who found that when controlling for placebo effects (i.e., similar to our active control condition), the near-transfer effects become quite small, especially within an atypical population. It may be the case that for preschoolers with ADHD, the content of CWMT does not facilitate generalization of EF skills (near- or far-transfer effects) or academic/behavioral improvements (far-transfer effects) more broadly. Similarly, as discussed in the review by Peijnenborgh et al. (2016), cognitive training is not a "one size fits all" model, such that focusing solely on working memory does not capture the core deficits across presentations and subtypes of ADHD. However, it is also important to note that such cognitive training was conducted within an intensive behavioral modification program that also included a brief EF classroom period. These EF games may more broadly address some of the deficits seen across presentations of ADHD, such as behavioral inhibition, motivation, and planning/sequencing, along with working memory (Peijnenborgh et al., 2016). Thus, it appears that CWMT simply does not add any incremental value to improving children with EBP's adaptive functioning when embedded within a more comprehensive psychosocial intervention such as the STP-PreK.

Consistent with our hypotheses, we found significant improvements in children's behavioral, academic, and executive functioning. These findings align with prior research examining the STP-PreK (Graziano and Hart, 2016, Graziano et al., 2014) demonstrating improvements across various domains, including a reduction in ADHD symptomology. Such improvements within the behavioral domain is not surprising given that the STP-PreK also includes a parent training component. Parent training is the first line of treatment for young children with ADHD and EBP with numerous studies supporting its effect on children's behavioral functioning (Chronis et al., 2004, Pelham and Fabiano, 2008, Kaminski et al., 2008, Comer, Chow, Chan, Cooper-Vince, & Wilson, 2013). On the other hand, the continued success of the STP-PreK in targeting children's academic and executive functioning is noteworthy as parent training programs have traditionally not been successful addressing academic and executive functioning impairments (Graziano and Hart, 2016, Kaminski et al., 2008). Thus, it appears that the inclusion of an academic and social-emotional/self-regulation classroom curriculum in a daily camp along with more traditional behavioral parent training contributes to the STP-PreK's success in targeting children's academic and executive functioning.

Strengths of this study include the randomized design where parents and teachers were unaware of the CWMT condition to which the child was assigned. Prior research did not include randomization, and even recently, reporters have typically been unblinded to treatment condition, such that parents/teachers knew the children were receiving training, leading to a possible illusory reported bias (Rapport et al., 2009). Furthermore, when controlling for blinded reporters, many of the previously significant effects became null findings (Cortese et al., 2015). The current study also examined the incremental effect of CWMT with a more comprehensive behavioral modification curriculum that includes classroom EF circle time games, which could potentially yield greater, more robust effects than cognitive training alone. Finally, the measurement of EF was multimodal utilizing multiple informants, as well as direct assessment. As discussed by Shipstead, Redick, and Engle (2012), using single tasks to define change in ability raises concern, and is an overrepresentation of what may be occurring with near- and far-transfer effects of cognitive training. Indeed, prior research was limited to task performance only (Thorell et al., 2009; Rueda et al., 2012), or failed to integrate measures of both near transfer effects (i.e., task performance) and far transfer effects (reported measures and academic achievement outcomes (Rapport et al., 2009). However, our study examined multiple measures of EF at both time points, which provide a stronger evaluation of cognitive training outcomes and the lack of near- or far-transfer effects.

There were also limitations to the current study. Most notably, there was no true control condition as all children received some version of the STP-PreK. Additionally, while we chose to randomize the CWMT, this randomization meant that the EF games period remained as part of both the nonadaptive and adaptive conditions. Alternatively, we could have randomized the EF games period and kept the CWMT as part of the standard STP-PreK's EF curriculum. However, we chose randomizing CWMT given the additional costs that it may yield for current clinical practices that are recommending for families to use at home (http://www.cogmed.com). It may also be more practical to implement free EF games rather than computerized training given the expensive costs associated per child. Additionally, the current study did not include a follow-up assessment period. Thus, it is possible that children in the adaptive CWMT experienced either additional improvements or better maintenance of the treatment effects across time. Future research should examine the potential sleeper effect of CWMT on children's school functioning. Furthermore, the sample for this study was homogenous, largely Hispanic (76%), limiting the generalizability of these results to other settings and populations. However, this limitation can also be viewed as a strength as Hispanic children are the fastest growing minority in the country, and are largely understudied in research (LaGreca, Silverman, & Lochman, 2009). Lastly, our sample had relatively lower levels of general intelligence, albeit still within the low average range, compared to previous cognitive training trials with typically developing children (Peijnenborgh et al., 2016). However, the low average IQ in our sample may be representative of a community referred clinical sample, and is consistent with previous cognitive training research with children with disabilities (Peijnenborgh et al., 2016). The extent to which lower overall cognitive functioning impacts the lack of near- or far-transfer effects remains an important question for future work.

Despite the limitations of the current study, our findings have clinical implications. For preschool children with EBP, CWMT does not appear to provide any incremental benefits to children's EF, behavior, or academics when implemented within a comprehensive behavioral modification intervention that also included a brief EF classroom period. However, the results from this study provide continued support for the STP-PreK in improving school readiness outcomes. Given the expensive cost of cognitive training, this study, along with a larger body of literature (Cortese et al., 2015) suggests that CWMT should not be implemented as either a stand-alone intervention for children with EBP nor as an adjunctive intervention. Rather, it provides support for the implementation of an EF games period in classrooms, along with behavior modification.

The results of our study, in combination with many meta-analyses (Melby-Lervåg et al., 2016, Sala and Gobet, 2017, Soveri et al., 2017) demonstrates that cognitive training fails to provide strong evidence for far-transfer effects. Future research should move beyond the traditional cognitive training, and expand to more innovative technology, such as virtual reality. For example, virtual reality has been effective in treating phobias and Post Traumatic Stress Disorder by simulating real-life situations (Botella, Serrano, Baños, & Garcia-Palacios, 2015). It will be important for future work to use virtual reality to create situations more analogous to the classroom setting, in which demands for self-regulation and advanced cognitive performance are necessary for school success. By expanding beyond the technologically outdated cognitive interventions and laboratory tasks, virtual reality could be an important next step in the realm of behavioral intervention.

Acknowledgments

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R324A120136 as well as a local grant from The Children's Trust (1329-7290) to the third author. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education or The Children's Trust. We would also like to acknowledge the support of Miami-Dade County Public Schools and thank the families and dedicated staff who participated in the study.

Funding

This work was supported by the Institute of Education Sciences [R324A120136];The Children's Trust [1329-7290].

References

Alloway, T. P, Gathercole, S. E, Kirkwood, H, and Elliott, J. (2008). Evaluating the validity of the automated working memory assessment. *Educational Psychology*, *28*(7), 725-734.

Alloway, T. P., Gathercole, S. E., and Pickering, S. J. (2004). Automated working memory assessment [Computerised test battery].

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed. ed.). Washington, DC: Author.

Blair, C., and Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology*, *20*(3), 899–911.

Botella, C., Serrano, B., Baños, R. M., and Garcia-Palacios, A. (2015). Virtual reality exposure-based therapy for the treatment of post-traumatic stress disorder: A review of its efficacy, the adequacy of the treatment protocol, and its acceptability. *Neuropsychiatric Disease and Treatment*, *11*, 2533.

Calkins, S. D. (2007). The emergence of self-regulation: Biological and behavioral control mechanisms supporting toddler competencies. *In* C. A. Brownell & C. B. Kopp (Eds.), *Socioemotional development in the toddler years: Transitions and transformations* (pp. 261–284). New York, NY: Guilford Press.

Chronis, A. M., Chacko, A., Fabiano, G. A., Wymbs, B. T., and Pelham, W. E. (2004). Enhancements to the behavioral parent training paradigm for families of children with ADHD: Review and future directions. *Clinical Child and Family Psychology Review*, *7*(1), 1–27.

Comer, J. S., Chow, C., Chan, P. T., Cooper-Vince, C., and Wilson, L. A. (2013). Psychosocial treatment efficacy for disruptive behavior problems in very young children: A meta-analytic examination. *Journal of the American Academy of Child & Adolescent Psychiatry*, *52*(1), 26–36.

Cortese, S., Ferrin, M., Brandeis, D., Buitelaar, J., Daley, D., Dittmann, R. W., … Zuddas, A. (2015). Cognitive training for attention-deficit/hyperactivity disorder: Meta-analysis of clinical and neuropsychological outcomes from randomized controlled trials. *Journal of the American Academy of Child & Adolescent Psychiatry*, *54*(3), 164–174.

Diamond, A., and Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, *333*(6045), 959–964.

Domitrovich, C., Durlak, J., Goren, P., and Weissberg, R. (2013). *Effective social and emotional learning programs: Preschool and elementary school edition*. Chicago, IL: CASEL.

Douglas, V. I. (2005). Cognitive deficits in children with attention deficit hyperactivity disorder: A long-term follow-up. *Canadian Psychology/Psychologie Canadienne*, *46*(1), 23.

Garon, N., Bryson, S. E., and Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin*, *134*(1), 31.

Gioia, G. A., Isquith, P. K., Guy, S. C., and Kenworthy, L. (2000). *Behavior Rating Inventory of Executive Function: BRIEF*. Odessa, FL: Psychological Assessment Resources.

Graziano, P. A., and Hart, K. (2016). Beyond behavior modification: Benefits of social–Emotional/self-regulation training for preschoolers with behavior problems. *Journal of School Psychology*, *58*, 91–111.

Graziano, P. A., Reavis, R. D., Keane, S. P., and Calkins, S. D. (2007). The role of emotion regulation in children's early academic success. *Journal of School Psychology*, *45*(1), 3–19.

Graziano, P. A., Ros, R., Hart, K. C., and Slavec, J. (2018). Summer treatment program for preschoolers with externalizing behavior problems: A preliminary examination of parenting outcomes. *Journal of Abnormal Child Psychology*, 46(6), 1253–1265.

Graziano, P. A., Slavec, J., Hart, K., Garcia, A., and Pelham, W. E. (2014). Improving school readiness in preschoolers with behavior problems: Results from a summer treatment program. *Journal of Psychopathology and Behavioral Assessment*, *36*(4), 555–569.

Hambrick, D. Z. (2014). Brain training doesn't make you smarter. Retrieved from https://www.scientificamerican.com/article/brain-training-doesn-t-make-you-smarter/

Kaminski, J. W., Valle, L. A., Filene, J. H., and Boyle, C. L. (2008). A meta-analytic review of components associated with parent training program effectiveness. *Journal of Abnormal Child Psychology*, *36*(4), 567–589.

La Greca, A. M., Silverman, W. K., and Lochman, J. E. (2009). Moving beyond efficacy and effectiveness in child and adolescent intervention research. *Journal of Consulting and Clinical Psychology*, *77*(3), 373.

McClelland, M. M., Cameron, C. E., Duncan, R., Bowles, R. P., Acock, A. C., Miao, A., and Pratt, M. E. (2014). Predictors of early growth in academic achievement: The head-toes-knees-shoulders task. *Frontiers in Psychology*, *5*, 599.

Melby-Lervåg, M., Redick, T. S., and Hulme, C. (2016). Working memory training does not improve performance on measures of intelligence or other measures of "far transfer" evidence from a meta-analytic review. *Perspectives on Psychological Science*, *11*(4), 512–534.

Peijnenborgh, J. C., Hurks, P. M., Aldenkamp, A. P., Vles, J. S., and Hendriksen, J. G. (2016). Efficacy of working memory training in children and adolescents with learning disabilities: A review study and meta-analysis. *Neuropsychological Rehabilitation*, *26*(5–6), 645–672.

Pelham, W. E., Jr, and Fabiano, G. A. (2008). Evidence-based psychosocial treatments for attention-deficit/hyperactivity disorder. *Journal of Clinical Child & Adolescent Psychology*, *37*(1), 184–214.

Pelham, W. E., Jr, Gnagy, E. M., Greenslade, K. E., and Milich, R. (1992). Teacher ratings of DSM-III-R symptoms for the disruptive behavior disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, *31*(2), 210–218.

Pelham, W. E., Gnagy, E. M., Greiner, A. R., Waschbusch, D. A., Fabiano, G. A., and Burrows-Maclean, L. (2010). Summer treatment programs for attention-deficit/hyperactivity disorder. *Evidence-Based Psychotherapies for Children and Adolescents*, *2*, 277–292.

Pennington, B. F., and Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *37*(1), 51–87.

Ponitz, C. C., McClelland, M. M., Matthews, J. S., and Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. *Developmental Psychology*, *45*(3), 605.

Ponitz, C. E. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., and Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly*, *23*(2), 141–158.

Rapport, M. D., Bolden, J., Kofler, M. J., Sarver, D. E., Raiker, J. S., and Alderson, R. M. (2009). Hyperactivity in boys with attention-deficit/hyperactivity disorder (ADHD): A ubiquitous core

symptom or manifestation of working memory deficits? *Journal of Abnormal Child Psychology*, *37*(4), 521–534.
Rapport, M. D., Orban, S. A., Kofler, M. J., and Friedmxan, L. M. (2013). Do programs designed to train working memory, other executive functions, and attention benefit children with ADHD? A meta-analytic review of cognitive, academic, and behavioral outcomes. *Clinical Psychology Review*, *33*(8), 1237–1252.
Redick, T. S., Shipstead, Z., Wiemers, E. A., Melby-Lervåg, M., and Hulme, C. (2015). What's working in working memory training? An educational perspective. *Educational Psychology Review*, *27*(4), 617–633.
Reynolds, C. R., and Kamphaus, R. W. (1992). *Behavior assessment system for children: Manual.* Circle Pines, MN: American Guidance Service.
Rimm-Kaufman, S. E., and Pianta, R. C. (2000). An ecological perspective on the transition to kindergarten: A theoretical framework to guide empirical research. *Journal of Applied Developmental Psychology*, *21*(5), 491–511.
Roche, J. D., and Johnson, B. D. (2014). Cogmed working memory training product review. *Journal of Attention Disorders*, *18*(4), 379–384.
Rubin, D. B. (1987). Comment. *Journal of the American Statistical Association*, *82*, 543–546.
Rueda, M. R., Checa, P., and Cómbita, L. M. (2012). Enhanced efficiency of the executive attention network after training in preschool children: Immediate changes and effects after two months. *Developmental Cognitive Neuroscience*, *2*, S192–S204.
Sala, G., and Gobet, F. (2017). Working memory training in typically developing children: A meta-analysis of the available evidence. *Developmental Psychology*, *53*(4), 671.
Schmitt, S. A., McClelland, M. M., Tominey, S. L., and Acock, A. C. (2015). Strengthening school readiness for head start children: Evaluation of a self-regulation intervention. *Early Childhood Research Quarterly*, *30*, 20–31.
Schoemaker, K., Mulder, H., Deković, M., and Matthys, W. (2013). Executive functions in preschool children with externalizing behavior problems: A meta-analysis. *Journal of Abnormal Child Psychology*, *41*(3), 457–471.
Shaffer, D., Fisher, P., Lucas, C. P., Dulcan, M. K., and Schwab-Stone, M. E. (2000). NIMH diagnostic interview schedule for children version IV (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. *Journal of the American Academy of Child & Adolescent Psychiatry*, *39*(1), 28–38.
Shipstead, Z., Redick, T. S., and Engle, R. W. (2012). Is working memory training effective? *Psychological Bulletin*, *138*(4), 628.
Simons, D. J., Boot, W. R., Charness, N., Gathercole, S. E., Chabris, C. F., Hambrick, D. Z., and Stine-Morrow, E. A. (2016). Do "brain-training" programs work? *Psychological Science in the Public Interest*, *17*(3), 103–186.
Soveri, A., Antfolk, J., Karlsson, L., Salo, B., and Laine, M. (2017). Working memory training revisited: A multi-level meta-analysis of n-back training studies. *Psychonomic Bulletin & Review*, *24*(4), 1077–1096.
Stine-Morrow, E. A. L, and Basak, C. (2011). Cognitive interven- tions. In (Eds.), *Handbook of the psychology of aging*, (7th Ed). (pp. 153–170). New York, NY: Elsevier.
Tamm, L., Nakonezny, P. A., and Hughes, C. W. (2014). An open trial of a metacognitive executive function training for young children with ADHD. *Journal of Attention Disorders*, *18*(6), 551–559.
Thorell, L. B., Lindqvist, S., Bergman Nutley, S., Bohlin, G., and Klingberg, T. (2009). Training and transfer effects of executive functions in preschool children. *Developmental Science*, *12*(1), 106–113.
Tominey, S. L., and McClelland, M. M. (2011). Red light, purple light: Findings from a randomized trial using circle time games to improve behavioral self-regulation in preschool. *Early Education & Development*, *22*(3), 489–519.
Ursache, A., Blair, C., and Raver, C. C. (2012). The promotion of self-regulation as a means of enhancing school readiness and early achievement in children at risk for school failure. *Child Development Perspectives*, *6*(2), 122–128.

van der Donk, M., Hiemstra-Beernink, A. C., Tjeenk-Kalff, A., Van der Leij, A., and Lindauer, R. (2015). Cognitive training for children with ADHD: A randomized controlled trial of cogmed working memory training and ‘paying attention in class’. *Frontiers in Psychology*, *6*, 1081.

Vinogradov, S., Fisher, M., and de Villers-Sidani, E. (2012). Cognitive training for impaired neural systems in neuropsychiatric illness. *Neuropsychopharmacology*, *37*(1), 43.

Wechsler, D. (2012). *Wechsler preschool and primary scale of intelligence*. (4th Ed.).San Antonio, TX: Psychological Corporation

Welsh, M. C. (2002). Developmental and clinical variations in executive functions. In D. L. Molfese & V. J. Molfese (Eds.), *Developmental variations in learning: Applications to social, executive function, language, and reading skills* (pp. 139–185). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Wichstrøm, L., Berg-Nielsen, T. S., Angold, A., Egger, H. L., Solheim, E., and Sveen, T. H. (2012). Prevalence of psychiatric disorders in preschoolers. *Journal of Child Psychology and Psychiatry*, *53*(6), 695–705.

Woodcock, R. W., McGrew, K. S., and Mather, N. (2001). *Woodcock-Johnson tests of achievement*. Itasca, IL: Riverside Publishing.