

Self-Regulation Assessment Among Preschoolers With Externalizing Behavior Problems

Paulo A. Graziano
Florida International University

Janine Slavec
University of Maine

Rosmary Ros, Leanna Garb, Katie Hart, and Alexis Garcia
Florida International University

This study examined the construct validity and clinical utility of a brief self-regulation assessment (Head-Toes-Knees-Shoulders, HTKS) among a clinical sample of children with externalizing behavior problems (EBP). Participants for this study included 101 preschool children (72% male; $M_{\text{age}} = 5.10$ years; 79% Hispanic) with at-risk or clinically elevated levels of EBP. Self-regulation measures included the HTKS task, 4 standardized subtests from the Automated Working Memory Assessment (AWMA), parent and teacher reports of children's executive functioning (EF), and children's self-regulation performance across a series of executive functioning classroom games conducted as part of a summer treatment camp. Additional outcomes included school readiness as measured by standardized achievement tests, and parent and teacher reports of kindergarten readiness and behavioral impairment related to academic functioning. Performance on the HTKS task was moderately correlated with children's performance on the standardized working memory tasks and observed self-regulation performance in the classroom. Low to moderate correlations were observed between performance on the HTKS task and parent report of children's EF difficulties, as well as parent and teacher reports of children's kindergarten readiness and behavioral impairment related to academic functioning. Moderate to high correlations were observed between performance on the HTKS task and standardized academic outcomes. These findings highlight the promise of the HTKS task as a brief, ecologically valid, and integrative EF task tapping into both behavioral and cognitive aspects of self-regulation that are important for children with EBP's success in school.

Keywords: school readiness, self-regulation, executive functioning, externalizing behavior problems, preschool

Externalizing behavior problems (EBP), including aggression, noncompliance, inattention, hyperactivity, and impulsivity represent the most frequent concerns cited in children's mental health, primary care, and educational settings (Cormier, 2008). Epidemiological studies estimate that between 15% and 20% of preschoolers experience social, emotional, and behavioral problems (Gothelf et al., 2006; Lavigne et al., 1996; Pianta & Caldwell, 1990; Van

Hulle, Rodgers, D'Onofrio, Waldman, & Lahey, 2007). Rates of EBP reported by teachers are even higher, suggesting that up to 25% of kindergarteners experience difficulties sitting still, following directions, and/or working independently (McClelland, Morrison, & Holmes, 2000). Early difficulties in behavioral functioning are associated with worse academic and social outcomes, such as low literacy scores (Lonigan et al., 1999), academic difficulties in kindergarten and 1st grade (Bulotsky-Shearer & Fantuzzo, 2011), and peer rejection in kindergarten (Keane & Calkins, 2004). Given the aforementioned negative trajectories associated with EBP, early identification and subsequent remediation of such difficulties may be necessary to promote a successful transition to kindergarten. The purpose of the present study was to examine the validity and utility of the Head-Toes-Knees-Shoulders task (HTKS; Ponitz, McClelland, Matthews, & Morrison, 2009) as a measure of self-regulation in a sample of preschoolers with EBP. Within this clinical population, the current study also sought to examine the predictive validity of self-regulatory skills, as measured by the HTKS, in relation to academic and socioemotional domains of school readiness.

Behavioral, social, and emotional abilities described as necessary for optimal functioning fall under the broad domain of *self-regulatory abilities* (Baumeister & Vohs, 2004), wherein "self-regulation" refers to the skills and processes associated with the

This article was published Online First March 30, 2015.

Paulo A. Graziano, Center for Children and Families & Department of Psychology, Florida International University; Janine Slavec, Department of Psychology, University of Maine; Rosmary Ros, Leanna Garb, Katie Hart, and Alexis Garcia, Center for Children and Families & Department of Psychology, Florida International University.

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). 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.

Correspondence concerning this article should be addressed to Paulo A. Graziano, Center for Children and Families & Department of Psychology, Florida International University, Miami, FL 33199. E-mail: pgraziano@fiu.edu

direction, planning, and control of attention, cognition, emotion, and action (Cameron Ponitz et al., 2008). Traditionally, self-regulation has included aspects of behavioral regulation, including delaying gratification, modulating arousal, and following instructions (Kopp, 1982). More recently, executive functioning (EF) has emerged as a critical factor underlying the development and control of behavioral and cognitive aspects of self-regulation (Ursache, Blair, & Raver, 2012). Although multiple definitions of EF have been proposed (Jurado & Rosselli, 2007), strong support exists for a model consisting of core neuropsychological skills that include cognitive flexibility, working memory, and inhibitory control (Miyake et al., 2000). As such, EF and self-regulation more broadly encompass elements of both cognitive and behavioral control. Accurate measurement of self-regulatory functioning therefore requires tools sensitive to the neuropsychological aspects of EF, namely those tapped by the HTKS task.

Successful classroom functioning and behavioral regulation require children to effectively use each of the core EFs. Cognitive flexibility refers to the ability of intentionally disengaging from a current behavior or way of thinking and reengaging in a different manner (Daffner & Searl, 2008). It allows the back and forth transfer of attention between multiple tasks and plays a role in filtering task-relevant from task-irrelevant stimuli. In a classroom setting this may be illustrated as the ability to attend to teacher instructions despite a distracting classroom environment (Anderson, 2002; Monsell, 1996). Working memory refers to the processes involved in the temporary storage and manipulation of information (Baddeley, 1996; Miyake & Shah, 1999). It enables children to remember classroom rules while participating in activities (McClelland et al., 2007; Senn, Espy, & Kaufmann, 2004). Lastly, inhibitory control refers to the deliberate inhibition of an automatic response (Miyake et al., 2000), such as engaging in reflection before acting (e.g., raising hand instead of shouting an answer; Barkley, 1997). Together, these abilities comprise the construct of EF, which in turn subserves and supports the mechanisms necessary for self-regulatory processes (Hofmann, Schmeichel, & Baddeley, 2012).

Self-regulation skills, including EF abilities, are particularly important for early classroom behavioral and academic functioning. Individual differences in EF have been shown to be concurrently and longitudinally associated with children's math and literacy scores in preschool, kindergarten, and 1st grade (Blair & Razza, 2007; Clark, Pritchard, & Woodward, 2010; Espy et al., 2004; McClelland et al., 2007; Welsh, Nix, Blair, Bierman, & Nelson, 2010). Unfortunately, teachers report that a large proportion of preschoolers do not possess the adequate self-regulatory skills that are necessary for a successful transition to kindergarten (West, Denton, & Reaney, 2001). Deficits in self-regulation skills are disproportionately higher in preschoolers who display at-risk or clinically elevated levels of EBP (Kupersmidt, Bryant, & Willoughby, 2000; Nolan, Gadow, & Sprafkin, 2001; Upshur, Wenz-Gross, & Reed, 2009). Identification and assessment of self-regulation deficits among preschoolers may, therefore, be a useful means of determining which children are at risk for early school difficulties.

Extant measures of child self-regulatory functioning include structured and unstructured lab assessments, many of which, rely solely on observation and have been found to be inefficient for identifying children at-risk for self-regulation difficulties during

the transition to kindergarten (Blair, Zelazo, & Greenberg, 2005; Carlson, 2005; Smith-Donald, Raver, Hayes & Richardson, 2007). Observational methods, that typically measure disappointment, frustration, or utilize separation paradigms, infer the expression of emotional or behavioral intent through gestures, facial expression, and verbal behavior (e.g., Calkins, Gill, Johnson, & Smith, 1999; Cole, Zahn-Waxler, & Smith, 1994; Molitor, Mayes, & Ward, 2003). Still, these assessments are often limited by a focus on the emotional aspects of self-regulation, require extensive coder training, and include lengthy observational protocols (Degnan, Calkins, Keane, & Hill-Soderlund, 2008; Pfeifer, Goldsmith, Davidson, & Rickman, 2002; Smith-Donald, Raver, Hayes, & Richardson, 2007).

Questionnaires and/or neuropsychological assessment measures of self-regulation and EF have been proposed as alternatives to observational schemes. Parent and teacher reports of child functioning (e.g., Child Behavior Rating Scale, Bronson, Tivnan, & Seppanen, 1995; Behavior Rating Inventory of Executive Function [BRIEF], Gioia, Isquith, Guy, & Kenworthy, 2000) are easy to administer and are more time-efficient than lengthy observational protocols, yet are limited by the subjective nature of questionnaires. In contrast, neuropsychological or cognitive assessments offer an objective and direct means of evaluating specific indices of EF in isolation, such as attention (e.g., Attention Network Task; Rueda, Posner, & Rothbart, 2005) or working memory (e.g., Working Memory Test Battery for Children; Pickering & Gathercole, 2004). Still, these tasks often require specialized training and materials, which limit their widespread use (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Manly et al., 2001; Simpson & Riggs, 2006). Moreover, when focusing on isolated cognitive skills, researchers fail to assess children's ability to integrate multiple aspects of EF (e.g., working memory and inhibitory control) that are important for meeting the complex contextual day-to-day behavioral demands of a classroom.

The HTKS (Ponitz et al., 2009) and its predecessor, the Head-to-Toes Task (HTT; Cameron Ponitz et al., 2008) were developed to address the limitations of existing self-regulatory assessments. Developed as an observational self-regulatory measure for children ages 4 to 6, the HTKS is brief and does not require extensive assessor training or specialized materials. Initially, the task requires children to play a game where they follow paired behavioral commands (e.g., "touch your head"). Later, children are asked to provide an opposite behavior in response to a directive command (e.g., touching their shoulders when told "touch your knees"). The HTKS task involves an objective observation of behavioral regulation, defined as the manifestation of EFs in overt, observable responses via children's gross motor actions (Ponitz et al., 2009). Multiple components of EF are required to perform the HTKS task including *working memory* (that is required to remember the rules of the game), *cognitive flexibility* (that is required to alternate between responses as the items ["touch your head," "touch your toes"] alternate), and *inhibitory control* (that is required to stop exhibition of a prepotent motor response in favor of the correct opposite response). Hence, the HTKS task can be conceptualized as an integrative EF task tapping into both behavioral and cognitive aspects of self-regulation.

The HTKS task has been validated with two diverse samples drawn from separate locations in the United States (Cameron Ponitz et al., 2008; McClelland et al., 2007). Samples included

children from both Head Start and local preschools who were participating in a 5-year longitudinal study assessing various aspects of academic, cognitive, and behavioral functioning. Examination of the psychometric properties of the HTKS revealed 3-month test-retest reliability above .90 (Cameron Ponitz et al., 2008), high concurrent validity with parent ratings of attention and inhibitory control (Ponitz et al., 2009), and good concurrent validity with teacher ratings of children's self-regulation in preschool and kindergarten (McClelland et al., 2007; Ponitz et al., 2009). The predictive validity of the HTKS task has also been established as higher scores on the HTKS predict higher math, vocabulary, and early literacy scores several months later (McClelland et al., 2007; Ponitz et al., 2009).

Despite promising psychometric properties, it is important to note that the HTKS task has primarily been tested with normative populations and within at-risk populations, based on SES/family background variables (e.g., Head Start). Given the disproportionately elevated rates of EBP among Head Start preschoolers (Jones Harden et al., 2000), it is likely that children with EBP have been included in previous studies. However, the validity of the HTKS task within a strictly behaviorally impaired population remains unclear. Recommendations for establishing construct validity and clinical utility call for measurement with clinical populations of interest because target constructs, in this case, self-regulation and EF, may manifest differently across samples (Clark & Watson, 1995). Furthermore, although the task has been validated against parent report of attention and inhibitory control as well as with teacher ratings of classroom behavioral regulation (Ponitz et al., 2009), to our knowledge, its underlying constructs have not been tested against existing measures of neuropsychological functioning (e.g., working memory measures) or objective observational measures of self-regulatory skills. Lastly, although higher rates of EBP are associated with poorer behavioral self-regulation skills (e.g., Eisenberg, 2000), it is unclear whether the HTKS task provides additional or useful information, beyond parent or teacher reports, in assessing the academic, behavioral, and socioemotional aspects of school readiness among children with existing behavior problems.

Goals of the Current Study

The goal of the current study was to examine the validity of the HTKS task within a clinical sample of children with EBP. The construct validity of the HTKS task was examined via its associations with a neuropsychological battery of EF measures, parent and teacher reports, and observations in the classroom. The utility of the HTKS task was examined via concurrent associations with school readiness measures, including standardized achievement tests and parent/teacher reports of kindergarten readiness as well as behavioral impairment related to academic functioning. We expected that the HTKS task would have good construct validity in assessing behavioral and cognitive aspects of self-regulation through associations with parent/teacher reports and neuropsychological measures. We also expected that the HTKS would provide unique information regarding school readiness outcomes among preschoolers with EBP.

Method

Participants and Recruitment

The study was conducted at a large, urban university in the southeastern United States with a large Hispanic population. Children and their caregivers were recruited across two summers from local preschools and mental health agencies via brochures, radio and newspaper ads, and open houses/parent workshops for participation in a summer treatment program for prekindergarteners (STP-PreK). Interested parents were asked to call or speak with study staff to have the study explained to them and schedule a screening appointment to determine eligibility. There were 138 families who scheduled a screening appointment. The primary caregiver provided written consent before the start of the initial screening assessment. To qualify for the study participants were required to: (a) have an externalizing problems composite *T* score of 60 or above on the parent ($M = 66.21$, $SD = 13.30$) or teacher ($M = 67.12$, $SD = 13.89$) BASC-2 (Reynolds & Kamphaus, 2006) collected as part of the initial assessment, (b) be enrolled in preschool during the previous year, (c) have an estimated IQ of 70 or higher ($M = 91.15$, $SD = 15.04$) on the Wechsler Preschool and Primary Scale of Intelligence-Third or Fourth Edition (WPPSI-III; Wechsler, 2002; WPPSI-IV; Wechsler, 2012), (d) have no history of Autistic or Psychotic Disorder as per parental report during a semistructured interview, and (e) be able to attend the 8-week STP-PreK before the start of kindergarten (see Graziano, Slavec, Hart, Garcia, & Pelham, 2014 for a full description of the intervention). Thirty-seven families were excluded from this study because of: not completing the screening process ($n = 20$), having a significant developmental delay as evident by an IQ below 70 ($n = 5$), not being able to attend the STP-PreK for the full duration ($n = 6$), or not having significant behavior problems as measured via the BASC-2 ($n = 6$).

The final sample consisted of 101 preschool children (72% boys) with at-risk or clinically elevated levels of EBP whose parents provided informed consent to participate in the study. Study questionnaires were filled out primarily by mothers (89%). The mean age of the participating children was 5.19 years (range 4 to 6 years, $SD = 6$ months) with Hollingshead SES scores in the lower to middle class range ($M = 42.60$, $SD = 13.16$). In terms of the ethnic and racial makeup, 79% of the children were Hispanic-White, 12% were Non-Hispanic White, 6% were Black, and the remaining 3% identified as biracial/other. Sixty-four percent of the children were from an intact biological family, 32% were from a single biological parent household, and 4% were in an adoptive/foster family placement. Forty-nine percent of the sample were self-referred, 25% were referred by preschools, whereas the remaining 26% were referred by a mental health professional or physician.

According to the Diagnostic Interview Schedule for Children (C-DISC; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), conducted by mental health graduate students under the supervision of a licensed psychologist, 49% of children met *Diagnostic and Statistical Manual for Mental Disorders-Fourth Edition* (DSM-IV) criteria for both Attention-Deficit Hyperactivity Disorder (ADHD) and Oppositional Defiant Disorder (ODD) at the intake assessment. An additional 33% met criteria for ADHD-only whereas 7% met criteria for ODD-only. Of note, although the

C-DISC was originally developed for assessing children 6 years of age and older, several studies have documented the reliability and validity of the C-DISC for diagnosing disruptive behavior disorders in samples of children as young as 4 (Frick et al., 1994; Lahey, Loeber, Burke, & Applegate, 2005; Luby et al., 2002). Four children included in the present study had a prior diagnosis of Pervasive Developmental Disorder, Not Otherwise Specified. We included these children as their cognitive, motor, and/or language delays were not significant enough (e.g., IQ scores >70) to impair functioning or participation within the STP-PreK camp. Only one child was concurrently receiving psychotropic medication (stimulant).

Study Design and Procedure

This study was approved by the university's Institutional Review Board. Children recruited during the first year participated in the STP-PreK as part of an open trial while children in the second year participated in a randomized trial of the STP-PreK. Only children who met inclusion criteria and were able to participate in the STP-PreK (either open or randomized trials) were included in the present study. Results for the open trial have been reported elsewhere (Graziano, Slavec, Hart, Garcia, & Pelham, 2014). For the present study, the validity of the HTKS task as a brief self-regulation assessment before the start of the STP-PreK was examined.

As part of the pretreatment assessment, consenting caregivers brought their children to the laboratory on two occasions and were videotaped during several tasks. The tasks were standardized and children were given small breaks at the end of each activity to ensure that there were no carry over effects from one task to another. During the first visit, clinicians administered two subtests from the WPPSI-III (Wechsler, 2002) or WPPSI-IV (Wechsler, 2012), the Bracken School Readiness Assessment (BSRA; Bracken, 2002), and six subtests from the Woodcock-Johnson Test of Achievement-Third Edition (WJ-III; Woodcock, McGrew, & Mather, 2001). While in the laboratory, the consenting caregiver completed various questionnaires and participated in a structured interview (C-DISC; Shaffer et al., 2000). Eligible participants were invited to attend the second laboratory visit, where children were administered the HTKS task (Cameron Ponitz et al., 2008), along with four subtests from the Automated Working Memory Assessment (AWMA; Alloway, Gathercole, & Pickering, 2004). Additionally, children attending the STP-PreK participated in a daily 30-min self-regulation period throughout the 8-week program in which they engaged in various EF games (e.g., Red Light/Green Light, Orchestra) adapted from a series of circle time games shown to improve preschoolers' self-regulation (Tominey & McClelland, 2011).

All children involved in the present study were required to be fluent in English as administration of standardized academic measures (e.g., WPPSI, AWMA, Bracken, and WJ-III) could only be conducted in English. Thus, all child testing was conducted in English. In instances of parental bilingualism, parents were asked if they were more comfortable reading in English or Spanish and parent report forms/parent interview were provided in the language of choice. There were no significant differences in any variables reported between English and Spanish speaking parents.

Screening Measures

Externalizing behavior problems. To assess children's behavioral functioning, parents and teachers completed the Behavior Assessment System for Children-Second Edition (BASC-2; Reynolds & Kamphaus, 2004). The BASC-2 is a widely used behavior checklist that taps into emotional and behavioral domains of children's functioning. For the present study, the Preschool Form (ages 2–5, 134 total items) was used. Each item on the BASC-2 is rated on a 4-point scale with respect to the frequency of occurrence (*never, sometimes, often, and almost always*). The measure yields scores on broad internalizing, externalizing, and behavior symptom domains as well as specific adaptive/social functioning skills scales. The BASC-2 has well-established internal consistency, reliability and validity (Reynolds & Kamphaus, 2006). *T* scores of 60 to 69 fall in the "at-risk" range, whereas scores at or above 70 are considered "clinically significant" and suggest a high level of maladaptive behavior (Reynolds & Kamphaus, 2004). The externalizing behavior problems composite ($\alpha = .65-.80$), which assesses symptoms of hyperactivity, aggression, and conduct problems, was used as the primary screening measure.

Intelligence. For screening purposes, children were administered the Vocabulary and Block Design subtests of the WPPSI-III (Wechsler, 2002) or WPPSI-IV (Wechsler, 2012). These two subtests are useful for rapid screening and have been shown to be reliable in estimating children's full scale IQ (Sattler & Dumont, 2004).

Measures of Self-Regulation

EF-Standardized assessment 1. Children were administered the HTKS tasks (Cameron Ponitz et al., 2008), a widely used preschool measure for the assessment of multiple aspects of EF. In the HTKS task, children are initially provided with two paired behavioral rules (e.g., "touch your head" and "touch your toes") and are asked to follow these commands multiple times to ensure understanding and induce habituation. Next, children are instructed to switch and respond in a different or opposite way (e.g., when the experimenter says, "Touch your toes" the child should touch their head) across 10 test trials. The task then switches to a habituation condition in which children are again required to follow two other verbal commands (e.g., "touch your knees" and "touch your shoulders"). The final aspect of the task consists of 10 more test trials in which the children are required to remember both head/toes and knees/shoulders commands while responding to the opposite of what the experimenter asks (e.g., when the experimenter says "touch your knees" the child should touch their shoulders). The measure is scored such that 2 points are awarded for a correct opposite response, 0 points for an incorrect response, and 1 point if any motion to the incorrect response is made but then self-corrected. Scores range from 0 to 40, with higher scores indicating better EF.

EF—Standardized assessment 2. Children were individually administered four subtests from the AWMA (Alloway et al., 2004). The AWMA is a PC-based assessment of working memory skills for children and adults ages 4 through 22. Four subtests were chosen for inclusion in the present battery because of their ease of comprehension for young children and lack of reliance on (previously learned) academic information (e.g., recall of numbers). Subtests included: (a) Word Recall (auditory short-term memory

[STM]); (b) Listening Recall (auditory working memory); (c) Dot Matrix (visuospatial STM); and (d) Mister X (visuospatial working memory). In the Word Recall task, children are asked to repeat back a progressively longer series of one and two-syllable words, in order. In the Listening Recall task, children are first asked to judge the validity of a sentence (true/false) and then asked to recall the last word in the sentence. Additional sentences are progressively added to increase difficulty. During the Dot Matrix task, children are presented with a series of dots presented on a 4×5 grid, and asked to recall the spatial location of each dot, sequentially. During the Mister X task, children are presented with two similar cartoon figures each holding a ball in one hand. One of the figures is rotated between 45 and 315 degrees. Children are first asked to make a judgment about the spatial orientation of the figures (i.e., "Are they holding a ball in the same or different hands?") and are then asked to recall the location of the rotated figure's ball from six possibilities. Raw scores are converted to standard scores using gender and age norms. The AWMA has adequate test-retest reliability (.76, .83, .81, and .77 for Word Recall, Listening Recall, Dot Matrix, and Mister X, respectively; Alloway, Gathercole, & Pickering, 2006) and has established convergent validity with the working memory index of the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Alloway, Gathercole, Kirkwood, & Elliott, 2008; Wechsler, 2003). It has also demonstrated discriminant validity by distinguishing children with exclusive difficulties in working memory from children with disruptive behavior problems on behavioral rating scales of working memory function (e.g., BRIEF; Gioia et al., 2000) and academic measures (WISC-IV fluid intelligence; Engel de Abreu, Conway, & Gathercole, 2010). To reduce the number of analyses and given the high correlations among the four subtests ($r_s .66-.80, p < .001$), an average standardized score was calculated and used in subsequent analyses.

EF-Classroom. Children attending the STP-PreK participated in a 30-min self-regulation period (Monday through Thursday) in which they engaged in various EF games (e.g., Red Light/Green Light, Orchestra) adapted from a series of circle time games shown to improve preschoolers' self-regulation (Tominey & McClelland, 2011). During the first half of the period, all children in the classroom practiced the self-regulation skills provided as part of the activity and received feedback on their performance from counselors. After the practice period, children were informed that the "real game" would begin and the winner would receive an extra prize (e.g., sticker). During this competitive period, the game became progressively more difficult and children who did not follow the rules of the game were taken "out" of the game (e.g., child forgot to freeze when music stopped). This continued until only one child was left. The winners of circle time games were tracked by classroom counselors. In total, 30 days were assessed. Total number of wins was used as the measure of children's EF in the classroom.

EF—Parent and teacher report. Parents and teachers completed the BRIEF-P (Gioia, Espy, & Isquith, 2003). The parent and teacher versions contain 63 items rated on a 3-point Likert scale (*never, sometimes, and often*), which yield five nonoverlapping but correlated clinical scales (inhibit, shift, emotional control, working memory, and plan-organize) as well as two validity scales. Scores on these clinical scales are also summed to create composite indices 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 indicate poorer EF skills. The BRIEF-P has well-established internal consistency, reliability and validity (Isquith, Gioia, & Espy, 2004; Mahone & Hoffman, 2007). For the purpose of the present study, the emergent metacognition index raw score ($\alpha_s = .77-.79$), which focuses on the cognitive aspects of self-regulation was used as our parent and teacher measure of EF.

Measures of School Readiness

Academic school readiness. Children were individually administered the BSRA (Bracken, 2002), a widely used kindergarten readiness test that consists of five subtests assessing children's receptive knowledge of colors, letters, numbers/counting, sizes/comparisons, and shapes. The BSRA has strong psychometric properties and has been shown to be a strong predictor of children's academic outcomes (Bracken, 2002; Panter & Bracken, 2009). For the purposes of this study, the overall school readiness composite raw score was used.

Kindergarten readiness. Parents and teachers were also asked to complete the Kindergarten Behavior and Academic Competency Scale (KBACS; Hart & Graziano, 2013). The KBACS is a 24-item questionnaire that requires parents and teachers to rate the extent to which their child is ready for kindergarten across various domains (e.g., following classroom rules, completing academic work) along a 5-point scale (*poor, fair, average, above average, and excellent*). For the present study, the overall kindergarten readiness item was used as a measure of kindergarten readiness. The overall kindergarten readiness item asks parents and teachers to rate on a scale from 1 to 100 how ready they feel the child is in meeting the academic and behavioral demands of kindergarten. Higher scores indicate greater kindergarten readiness. Although the KBACS is a measure in development, preliminary data indicate that the overall readiness item shows excellent test-retest reliability ($ICC = .82$) and sensitivity to treatment effects (Graziano et al., 2014).

Academic functioning. Children were individually administered six subtests of the WJ-III (Woodcock et al., 2001), a widely used, norm-referenced measure of academic ability that has excellent psychometric properties (Mather & Woodcock, 2001). The six subtests administered were Applied Problems, Calculation, Writing Samples, Letter-Word Identification, Passage Comprehension, and Spelling. The current study examined the derived composite scores: *Brief Reading* (Letter-Word Identification + Passage Comprehension), *Brief Math* (Applied Problems + Calculation), and *Brief Writing* (Spelling + Writing Samples).

Behavioral impairment related to academic functioning. Parents and teachers completed the Impairment Rating Scale (IRS; Fabiano et al., 2006). The IRS measures the severity of children's impairment in multiple areas across six items rated on a 7-point Likert scale ranging from 0 = *no impairment* to 6 = *extreme impairment*. Areas of impairment included academic functioning, classroom functioning, self-esteem, relationships with peers/teachers, and overall functioning. The IRS has well-established internal consistency, cross-informant reliability and convergent and divergent validity with other measures of impairment (Fabiano et al., 2006). Consistent with the current study's focus on school readi-

ness, the extent to which children's behavior problems were impairing their *academic functioning* in the classroom was examined.

Data Analysis Plan

All analyses were conducted using the Statistical Package for the Social Sciences, version 19.0 (SPSS 19.0, Chicago, IL). There were no missing data for any parent reports or the HTKS task. However, neuropsychological testing and teacher data were missing from 33 participants. According to Little's missing at random test, there was no evidence to suggest the data were not missing at random ($\chi^2 = .09, p > .05$). Multiple imputation with five imputations was conducted, which is sufficient to accurately estimate the data for this sample size (Rubin, 1987). Preliminary analyses examined the extent to which children's performance on the HTKS task was related to demographic variables. To examine the construct validity and utility of the HTKS task, Pearson's bivariate correlations were conducted examining the HTKS task, all self-regulation measures, and school readiness outcomes. Lastly, hierarchical regression analyses were conducted to examine the extent to which performance on the HTKS task was uniquely associated with school readiness outcomes, after accounting for parental and teacher report of self-regulation.

Results

Preliminary Analyses

Descriptive statistics. Descriptive statistics for all outcome variables are presented in Table 1. Analysis of demographic

variables revealed a significant association between children's age at the start of the STP-PreK and their performance on the HTKS task, $r = .33, p < .001$, the neuropsychological battery (AWMA; $r = .38, p < .01$), kindergarten readiness (parent report; $r = .29, p < .01$) and standardized writing achievement, $r = .27, p < .05$. As expected, older children obtained higher scores on the HTKS task, the neuropsychological battery, standardized writing achievement assessment, and were reported by their parents as being better prepared for kindergarten. Therefore, all subsequent analyses controlled for child age. Preliminary analyses did not yield any other significant associations between demographic variables (e.g., SES, sex, marital status, parent/child ethnicity/race, and child adoption status) and self-regulation or school readiness outcomes.

Concurrent Validity: HTKS and Self-Regulation Measures

As seen in Table 2, performance on the HTKS task was significantly correlated with average standardized scores on the AWMA, $r = .45, p < .001$ as well as with self-regulation performance in the classroom, $r = .47, p < .001$. Specifically, children with higher scores on the HTKS task performed better across the working memory neuropsychological tasks and won more self-regulation games in the classroom. Children with higher scores on the HTKS task were also reported by parents as having fewer EF problems, $r = -.23, p < .05$. However, HTKS scores were unrelated to teacher ratings of EF problems, $r = -.18, p > .05$.

Table 1
Descriptive Statistics for Outcome Measures

	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Screening measures				
BASC-2: EBP Composite T-score (P)	66.21	13.30	41	115
BASC-2: EBP Composite T-score (T)	67.13	13.89	43	114
Child Full Scale IQ estimate (O)	91.15	15.05	62	130
Self-regulation measures				
HTKS Performance: Total raw score (O)	11.78	11.93	0	38
AWMA Performance: Listening recall standard score (O)	86.01	20.29	0	119
AWMA Performance: Word recall standard score (O)	84.62	25.52	0	124
AWMA Performance: Dot matrix standard score (O)	77.46	24.16	0	121
AWMA Performance: Mister X standard score (O)	96.83	27.07	0	150
Number of self-regulation games won in classroom (O)	1.66	2.14	0	10
BRIEF EF Difficulties: Emergent metacognition standard score (P)	72.09	14.14	41	105
BRIEF EF Difficulties: Emergent metacognition standard score (T)	66.71	13.88	41	95
School readiness measures				
KBACS: Overall raw score (P)	43.96	23.61	0	100
KBACS: Overall raw score (T)	48.46	26.82	0	100
IRS: Behavioral impairment related to academic functioning (P)	3.76	1.84	0	6
IRS: Behavioral impairment related to academic functioning (T)	3.94	2.01	0	6
Bracken: School readiness composite (O)	97.01	13.90	62	128
WJ-III: Brief reading composite (O)	103.07	14.45	67	151
WJ-III: Brief math composite (O)	94.84	18.04	51	140
WJ-III: Brief writing composite (O)	92.39	19.23	58	137

Note. O = observational measure; P = parent report measure; T = teacher report measure; EBP = externalizing behavior problems; BASC-2 = Behavior Assessment System for Children-Second Edition; KBACS = Kindergarten Behavior and Academic Competency Scale; BRIEF = Behavior Rating Inventory of Executive Function-Preschool; EF = executive functioning; AWMA = Automated Working Memory Assessment; IRS = Impairment Rating Scale; HTKS = Head-Toes-Knees-Shoulders Task; WJ-III = Woodcock-Johnson Test of Achievement-Third Edition.

Table 2
Correlations Among Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. HTKS performance (O)	—												
2. BRIEF: Emergent metacognition T-score (P)	-.23*	—											
3. BRIEF: Emergent metacognition T-score (T)	-.18	.22*	—										
4. AWMA Mean Performance SS (O)	.45***	-.18†	-.46***	—									
5. Number of self-regulation games won in classroom (O)	.47***	-.21*	-.23*	.43***	—								
6. KBACS: Overall raw score (P)	.30**	-.38***	-.38***	.27**	.27**	—							
7. KBACS: Overall raw score (T)	.23*	-.21†	-.52***	.45***	.35**	.45***	—						
8. IRS: Behavioral imp. related to academic functioning (P)	-.27**	.36***	.26*	-.39***	-.37***	-.28**	-.34***	—					
9. IRS: Behavioral imp. related to academic functioning (T)	-.18†	.15	.54***	-.31**	-.58***	-.39***	-.64***	.26*	—				
10. Bracken: School readiness composite (O)	.35***	-.21*	-.20*	.52***	.31**	.27**	.44***	-.23*	-.25*	—			
11. WJ-III: Brief reading composite (O)	.43***	-.41***	-.15	.42***	.47***	.36***	.40***	-.32**	-.33***	.56***	—		
12. WJ-III: Brief math composite (O)	.55***	-.43***	-.16	.53***	.48***	.34**	.17†	-.38***	-.18†	.53***	.64***	—	
13. WJ-III: Brief writing composite (O)	.40***	-.32**	-.24*	.51***	.37***	.43***	.42***	-.39***	-.38***	.54***	.65***	.58***	—

Note. O = observational measure/assessment; P = parent report measure; T = teacher report measure. All analyses controlled for children's age. KBACS = Kindergarten Behavior and Academic Competency Scale; BRIEF = Behavior Rating Inventory of Executive Function-Preschool; EF = executive functioning; AWMA = Automated Working Memory Assessment; IRS = Impairment Rating Scale; HTKS = Head-Toes-Knees-Shoulders Task; WJ-III = Woodcock-Johnson Test of Achievement-Third Edition.

† $p < .101$. * $p < .05$. ** $p < .011$. *** $p < .001$.

Utility: HTKS and School Readiness Outcomes

Performance on the HTKS task was positively associated with all standardized academic outcomes (r s .35 to .55, $p < .001$; see Table 2). Specifically, children who performed better on the HTKS task obtained higher math, reading, and writing scores on the WJ-III. Children who performed better on the HTKS task were also rated by teachers and parents on the KBACS as being better prepared academically and behaviorally for kindergarten ($r = .23$, $p < .05$ and $r = .30$, $p < .01$, respectively). Children with higher HTKS scores were also less likely to have their behavior problems impact their academic functioning ($r = -.27$, $p < .01$ for parent report and $r = -.18$, $p < .07$ for teacher report).

Regression Analyses

Hierarchical linear regressions were conducted to determine the extent to which performance on the HTKS task uniquely predicted school readiness outcomes, above and beyond parent and teacher reports of EF. As demonstrated in Tables 3 and 4, these analyses revealed a moderate to large effect for the overall association between self-regulation measures and children's academic outcomes on the WJ-III and BSRA (R^2 s = .13 to .42). Moderate effects sizes were also found between self-regulation measures and parent/teacher reports of school readiness on the KBACS and behavioral impairment related to academic functioning as measured by the IRS (R^2 s = .20 to .31). The examination of the standardized beta weights further indicated that performance on the HTKS task was positively associated with all standardized academic outcomes (β s = .29 to .51, $p < .01$), even when parent and teacher report of EF difficulties were entered into the model. Performance on the HTKS task was also significantly associated with parent report of school readiness on the KBACS and mar-

ginally associated with behavioral impairment related to academic functioning, even after taking into account parent and teacher report of EF difficulties. Of note, parent report of EF difficulties were significantly associated with two out of the four academic outcomes, with an additional marginal finding in the Writing domain (the only nonsignificant finding was with the BSRA). Parent-rated EF was also associated with parent reports of school readiness, even after taking teacher report and performance on the HTKS task into account. Lastly, teacher reports of EF difficulties were not uniquely associated with any standardized academic outcomes, but were associated with both parent and teacher reports of school readiness.

Discussion

This study supports the use of the HTKS task as a brief, ecologically valid, and integrative EF task tapping into both behavioral and cognitive aspects of self-regulation among children with EBP. The HTKS task demonstrated good construct validity when compared to: (a) an extensive working memory neuropsychological battery, (b) a direct observational measure of children's self-regulation in the classroom, and (c) parent-reported EF difficulties. Additionally, the HTKS showed good utility as evidenced by positive associations with both standardized academic tests and parent reports of school readiness as well as negative associations with parent reports of behavioral impairment related to academic functioning. Regression analyses further demonstrated continued associations with school readiness outcomes, even after accounting for parent/teacher reports of EF. The implications of our findings are discussed in further detail below.

The entrance to kindergarten coincides with a shift in environmental demands, including a decrease in support as compared with preschool (Rimm-Kaufman & Pianta, 2000). Therefore, it is not

Table 3

Model for Predicting School Readiness: Standardized Outcomes

	β	<i>T</i> -value	Model R^2	R^2 Change	<i>F</i> Change
Bracken: School readiness composite (O)					
Step 1. Child age	.32***	3.52	.18	.18	21.87***
Step 2. BRIEF EF difficulties: Emergent metacognition T-score (P)	-.10	-1.09	.31	.13	5.85**
BRIEF EF difficulties: Emergent metacognition T-score (T)	-.12	-1.14	—	—	—
HTKS performance: Total raw score (O)	.29**	3.12	—	—	—
WJ-III: Brief reading composite (O)					
Step 1. Child age	-.17	-1.37	.01	.01	.62
Step 2. BRIEF EF difficulties: Emergent metacognition T-score (P)	-.32**	-3.16	.31	.30	13.85***
BRIEF EF difficulties: Emergent metacognition T-score (T)	-.03	-.162	—	—	—
HTKS performance: Total raw score (O)	.38***	3.99	—	—	—
WJ-III: Brief math composite (O)					
Step 1. Child Age	-.14	-1.34	.00	.00	.372
Step 2. BRIEF EF difficulties: Emergent metacognition T-score (P)	-.31**	-3.03	.42	.42	23.37***
BRIEF EF difficulties: Emergent metacognition T-score (T)	-.02	-.101	—	—	—
HTKS performance: Total raw score (O)	.51***	4.79	—	—	—
WJ-III: Brief writing composite (O)					
Step 1. Child age	.14	1.39	.07	.07	7.84***
Step 2. BRIEF EF difficulties: Emergent metacognition T-score (P)	-.20†	-1.87	.29	.22	10.01***
BRIEF EF difficulties: Emergent metacognition T-score (T)	-.14	-1.32	—	—	—
HTKS performance: Total raw score (O)	.34**	3.46	—	—	—

Note. O = observational measure; P = parent report measure; T = teacher report measure; BRIEF = Behavior Rating Inventory of Executive Function-Preschool; EF = Executive Functioning; HTKS = Head-Toes-Knees-Shoulders Task; WJ-III = Woodcock-Johnson Test of Achievement, 3rd Edition.

† $p < .08$. * $p < .05$. ** $p < .01$. *** $p < .001$.

surprising that an emerging literature has documented the importance of children's self-regulation skills for fostering school readiness as measured by both academic and socioemotional outcomes (Blair, 2002). While the assessment of self-regulation difficulties among preschoolers may be a useful means of identifying children at-risk for early school difficulty, the complex nature of self-

regulation has contributed to a lack of ecologically valid, brief, and simple measures (McClelland & Cameron, 2012). EF, as measured by working memory and cognitive flexibility, has been a particularly important cognitive aspect of self-regulation as it relates to school readiness (Blair & Diamond, 2008). EF has traditionally been assessed via long neuropsychological batteries and despite

Table 4

Model for Predicting School Readiness: Parent/Teacher Outcomes

	β	<i>T</i> -value	Model R^2	R^2 Change	<i>F</i> Change
KBACS: Overall kindergarten readiness raw score (P)					
Step 1. Child age	.20*	2.16	.08	.08	8.90**
Step 2. BRIEF EF difficulties: Emergent metacognition T-score (P)	-.25**	-2.88	.33	.25	12.21***
BRIEF EF difficulties: Emergent metacognition T-score (T)	-.29**	-2.99	—	—	—
HTKS performance: Total raw score (O)	.21*	2.18	—	—	—
KBACS: Overall kindergarten Readiness raw score (T)					
Step 1. Child age	.08	.67	.03	.03	2.95+
Step 2. BRIEF EF difficulties: Emergent metacognition T-score (P)	-.07	-.628	.33	.30	14.51***
BRIEF EF difficulties: Emergent metacognition T-score (T)	-.48***	-4.56	—	—	—
HTKS performance: Total raw score (O)	.15	1.31	—	—	—
IRS: Behavioral impairment related to academic functioning (P)					
Step 1. Child age	-.02	-.16	.01	.01	1.12
Step 2. BRIEF EF difficulties: Emergent metacognition T-score (P)	.28**	2.78	.21	.20	7.47***
BRIEF EF difficulties: Emergent metacognition T-score (T)	.17	1.53	—	—	—
HTKS performance: Total raw score (O)	-.20†	-1.94	—	—	—
IRS: Behavioral impairment related to academic functioning (T)					
Step 1. Child age	.01	.082	.01	.01	.448
Step 2. BRIEF EF difficulties: Emergent metacognition T-score (P)	.01	.149	.32	.31	14.53***
BRIEF EF difficulties: Emergent metacognition T-score (T)	.53***	5.26	—	—	—
HTKS performance: Total raw score (O)	-.11	-1.08	—	—	—

Note. O = observational measure; P = parent report measure; T = teacher report measure; BRIEF = Behavior Rating Inventory of Executive Function-Preschool; EF = executive functioning; HTKS = Head-Toes-Knees-Shoulders Task; IRS = Impairment Rating Scale; KBACS = Kindergarten Behavior and Academic Competency Scale.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

the National Institute of Health's tool box initiative, "brief" batteries still take about 45 min to administer and require specialized training (Weintraub et al., 2013). The HTKS task differs from these batteries in that it requires less than 10 min of administration time. Furthermore, our findings extend the construct validity of the task by demonstrating associations between the HTKS and neuropsychological performance (i.e., self-regulation games, AWMA, and BRIEF) in a clinical population. Our findings, taken in conjunction with previous validation studies of the HTKS (e.g., Ponitz et al., 2009), suggest that the HTKS can be conceptualized as an integrative EF task tapping into both behavioral and cognitive aspects of self-regulation.

In addition to the more traditional cognitive aspects of self-regulation, it is important to recognize the important role of children's inhibitory or behavioral control in the classroom. Children who have difficulty controlling impulsive behaviors are more likely to experience co-occurring (Al Otaiba & Fuchs, 2002; Malecki & Elliot, 2002) and later academic difficulties (Masten et al., 2005; Risi, Gerhardstein, & Kistner, 2003). Additionally, teachers exhibit lower tolerance for children displaying poor behavioral control (Arbeau & Coplan, 2007) and report a more negative student-teacher relationship with these students (Graziano, Reavis, Keane, & Calkins, 2007; Pianta, Steinberg, & Rollins, 1995). These findings speak to the need for solid observational methods of assessing children's classroom self-regulation. Our findings, showing a positive association between performance on the HTKS task and children's observed self-regulation skills in the classroom, further extend the ecological validity of the HTKS task within a population of children with well documented behavioral control problems. Of note, the current study did not find a significant association between teacher report of EF and children's performance on the HTKS task. This null finding may be partially attributed to a restricted range in scoring because of the possibility of teachers rating children with EBP more positively than parents with respect to EF skills, thus making it difficult to obtain an association between the two measures. It is possible that parent ratings take into account cross-domain functioning, including both home and school behavior, which may result in higher (i.e., more severe) scores of EF problems. This discrepancy between parent and teacher reports again highlights the need for an observed, objective measure of self-regulation.

A major challenge for an observational and direct measure of a construct of interest is showing its utility in predicting outcomes above and beyond the field's gold standard (Johnston & Murray, 2003; Wakschlag et al., 2005). Parent and teacher reports of children's self-regulation and related constructs, such as attention and behavioral functioning, are considered the gold standard in developmental and clinical psychology (Pelham, Fabiano, & Massetti, 2005; Wakschlag et al., 2005). The current study provides compelling data revealing the utility of an observational measure, the HTKS task, through its association with multiple aspects of school readiness among children with EBP, even after accounting for parental and teacher reports of children's EF. Consistent with previous HTKS studies demonstrating a link between self-regulation and academic performance (Cameron Ponitz et al., 2008; McClelland et al., 2007), the current study found that performance on the HTKS task was related to standardized math, reading, and writing scores as well as parent report of school readiness for preschoolers with EBP. Of note, performance on the

HTKS task was not related to teacher reports of school readiness once parent and teacher report of children's EF was accounted for. However, these findings may be a function of shared method variance as teachers rated both EF and children's school readiness. Given the moderately high correlation between teacher rated EF and children's school readiness ($r = -.52$), there was little variance left in the outcome measures to be explained by the HTKS task. Nonetheless, the moderately high correlation between teacher-reported EF and school readiness does affirm the importance that teachers place on children's self-regulation skills as it relates to learning and subsequent educational achievement.

Some limitations to the current study should be addressed. First, although findings were statistically significant with moderate effect sizes, the cross-sectional aspect of this study precludes us from determining the directionality of our findings. Hence, it is feasible that children's academic difficulties further exacerbated self-regulation difficulties by decreasing children's positive attitude toward learning that may have led to self-control problems. Longitudinal work measuring children's self-regulation across multiple time points using cross-lagged models may be able to provide more conclusive findings on the directionality of the findings presented in the current study. Second, it is important to acknowledge that we only examined cognitive and behavioral aspects of self-regulation in relation to the HTKS task. However, children's ability to regulate their emotions has also been shown to be important for children's school readiness (Graziano et al., 2007; Raver, 2003). It will be important for future work to determine the extent to which performance on the HTKS task relates to individual differences in emotion regulation. If the HTKS task shows divergent validity with emotion regulation, it may be worthwhile for researchers to examine the viability of creating a brief emotion regulation assessment as current temperament batteries that assess children's emotion regulation require extensive coding procedures (Calkins et al., 1999; Carlson & Wang, 2007). A third limitation was the homogeneity of the sample, which was largely Hispanic (79%) because of the study's geographical location. However, the development of self-regulation among bilingual learners has been largely understudied and additional research with bilingual families is warranted (Oades-Sese, Esquivel, Kaliski, & Maniatis, 2011). Our findings showing the validity and utility of the HTKS task among not only a clinical group of children with EBP, but also a predominantly Hispanic sample, is consistent with previous HTKS research showing the validity of this measure across different cultures and societies (Wanless et al., 2013).

In summary, moving beyond the psychometric and conceptual shortcomings of examining different aspects of self-regulation in an isolated manner (see McClelland & Cameron, 2012), our findings highlight the promise of the HTKS task as a brief, ecologically valid, and integrative EF task tapping into both behavioral and cognitive aspects of self-regulation that are important for children's success in school. Equally important, our findings show that the HTKS task can be easily implemented within clinical populations, such as preschoolers with EBP. When viewed in conjunction with preliminary findings showing that the HTKS task is sensitive to intervention effects (Graziano et al., 2014; Tominey & McClelland, 2011), it appears that this task may be relevant for children with poor behavioral self-regulation. It will be important for larger studies to examine the extent to which the HTKS task can be used with other clinical populations (e.g., children with

learning disabilities) as well as compare clinical and nonclinical populations within the same study as this would provide a more robust test of the validity of the HTKS task. Finally, similar to challenges of more extensive EF tests, it will be important to determine whether the HTKS task can be adapted for use with a wider age range to provide insight into the development of children's integrated self-regulation skills.

References

- Alloway, T. P., Gathercole, S. E., Kirkwood, H. J., & Elliott, J. E. (2008). Evaluating the validity of the Automated Working Memory Assessment. *Educational Psychology, 28*, 725–734. <http://dx.doi.org/10.1080/01443410802243828>
- Alloway, T. P., Gathercole, S. E., & Pickering, S. J. (2004). The automated working memory assessment. Test battery available from authors.
- Alloway, T. P., Gathercole, S. E., & Pickering, S. J. (2006). Verbal and visuospatial short-term and working memory in children: Are they separable? *Child Development, 77*, 1698–1716. <http://dx.doi.org/10.1111/j.1467-8624.2006.00968.x>
- Al Otaiba, S., & Fuchs, D. (2002). Characteristics of children who are unresponsive to early literacy intervention: A review of the literature. *Remedial and Special Education, 23*, 300–316. <http://dx.doi.org/10.1177/07419325020230050501>
- Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. *Child Neuropsychology, 8*, 71–82. <http://dx.doi.org/10.1076/chin.8.2.71.8724>
- Arbeau, K. A., & Coplan, R. J. (2007). Kindergarten teachers' beliefs and responses to hypothetical prosocial, asocial, and antisocial children. *Merrill-Palmer Quarterly, 53*, 291–318. <http://dx.doi.org/10.1353/mpq.2007.0007>
- Baddeley, A. (1996). Exploring the central executive. *The Quarterly Journal of Experimental Psychology, 49*, 5–28. <http://dx.doi.org/10.1080/713755608>
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin, 121*, 65–94. <http://dx.doi.org/10.1037/0033-2909.121.1.65>
- Baumeister, R. F., & Vohs, K. D. (2004). *Handbook of self-regulation: Research, theory, and applications*. New York, NY: Guilford Press.
- Blair, C. (2002). School readiness. Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist, 57*, 111–127. <http://dx.doi.org/10.1037/0003-066X.57.2.111>
- Blair, C., & 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*, 899–911. <http://dx.doi.org/10.1017/S0954579408000436>
- Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78*, 647–663. <http://dx.doi.org/10.1111/j.1467-8624.2007.01019.x>
- Blair, C., Zelazo, P. D., & Greenberg, M. T. (2005). The measurement of executive function in early childhood. *Developmental Neuropsychology, 28*, 561–571. http://dx.doi.org/10.1207/s15326942dn2802_1
- Bracken, B. A. (2002). *Bracken school readiness assessment*. San Antonio, TX: The Psychological Corporation.
- Bronson, M. B., Tivnan, T., & Seppanen, P. S. (1995). Relations between teacher and classroom activity variables and the classroom behaviors of pre-kindergarten children in chapter 1 funded programs. *Journal of Applied Developmental Psychology, 16*, 253–282. [http://dx.doi.org/10.1016/0193-3973\(95\)90035-7](http://dx.doi.org/10.1016/0193-3973(95)90035-7)
- Bulotsky-Shearer, R. J., & Fantuzzo, J. W. (2011). Preschool behavior problems in classroom learning situations and literacy outcomes in kindergarten and first grade. *Early Childhood Research Quarterly, 26*, 61–73. <http://dx.doi.org/10.1016/j.ecresq.2010.04.004>
- Calkins, S. D., Gill, K. L., Johnson, M. C., & Smith, C. L. (1999). Emotional reactivity and emotional regulation strategies as predictors of social behavior with peers during toddlerhood. *Social Development, 8*, 310–334. <http://dx.doi.org/10.1111/1467-9507.00098>
- Cameron Ponitz, C. E., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly, 23*, 141–158. <http://dx.doi.org/10.1016/j.ecresq.2007.01.004>
- Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology, 28*, 595–616. http://dx.doi.org/10.1207/s15326942dn2802_3
- Carlson, S. M., & Wang, T. S. (2007). Inhibitory control and emotion regulation in preschool children. *Cognitive Development, 22*, 489–510. <http://dx.doi.org/10.1016/j.cogdev.2007.08.002>
- Clark, C. A. C., Pritchard, V. E., & Woodward, L. J. (2010). Preschool executive functioning abilities predict early mathematics achievement. *Developmental Psychology, 46*, 1176–1191. <http://dx.doi.org/10.1037/a0019672>
- Clark, L. A., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment, 7*, 309–319. <http://dx.doi.org/10.1037/1040-3590.7.3.309>
- Cole, P. M., Zahn-Waxler, C., & Smith, K. D. (1994). Expressive control during a disappointment: Variations related to preschoolers' behavior problems. *Developmental Psychology, 30*, 835–846. <http://dx.doi.org/10.1037/0012-1649.30.6.835>
- Cormier, E. (2008). ADHD: A review and update. *Journal of Pediatric Nursing, 23*, 345–357. <http://dx.doi.org/10.1016/j.pedn.2008.01.003>
- Daffner, K. R., & Searl, M. M. (2008). The dysexecutive syndromes. *Handbook of Clinical Neurology, 88*, 249–267. [http://dx.doi.org/10.1016/S0072-9752\(07\)88012-2](http://dx.doi.org/10.1016/S0072-9752(07)88012-2)
- Degnan, K. A., Calkins, S. D., Keane, S. P., & Hill-Soderlund, A. L. (2008). Profiles of disruptive behavior across early childhood: Contributions of frustration reactivity, physiological regulation, and maternal behavior. *Child Development, 79*, 1357–1376. <http://dx.doi.org/10.1111/j.1467-8624.2008.01193.x>
- Eisenberg, N. (2000). Emotion, regulation, and moral development. *Annual Review of Psychology, 51*, 665–697. <http://dx.doi.org/10.1146/annurev.psych.51.1.665>
- Engel de Abreu, P. M. J., Conway, A. R. A., & Gathercole, S. E. (2010). Working memory and fluid intelligence in young children. *Intelligence, 38*, 552–561. <http://dx.doi.org/10.1016/j.intell.2010.07.003>
- Espy, K. A., McDiarmid, M. M., Cwik, M. F., Stalets, M. M., Hamby, A., & Senn, T. E. (2004). The contribution of executive functions to emergent mathematic skills in preschool children. *Developmental Neuropsychology, 26*, 465–486. http://dx.doi.org/10.1207/s15326942dn2601_6
- Fabiano, G. A., Pelham, W. E., Jr., Waschbusch, D. A., Gnagy, E. M., Lahey, B. B., Chronis, A. M., . . . Burrows-MacLean, L. (2006). A practical measure of impairment: Psychometric properties of the impairment rating scale in samples of children with attention deficit hyperactivity disorder and two school-based samples. *Journal of Clinical Child and Adolescent Psychology, 35*, 369–385.
- Frick, P. J., Lahey, B. B., Applegate, B., Kerdyck, L., Ollendick, T., Hynd, G. W., . . . Waldman, I. (1994). *DSM-IV* field trials for the disruptive behavior disorders: Symptom utility estimates. [Hillsdale, NJ: Erlbaum.]. *Journal of the American Academy of Child & Adolescent Psychiatry, 33*, 529–539. <http://dx.doi.org/10.1097/00004583-199405000-00011>
- Gioia, G. A., Espy, K. A., & Isquith, P. K. (2003). *Behavior rating inventory of executive function, preschool version (BRIEF-P)*. Lutz, FL: Psychological Assessment Resources.

- Gioia, G., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). *Behavior Rating Inventory of Executive Function*. Lutz, FL: Psychological Assessment Resources.
- Gothelf, D., Gertner, S., Mimouni-Bloch, A., Freudenstein, O., Yirmiya, N., Weitz, R., . . . Spitzer, S. (2006). Follow-up of preschool children with severe emotional and behavioral symptoms. *Israel Journal of Psychiatry and Related Sciences*, 43, 16–20.
- Graziano, P. A., Reavis, R. D., Keane, S. P., & Calkins, S. D. (2007). The role of emotion regulation in children's early academic success. *Journal of School Psychology*, 45, 3–19. <http://dx.doi.org/10.1016/j.jsp.2006.09.002>
- Graziano, P. A., Slavec, J., Hart, K., Garcia, A., & Pelham, W. E., Jr. (2014). Improving school readiness in preschoolers with behavior problems: Results from a summer treatment program. *Journal of Psychopathology and Behavioral Assessment*, 36, 1–15.
- Hart, K., & Graziano, P. (2013, November). *Assessing kindergarten readiness: The development of a new tool to assess preschoolers' behavioral, social-emotional, and academic functioning in the transition to kindergarten*. Paper presented at the Association for Behavioral and Cognitive Therapies, Nashville, TN.
- Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, 16, 174–180. <http://dx.doi.org/10.1016/j.tics.2012.01.006>
- Isquith, P. K., Gioia, G. A., & Espy, K. A. (2004). Executive function in preschool children: Examination through everyday behavior. *Developmental Neuropsychology*, 26, 403–422. http://dx.doi.org/10.1207/s15326942dn2601_3
- Johnston, C., & Murray, C. (2003). Incremental validity in the psychological assessment of children and adolescents. *Psychological Assessment*, 15, 496–507.
- Jones Harden, B., Winslow, M. B., Kendziora, K. T., Shahinfar, A., Rubin, K. H., Fox, N. A., . . . Zahn-Waxler, C. (2000). Externalizing problems in Head Start children: An ecological exploration. *Early Education and Development*, 11, 357–385. http://dx.doi.org/10.1207/s15566935eed1103_8
- Jurado, M. B., & Rosselli, M. (2007). The elusive nature of executive functions: A review of our current understanding. *Neuropsychology Review*, 17, 213–233. <http://dx.doi.org/10.1007/s11065-007-9040-z>
- Keane, S. P., & Calkins, S. D. (2004). Predicting kindergarten peer social status from toddler and preschool problem behavior. *Journal of Abnormal Child Psychology*, 32, 409–423. <http://dx.doi.org/10.1023/B:JACP.0000030294.11443.41>
- Kochanska, G., Murray, K., Jacques, T. Y., Koenig, A. L., & Vandegeest, K. A. (1996). Inhibitory control in young children and its role in emerging internalization. *Child Development*, 67, 490–507. <http://dx.doi.org/10.2307/1131828>
- Kopp, C. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology*, 18, 199–214. <http://dx.doi.org/10.1037/0012-1649.18.2.199>
- Kupersmidt, J. B., Bryant, D., & Willoughby, M. T. (2000). Prevalence of aggressive behaviors among preschoolers in head start and community child care programs. *Behavioral Disorders*, 26, 42–52.
- Lahey, B. B., Loeber, R., Burke, J. D., & Applegate, B. (2005). Predicting future antisocial personality disorder in males from a clinical assessment in childhood. *Journal of Consulting and Clinical Psychology*, 73, 389–399. <http://dx.doi.org/10.1037/0022-006X.73.3.389>
- Lavigne, J. V., Gibbons, R. D., Christoffel, K. K., Arend, R., Rosenbaum, D., Binns, H., . . . Isaacs, C. (1996). Prevalence rates and correlates of psychiatric disorders among preschool children. *Journal of the American Academy of Child & Adolescent Psychiatry*, 35, 204–214. <http://dx.doi.org/10.1097/00004583-199602000-00014>
- Lonigan, C. J., Bloomfield, B. G., Anthony, J. L., Bacon, K. D., Phillips, B. M., & Samwel, C. S. (1999). Relations among emergent literacy skills, behavior problems, and social competence in preschool children from low-and middle-income backgrounds. *Topics in Early Childhood Special Education*, 19, 40–53. <http://dx.doi.org/10.1177/027112149901900104>
- Luby, J. L., Heffelfinger, A. K., Mrakotsky, C., Hessler, M. J., Brown, K. M., & Hildebrand, T. (2002). Preschool major depressive disorder: Preliminary validation for developmentally modified DSM-IV criteria. *Journal of the American Academy of Child & Adolescent Psychiatry*, 41, 928–937. <http://dx.doi.org/10.1097/00004583-200208000-00011>
- Mahone, E. M., & Hoffman, J. (2007). Behavior ratings of executive function among preschoolers with ADHD. *The Clinical Neuropsychologist*, 21, 569–586. <http://dx.doi.org/10.1080/13854040600762724>
- Malecki, C. K., & Elliot, S. N. (2002). Children's social behaviors as predictors of academic achievement: A longitudinal analysis. *School Psychology Quarterly*, 17, 1–23. <http://dx.doi.org/10.1521/scpq.17.1.1.19902>
- Manly, T., Anderson, V., Nimmo-Smith, I., Turner, A., Watson, P., & Robertson, I. H. (2001). The differential assessment of children's attention: The Test of Everyday Attention for Children (TEA-Ch), normative sample and ADHD performance. *Journal of Child Psychology and Psychiatry*, 42, 1065–1081. <http://dx.doi.org/10.1111/1469-7610.00806>
- Masten, A. S., Roisman, G. I., Long, J. D., Burt, K. B., Obradović, J., Riley, J. R., . . . Tellegen, A. (2005). Developmental cascades: Linking academic achievement and externalizing and internalizing symptoms over 20 years. *Developmental Psychology*, 41, 733–746.
- Mather, N., & Woodcock, R. W. (2001). *Examiners manual: Woodcock-Johnson III tests of achievement*. Itasca, IL: Riverside Publishing.
- McClelland, M. M., & Cameron, C. E. (2012). Self-regulation in early childhood: Improving conceptual clarity and developing ecologically valid measures. *Child Development Perspectives*, 6, 136–142. <http://dx.doi.org/10.1111/j.1750-8606.2011.00191.x>
- McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*, 43, 947–959. <http://dx.doi.org/10.1037/0012-1649.43.4.947>
- McClelland, M. M., Morrison, F. J., & Holmes, D. L. (2000). Children at risk for early academic problems: The role of learning-related social skills. *Early Childhood Research Quarterly*, 15, 307–329. [http://dx.doi.org/10.1016/S0885-2006\(00\)00069-7](http://dx.doi.org/10.1016/S0885-2006(00)00069-7)
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "Frontal Lobe" tasks: A latent variable analysis. *Cognitive Psychology*, 41, 49–100. <http://dx.doi.org/10.1006/cogp.1999.0734>
- Miyake, A., & Shah, P. (Eds.). (1999). *Models of working memory: Mechanisms of active maintenance and executive control*. New York, NY: Cambridge University Press. <http://dx.doi.org/10.1017/CBO9781139174909>
- Molitor, A., Mayes, L. C., & Ward, A. (2003). Emotion regulation behavior during a separation procedure in 18-month-old children of mothers using cocaine and other drugs. *Development and Psychopathology*, 15, 39–54. <http://dx.doi.org/10.1017/S0954579403000038>
- Monsell, S. (1996). Control of mental processes. In V. Bruce (Ed.), *Unsolved mysteries of the mind* (pp. 93–148). Oxford, England: Erlbaum.
- Nolan, E. E., Gadow, K. D., & Sprafkin, J. (2001). Teacher reports of DSM-IV ADHD, ODD, and CD symptoms in schoolchildren. *Journal of the American Academy of Child & Adolescent Psychiatry*, 40, 241–249. <http://dx.doi.org/10.1097/00004583-200102000-00020>
- Oades-Sese, G. V., Esquivel, G. B., Kaliski, P. K., & Maniatis, L. (2011). A longitudinal study of the social and academic competence of economically disadvantaged bilingual preschool children. *Developmental Psychology*, 47, 747–764. <http://dx.doi.org/10.1037/a0021380>
- Panther, J. E., & Bracken, B. A. (2009). Validity of the Bracken School Readiness Assessment for predicting first grade readiness. *Psychology in the Schools*, 46, 397–409. <http://dx.doi.org/10.1002/pits.20385>

- Pelham, W. E., Jr., Fabiano, G. A., & Massetti, G. M. (2005). Evidence-based assessment of attention deficit hyperactivity disorder in children and adolescents. *Journal of Clinical Child and Adolescent Psychology*, 34, 449–476. http://dx.doi.org/10.1207/s15374424jccp3403_5
- Pfeifer, M., Goldsmith, H. H., Davidson, R. J., & Rickman, M. (2002). Continuity and change in inhibited and uninhibited children. *Child Development*, 73, 1474–1485. <http://dx.doi.org/10.1111/1467-8624.00484>
- Pianta, R. C., & Caldwell, C. B. (1990). Stability of externalizing symptoms from kindergarten to first grade and factors related to instability. *Development and Psychopathology*, 2, 247–258. <http://dx.doi.org/10.1017/S0954579400000754>
- Pianta, R. C., Steinberg, M. S., & Rollins, F. B. (1995). The first two years of school: Teacher-child relationships and deflections in children's classroom adjustment. *Development and Psychopathology*, 7, 295–312. <http://dx.doi.org/10.1017/S09545794000006519>
- Pickering, S. J., & Gathercole, S. E. (2004). Distinctive working memory profiles in children with special educational needs. *Educational Psychology*, 24, 393–408. <http://dx.doi.org/10.1080/0144341042000211715>
- Ponitz, C. C., McClelland, M. M., Matthews, J. S., & Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. *Developmental Psychology*, 45, 605–619. <http://dx.doi.org/10.1037/a0015365>
- Raver, C. (2003). Young children's emotional development and school readiness. *Social Policy Report*, 16, 3–19.
- Reynolds, C. R., & Kamphaus, R. W. (2004). *BASC 2, Behavior assessment system for children*. Circle Pines, MN: American Guidance Service.
- Reynolds, C. R., & Kamphaus, R. W. (2006). *BASC-2: Behavior assessment system for children* (2nd ed.). New York, NY: Pearson Publishing.
- Rimm-Kaufman, S. E., & 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, 491–511. [http://dx.doi.org/10.1016/S0193-3973\(00\)00051-4](http://dx.doi.org/10.1016/S0193-3973(00)00051-4)
- Risi, S., Gerhardstein, R., & Kistner, J. (2003). Children's classroom peer relationships and subsequent educational outcomes. *Journal of Clinical Child and Adolescent Psychology*, 32, 351–361. http://dx.doi.org/10.1207/S15374424JCCP3203_04
- Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys*. New York, NY: John Wiley & Sons. <http://dx.doi.org/10.1002/9780470316696>
- Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2005). The development of executive attention: Contributions to the emergence of self-regulation. *Developmental Neuropsychology*, 28, 573–594. http://dx.doi.org/10.1207/s15326942dn2802_2
- Sattler, J., & Dumont, R. (2004). *Assessment of Children: WISC-IV and WPPSI-III Supplement*. San Diego, CA: Sattler.
- Senn, T. E., Espy, K. A., & Kaufmann, P. M. (2004). Using path analysis to understand executive function organization in preschool children. *Developmental Neuropsychology*, 26, 445–464. http://dx.doi.org/10.1207/s15326942dn2601_5
- Shaffer, D., Fisher, P., Lucas, C. P., Dulcan, M. K., & 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, 28–38. <http://dx.doi.org/10.1097/00004583-200001000-00014>
- Simpson, A., & Riggs, K. J. (2006). Conditions under which children experience inhibitory difficulty with a “button-press” go/no-go task. *Journal of Experimental Child Psychology*, 94, 18–26. <http://dx.doi.org/10.1016/j.jecp.2005.10.003>
- Smith-Donald, R., Raver, C. C., Hayes, T., & Richardson, B. (2007). Preliminary construct and concurrent validity of the preschool self-regulation assessment (PSRA) for field-based research. *Early Childhood Research Quarterly*, 22, 173–187. <http://dx.doi.org/10.1016/j.ecresq.2007.01.002>
- Tominey, S., & McClelland, M. (2011). Red light, purple light: Findings from a randomized trial using circle time games to improve behavioral self-regulation in preschool. *Early Education and Development*, 22, 489–519. <http://dx.doi.org/10.1080/10409289.2011.574258>
- Upshur, C., Wenz-Gross, M., & Reed, G. (2009). A pilot study of early childhood mental health consultation for children with behavioral problems in preschool. *Early Childhood Research Quarterly*, 24, 29–45. <http://dx.doi.org/10.1016/j.ecresq.2008.12.002>
- Ursache, A., Blair, C., & 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, 122–128. <http://dx.doi.org/10.1111/j.1750-8606.2011.00209.x>
- Van Hulle, C. A., Rodgers, J. L., D'Onofrio, B. M., Waldman, I. D., & Lahey, B. B. (2007). Sex differences in the causes of self-reported adolescent delinquency. *Journal of Abnormal Psychology*, 116, 236–248. <http://dx.doi.org/10.1037/0021-843X.116.2.236>
- Wakschlag, L. S., Leventhal, B. L., Briggs-Gowan, M. J., Danis, B., Keenan, K., Hill, C., . . . Carter, A. S. (2005). Defining the “disruptive” in preschool behavior: What diagnostic observation can teach us. *Clinical Child and Family Psychology Review*, 8, 183–201. <http://dx.doi.org/10.1007/s10567-005-6664-5>
- Wanless, S. B., McClelland, M. M., Lan, X., Son, S.-H., Cameron, C. E., Morrison, F. J., . . . Sung, M. (2013). Gender differences in behavioral regulation in four societies: The United States, Taiwan, South Korea, and China. *Early Childhood Research Quarterly*, 28, 621–633. <http://dx.doi.org/10.1016/j.ecresq.2013.04.002>
- Wechsler, D. (2002). *WPPSI-III administration and scoring manual*. San Antonio, TX: Psychological Corp.
- Wechsler, D. (2003). *Wechsler Intelligence Scale for Children. Fourth Edition. Administration and scoring manual*. San Antonio, TX: Harcourt Assessment, Inc.
- Wechsler, D. (2012). *Wechsler Preschool and Primary Scale of Intelligence* (4th ed.). San Antonio, TX: NCS Pearson.
- Weintraub, S., Dikmen, S. S., Heaton, R. K., Tulsky, D. S., Zelazo, P. D., Bauer, P. J., . . . Gershon, R. C. (2013). Cognition assessment using the NIH Toolbox. *Neurology*, 80 (Suppl. 3), S54–S64. <http://dx.doi.org/10.1212/WNL.0b013e3182872ded>
- Welsh, J. A., Nix, R. L., Blair, C., Bierman, K. L., & Nelson, K. E. (2010). The development of cognitive skills and gains in academic school readiness for children from low-income families. *Journal of Educational Psychology*, 102, 43–53. <http://dx.doi.org/10.1037/a0016738>
- West, J., Denton, K., & Reaney, L. M. (2001). *The kindergarten year: Findings from the early childhood longitudinal study. Tech. Rep. No. NCES 2001–023*. Washington, DC: National Center for Educational Statistics.
- Woodcock, R. W., McGrew, K., & Mather, N. (2001). *Woodcock-Johnson tests of achievement*. Itasca, IL: Riverside Publishing.

Received April 3, 2014

Revision received January 30, 2015

Accepted February 9, 2015 ■