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## Are Sluggish Cognitive Tempo Symptoms Associated with Executive Functioning in Preschoolers?

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### Abstract

The aim was to investigate whether sluggish cognitive tempo (SCT) symptoms are associated with neurocognitive task performance and ratings of real world executive functioning in preschoolers at risk for attention-deficit/hyperactivity disorder (ADHD). The associations between parent and teacher rated SCT symptoms and neuropsychological task performance and ratings of executive functioning in 61 four-year-old preschool children (51 boys, 10 girls) with self-regulation difficulties were examined with regression analyses controlling for the effects of ADHD inattention symptoms. Higher teacher rated SCT symptoms were significantly associated with poorer performance on tasks of visual-perceptual abilities, auditory and visual attention, sustained and selective attention, inhibitory control, pre-numerical/numerical concepts, and slower processing speed, but SCT symptoms were not significantly associated with working memory, attention shifting or cognitive flexibility when controlling for ADHD inattention. Higher parent rated SCT symptoms were significantly associated with visual-perceptual abilities. ADHD inattention symptoms were more strongly associated than SCT with daily life executive functioning ratings; neither parent nor teacher rated SCT symptoms were significantly associated with daily life ratings of inhibition, working memory, or planning/organization after controlling for ADHD inattention. This study suggests that SCT symptoms contribute to the executive functioning deficits, at least on neurocognitive tasks assessing visual-perceptual/spatial abilities

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and attention to detail and processing speed, observed in young children at risk for ADHD and may be an important intervention target.

### Keywords

attention; cognition; daydreaming; development; executive functions; visual-perceptual; processing speed

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### Introduction

Sluggish cognitive tempo (SCT) is characterized by excessive daydreaming, mental confusion or “fogginess”, and slowed behavior and thinking (Barkley, 2014). There has been increasing interest in the SCT construct in the last 15 years (Becker, Marshall, & McBurnett, 2014), particularly in determining whether SCT is distinct from symptoms of attention-deficit/hyperactivity disorder (ADHD) and associated with unique external correlates. A recent meta-analysis found strong support for the internal validity of SCT and promising support for the external validity of SCT (Becker, Leopold, et al., 2016). That is, studies have quite consistently found SCT to be empirically distinct from ADHD, and a limited yet growing body of research indicates that SCT is also associated with poorer functioning and greater impairment. However, one domain that has particularly mixed findings is that of executive functioning (EF). EF is a set of mental processes used to perform activities such as planning, organizing, strategizing, paying attention to and remembering details, and managing time. EF is assessed utilizing neurocognitive measures as well with behavioral ratings; thus EF involves both performance-based and behavioral components.

It is important to better understand whether SCT is associated with EF deficits, particularly since “an underlying cognitive deficit of SCT has not yet been identified, making the continued use of the term ‘sluggish *cognitive* tempo’ akin to putting the terminological horse before the theoretical cart” (Becker, Luebke, & Joyce, 2015, p. 1038). Moreover, in reviewing the extant research in this area Barkley (2014) concluded that “*SCT is not primarily a disorder of executive functioning (EF) as manifested in daily life activities or on most EF tests*” (p. 121, italics in original). However, as reviewed below, recent studies have indicated that SCT may indeed be associated with EF, though additional studies that include a broader range of neuropsychological tests as well as daily life EF ratings are clearly needed. Understanding whether SCT is associated with EF deficits, and which deficits in particular, has implications for theory and intervention.

Furthermore, the importance of examining SCT across the full developmental span and in non-ADHD-specific samples have also been identified as important areas for future research (Becker & Barkley, in press; Becker, Leopold, et al., 2016). In particular, identifying cognitive correlates of SCT in early childhood may inform what is known about the developmental trajectory of SCT, which is especially important since there is some indication that SCT symptoms increase across childhood and adolescence (Becker, Leopold et al., 2016; Leopold et al., 2016). In order to begin addressing these gaps in the literature, we examined the association between SCT and EF in a sample of at-risk preschool students,

using a multi-rater, multi-method design that included both parent and teacher ratings of SCT as well as both neurocognitive tests and daily life ratings of EF.

### **SCT and Neurocognitive Tasks of Executive Functioning**

Only a handful of studies have examined SCT symptoms in relation to children's neurocognitive task performance. These studies have generally found significant bivariate associations between SCT symptoms and various neurocognitive performance domains including behavioral inhibition, working memory, processing speed, sustained attention, reaction time variability, and vigilance [see (Becker, Leopold, et al., 2016), for a meta-analytic review]. However, findings are much more mixed among studies that have evaluated whether SCT is independently associated with neurocognitive test performance above and beyond ADHD symptoms.

Two studies examined whether SCT impacts the neurocognitive functioning of children diagnosed with ADHD (Capdevila-Brophy et al., 2014; Hinshaw, Carte, Sami, Treuting, & Zupan, 2002). Neither of these studies found support for a unique neuropsychological profile among children with ADHD who also displayed elevated SCT symptoms, and, in fact, in the Capdevila-Brophy et al. (2014) study youth with ADHD who also displayed elevated SCT symptoms had *better* sustained attention as measured with omissions on a continuous performance test (CPT) than other youth with ADHD. The one exception to this pattern was the finding that girls with ADHD and elevated SCT had slower motor speed than other girls with ADHD (Hinshaw et al., 2002). It is important to note, however, that both of these studies only included children who had been diagnosed with ADHD, which may cloud any ability to detect SCT-unique neuropsychological impairments since clinical samples of ADHD are impaired by definition and at the group level experience a wide range of cognitive and neuropsychological deficits (Barkley, 2014; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005).

Several other studies have examined whether SCT is associated with neurocognitive task performance in samples that included both ADHD and comparison youth, with a primary interest in evaluating whether SCT symptoms remained associated with task performance after controlling for ADHD symptoms. Both Bauermeister et al. (Bauermeister, Barkley, Bauermeister, Martinez, & McBurnett, 2012) and Skirbekk et al. (Skirbekk, Hansen, Oerbeck, & Kristensen, 2011) examined SCT in relation to performance across a range of neurocognitive tasks (e.g., working memory, processing speed, inhibition, planning, reaction time, reaction time variability) in similarly sized samples of school-aged children (Bauermeister et al.:  $N = 140$ , ages 6-11 years; Skirbekk et al.:  $N = 141$ , ages 7-13 years). Neither study found an association between SCT and neurocognitive task performance when ADHD symptoms were also included in the model. The sole exception was a significant association between SCT and spatial memory variability assessed with the Finger Windows subtest of the Wide Range Assessment of Memory and Learning in the study by Skirbekk and colleagues (Skirbekk et al., 2011), an association that remained significant even after controlling for ADHD inattentive symptoms.

The studies reviewed above generally indicate a lack of association between SCT and neurocognitive task performance when controlling for ADHD (with the possible exceptions

of motor speed and spatial memory variability). In contrast, two other studies (Wählstedt & Bohlin, 2010; Willcutt et al., 2014) with somewhat larger samples provide stronger support for an association between SCT and neurocognitive task performance (Wählstedt & Bohlin:  $N=209$ , ages 7-9 years; Willcutt et al.:  $N=721$ , ages 8-16 years). Specifically, as in the other studies reviewed above, SCT was unassociated with reaction time variability, working memory, or inhibitory control when accounting for ADHD symptoms. However, both Wählstedt and Bohlin (Wählstedt & Bohlin, 2010) and Willcutt et al. (Willcutt et al., 2014) found SCT to remain significantly associated with poorer sustained attention even after controlling for ADHD symptoms. Moreover, in both studies SCT was a stronger predictor of sustained attention than were ADHD inattentive symptoms. In addition, Willcutt and colleagues (Willcutt et al., 2014) found SCT to be significantly uniquely associated with slower processing speed and naming speed above and beyond ADHD symptoms.

Taken together, studies to date generally indicate that SCT is correlated with poorer performance on neurocognitive tasks of EF in school-aged children. However, effect sizes are small (weighted  $r_s=0.19-0.29$ ), inconsistent across studies, and sometimes reduced to non-significance when controlling for ADHD inattention (Becker, Leopold, et al., 2016). Further, the samples in these studies included school-aged children precluding an examination of whether SCT symptoms are associated with EF in younger children. Additionally, as noted above, because most measures used are typically administered to ADHD-defined and/or clinically referred samples, impairment unique to SCT may have been hard to identify in studies conducted to date (Barkley, 2014; Becker, Leopold, et al., 2016).

### **SCT and Ratings of Daily Life EF**

While it is critical to evaluate the association of SCT symptoms with EF measured with objective neurocognitive measures, these tasks may lack real-world ecological validity (Barkley & Fischer, 2011; Toplak, West, & Stanovich, 2013). Measures such as the Behavior Rating Inventory of Executive Function (BRIEF) or Barkley Deficits in Executive Functioning Scale (BDEFS) are thought to provide a picture of an individual's idiographic cognitive functioning (McCandless & O'Laughlin, 2007) and may be more likely to predict real-life impairments than cognitive tests (Barkley & Fischer, 2011). Daily life EFs include behaviors related to time management, organization and problem solving, self-discipline, motivation, and activation (Barkley & Fischer, 2011), and have been shown to be significantly associated with relevant outcomes such as academic performance (Langberg, Dvorsky, & Evans, 2013).

A study examining the association of parent rated BRIEF subscales and SCT in youth aged 6-17 years showed that SCT significantly accounted for variance in the Emotional Control, Plan/Organize, Working Memory, Organize Materials, and Monitor scales; even after including ADHD inattention symptoms in the model, SCT was significantly associated with Plan/Organize, Working Memory, and Organization of Material scales (Jimenez, Cluaustre, Martin, Arrufat, & Ciacobo, 2015). Similarly, after controlling for ADHD symptoms, SCT symptoms were significantly associated with the BRIEF Metacognitive Index (derived from the BRIEF Initiation, Working Memory, Planning/Organizing, Organization of Materials,

and Monitoring subscales) in a sample of adolescents (ages 12-16) diagnosed with ADHD (Becker & Langberg, 2014). In addition, in school-aged children, parent rated BRIEF Self-monitoring and Behavior Regulation subscales were poorer in the group with high SCT and high ADHD symptoms compared to those with ADHD only, although the groups did not differ on other domains of daily life EF such as Emotional Control, Initiation, Working Memory, and Planning/Organization (Capdevila-Brophy et al., 2014). Finally, in a nationally representative sample of youth ages 6-17 years, SCT was significantly associated with parent ratings of deficits in Time Management, Self-organization, Self-restraint, Self-motivation, and Emotion Regulation, although ADHD inattention was a far stronger predictor than SCT of these EF domains (Barkley, 2013).

These studies suggest that SCT is associated with poorer daily life EF ratings, although it also appears that ADHD inattention symptoms are more strongly and consistently associated than SCT with EF ratings in school-aged children (Barkley, 2014). However, it is unknown whether SCT or ADHD symptoms are more strongly associated with EF ratings in preschoolers.

### **SCT in Young Children**

It is important to evaluate the correlates of SCT in other developmental periods including preschoolers (Becker & Barkley, in press; Becker, Leopold, et al., 2016). Studies examining SCT in young children are especially needed since children identified as at-risk during this developmental period are often at greatest risk for maladjustment as they progress through life (Campbell, Shaw, & Gilliom, 2000; Gutman, Sameroff, & Cole, 2003), and findings during this developmental period are informative for theory and also point to possible directions for prevention and intervention (Egger & Angold, 2006). In particular, preschool is often the first time children are exposed to the increasingly structured setting of formal schooling, as well as a consistent peer group, that often sets the stage for subsequent classroom and socio-emotional adaptation (Coolahan, Fantuzzo, Mendez, & McDermott, 2000; Ladd & Price, 1987; Mesman & Koot, 2001).

Only a handful of extant SCT studies have included preschool-aged children (ages 3-4 years), and none of the studies examined correlates of SCT specifically in this age range (Jacobson et al., 2012; Lahey et al., 2004; Leopold et al., 2016; McBurnett, Pfiffner, & Frick, 2001; Penny, Waschbusch, Klein, Corkum, & Eskes, 2009). Rather, these studies included preschoolers as part of larger efforts to identify the structure of SCT as compared to ADHD, and thus included preschool children in addition to school-aged children and adolescents. Nevertheless, one recent study importantly demonstrated that SCT can be reliably measured in preschool children specifically (Leopold et al., 2016). Moreover, this study found that SCT increases across childhood and adolescence (Leopold et al., 2016), further underscoring the importance of understanding SCT in early development. However, no study to date has examined correlates of SCT in preschool-aged children. Since EF is important for both academic and social success (Diamond, 2013; Morrison, Ponitz, & McClelland, 2010) and there is ongoing interest in developing interventions that target EF deficits in young children in hopes of shifting adverse developmental trajectories (Diamond, Barnett, Thomas, & Munro, 2007; Tamm & Nakonezny, 2015), we examined whether SCT

was associated with EF as measured using both neurocognitive task performance and parent and teacher ratings of daily life EF in preschoolers. We first examined whether SCT was bivariately associated with executive functioning, and then examined whether SCT remained associated with executive functioning above and beyond ADHD inattentive symptoms. This latter analysis is particularly important for evaluating whether SCT is uniquely associated with executive functioning, particularly given the strong link between SCT and ADHD inattention (Becker, Leopold et al., 2016) as well as between ADHD-IN and executive functioning (Willcutt et al., 2012).

## Methods

The study was approved by the Hospital Institutional Review Board and informed consent/ assent was obtained from all participants prior to initiating any procedures.

## Participants

Data for the current study was obtained from a larger clinical trial investigating EF interventions for preschool children at risk for ADHD (i.e., “self-control” difficulties). For the current study, we included children whose parent or teacher completed the SCT measure [Strengths and Weaknesses of ADHD symptoms and Normal behavior rating scales or SWAN; (Swanson et al., 2012)]. We included young children at risk for ADHD as these children demonstrate difficulties with EF including self-regulation, attention, working memory, cognitive flexibility, behavioral inhibition, and ability to sustain attention (American Psychological Association, 2013; Byrne et al., 1998; Hughes et al., 2000; Mariani & Barkley, 1997). These EF deficits independently contribute to poorer outcomes (Wahlstedt et al., 2008; Willcutt et al., 2005), and have been linked directly to impairments in academic (Raggi & Chronis, 2006) and social (Diamantopoulou et al., 2007) functioning.

Participants were 4 years old, were all in a structured educational setting, were predominantly non-Hispanic White males, and had a mother with at least some high school education (see Table 1). All children were required by the primary study to have a *T*-score  $\geq 60$  as rated by the parent or the teacher on the Emergent Metacognition Index (EMI) of the Behavior Rating Inventory of Executive Functioning-Preschool Version (BRIEF-P) (Gioia, Isquith, Guy, & Kenworthy, 2000). Exclusion criteria included currently taking psychotropic medications or participating in other psychological interventions, history of head injury, diagnosed with a congenital or acquired neurological condition, a score  $\leq 6$  (severely ill) on the Clinical Global Impressions interview (Leon et al., 1993), and non-English speaking. It should be noted that 40 (~68%) of the participants met criteria for ADHD based on the computerized Preschool Age Psychiatric Assessment (ePAPA) (Egger & Angold, 2004) administered to parents by individuals with master's or doctoral degrees in clinical psychology. Participants in the primary study were compensated up to \$100 for completing the four visits of the primary study.

## Measures

### Child neurocognitive measures

**Differential Ability Scales – II (DAS-II) Early Years Battery (Elliott, 2007):** The DAS-II includes several subtests assessing verbal, nonverbal reasoning, and spatial abilities, which together contribute to the General Cognitive Ability (GCA) composite, an estimate of IQ. Subtests include the Verbal Comprehension subtest assessing receptive language, Naming Vocabulary assessing expressive language, Picture Similarities subtest assessing a child's ability to match pictures that share common elements, Matrices subtest assessing fluid reasoning, and Pattern Construction and Copying subtests assessing visual-perceptual abilities. Diagnostic subtests were also administered to assess number concepts and short-term memory abilities. The Early Number Concepts subtest assessed knowledge of pre-numerical and numerical concepts. Objects Immediate and Delayed subtests measured storage and retrieval of verbal and pictorial information from short-term and immediate-term memory, respectively. Digits Forward required the child to recall a sequence of numbers from short-term auditory memory. The DAS-II has excellent psychometric properties including high reliability and good evidence of concurrent and construct validity (Gordon & Elliot, 2001). Given the wide array of EF abilities assessed by the DAS-II subtests, all of which have ample or adequate specificity (Sattler, 2008), we opted to examine the association of SCT ratings with each subtest *T*-score independently.

**Clinical Evaluation of Language Fundamentals (CELF) Preschool Second Edition - Concepts and Following Directions (Wiig, Secord, & Semel, 2004):** The Concepts and Following Directions subtest required children to interpret, recall, and execute oral commands of increasing length and complexity. The Concepts and Following Directions subtest scaled score was included as a measure of auditory and visual attention. For the 4 year old age group, internal consistency reliability coefficients was .85 (Wiig et al., 2004).

**NEPSY-Visual Attention (Korkman, Kirk, & Kemp, 1998):** The Visual Attention subtest assesses the speed and accuracy with which a child can scan an array and locate a target. The subtest scaled score was included as a measure of selective and sustained attention and involves inhibition, vigilance, scanning, and impulse control. Reliability for this measure at age four is .76 (Korkman et al., 1998).

**Willoughby Computerized Battery of Executive Functioning Tasks:** The Executive Function Touch battery based on tasks developed by Willoughby et al. (Willoughby & Blair, 2011) is administered on a computer touch screen. The battery consists of several tasks that assess working memory, inhibitory control, attention shifting, and processing speed. Tasks utilized in the current study include the Silly Sounds Game, Animal Go/NoGo, Pick the Picture, Something's the Same, and Bubbles tasks. The psychometric properties of the computerized tasks have yet to be investigated. Test-retest reliabilities for the paper version were moderate ranging from .52 to .66 for individual tasks (excluding the Pick the Picture and Bubbles task since these were not available in the paper version), and high retest reliability, .95, for the full EF battery (Willoughby & Blair, 2011). It should be noted that 15 children were not administered the computerized tasks because it was not available during their participation in the study ( $n=10$ ), they did not return for the second part of the

scheduled assessment battery ( $n=3$ ), or the children were not eligible for the primary study from which this sample was derived ( $n=2$ ).

The Silly Sounds Game (Stroop) and Animal Go/NoGo tasks measure cognitive flexibility and inhibitory control. In the Silly Sounds Game the child sees a dog and a cat while at the same time the child hears either a meow or bark sound. The child is instructed to select the dog when hearing the meow, and to select the cat when hearing the bark. The dependent variable for this task is the proportion of correct items. The Animal Go/NoGo task presents the child with several different animals (e.g., cow, cat, or bird), one at a time; the child is required to click a button for every animal except the pig, to which the child withholds their button press. The dependent variable for this task is the proportion of nogo trials correctly inhibited. Visual working memory is assessed with the Pick the Picture (self-ordered pointing); children must choose a picture from an array of pictures, and then on the next trial must choose a new picture that was not selected previously (i.e., the child has to remember which pictures in each item set they have already touched). The dependent variable for this task is the proportion of correct items. The Something's the Same task (flexible item selection task) measures attention shifting; children are presented with two pictures that share a common element (color, shape, or size). Then the child is shown a third picture and is asked to select from the previous two pictures a way in which one is similar to the new picture. The dependent variable for this task is the proportion of correct items. Motoric processing speed is assessed with the Bubbles task; children are asked to touch pictures of bubbles as fast as they can. The dependent variable for Bubbles is the simple reaction time.

### Parent and teacher ratings

**Strengths and Weaknesses of ADHD symptoms and Normal Behavior Rating Scales (SWAN) (Swanson et al., 2012):** Parents and teachers completed this 30-item rating scale which includes symptoms of ADHD and oppositional defiant disorder derived from the Diagnostic and Statistical Manual of Mental Disorders (American Psychological Association, 1994, 2013) and three SCT symptoms: 1) remains focused on task - does not stare into space or daydream, 2) maintains appropriate energy level - not sluggish or drowsy, and 3) engages in goal directed activity - not apathetic/unmotivated. Parents and teachers rated children's behavior compared to peers over the past month on a 7-point scale (3=*far below*, 2=*below*, 1=*slightly below*, 0=*average*, -1=*slightly above*, -2=*above*, -3=*far above*) where higher scores reflect greater symptomology. The SWAN demonstrates strong internal consistency (.95), test-retest reliability ranging from .71 to .76, and good convergent and discriminant validity when compared to the Strengths and Difficulties Questionnaire in preschool children (Lakes, Swanson, & Riggs, 2012). For the current study, we computed an average inattention score (mean of 9 ADHD inattention items; parent  $\alpha = .88$ , teacher  $\alpha = .91$ ), average hyperactivity/impulsivity score (mean of 9 ADHD hyperactivity/impulsivity items; parent  $\alpha = .86$ , teacher  $\alpha = .94$ ) and average SCT score (mean of the 3 SCT items; parent  $\alpha = .73$ , teacher  $\alpha = .66$ ) for the parent and teacher.

**Behavior Rating Inventory of Executive Function - Preschool Version (BRIEF-P) (Gioia, Espy, & Isquith, 2003):** Parents and teachers completed this rating scale assessing EF behaviors yielding *T*-scores on several subscales; higher scores indicate more



impairment in daily life EF. The Inhibit subscale assesses inhibitory control and impulsivity, the Shift scale assesses ability to move between situations, aspects, or problems, the Emotional Control scale assesses the impact of EF difficulties on emotional expression, the Working Memory scale assesses the ability to hold information in memory to complete a task, and the Plan/Organize scale assesses a child's ability to manage task demands within the situational context. The EMI is composed of the Working Memory and Plan/Organize scales. Studies investigating psychometric properties of the BRIEF-P report good convergent and discriminant validity between the BRIEF-P and other behavioral rating systems, test-retest reliability ranging from .79 to .88, and internal consistency ranging from .80 to .98 (Gioia et al., 2003).

### Design and Procedure

In the larger study from which the data in the current study were derived, parents responded to an initial telephone screen. Those who met initial eligibility criteria were mailed the BRIEF-P to complete, and the child's teacher was also mailed the BRIEF-P. If a child was rated as  $T < 60$  on the BRIEF-P EMI by either the teacher or parent, the family was invited to participate in a baseline evaluation which included the parent completing several rating scales, and the child being administered the neurocognitive measures with the computerized battery being administered last. Teachers were also mailed a packet of rating scales to complete. For the current study, children with SCT ratings provided by the parent and/or teacher were included.

### Statistical Analysis

All analyses were carried out using SPSS software. Pearson correlations were computed to examine the relationship between parent and teacher ratings of ADHD and SCT symptoms, neurocognitive, and EF measures. Neurocognitive or BRIEF-P variables shown to have a significant correlation with parent or teacher rated SCT were selected for further analysis with multiple regressions.

Multiple regressions were used to evaluate whether SCT symptom ratings are associated with neurocognitive performance (DAS-II subtest  $T$ -scores, NEPSY Visual Attention subtest scaled score, CELF Concepts and Following Directions subtest scaled score, simple reaction time in milliseconds, proportion of items correct on Animal Go/NoGo, self-ordered pointing, Stroop, and flexible item selection tasks) and BRIEF-P  $T$ -scores ratings for parent and teacher separately. We controlled for parent or teacher inattention ratings on the SWAN because previous studies have shown an association between inattention and SCT (Becker, Leopold, et al., 2016), as well as ADHD inattention and executive functioning (Willcutt et al., 2012).

Missing data varied across measures with 1.6% of the sample missing at least one parent measure (SWAN or BRIEF-P), 8.2% of the sample missing the SWAN completed by teachers, and up to 24.6% of the sample missing at least one of the child neurocognitive measures (DAS-II, CELF, NEPSY, or computerized tasks). Tests of patterns of missingness suggested data were missing completely at random (Little's MCAR test:  $\chi^2=285.96$ ,  $df=297$ ,  $p=.667$ ). Comparison of participants who did and did not have complete data revealed that

the groups did not differ significantly with regards to sex, race, maternal education, or IQ (all  $p$ 's > .20). It should also be noted that gender did not significantly correlate with any of the child neurocognitive measures with the exception of Recall of Objects Delayed ( $r = -.32$ ,  $p = .026$ ) and was therefore not considered further.

## Results

### SCT in Relation to Neurocognitive Measures

**Teacher rated SCT**—As summarized in Table 2 (non-computerized neurocognitive measures), teacher SCT ratings were significantly negatively correlated with Pattern Construction, Copying, Recall of Objects Immediate, and Early Number Concepts subtest  $T$ -scores on the DAS-II, and significantly negatively correlated with CELF Concepts and Following Directions and NEPSY Visual Attention subtest scaled scores. We did not observe significant correlations between teacher SCT ratings and the other DAS-II subtest  $T$ -scores (i.e., Verbal Comprehension, Picture Similarities, Naming Vocabulary, Matrices, Recall of Objects Delayed, or Digits Forward). Teacher SCT ratings were also significantly positively correlated with teacher ratings of inattention and hyperactivity/impulsivity. Teacher ratings of inattention and hyperactivity/impulsivity were not significantly correlated with neurocognitive performance, with the exception of DAS-II Early Number Concepts being significantly negatively correlated with inattention ratings.

As summarized in Table 3 (computerized neurocognitive measures), teacher SCT ratings were significantly positively correlated with processing speed (simple reaction time) and commission errors on an inhibitory go/nogo task, and significantly negatively correlated with the proportion of items correct on a working memory task (self-ordered pointing), Stroop task, and an attention shifting task (flexible item selection). Teacher ratings of inattention and hyperactivity/impulsivity were not significantly correlated with computerized neurocognitive task performance, with the exception of Silly Sounds Stroop being significantly negatively correlated with inattention ratings.

Results of the regression analyses (Table 4) revealed that, after controlling for teacher ratings of inattention, teacher ratings of SCT significantly predicted DAS-II Pattern Construction, Copying, and Early Number Concepts, CELF Concepts and Following Directions, NEPSY Visual Attention, Bubbles Simple Reaction Time (processing speed), and Animal Go/NoGo (inhibitory control). Teacher ratings of SCT did not significantly predict DAS-II Recall of Objects Immediate, Pick the Picture self-ordered pointing (working memory), Silly Sounds Game (cognitive flexibility/selective attention), or Something's the Same flexible item selection (attention shifting) after controlling for inattention. Teacher ratings of inattention significantly predicted cognitive interference as measured with the Silly Sounds Game.

**Parent rated SCT**—As summarized in Table 2, parent SCT ratings were significantly negatively correlated with the Copying subtest  $T$ -score on the DAS-II. No other significant correlations between parent SCT ratings and neurocognitive measures (DAS-II subtests, CELF, or NEPSY) were observed. Parent SCT ratings were significantly positively correlated with parent ratings of inattention and hyperactivity/impulsivity. Parent ratings of inattention and hyperactivity/impulsivity were not significantly correlated with

neurocognitive performance with the exception of DAS-II Copying being significantly negatively correlated with inattention. Parent SCT ratings were not significantly correlated with child performance on the computerized neurocognitive tasks (Table 3).

Regression analyses revealed that parent ratings of SCT ( $\beta=-.31$ ,  $R^2=.08$ ,  $p<.05$ ) significantly predicted DAS-II Copying after controlling for parent ratings of inattention ( $\beta=-.15$ ,  $R^2=.09$ , n.s.).

### SCT in Relation to Ratings of Daily Life EF

**Teacher rated SCT**—As summarized in Table 5, teacher SCT ratings were significantly positively correlated with teacher ratings on the BRIEF-P Working Memory and Planning/Organization subscale *T*-scores, but not Inhibit, Shift, or Emotion Regulation subscale *T*-scores.

Results of the regression analyses (Table 6) revealed that, after controlling for teacher ratings of inattention, teacher ratings of SCT were not significantly associated with BRIEF-P Working Memory or Plan/Organize subscales. Teacher ratings of inattention were a significant predictor for the BRIEF-P subscales, however.

**Parent rated SCT**—Parent SCT ratings were significantly positively correlated with parent ratings on the BRIEF-P Inhibit, Working Memory and Planning/Organization subscale *T*-scores, but not Shift or Emotion Regulation subscale *T*-scores (Table 5).

Results of the regression analyses (Table 6) showed that parent ratings of SCT did not significantly predict parent rated BRIEF-P Inhibit, Working Memory and Plan/Organize subscales after controlling for inattention. Inattention was a significant predictor for these subscales.

## Discussion

The current study is the first to investigate parent and teacher ratings of SCT in relation to child neurocognitive task performance and daily life EF ratings in preschoolers with self-control difficulties (i.e., at risk for ADHD). When controlling for ADHD inattentive symptoms, higher teacher rated SCT symptoms were significantly associated with poorer performance on neurocognitive tasks of visual-perceptual abilities, auditory and visual attention, sustained and selective attention, inhibitory control, pre-numerical/numerical concepts, and slower processing speed. In contrast, teacher rated SCT was not significantly associated with working memory, attention shifting, or cognitive flexibility performance when controlling for ADHD inattention. Parent rated SCT was unassociated with neurocognitive task performance with the exception of higher parent rated SCT symptoms being significantly associated with poorer visual-perceptual abilities when controlling for inattention. Neither parent nor teacher rated SCT symptoms were significantly associated with daily life EF ratings on the BRIEF-P Inhibit, Working Memory, or Plan/Organize subscales after controlling for inattention.

## Association of SCT and Neurocognitive Task Performance

Teacher rated SCT was significantly associated with poorer performance on tasks that involve visual-perceptual and spatial skills as well as attention to detail (i.e., DAS-II Pattern Construction and Copying, and NEPSY Visual Attention); parent rated SCT was also significantly associated with poorer performance on the DAS-II Copying task. No previous studies examining SCT and neurocognitive task performance specifically examined this cognitive construct although one study included the NEPSY Visual Attention subtest and did not report significant findings with SCT (Capdevila-Brophy et al., 2014). However, the Capdevila-Brophy et al. study dichotomized clinically referred school-aged children with ADHD into low and high SCT bands with the high band being one standard deviation above the mean on SCT symptoms, for which descriptive information is not provided. Thus, it is difficult to directly compare the two studies as the current study included a) younger children, b) children who were at-risk for but not necessarily diagnosed with ADHD, c) examined SCT dimensionally, and d) utilized different SCT symptoms. Given that the finding in the current study was observed for three separate tasks involving similar cognitive constructs, our study provides strong preliminary evidence of an association between high SCT symptoms and poorer performance on tasks involving spatial skills, visual motor coordination, and attention to visual details in preschool children.

Interestingly, DAS-II Pattern Construction and Copying and NEPSY Visual Attention scores have been shown to be lower in individuals with sleep-disordered breathing than typically developing controls and associated with a Total Arousal Index (a score derived from sleep time combining respiratory and spontaneous arousal) (O'Brien et al., 2004); SCT symptoms have also been shown to be associated with sleep difficulties (Becker, Garner, & Byars, 2016; Koriakin, Mahone, & Jacobson, 2015). The DAS-II Pattern Construction and Copying, and NEPSY Visual Attention tasks also involve motor speed and one previous study did find evidence for slower motor speed in girls with ADHD who also had high SCT (Hinshaw et al., 2002); the current study also showed higher teacher rated SCT symptoms predicted slower simple reaction times in the computerized Bubbles task, and poorer inhibition on the Animal Go/NoGo task. Sleep deficits are associated with longer reaction times on simple reaction time tasks, perhaps reflecting deficits in vigilance (Sagaspe et al., 2012; Versace, Cavallero, De Min Tona, Mozzato, & Stegagno, 2006), as well as with poorer inhibitory motor control (Sagaspe et al., 2012). Although SCT is not synonymous with sleep difficulties or daytime sleepiness (Becker, Garner, et al., 2016; Langberg, Becker, Dvorsky, & Luebbe, 2014), it is possible that the sleepy, sluggish, lethargic behaviors characteristic of SCT reflects slowed central nervous system functioning reflected by slowed psychomotor speed and lower alertness. Of note, simple reaction time tasks are thought to emphasize perceptual-motor ability as opposed to cognitive response time (Bates & Stough, 1998), adding further support to this hypothesis. Furthermore, processing speed is strongly associated with early numerical abilities (Bull, Espy, & Wiebe, 2008; Passolunghi, Lanfranchi, Altoe, & Sollazzo, 2015) which may explain why SCT was negatively associated with DAS-II Early Number Concepts.

It has also been shown that difficulties with tasks involving visual-perception, planning, and motor output are associated with difficulties with social perception (Schafer & Semrud-

Clikeman, 2008). In fact, it has been argued that factors underlying the cognitive constructs are required for social perception (Schafer & Semrud-Clikeman, 2008). One of the most consistent findings in SCT research to date is that of an association between SCT and social impairment, an association that remains even after controlling for ADHD, oppositional defiant disorder, conduct disorder, anxiety, and depression (Becker, Leopold, et al., 2016). Although speculative, we hypothesize that perhaps deficits in cognitive constructs captured by the DAS-II Pattern Construction and Copying tasks and NEPSY Visual Attention task may mediate these deficits in social functioning. For example, difficulties in spatial skills and motor coordination may make it more difficult for a child to effectively enter into a peer group or have success in peer-related activities (e.g., athletics), in turn contributing to increased isolation and withdrawal that is characteristic of SCT (Marshall, Evans, Eiraldi, Becker, & Power, 2014; Willcutt et al., 2014). Future research is necessary to confirm whether similar social impairments are observed in preschoolers with high SCT symptoms as well as to test whether such deficits are associated with visual-perception and motor planning skills.

Consistent with previous research (Bauermeister et al., 2012), no evidence was found for parent or teacher rated SCT symptoms to predict performance on cognitive interference/flexibility/attention shifting tasks after controlling for inattention symptoms (i.e., no effect on the Silly Sounds Stroop or Something's the Same). With regards to working memory (auditory and visual), we did not find an association with parent or teacher rated SCT symptoms. Correlations were not significant for DAS-II Digits Forward or Delayed Recall of Objects, and the significant correlations observed for Immediate Recall of Objects and performance on the self-ordered pointing (Pick the Picture) working memory tasks did not remain significant when included in the regression models controlling for inattention. Thus, consistent with the majority of studies [(Bauermeister et al., 2012; Wåhlstedt & Bohlin, 2010; Willcutt et al., 2014) with the one exception being spatial working memory (Skirbekk et al., 2011) which was not directly or specifically assessed in the current study], we do not find a unique association for SCT and working memory in preschoolers above and beyond ADHD inattention.

Somewhat surprisingly, parent and teacher ratings of inattention were not as strongly correlated as SCT ratings with child neurocognitive task performance (Tables 2 and 3) despite inattention and SCT being themselves moderately correlated (parent  $r=.47$ ; teacher  $r=.65$ ). Further, parent or teacher ratings of inattention were not statistically significantly associated with neurocognitive task performance in the regression models, with the exception of the Silly Sounds Stroop game in the teacher model (Table 4). Thus, it is possible that the three SCT symptoms rated on the SWAN are more sensitive to EF deficits captured by objective neurocognitive tasks. Alternatively, developmental differences may contribute to lower associations between inattention and neurocognitive task performance. In fact, previous studies with preschoolers have reported lower associations between ADHD symptoms and EFs (Sonuga-Barke, Dalen, Daley, & Remington, 2002; Thorell, 2007; Thorell & Wahlstedt, 2006; Willcutt et al., 2007) than those in school-aged children (Willcutt et al., 2012). Thus, additional work is needed to explore the meaning of the association between SCT and EF deficits in young children.

## Association of SCT and Daily Life EF Ratings

Given that previous studies have shown SCT to be related to parent and teacher BRIEF ratings (Becker & Langberg, 2014; Capdevila-Brophy et al., 2014; Jimenez et al., 2015), even after controlling for ADHD, it was somewhat surprising that no such relations were observed for either parent or teacher BRIEF-P ratings in the current study. Instead, much like Barkley (Barkley, 2013), ratings of inattention were the strongest predictor of daily life ratings related to inhibition, working memory, and planning/organization skills. This may suggest that ADHD symptoms are much more associated with these daily life EF ratings than SCT. However, one major difference between the BRIEF and BRIEF-P is that the BRIEF-P includes far fewer items related to the metacognitive aspect of EF (e.g., planning/organization, initiating, monitoring), which is more difficult to measure in preschoolers than school-aged children (Gioia et al., 2003) and has a protracted developmental course (Espy, Kaufmann, McDiarmid, & Glisky, 2001). Indeed, it is the metacognitive aspect of EF that has been most consistently associated with SCT in studies with older children (Barkley, 2013; Becker & Langberg, 2014; Jimenez et al., 2015). Thus, there may be developmental differences in the impact of SCT on daily life EF ratings, such that SCT symptoms may more negatively impact metacognitive EF functions as children develop, and be less associated with behavioral and emotional regulation in the preschool period. In line with this possibility, several studies conducted with adults demonstrate a significant association between SCT and daily life EF ratings, even when controlling for ADHD symptoms (Barkley, 2012; Flannery et al., 2016; Jarrett, Rapport, Rondon, & Becker, 2014; Wood, Lewandowski, Lovett, & Antshel, 2014).

Perhaps the dissociation in findings between neurocognitive performance and daily life EF ratings and SCT is not surprising given that scores from neuropsychological measures and ratings of EF are not highly correlated with one another and likely measure quite different cognitive constructs (Toplak et al., 2013). Daily life EF ratings likely reflect cognitive processing related to pursuit of goals while neurocognitive measures reflect efficiency of processing related to behavioral control (Toplak et al., 2013), the former which may be underdeveloped and more difficult to measure in preschoolers and/or more associated with inattention symptomatology.

## Are Teachers Better Raters of SCT than Parents?

Interestingly, and consistent with the literature, associations were primarily observed for teacher ratings of SCT and neurocognitive task performance, and far less so when parent ratings of SCT were used. This may not be particularly surprising given that parents and teachers typically demonstrate low agreement on behavioral ratings (range of .09 to .43), e.g., (Antrop, Roeyers, Oosterlaan, & Van Oost, 2002; Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000; Narad et al., 2015), particularly in preschoolers (Murray et al., 2007; Verhulst & Akkerhuis, 1989), but does highlight the importance of including both raters. Incorporating both parent and teacher ratings contributes different perspectives and provides information regarding the manifestation of SCT across different settings. For example, one previous study found that parent ratings of SCT were associated with greater impairment in the home whereas teacher ratings of SCT were associated with less impairment in the school setting (Watabe, Owens, Evans, & Brandt, 2014). More research is needed to examine how

SCT manifests in different settings. It is clear that parents and teachers can rate SCT in both the home and school settings, and both informants' ratings are associated with impairment (Becker, Leopold, et al., 2016). However, additional research is needed to determine who is considered an optimal rater of SCT. There is preliminary evidence suggesting that teachers may be considered more optimal raters since teacher ratings are somewhat better than parent ratings at distinguishing between SCT and ADHD (Garner, Marceaux, Mrug, Patterson, & Hodgens, 2010; McBurnett et al., 2001), and teacher ratings of SCT are more strongly associated than parent ratings with impairment in both the home and school contexts (Burns, Becker, Servera, Bernad, & García-Banda, in press). Our results are consistent with these previous studies in that we found clearer evidence for teacher rated SCT (as opposed to parent rated SCT) being associated with neurocognitive task performance.

### Limitations

The primary limitation of our study is that the SCT measure was only comprised of 3 items. One of the challenges contributing to variability of findings in the SCT literature is that there is inconsistency in the number of items utilized to assess SCT, with studies including anywhere from 2 to 44 items to assess SCT, and some SCT symptoms being more associated with inattention than others [see (Becker, Leopold, et al., 2016), for a meta-analytic review]. Further, it is also unclear whether SCT should be considered a unidimensional construct or as a multidimensional construct (Becker, Leopold, et al., 2016). Thus, replication of the current findings with a broader measure of SCT is warranted. Another limitation in the current study was that only 4 year olds were included; thus, the full extent of the impact of SCT on EF in preschoolers could not be assessed despite the rapid growth of EF in this developmental period. Relatedly, the findings may not generalize to younger or older children. While it is a strength that the study included children at-risk for ADHD, this may limit generalizability to clinical samples of children diagnosed with ADHD. Population- and community-based studies are also warranted to inform our understanding of the SCT construct. Finally, the sample size of 61 may have reduced our power to detect significant effects.

### Conclusions

Overall, our results suggest that in preschoolers with self-control difficulties, SCT is associated with EF challenges as measured by neurocognitive tasks, but not daily life EF ratings. That fact that elevated SCT symptom ratings were associated with poorer EF performance is important to note given that the neurocognitive tasks were obtained in optimal conditions (one on one testing in a quiet environment with behavioral reinforcers in place) designed to elicit the child's best performance, suggesting SCT symptoms significantly negatively impact efficient processing, at least on some tasks. Consistent with studies of school-aged children, it appears SCT is important to assess clinically in preschool children, and may be an appropriate target for intervention. Replication is warranted with a larger battery of EF measures and longer scales designed specifically to assess SCT.

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Table 1

## Participant Demographics

Demographic Characteristic	<i>n</i> = 61
Gender	
Male	83.6%
Female	16.4%
Race	
Asian	1.6%
Black	19.7%
White	72.1%
Biracial	6.6%
Hispanic Ethnicity	0%
IQ <sup>a</sup>	<i>M</i> = 104.63, <i>SD</i> = 14.65
Mother Education	
Some High School	3.3%
High School Graduate	11.5%
Some College	18.0%
College Graduate	41.0%
Graduate Degree/Professional Training	24.6%

<sup>a</sup>IQ was missing for 2 children

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**Table 2**  
**Inter-correlations and Descriptive Statistics with Non-computerized Neurocognitive Measures**

	1 TSCT	2 TIA	3 THI	4 PSCT	5 PIA	6 PHI	7 VC	8 PS	9 NV	10 PC	11 Mat.	12 Copy	13 Obj Imm	14 Obj Del	15 Dig Fwd	16 ENC	17 CFD	18 VA	
1 TSCT	--																		
2 TIA	.65***	--																	
3 THI	.42***	.67***	--																
4 PSCT	.13	.12	.09	--															
5 PIA	-.05	.10	.12	.47***	--														
6 PHI	.00	.07	.26	.28*	.66***	--													
7 VC	-.24	-.14	-.14	.02	-.04	.09	--												
8 PS	-.27	-.05	-.07	.02	.03	.20	.28*	--											
9 NV	-.03	.15	.22	-.03	-.10	-.15	.36*	.29*	--										
10 PC	-.45***	-.20	-.16	-.07	-.04	-.03	.40***	.25	.29*	--									
11 Mat.	-.12	-.05	-.02	-.13	-.18	.01	.28*	.36*	.21	.32*	--								
12 Copying	-.47***	-.26	-.18	-.38***	-.30*	-.18	.30*	.33*	.16	.55***	.47***	--							
13 Obj Imm	-.36*	-.27	-.22	.14	.14	.07	.55***	.24	.26	.38***	.16	.24	--						
14 Obj Del	.05	.04	.01	-.01	.12	.28	.33*	.05	.10	.20	-.09	.10	.47***	--					
15 Dig Fwd	-.15	-.12	.00	.11	-.18	-.03	.42***	.33*	.25	.28	.28*	.33*	.41***	.23	--				
16 ENC	-.49***	-.33*	-.19	.02	-.04	-.10	.52***	.24	.36***	.50***	.26	.52***	.37***	.02	.38***	--			
17 CFD	-.37***	-.20	-.10	.18	.09	.00	.60***	.34*	.34*	.46***	.35*	.45***	.40***	.14	.48***	.59***	--		
18 VA	-.28*	.02	-.06	.05	.16	-.03	.25	.29*	.07	.20	.29*	.41	.20	-.02	.10	.34*	.34*	--	
Mean	.63	1.15	1.30	.32	.97	1.4	52.2	54.1	56.3	50.7	55.6	46.0	43.6	44.9	53.3	51.8	8.8	10.5	
SD	1.0	.94	1.1	.98	.79	.73	9.8	11.4	11.9	8.6	7.0	10.4	12.1	9.8	10.8	11.6	3.4	2.2	
n	56	56	56	60	60	60	51	51	50	51	50	50	49	49	50	50	61	61	61

Note. T=Teacher; P=Parent; SCT=Sluggish Cognitive Tempo; IA=Inattention; HI=hyperactivity/impulsivity; VC=Verbal Comprehension; PS=Picture Similarities; NV=Naming Vocabulary; PC=Pattern Construction; Mat=Matrices; Obj=Object; Imm=Immediate; Del=Delayed; Dig Fwd = Digits Forward; ENC=Early Number Concepts; CFD=Concepts and Following Directions; VA=Visual Attention.

\*  $p < .05$ .

\*\*  $p < .01$ .

**Table 3**  
**Inter-correlations and Descriptive Statistics with Computerized Neurocognitive Measures**

	1 T SCT	2 T IA	3 T HI	4 P SCT	5 P IA	6 P HI	7 SRT	8 GNG	9 SOP	10 SSS	11 FIS
1 T SCT	--										
2 T IA	.65**	--									
3 T HI	.42**	.67**	--								
4 P SCT	.13	.12	.09	--							
5 P IA	-.05	.10	.12	.47**	--						
6 P HI	.00	.07	.26	.28*	.66**	--					
7 SRT	.37*	.18	.03	.03	.15	.07	--				
8 GNG	-.36*	-.17	-.08	-.08	-.05	.03	-.22	--			
9 SOP	-.30*	-.20	-.04	-.16	-.16	.05	-.12	-.07	--		
10 SSS	-.41**	-.37*	-.11	.09	-.08	.05	-.22	-.28	.10	--	
11 FIS	-.36*	-.23	-.04	-.02	-.13	-.06	-.18	-.30	.42**	.54**	--
Mean	.63	1.15	1.30	.32	.97	1.4	1066.6	.71	.62	.63	.68
SD	1.0	.94	1.1	.98	.79	.73	242.1	.28	.17	.23	.16
n	56	56	56	60	60	60	46	42	45	40	45

Note. T=Teacher; P=Parent; SCT=Sluggish Cognitive Tempo; IA=Inattention; HI=hyperactivity/impulsivity; SRT = Bubbles Simple Reaction Time; GNG=Animal Go/No Go proportion of no-go trials correctly inhibited; SOP = Pick the Picture Self Ordered Pointing proportion correct; SSS = Silly Sounds Game Stroop proportion correct; FIS = Something's the Same Flexible Item Selection proportion correct.

\*  $p < .05$ .

\*\*  $p < .01$ .

**Table 4**  
**Multiple Regressions Examining Teacher Ratings of SCT in Relation to Neurocognitive Task Performance**

Predictor	Pattern Construction		Copying		Recall of Objects Immediate		Early Number Concepts		Concepts and Following Directions		Visual Attention		Simple Reaction Time		Animal Go/NoGo inhibition		Self-ordered Pointing		Stroop		Flexible Item Selection	
	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β	R <sup>2</sup>	β
IA	.04	.15	.07	.08	.07	-.06	.11	-.01	.04	.06	.00	.34	.03	.10	.03	-.11	.04	-.01	.13*	-.17	.06	-.00
SCT	.17**	-.54	.16**	-.53	.06	-.32	.14**	-.49	.10*	-.41	.15***	-.51	.11*	-.44	.11*	.43	.05	-.29	.05	-.31	.07	-.35

Note. IA = attention-deficit/hyperactivity disorder inattention. SCT = sluggish cognitive tempo.

\*  $p < .05$ ;

\*\*  $p < .01$



**Table 5**  
**Inter-correlations and Descriptive Statistics with Executive Function Ratings**

	1 T SCT	2 T IA	3 T HI	4 P SCT	5 P IA	6 P HI	7 T Inhibit	8 T Shift	9 T ER	10 T WkgM	11 T Plan	12 P Inhibit	13 P Shift	14 P ER	15 P WkgM	16 P Plan
1 T SCT	--															
2 T IA	.65**	--														
3 T HI	.42**	.67**	--													
4 P SCT	.13	.12	.09	--												
5 P IA	-.05	.10	.12	.47**	--											
6 P HI	.00	.07	.26	.28*	.66**	--										
7 T Inhibit	.12	.40**	.64**	-.08	.13	.28*	--									
8 T Shift	.17	.23	.56**	.09	.01	.06	.46**	--								
9 T ER	.03	.18	.53**	-.06	-.06	.10	.61**	.82**	--							
10 T WkgM	.50**	.74**	.53**	-.01	.14	.17	.65**	.38**	.34**	--						
11 T Plan	.46**	.64**	.61**	-.05	.05	.17	.67**	.47**	.46**	.88**	--					
12 P Inhibit	-.02	.08	.19	.32*	.59**	.66**	.26*	-.05	-.06	.15	.15	--				
13 P Shift	-.04	-.08	-.07	.07	.00	.08	-.03	-.04	.05	-.11	.05	.20	--			
14 P ER	-.05	-.07	.05	.22	.29*	.47**	-.03	.06	.00	-.02	.13	.60**	.57**	--		
15 P WkgM	.10	.14	-.01	.40**	.69**	.59**	.07	-.22	-.23	.13	.06	.76**	.13	.44**	--	
16 P Plan	-.00	.18	.12	.32*	.64**	.54**	.12	-.14	-.17	.21	.14	.74**	.21	.50**	.80**	--
Mean	.63	1.15	1.30	.32	.97	1.4	70.0	58.8	64.4	70.8	70.0	72.8	57.2	69.3	73.7	69.1
SD	1.0	.94	1.1	.98	.79	.73	14.2	13.4	17.0	13.9	14.6	12.4	14.0	14.0	14.8	13.5
n	56	56	56	60	60	60	61	61	61	61	61	60	60	60	60	59

Note. T=Teacher; P=Parent; SCT=Sluggish Cognitive Tempo; IA=Inattention; HI=hyperactivity/impulsivity; ER=Emotion Regulation; WkgM=Working Memory; Plan = Planning/Organization.

\*  $p < .05$ .

\*\*  $p < .01$ .

Table 6

## Multiple Regressions Examining SCT in Relation to EF Ratings

Predictor	BRIEF Inhibit		BRIEF Working Memory		BRIEF Plan/Organize	
	R <sup>2</sup>	$\beta$	R <sup>2</sup>	$\beta$	R <sup>2</sup>	$\beta$
<b>Teacher</b>						
Inattention			.55**	.71	.41**	.59
SCT			.00	.04	.00	.08
<b>Parent</b>						
Inattention	.35**	.57	.48**	.65	.41**	.63
SCT	.00	.05	.01	.09	.00	.02

Note. IA = attention-deficit/hyperactivity disorder inattention. SCT = sluggish cognitive tempo.

\*  $p < .05$ ;

\*\*  $p < .01$ ; greyed out area – not computed (correlations non-significant)