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Do sluggish cognitive tempo symptoms improve with school-based ADHD interventions? Outcomes and predictors of change.

Zoe Smith
Virginia Commonwealth University

Do sluggish cognitive tempo symptoms improve with school-based ADHD interventions? Outcomes and predictors of change.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

By:
Zoe R. Smith,
Master of Science, Clinical Psychology
Virginia Commonwealth University, May 2017

Director:
Joshua M. Langberg, Ph.D.,
Associate Dean of Research, College of Humanities and Sciences
Associate Professor, Department of Psychology

Virginia Commonwealth University
Richmond, VA
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Abstract

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Sluggish cognitive tempo (SCT) is a construct that includes symptoms of slowness, mental confusion, excessive daydreaming, low motivation, and drowsiness/sleepiness. SCT is often co-morbid with attention-deficit/hyperactivity disorder (ADHD), and SCT symptoms are associated with significant academic and interpersonal impairment above and beyond the influence of ADHD symptoms. Despite the overlap between ADHD and SCT and associated impairments, no studies have evaluated how evidence-based psychosocial interventions for adolescents with ADHD impact symptoms of SCT. This study examined whether SCT symptoms improved in a sample of 274 young adolescents with ADHD who received either an organizational skills or a homework completion intervention. SCT intervention response was evaluated broadly in all participants, and specifically, for participants in the clinical range for SCT symptom severity at baseline. Change in ADHD symptoms of inattention, executive functioning, and motivation was examined as potential predictors of improvement in SCT. Multilevel modeling analyses indicated that SCT symptoms decreased at the same rate for adolescents in both the organizational skills and homework completion interventions when compared to the waitlist group (d = .410). For adolescents with parent-reported clinical levels of SCT, the decrease in symptoms was more pronounced (d = .517), with the interventions decreasing the total score of SCT by 2.91 (one symptom). Additionally, in the high SCT group, behavior regulation executive functioning, metacognitive executive functioning, and inattention predicted change. Clinical implications and future directions are discussed, including development of interventions for adolescents with high levels of SCT.

Do sluggish cognitive tempo symptoms improve with school-based ADHD interventions? Outcomes and predictors of change.

This introduction provides a review of the history, prevalence, symptomology, distinction from other constructs, and associated impairment and psychopathology of sluggish cognitive tempo (SCT). Potential theoretical and etiological underpinnings of SCT and attention-deficit/hyperactivity disorder (ADHD) are also discussed. Next, school-based interventions targeting the homework problems of students with ADHD are reviewed in the context of their potential to alleviate SCT symptoms. Further, a theoretical rationale for factors targeted in school-based ADHD interventions that might be associated with change in SCT is presented, with a focus on ADHD symptoms of inattention, executive functioning (EF), and motivation. Finally, study aims, hypotheses, and proposed analyses are outlined.

History of SCT

The construct of SCT includes symptoms of slowness, mental confusion or “fogginess,” excessive daydreaming, apathy, and drowsiness/sleepiness. Importantly, there is some debate regarding the best label for this compilation of symptoms, and “Concentration Deficit Disorder” (CDD) has been recommended as an alternative (e.g, Barkley, 2014, 2018; Becker, Luebbe, et al., 2015). The rationale for CDD is that the term may be less offensive as well as better focused on the symptoms of the construct and the overlapping but distinct nature of SCT and ADHD (Barkley, 2014; Barkley, 2018; Becker, Luebbe, et al., 2015; Saxbe & Barkley, 2014). The term SCT will be used throughout this manuscript because the field has yet to agree upon a name and historically, SCT is the most commonly used term.

Research on SCT began in the 1980s, likely due to the fact that during that time the DSM-III (American Psychiatric Association [APA], 1980) created two different types of ADHD, ADD with (+H) and without (–H) hyperactivity. As such, research started focusing on differences between ADD +H and –H, finding that ADD +H was associated with higher levels of behavior problems and conduct disorder, while ADD –H was associated with withdrawal, drowsiness, apathy, and daydreaming behaviors (Lahey, Schaughency, Frame, & Strauss, 1985; Carlson, 1986; Carlson, Lahey, & Neeper, 1986). In some of the earliest work with SCT, a cluster analysis was run on a group of children with ADD +H and –H and learning disabilities (LD), identifying students with high levels of what was called a sluggish tempo factor (e.g., apathy, lethargy, sluggishness, drowsiness) and low levels of hyperactivity (Carlson, 1986). This early work spurred research seeking to understand whether SCT was a subtype of ADHD or whether SCT symptoms should be incorporated into the ADHD inattention domain.

Distinction of SCT

To date, most research has focused on whether SCT and ADHD are distinct constructs. However, recent work has also begun to evaluate the distinction between SCT and other forms of psychopathology (e.g., anxiety/depression). In the DSM-IV, ADHD was described as having two subtypes, ADHD combined type (ADHD-C), which included six or more symptoms of both inattention and hyperactivity/impulsivity, and ADHD inattentive type (ADHD-IA), which included six or more symptoms of inattention and less than six symptoms of hyperactivity/ impulsivity. During this period, SCT research focused on evaluating whether SCT and ADHD symptoms (particularly the inattention domain) were distinct. In the first study to test this distinction, Milich, Balentine, and Lyman (2001) found three distinct factors, two of which categorized ADHD-IA and ADHD hyperactive/impulsive symptoms, and one factor that separated out to be SCT. This finding was then corroborated by multiple studies using factor analysis and direct observation using this framework for ADHD (e.g., Pfiffner, & Frick, 2001;

McConaughy & Achenbach, 2001; Todd, Rasmussen, Wood, Levy, & Hay, 2004). Currently, over 20 studies and a meta-analysis support the assertion that both ADHD symptom domains are distinct from SCT, though the ADHD-IA domain is significantly correlated with SCT symptoms (Barkley, 2013; Bauermeister, Barkley, Bauermeister, Martinez, McBurnett, 2012; Becker, Leopold, et al., 2016; Carlson & Mann, 2002; Garner, Marceaux, Mrug, Patterson, & Hodgens, 2010). In terms of prevalence, estimates show that 30-63% of youth that meet criteria for ADHD-IA or ADHD-C also have high levels of SCT (Barkley, 2018; Carlson & Mann, 2002; Garner et al., 2010; McBurnett et al., 2001). Thus, although SCT is distinct from ADHD, there is a clear association and comorbidity between inattentive and SCT symptoms.

In terms of the distinction between SCT and other forms of psychopathology, SCT appears to be distinct from oppositional defiant disorder (ODD), anxiety, depression, and daytime sleepiness (Becker, Luebbe, et al., 2014; Bernad et al., 2014; Burns et al., 2013; Garner et al., 2010; Jacobson et al., 2012; Lee et al., 2014; Penny, Waschbusch, Klein, Corkum, & Eskes, 2009; Smith, Eadeh, Breaux, & Lanbgerg, 2018; Willcutt et al., 2014). Specifically, four studies have examined whether SCT is distinct from anxiety and depression, finding through confirmatory factor analysis (CFA), that SCT, depression, and anxiety are three distinct factors (Becker, Luebbe, et al., 2014; Burns et al., 2013; Lee et al., 2014; Smith, Eadeh et al., 2018). Interestingly, given that SCT emerged from the ADHD literature, recent studies examining SCT and psychopathology have shown that SCT is more strongly associated with internalizing problems than externalizing problems (Becker, Leopold et al., 2016; Smith & Langberg, 2017). SCT is moderately to strongly associated with internalizing symptoms, such as depression and anxiety (Bernad et al., 2015; Smith & Langberg, 2017). In contrast, SCT negatively predicts or is unrelated to oppositional and hyperactive/impulsive symptoms (Bauermeister 2012; Burns et al., 2013; Lee et al., 2013; Smith & Langberg, 2017). However, it remains unclear whether SCT can be considered a clinically distinct disorder. Importantly, this endeavor has been limited by measurement problems, including lack of agreement upon set of items and about which source (i.e., parent, child, or teacher) can most accurately report on SCT symptoms.

Measurement of SCT

SCT Symptom Set. Although there is no official symptom or item set for SCT, researchers have identified key items that are most salient to symptomology. One of the first studies to examine an SCT symptom set was Penny and colleagues (2009), who created the Sluggish Cognitive Tempo Scale (SCTS) used in the present study. To develop this scale, five experts in the field of SCT rated 26 items identified from a literature search on the representativeness and uniqueness of each of the items to the construct of SCT. Experts also reviewed how well the items as a whole characterized SCT and considered whether there were additional items that should be included (Penny et al., 2009). Fourteen of the 26 items were found to be representative and unique, with interclass correlation (ICC) of raters at .63. The fourteen items can be found in Table 1. Factor analysis suggested these items hung together well in both ADHD and typically developing samples (Jacobson et al., 2012; Penny et al., 2009; Smith, Becker, et al., 2018). A recent meta-analysis identified 13 items that loaded highly on an SCT factor and were not redundant with other items (Becker, Leopold, et al., 2016; Becker, Burns, Schmitt, Epstein, & Tamm, 2017). Of these items, 10 are included on the SCTS, which to date, is the only measure that has parent-, teacher-, and self-report versions and has been used with children and adolescents (Becker, Luebbe et al., 2015; Jacobson et al., 2012; Penny et al., 2009; Smith, Becker et al., 2018).

Rating Scales of SCT. The two SCT scales with the most psychometric validation are the Penny et al. (2009) SCTS and the Barkley Sluggish Cognitive Tempo Scale: Child and Adolescents (BSCTS-CA; Barkley, 2018). These scales are reviewed in some detail below because the SCTS will be used in the present study, along with Barkley's (2018) method of identifying youth with high levels of SCT.

Penny and colleagues (2009) originally ran an exploratory factor analysis (EFA) on a set of 14 items, finding three factors for parent-report of SCT (Slow, Sleepy, Daydreamer) and two factors for teacher-report of SCT (Slow, Sleepy/Daydreamer). Internal consistencies for parents and teachers and test-retest reliabilities (only for parent-report) for each subscale were satisfactory to high (α = .86 - .96, test-retest α = .70 - .87). To further evaluate the validity of this factor structure, CFA and bifactor modeling were conducted with the SCTS (Penny et al., 2009) using an ADHD (Smith, Becker et al., 2018) and non-clinical sample (Becker et al., 2015). A bifactor model was found to be the best fit in the Becker et al. (2015) and Smith and colleagues (2018) studies, with one underlying general factor of SCT and three specific factors of Slow, Sleepy, and Daydreamer. When comparing parent- and self-report models, global fit indices suggested that the self-report of SCT model fit best, while parent-report fit adequately in the ADHD sample and was not tested in the non-clinical sample. However, reliability analyses for both parent- and self-report controlling for the general factor found that the specific SCT factors were unreliable and not recommended for use unless they were shown to differentially predict impairment or related psychopathology (Becker et al., 2015; Smith, Becker, et al., 2018). Therefore, use of the total score of SCT on the SCTS for both parent- and self-report is warranted.

Table 1. *Sluggish Cognitive Tempo Scale Items (Penny et al., 2009)*

Parent-Report	Self-Report
1. Is apathetic; shows little interested in things or activities	1. I am not interested in participating in activities
2. Is slow or delayed in completing tasks	2. I am slow or delayed in completing tasks
3. Is unmotivated	3. I am unmotivated
4. Appears to be sluggish	4. I feel sluggish
5. Seems drowsy	5. I feel drowsy
6. Daydreams	6. I daydream
7. Appears tired; lethargic	7. I am tired or don't have energy
8. Gets lost in her or his own thoughts	8. I get lost in my own thoughts
9. Lacks initiative to complete work	9. I don't have the drive to complete my work
10. Seems to be in a world of her or his own	10. I feel like I am in a world of my own
11. Effort on tasks fades quickly	11. My effort on tasks goes away quickly
12. Has a yawning, stretching, sleepy-eye appeared	12. I feel like yawning or stretching or am sleepy
13. Needs extra time on assignments	13. I need extra time for assignments
14. Is underactive, slow moving, or lacks energy	14. I am underactive, slow moving, or lack energy

Development of the BSCTS-CA (Barkley, 2018) started with a review of the literature, finding 14 SCT items to best fit with the construct. The authors modeled this scale based upon empirical SCT item development work (McBurnett et al., 2001) and the SCTS (Penny et al., 2009), though the items did not fully correspond with the SCTS. The 14-item scale was completed by 1,922 parents of children ages six to seventeen through an online survey (Barkley, 2018). An EFA was run on the sample, finding two of the items cross-loaded on the ADHD-IA factor, and thus were removed from the scale. The remaining 12 items were broken into two factors, one with seven items called Slow/Lethargic and the other including five items and named Daydreaming/Spacey/Mind Wandering (Barkley, 2018). The two SCT factors were also found to be distinct from executive functioning factors. Four scores can be created using the BSCTS-CA, including a SCT Daydreamer score, SCT Sluggish score, SCT total score, and SCT symptom count. For the two subscale and total scores, items are summed to create a raw score. Internal consistencies (α = .87 - .93) and test-retest reliabilities are satisfactory to high (α = .79 - .84). Similar to ADHD rating scales, SCT symptoms are considered to be present at clinical levels if endorsed as occurring “often” or “very often.” Normative data suggests that endorsing at least three of the SCT symptoms as present at clinical levels places youth at or above the 93rd percentile. Thus, although there is currently no way of “diagnosing” SCT, this symptom count method is recommended as the most clinically useful way to identify someone with high levels of SCT (Barkley, 2018).

Multiple Raters of SCT. As with most psychological constructs, current best practice assessment of SCT includes the collection of information from multiple sources. In early SCT research, SCT symptoms were only assessed from the parent and teacher perspective, likely because SCT emerged from ADHD research, which emphasizes parent and teacher report (Pelham, Fabiano, & Massetti, 2005). However, SCT has multiple items that inquire about internal states (e.g., “I am unmotivated,” “I get lost in my own thoughts”), and SCT may be best rated by adolescents themselves, as self-report is considered best practice when evaluating internalizing disorders (Klein, Dougherty, & Olino, 2005; Silverman & Ollendick, 2005). Notably, one study examining youth with ADHD found that parent- and self-report of SCT on the SCTS were not invariant, meaning that each rater provided unique information (Smith, Becker et al., 2018). Unfortunately, only a handful of studies have even included self-report of SCT (Becker, Luebbe, et al., 2015; Sáez, Servera, Burns, & Becker, 2018; Smith & Langberg, 2017; Smith, Breaux, Green, & Langberg, 2018; Smith, Becker, et al., 2018) and only the SCTS has been modified and had psychometrics examined for self-report of SCT (Becker, Luebee, et al., 2015; Smith, Becker, et al., 2018). Thus, both parent- and self-report were used in the current study.

Constructs that may link ADHD and SCT

The high prevalence rate of comorbid SCT with ADHD, and overlap with ADHD symptoms of inattention in particular, suggests that there may be a shared etiology and/or core deficits across conditions. Indeed, according to one study, SCT shares half of its genetic contributions with ADHD (Moruzzi et al., 2014). Theoretical models associated with ADHD, particularly the inattentive domain, will be reviewed briefly below, with a focus on how they may relate to symptoms of SCT.

Multiple theories suggest that ADHD symptoms can be attributed to underlying cognitive deficits and emphasize the role of the prefrontal cortex (Barkley, 1997; Sagvolden, 1991; Sagvolden et al., 1998; Sonuga-Barke, 2005). In particular, two competing theoretical models have been posited, one in which ADHD is caused by executive dysfunction due to deficient inhibitory control (Barkley, 1997; Willcutt, Doyle, Nigg, Faraone, & Pennigton, 2005), and the other hypothesizing that ADHD is caused by the impairment in signaling delayed rewards and motivational processes (Sagvolden, 1991; Sagvolden et al., 1998). These two theories are both incorporated into the multiple pathway model of ADHD postulated by Sonuga-Barke (2005), which suggests that both EF and motivational deficits should be considered when examining youth with ADHD (Pennington, 2006; Sonuga-Barke, Dalen, & Remington, 2003; Willcutt et al., 2010; Willcutt, 2015). These theories are reviewed below.

Executive Functioning. EF represents “top-down” cognitive functions that facilitate decision making using working memory, suppressing irrelevant information, and inhibiting maladaptive or unhelpful responses (Willcutt, 2015). As such, EFs influence individuals' abilities to work towards goals (Sonuga-Barke, 2005). Barkley's (1997) unified theory of EF suggested that individuals with ADHD exhibit deficits in working memory, self-regulation, behavioral and response inhibition, planning, and initiation of behavior. This theory suggests that impairments in individuals with ADHD are grounded in response inhibition, which is the ability to inhibit an inappropriate response in favor of a more appropriate option (Barkley, 1997; Sonuga-Barke, 2005). Problems with regulation of effort, arousal, and activation have also been identified (Sergeant, 2005), which effect an individual's ability to react to a situation. Meta-analyses including over 250 studies of ADHD and EF have shown that ADHD symptoms are associated with multiple EF domains (e.g., working memory, planning, inhibition, delay aversion, state regulation), but only account for approximately 10% of the variance in ADHD symptoms (Wåhlstedt et al., 2009; Willcutt, 2015). This suggests that although EF deficits play a role in ADHD, there are clearly other factors that need to be considered.

When associations are found between SCT and EF, they tend to be weaker than the associations between EF and ADHD, with EF accounting for around 1-12% of the variance in SCT (Barkley, 2018; Becker & Langberg, 2014). Multiple studies show that SCT symptoms are associated with EF deficits in self-organization, planning and problem solving, self-regulation of emotion and behavior, and metacognitive EF above and beyond ADHD symptoms (Barkley, 2013, 2018; Becker & Langberg, 2014; Becker et al., 2017; Jarret, Rapport, Rondon, & Becker, 2014). In particular, one study found that both parent- and teacher-rated SCT in youth with ADHD were associated with metacognitive EF (i.e., ability to self-manage and monitor own progress and performance) above and beyond ADHD symptoms, math achievement, and spelling ability (Becker & Langberg, 2014). This was later corroborated by Jiménez and colleagues

(2015). Further, Barkley (2013) found significant associations between SCT and EF in four of the five domains of EF tested in a large, epidemiologically derived sample of children, however, these associations were modest (less than 1%, except for the approximately 5% found for planning and problem solving EF). Other studies have found nonsignificant associations between SCT and EF, particularly those using neuropsychological tests of EF (Bauermeister et al., 2012; Camprodon-Rosanas et al., 2018; Wahlsted & Bohlin, 2010). Overall, the current research is too limited to draw firm conclusions. Another likely possibility, particularly given that a core symptom of SCT is apathy, is that a motivation deficit at least partially underlies both ADHD and SCT.

Motivational Dysfunction. Multiple motivation-deficit based theories have been proposed as an alternative to cognitive theories of ADHD (Sagvolden, 1991; Sagvolder et al., 1998; Sonuga-Barke, 2005; Willcutt, 2015). These theories posit that ADHD is attributable to poor reward processes, including a dysfunctional response to behavioral contingencies (e.g., rewards and consequences; Luman, Oosterlaan, & Sergeant, 2005). Future consequences, whether positive or negative, are less salient, while individuals with ADHD are hypersensitive to immediate consequences (Luman et al., 2005; Modest-Lowe, Chaplin, Soovajian, & Meyer, 2013; Sonuga-Barke, 2005). It is argued that this difficulty waiting for a future reward is independent of deficits in inhibition or impulsivity, though there are clear similarities between the EF and motivational theories proposed for youth with ADHD (Luman et al., 2005; Solanto et al., 2001; Sonuga-Barke, 1994). Some studies have shown that incorporating response contingencies as immediate consequences improve and can even normalize task performance in individuals with ADHD (Carlson & Tamm, 2000; Slusrek, Velling, Bunk, & Eggers, 2001), while others show an effect of response contingencies, but no differences in response between individuals with and without ADHD (Scheres, Oosterlaan, & Sergeant, 2001; Shanahan, Pennigton, & Willcutt, 2008). Two recent reviews suggest that ADHD is associated with a deficit in motivation, particularly with regards to academic motivation (Modesto-Lowe et al., 2013; Smith & Langberg, 2018).

Despite the fact that SCT has multiple symptoms linked to motivation (e.g., lack of interest), very few studies have examined SCT and motivation (Barkley, 2013; Becker et al., 2017; Smith, Breaux et al., 2018). These studies found mixed results, with both Barkley (2013) and Becker and colleagues (2017) finding that SCT was not associated with motivation once controlling for ADHD symptoms. Smith and colleagues (2018), however, found that self- and parent-report of SCT were associated with homework motivation above and beyond symptoms of ADHD, ODD, anxiety, depression, age, and intelligence. They also used a psychometrically validated measure of motivation informed by the expectancy values theory of motivation (Wigfield & Eccles, 2000). This theory suggests that an individual's choice, persistence, and performance on a task can be understood by their beliefs regarding how well they will do and how much they value it (Wigfield & Eccles, 2000). The authors also used a task-specific measure of motivation (e.g., homework motivation), which is consistent with best practice recommendations as motivation can vary widely depending upon the task (Modesto-Lowe et al., 2013; Wigfield & Eccles, 2000). In that same study, an exploratory, cross-sectional mediation model using cross-informant measures (i.e., parent-report of SCT to self-report of motivation to teacher-report of homework performance) suggested that homework motivation may mediate the association between SCT and homework performance (Smith, Breaux, et al., 2018). Although SCT symptoms may show face validity in their association with motivation (e.g., having similar symptoms to motivation), clearly more work is needed to fully understand whether deficits in motivation account for the overlap between ADHD and SCT. Overall, it is likely that motivation, reward processing, and EF intertwine with SCT. As such, it is possible that ADHD interventions that target these constructs will also decrease SCT symptoms, and possibly the impairment associated with SCT.

SCT and Impairment

A recent meta-analysis concluded that SCT in children and adolescents was associated with significant global, social, and academic impairment (r=.38-.44; Becker, Leopold, et al., 2016). Specifically, SCT is associated with lower achievement scores (Bauermeister et al., 2012; Markovich-Pilon et al., 2017), deficits in math and writing performance (Bauermeister et al., 2012; Tamm et al., 2016), poor study skills (Flannery, Luebbe, & Becker, 2017), grades (Smith & Langberg, 2017), problems with organization (Langberg et al., 2014), and homework problems (Langberg et al., 2014; Smith & Langberg, 2017; Willcutt et al., 2014) after controlling for symptoms of ADHD. SCT is also associated with difficulties with social skills, with teachers rating 75% of youth with high levels of SCT as impaired in peer functioning (Becker et al., 2014). In particular, youth with high levels of SCT are more likely to be socially withdrawn even when controlling for symptoms of ADHD, ODD, conduct disorder, anxiety, depression, demographic variables, and intelligence (Becker & Langberg, 2013; Becker, 2014; Becker et al., 2014; Becker, Leopold, et al., 2016; Becker, Garner, et al., 2017; Burns et al., 2013; Capdevila-Brophy et al., 2014; Garner et al., 2010; Marshall et al., 2013; Willcutt et al., 2013).

SCT has also been linked to elevated ratings of inattention, anxiety, and depression (Bauermeister et al., 2012; Becker et al., 2014; Capdevlia-Brophy et al., 2014; Jacobson, Geist, & Mahone, 2018; Lee et al., 2013; Penny et al., 2009; Smith & Langberg, 2017). SCT predicts both anxiety and depression, and increases the risk of comorbidity for both disorders even when controlling for symptoms of ADHD (Barkley, 2013; Barkley, 2018; Bernad et al., 2014; Servera et al., 2016; Smith & Langberg, 2017). In fact, self-report of SCT may account for up to 30% of the variance in comorbid internalizing symptoms when controlling for the influence of ADHD symptoms (Smith & Langberg, 2017). Clearly, SCT is associated with significant academic and interpersonal impairment and with internalizing psychopathology. However, there has been very little SCT treatment outcome research.

Treatment of SCT

No pharmacological nor psychosocial interventions exist that specifically target youth with impairing levels of SCT. Further, few studies have examined how existing pharmacological or psychosocial interventions may impact SCT symptoms. To date, there have been three studies evaluating the impact of medication on SCT in ADHD samples and one examining how a psychosocial treatment changes SCT symptoms in an ADHD-IA sample. For youth with ADHD, pharmacologic interventions are the most common interventions, and more specifically, stimulant medications are often the first line treatment (Castle, Aubert, Verbrugge, Khalid, & Epstein, 2007; Farone et al., 2015; MTA, 1999). Stimulant medications increase the rate of neural activity in the frontal lobe, leading to improved cognitive functioning such as inability to pay attention and inhibit actions (Arnsten, 2006; Spencer, Biederman, & Wilens, 2000; Volkow et al., 2003). However, some studies have shown that stimulant medication, specifically methylphenidate commonly used to treat ADHD, does not have the same positive effects on SCT symptoms (Milich et al., 2001; Froehlich et al., 2018). Indeed, there is some evidence that having higher levels of SCT symptoms may actually predict poorer response to methylphenidate for youth with ADHD (Froehlich et al., 2018). One study evaluated a non-stimulant ADHD medication, finding that norepinephrine reuptake inhibitor, atomoxetine, was effective at reducing SCT symptoms in youth with both ADHD and dyslexia (McBurnett et al., 2017; Weitecha et al., 2013). Although, the etiology of SCT remains relatively unknown, SCT symptoms may be more strongly associated with abnormal activity in posterior networks as opposed to frontal-parietal networks in ADHD that stimulant medications target (Fassbender, Krafft, & Schweitzer, 2015). As such, it may be that non-stimulant medication, psychosocial treatment, or even medication typically used for anxiety and depression (e.g., selective serotonin reuptake inhibitors) would be more useful in decreasing SCT symptoms than stimulant medication (Barkley, 2018).

School-based Interventions for ADHD

Although no interventions have been created for youth with high levels of SCT, it is possible that existing interventions may alleviate these symptoms and associated impairment. Multiple school-based interventions have been developed to address the academic impairment common in youth and adolescents with ADHD. Adolescents with ADHD often forget to record homework, procrastinate, lose assignments, and turn in 15% fewer assignments on average when compared to peers (Kent et al., 2011; Langberg et al., 2011, 2018). As such, school-based interventions for adolescents with ADHD typically focus on developing strategies and skills that are essential for completing work in secondary school settings, such as organization and time-management skills. Some examples of school-based interventions that focus on these impairments include Family-School Success (Power et al., 2012), Challenging Horizons Program (Evans et al., 2016), Child Life and Attention Skills Program (CLAS; Pfiffner et al., 2014), Supporting Teens Academic Needs Daily (Sibley et al., 2013), and Homework, Organization, and Planning Skills (HOPS; Langberg et al., 2011, 2018). Two interventions will be examined in this study, HOPS and Completing Homework by Improving Efficiency and Focus (CHIEF).

The HOPS intervention was specifically designed to address difficulties with organization, time management, and planning (OTMP) skills, while CHIEF was created to address the behavioral aspects of homework completion, including keeping adolescents focused during work completion (Langberg et al., 2018). HOPS addresses the difficulties students with ADHD have in recording assignments, gathering materials needed to complete assignments, creating a study plan, managing their time, and bringing assignments back to school completed and ready to turn-in (Langberg et al., 2018). These abilities rely heavily on metacognitive EF skills, which are deficits associated with both ADHD and SCT (Becker & Langberg, 2014; Jiménez et al., 2015; Wåhlstedt et al., 2009; Willcutt, 2015). CHIEF specifically focuses on the difficulties many youth with ADHD have focusing during work completion, staying on task, and completing work accurately and efficiently (Langberg et al., 2018). In particular, this intervention helps increase motivation to stay on-task and complete homework through the application of behavioral reward contingencies. A recent randomized trial comparing HOPS and CHIEF to a waitlist control group showed that both interventions made significant and large improvements in homework problems and that adolescents in the HOPS intervention improved significantly more in OTMP skills as rated by both parents and teachers than those in CHIEF and waitlist control (Langberg et al., 2018). In fact, 68% of youth who received HOPS showed a high (>90%) acquisition of organizational and homework recording skills (Breaux et al., 2018). However, the impact of these interventions on comorbid SCT symptoms was not evaluated.

Only one study to date has examined how a psychosocial intervention may affect SCT symptoms. Pfiffner and colleagues (2007) designed CLAS as a psychosocial intervention for children (2^{nd}-5^{th} grade) with ADHD-IA presentation to target impairments at both home and school. Treatment components included psychoeducation, behavior parent training, social skills, improving homework routines, cognitive behavioral strategies, OTMP skills, self-management of alertness (e.g., repeat last comment made or activity that occurred), and self-care/independence. Teachers, parents, and children were taught skills in groups and a token economy was applied to maintain and reward skills use. Sixty-nine children were randomized into treatment or control groups and were compared at baseline and post-treatment. Pfiffner et al. (2007) reported that participants in the intervention group made improvements in ADHD symptoms and on a combined score of parent and teacher ratings of SCT ($\eta^2 = .224$; Pfiffner et al., 2007). However, self-report of SCT was not collected and no analyses were conducted to evaluate factors associated with change in SCT.

Statement of the Problem

Comorbid SCT is related to multiple forms of impairment in individuals with ADHD, above and beyond other important predictors. Despite this, only one study has examined how a psychosocial ADHD intervention affects SCT symptoms (Pfiffner et al., 2007). As SCT and ADHD have some overlap in presentation of symptomology, EF deficits, and genetic etiology, it is possible that interventions created to target ADHD symptoms will also alleviate SCT symptoms. If psychosocial interventions for youth with ADHD do improve SCT symptoms, it will be important to determine which factors are associated with change in SCT (e.g., inattention, EF, motivation). This information may help with the development of interventions specifically targeting SCT and also further the field's understanding of the etiology and underlying mental dysfunction of SCT.

Current Study

This study evaluated the impact of two types of school-based interventions for middle school students with ADHD (HOPS and CHIEF) on comorbid SCT symptoms relative to each other and to a waitlist control. As not all youth with ADHD exhibit SCT symptoms, the impact of the interventions on SCT was also evaluated separately with the participants who exhibit high levels of SCT at baseline. Finally, this study examined which constructs (i.e., inattention, EF, motivation) were associated with change in SCT symptoms.

Aims and Hypotheses

Aim 1. The first aim examined whether SCT symptoms changed with the HOPS and/or CHIEF interventions when compared to a waitlist control group.

Hypothesis a. I predicted that the HOPS and CHIEF interventions would not differ in how they decrease SCT symptoms as both interventions target areas associated with high levels of SCT. There will be a non-significant main effect of group when HOPS and CHIEF are compared, as well as no interaction effect of intervention group membership (HOPS or CHIEF) and time.

Hypothesis b. I hypothesized that SCT symptoms would decrease after completion of both interventions when compared to a waitlist control group. Thus, there would be a significant main effect of time (e.g., the slope for the intervention group will be negative from pre-intervention to post-intervention) and an interaction between group and time (e.g., individuals in intervention group will decrease in SCT symptoms while waitlist group will not) would be significant.

Aim 2. Using a clinically useful categorization method for SCT, we examined whether SCT symptoms change with HOPS/CHIEF when compared to waitlist control in a group of participants with high levels of SCT symptoms at baseline.

Hypothesis a. I hypothesized that approximately half the sample would show high levels of SCT, defined as marking "often" or "very often" for at least three SCT symptoms by parent- or self-report (Barkley, 2018).

Hypothesis b. I predicted that participants in this subgroup would make significant improvements in SCT symptoms, with a steeper, negative slope for the intervention group than found in Aim 1. I predicted the magnitude of change would be moderate to large in comparison to analyses with all participants where I predicted a small effect. This prediction was made given the likely presence of a floor effect in Aim 1 analyses.

Aim 3. Explored whether change in ADHD inattentive symptoms, EF, and motivation explained a significant proportion of the variance in the change in SCT symptoms.

Hypothesis a. I predicted that change in ADHD inattentive symptoms would be associated with a decrease in SCT symptoms.

Hypothesis b. When researchers have found an association between EF and SCT, it has been with the metacognitive EF (e.g., planning/organization). Therefore, I predicted that decreases in metacognitive EF would be associated with decreases in SCT symptoms, but that there would not be a significant main effect or interaction between decreases in SCT and decreases in behavioral regulation EF (e.g., inhibit behaviors appropriately).

Hypothesis c. One study has shown that SCT predicted lower levels of homework motivation, and that the homework motivation may be a mediating factor between SCT and homework performance (Smith, Breaux et al., 2018). As such, I predicted that increases in motivation to complete homework would be associated with decreases in SCT symptoms.

Method

Participants

This study used data collected from a total of 274 adolescents (age range 10-15 years, *M* age = 11.97, *SD* = 1.04) comprehensively diagnosed with ADHD. Participants were recruited from a total of six different middle schools within a single school district in the Eastern United States and were enrolled in grades six to eight. The full sample includes 52 participants who were assigned to a waitlist control group, 111 who received HOPS, and 111 who received CHIEF. Of those in the immediate treatment groups, approximately 73.7% of the participants were male (*n* = 202 males, 72 females), which is in line with the overall sex ratio observed in ADHD diagnoses (Willcutt, 2012). Caregivers of participants identified 28.5% (*n* = 78) of the youth as African-American/Black, 1.5% (*n* = 4) as Asian, 58.4% (*n* = 160) as Caucasian, 10.2% (*n* = 28) as multiracial, and 1.1% (*n* = 3) as Native American/Alaskan Native. One participant's parent declined to report race information.

Based upon an evidence-based assessment protocol (described in Procedure), 61.7% of participants (*n* = 169) met diagnostic criteria for ADHD, Predominantly Inattentive Presentation (ADHD-IA) and 38.3% (*n* = 105) met criteria for ADHD, Combined Presentation (ADHD-C). High levels of SCT were identified using a clinical cutoff of three or more symptoms reported as occurring "often" or "very often" on the Penny et al (2009) measure (described in Procedure). As SCT should be measured with both parent- and self-report, prevalence rates were determined from both the parent and adolescent perspective. For parent-report at baseline, 74% of adolescents met for high levels of SCT and for self-report 54.4% met criteria. Additionally, 54% (*n* = 148) were taking medication prescribed to manage ADHD symptoms. Importantly, no group differences on these variables are observed between the two intervention groups or waitlist group based upon chi-square and analysis of variance (ANOVA) testing (all p-values > .05).

Procedure

Participants were recruited to participate in a study examining the efficacy of two homework interventions for students with attention problems or with formally diagnosed ADHD. Study procedures were approved by the Virginia Commonwealth University Institutional Review Board; all caregivers provided signed consent and all adolescents provided assent. Participants were primarily referred to the study by school staff, specifically school counselors and school psychologists, at each of the study sites. School staff were given basic descriptions of the homework interventions and were provided recruitment flyers to distribute to caregivers of students who could potentially benefit from study participation. Additionally, the staff within each school contacted parents of potential study participants directly to ask for permission to provide family contact information to the research team. If caregivers agreed to be contacted, the research staff called them and provided a more in-depth explanation of the study and possible interventions. Caregivers were also allowed to initiate contact with the research team and inquire about participation, provided that their child was enrolled in one of the schools where interventions were provided. Once caregivers made contact with the research team and expressed interest in the study, they completed a brief telephone screen inquiring about the presence of the nine DSM inattentive symptoms of ADHD. In order to be scheduled for a full inclusion/exclusion evaluation, parents had to endorse that their child displayed at least four of nine DSM-IV-TR ADHD inattention symptoms on the phone screen. This threshold was chosen to reduce the number of families who participated in the full inclusion/exclusion evaluation who would ultimately not meet eligibility criteria.

If potential participants passed the telephone screen, a comprehensive ADHD evaluation was scheduled. The evaluation was based upon evidence based recommendations (American Academy of Pediatrics, 2011; Pelham, Fabiano, & Massetti, 2005) and upon prior clinical trials of ADHD interventions, such as the Multimodal Treatment of ADHD study (MTA Cooperative Group, 1999). As part of the evaluation, data were collected from the adolescent, caregiver, and at least one of the adolescent's core course teachers (i.e., English, math, science, or social studies). Parents and adolescents separately completed selected modules of the Children's Interview for Psychiatric Syndromes (ChIPS; Weller, Weller, Fristad, Rooney, & Schecter, 2000). Parents completed the ADHD, ODD, Conduct Disorder, Separation Anxiety, Social Phobia, Generalized Anxiety, Obsessive-Compulsive Disorder, Major Depressive Disorder, and Mania modules. Adolescents completed the same modules as parents, except for the ADHD and ODD modules. Parents also completed the Behavior Assessment System for Children, Second Edition (BASC-2; Kamphaus & Reynolds, 2004) as a general screening tool for mental health difficulties, and they completed the Vanderbilt ADHD Rating Scale (VADRS; Wolraich et al., 2008) to collect additional information about the presence of ADHD, ODD, and Conduct Disorder symptoms. Adolescents completed a brief general intelligence screening through a two-subtest (Block Design and Vocabulary) administration of the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV; Wechsler, 2003) and a brief academic achievement screening through a four-subtest (Word Reading, Pseudoword Decoding, Math Problem Solving, and Numerical Operations) administration of the Wechsler Individual Achievement Test, Third Edition (WIAT-III; Wechsler, 2009). Data regarding the presence of ADHD symptoms in the school setting was collected from teachers through administration of the teacher-report version of the VADRS. All available assessment information was then interpreted by a team of licensed clinical psychologists and advanced clinical psychology doctoral students, who made formal mental health diagnoses and study inclusion decisions.

Criteria for inclusion in the study required that children (a) attended one of the participating schools; (b) met full DSM-IV-TR (APA, 2000) diagnostic criteria for ADHD based on the Parent ChIPS (Weller, Weller, Fristad, Rooney, & Schecter, 2000) or parent interview combined with teacher ratings on the NICHQ Vanderbilt ADHD Rating Scale (Wolraich et al., 2003); (c) IQ of 80 or above as estimated using the Wechsler Intelligence Scale for Children – Fourth Edition (Wechsler, 2003); and (d) the adolescent did not meet diagnostic criteria for a pervasive developmental disorder, bipolar disorder, or psychosis. It should be noted that additional information, including rating scales and neuropsychological task performance, was also collected during this baseline evaluation. However, these measures were administered primarily for research purposes, and best-practice recommendations do not currently warrant their inclusion in diagnostic decisions (American Academy of Pediatrics, 2011; Pelham et al., 2005). Therefore, they did not contribute to the formal diagnostic decisions.

Group Randomization and Description of Interventions

Participants who met the full inclusion/exclusion criteria were randomly assigned into one of three groups. One group immediately received an organizational skills training intervention (i.e., HOPS), one group immediately received a homework completion intervention (i.e., CHIEF), and one group was placed on a one-semester waitlist for treatment. Group randomization was stratified by ADHD medication status at the baseline evaluation (i.e., currently taking any medication prescribed for ADHD vs. no current ADHD medication). Group assignment was randomized in a 2:2:1 ratio, with the immediate intervention groups containing more participants than the waitlist group.

Of the 355 families that were screened, 280 met full inclusion criteria and were randomized to HOPS, CHIEF, or to a waitlist control. Of the 280 families that were randomized, 274 participants (HOPS N = 111; CHIEF N = 111; Waitlist Control N = 52) completed at least one intervention session or were in the waitlist group. These families were included in the main outcomes analyses (see Langberg et al., 2018 for more details) and in this study.

ANOVA testing indicated that the groups did not significantly differ from one another along several demographic characteristics, including age, sex, race, ADHD presentation, ADHD medication status, prevalence of comorbid ODD or anxiety or depressive disorders, estimated FSIQ, parental education, or family income (all p-values >.05). See Table 2 for more details.

Intervention delivery format. Both interventions were administered by school mental health professionals who had earned a Masters-level degree in School Counseling. The school mental health professionals were provided with manuals for both interventions and administered each intervention to an approximately equal number of students. Interventions were administered in a one-on-one setting during the school day. Full completion of either intervention included 16 adolescent sessions and two parent meetings. Parent meetings were completed to help parents understand the specific intervention that their adolescent was receiving and to facilitate the transition of intervention skills into the home setting. Adolescents were briefly pulled from their regularly scheduled classes to complete the intervention; to reduce the potential negative impact on students' academic performance, sessions lasted no longer than 20 minutes. The first ten intervention sessions were administered twice-weekly, and the final six sessions were administered once-weekly. In total, the interventions took 11 weeks to complete. Both interventions also included a reward system for reinforcing the use of skills taught during the interventions. Adolescents enrolled in either intervention had the opportunity to earn a variety of small gift cards for demonstrating the skills taught in whichever intervention they received. Point systems were adjusted so that adolescents in either intervention had the opportunity to earn an equal number of gift cards over the full course of the interventions.

HOPS intervention protocol. The HOPS intervention was administered according to the procedures outline in the published manual (Langberg, 2011). The goal of the HOPS intervention was to train students on three main skills: organization and management of school materials, accurately recording assignments and projects, and developing daily and long-term plans to complete assignments and projects. These skills were introduced sequentially, beginning with materials organization and ending with planning skills, but all skills were introduced by the tenth session. When learning materials organization skills, students were introduced to a specific organizational system for their backpack, binder, and locker. Students also learned a system for transitioning all necessary school materials to and from school and developed a strategy for consistently monitoring their adherence to the organizational system. When learning assignment recording skills, students were introduced to the use of a daily planner for tracking all relevant school work (e.g., assignment due dates, upcoming exams). When planning skills were introduced, adolescents learned how to break larger assignments, such as long-term projects or studying for an exam, into a series of smaller steps that could then be incorporated into their assignment recording system. They also learned how to develop a schedule for the completion of assignments in the context of their other after-school activities (e.g., extracurricular activities, family events). After all skills were introduced, the remainder of the intervention focused on helping students troubleshoot difficulties with their organizational and planning systems and developing a system to help the student maintain their skill use after the intervention concluded. School mental health professionals monitored each student's use of specific skills through operationalized definitions of the skills. For example, students may have been rewarded for keeping all homework assignments in a designated homework folder or for accurately recording their assignments from each class during the previous day. To monitor these skills, school mental health professionals completed a behavior checklist during each intervention session.

The first parent meeting in the HOPS intervention focused on introducing the parents to the skills being taught. Parents also learned about how their adolescent's skills were being monitored, and parents developed their own strategies to monitor their child's skill use at home. The second parent meeting focused on helping parents troubleshoot the behavior monitoring systems they developed during the first meeting, as well as helping the parent develop a strategy to continue rewarding their child for using their skills after the intervention ended.

CHIEF intervention protocol. The CHIEF intervention was also administered according to a manualized procedure that was developed by the research team. The goal of the CHIEF intervention was to train students to set work completion goals and to maintain on-task behavior when completing assignments. Students either brought their own homework or assignments to each intervention session, or they were provided relevant academic work to complete if they did not bring any of their own materials. At the beginning of each session, the school mental health professional and student collaborated to set a specific work completion goal. Example completion goals may have included making a set number of vocabulary flashcards and completing a specific number of problems on a worksheet. Students were also taught to incorporate work accuracy checks into their completion goals, such as having a certain number of problems completed on a worksheet answered correctly. Students were encouraged to set work completion goals for subjects that they found more challenging or boring, but students were given the flexibility to choose the work they completed at each session. Additionally, students were taught an operational definition of “on-task” behavior, such as remaining in their seat and having their eye contact focused on school materials. During each session, school mental health providers monitored students’ on-task behavior on a regular time-interval schedule (every minute). If a student met the operational definition of on-task behavior during a particular monitoring period, they earned a point for their reward system. School mental health providers also offered periodic verbal praise of the student’s behavior. If a student was not on-task, they received a verbal prompt specifying how they could adjust their behavior to earn a reward point during the next monitoring period. Reward points for on-task behavior were tracked by the school mental health professional and presented visually to the student for the duration of the session through the use of a clear jar and tokens. Students also earned reward points if they met their work completion goal by the end of the session.

The parent meetings in the CHIEF intervention were similar to the HOPS parent meetings. The primary goal of the first meeting was to introduce parents to the skills being taught at school and developing strategies to monitor their adolescent’s homework completion behaviors in the home. Parents and school mental health providers problem-solved issues with the home monitoring system at the second meeting, and parents were taught how to maintain the reward system after the conclusion of the intervention.

Attendance was high for both treatment groups: 93% of CHIEF participants attended all 16 sessions, and 92% of HOPS participants attended all 16 sessions (see Langberg et al., 2018 for details), with an average meeting length of 19.42 (*SD* = 1.88) minutes for CHIEF and 17.42 (*SD* = 3.50) minutes for HOPS. Overall, treatment adherence to HOPS (85.4%) and CHIEF (89.2%) was high.

Table 2. *Baseline Participant Characteristics by Treatment Assignment*

Demographic variables	HOPS (*N* = 111) *M* (*SD*) or % (*n*)	CHIEF (*N* = 111) *M* (*SD*) or % (*n*)	Waitlist (*N* = 52) *M* (*SD*) or % (*n*)
Age (years)	12.00 (1.05)	12.02 (.99)	11.87 (1.12)
Sex (% males)	66.7 (74)	77.5 (86)	80.8 (42)
ADHD-IA	53.2 (59)	68.5 (76)	65.4 (34)
ADHD-C	46.8 (52)	31.5 (35)	34.6 (18)
ADHD medication	56.8 (63)	52.3 (58)	51.9 (27)
Estimated IQ	99.48 (13.17)	99.43 (12.04)	99.98 (11.86)
WIAT reading	99.25 (12.96)	98.59 (11.80)	99.83 (10.08)
WIAT math	92.04 (13.91)	93.45 (14.29)	94.73 (14.68)
IEP	28.9 (32)	18.0 (20)	32.7 (17)
504 Plan	26.1 (29)	21.6 (24)	13.5 (7)
Comorbid diagnoses	--	--	--
ODD	37.8 (42)	24.3 (27)	26.9 (14)
Anxiety	30.6 (34)	26.1 (29)	19.2 (10)
Depression	5.4 (6)	7.2 (8)	5.8 (3)
Race	--	--	--
African-American/Black	27.9 (31)	31.5 (35)	28.8 (15)
American Indian	1.8 (2)	.9 (1)	.0 (0)
Asian	.9 (1)	2.7 (3)	.0 (0)
Caucasian	55.9 (62)	56.7 (63)	57.7 (30)
Multiracial	13.5 (15)	7.2 (8)	13.5 (7)
Family Income	--	--	--
<$25,000	12.6 (14)	15.3 (17)	11.5 (6)
$25,000-75,000	39.6 (44)	38.7 (43)	26.9 (14)
>$75,000	47.7 (53)	45.9 (51)	61.5 (32)

Note. Chi-Square and ANOVA testing found nonsignificant group differences for all variables. ADHD-IA = attention deficit/hyperactivity disorder, predominantly inattentive presentation, ADHD-C = attention deficit/hyperactivity disorder, combined presentation, IQ = intelligence quotient, WIAT = Wechsler Individual Achievement Test, IEP = Individualized Education Program, ODD = oppositional defiant disorder. Comorbid diagnoses established based on parent-report on the PChIPS; anxiety counted as present if social phobia, separation anxiety, or generalized anxiety criteria were met for PChIPS.

Measures

SCTS (Penny et al., 2009). The parent and self-report versions of the Penny et al. (2009) SCT Scale were used in this study. The SCTS consists of 14 items rated on a four-point scale (0 = *Never* to 3 = *Very Often*). Originally, the scale was created for parents and teachers, with test-retest reliability estimates ranging from .70 to .87 for parent-report. Bifactor modeling on ADHD and non-ADHD samples have shown that use of the total score on the SCTS is reliable for parent- and self-report and had better overall global model fit when compared to confirmatory factor analyses of one-, two-, and three-factor models (Becker et al., 2015; Smith, Becker, et al., 2018). Smith, Becker, and colleagues (2018) found that parent- and self-report of SCT were not invariant, suggesting that each reporter provides unique information. In the present study, internal consistencies for parent and youth total scores were $\alpha = .87$ and $\alpha = .86$, respectively. Although clinical cutoffs have not been established for the SCTS, scales with similar items and number of items (i.e., 12 items instead of 14) have found that if parents endorse three or more symptoms as “often” or “very often,” that would put them in the 93rd percentile in the population (Barkley, 2018). Thus, clinical cutoffs of three or more symptoms were used.

Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000). The BRIEF is an 86-item measure designed to assess an individual’s behavioral application of EF abilities. Responses generate two Index scores: the Behavioral Regulation Index (BRI), which evaluates an individual’s ability to appropriately inhibit and control behaviors and emotions and shift between tasks and environments, and the Metacognition Index (MI), which measures their ability to self-manage and monitor one’s own progress and performance. Further, these indices can be broken down into eight clinical scales. The Shift, Inhibit, and Emotion Control scales combine to make up the BRI, whereas the Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor scales generate the MI. *T*-Scores below 64 are considered within normal limits. *T*-Scores above 65 may be indicative of a clinically significant deficit in that area. For this study, the parent-report version was used to capture adolescent EF abilities. Prior research has found good construct validity based upon expert review, as well as correlations between BRIEF scales and expected behavioral outcomes according to established behavior rating scales (e.g., Child Behavior Checklist, Teacher Report Form, and Conners' Rating Scale; Gioia et al., 2000). For the proposed study, the indexes, BRI and MI, will be used. Internal consistency based upon the data collected from the clinical trial was high for both indexes (αs = .81 and .85, respectively).

Expectancy Value Theory of Motivation Measure –Student Version (EVTM). The Wigfield and Eccles (2000) EVTM measure consists of 11 items that are each rated on a five-point scale, with higher scores signifying higher levels of motivation. For this study, the measure was modified as a homework completion motivation measure instead of a scale measuring motivation for a specific subject. For example, instead of "How good at math are you?" the question was modified to be "How good at finishing and turning in homework are you?". This scale has been used in prior studies and demonstrated excellent convergent and discriminant validity (Wang & Eccles, 2013; Wigfield & Eccles, 2000). In the present study, adolescents completed the ECTM and internal consistency was α = .86.

Vanderbilt ADHD Rating Scale –Parent Version (VARS; Wolraich et al., 2003). The VARS asks respondents to rate the frequency of occurrence for each of the 18 DSM-IV symptoms of ADHD. Parents rate each symptom on a four-point Likert scale (e.g., 0 = *Never,* 3 = *Very Often*). Internal consistencies for the total score (α = .94), inattention (α = .92), and hyperactivity/impulsivity (α = .96) were high in the present study.

Analytic Plan

All analyses were run using the SPSS Version 25 with MIXED command (IBM Corp, 2016; Peugh & Enders, 2005).

Missing Data Procedures.

Missing data from the baseline assessment time point is negligible, with less than 1% of all data missing across baseline variables of interest. At post-intervention, missing data were minimal for self-report variables (1.8%), but higher for parent-reported variables (12.4%). Missing data were managed using maximum likelihood, which calculates a set of parameter estimates that are most consistent with the observed data. Specifically, the restricted maximum likelihood (REML) estimator was used, which provides more accurate results as it uses the sample estimate of the population mean to incorporate uncertainty in the estimation of fixed effects (Kwock et al., 2008; Raudenbush & Bryk, 2002). REML treats fixed effects as sample-based estimates, which provides less biased estimates of variance. REML is the preferred estimated when there are normally distributed data (Holye & Gottfredson, 2015; Kwock et al., 2008).

Data Analyses

Aim 1. The first aim evaluated whether SCT symptoms decrease post-intervention (i.e., HOPS/CHIEF) as compared to a waitlist control group. To achieve this goal, longitudinal multilevel modeling (MLM) with the MIXED command in SPSS was used with both parent- and self-report of SCT total scores from baseline to post-intervention. Separate models were run for each rater. Each model included randomized condition (i.e., HOPS, CHIEF, waitlist) as a predictor variable based on time (e.g., pre- and post-time points). First, to understand if intervention group membership differentially changes SCT symptoms, HOPS and CHIEF were compared using a repeated measures random intercepts and slopes MLM with MIXED command. This allowed us to understand whether HOPS and CHIEF could be combined into a single intervention variable (HOPS/CHIEF vs waitlist) in subsequent analyses. If non-significant group differences on the fixed effects were found between HOPS and CHIEF, the groups were combined into an intervention variable, as this would suggest the slopes of HOPS and CHIEF intervention effects are not significantly different. If HOPS and CHIEF show significant differences in their slopes, then two dichotomous indicator variables would be created for subsequent analyses with waitlist as the comparison variable. The main effects of the slopes for each intervention as compared to the waitlist were examined, as well as the interaction between the different intervention and waitlist slopes. Finally, a repeated measures random intercepts and slopes MLM was run using the indicator variables or the intervention variable (i.e., HOPS/CHIEF together) to examine the main effects and interaction of the interventions' ability to decrease SCT symptoms when compared to waitlist. Main effects of the association between the slopes for group membership and time with SCT symptoms were examined, as was the interaction of group membership by time on SCT symptoms. Simple slopes and intercepts were calculated using the /TEST command in SPSS. To calculate the magnitude of these effects, repeated measures analyses of variance (ANOVAs) were run. Means and standard deviations were used to calculate Cohen's *d* effect sizes for pre- to post-intervention.

Aim 2. The second aim evaluated what percentage of adolescents with ADHD in the sample have high levels of SCT and whether their SCT symptoms changed post-intervention. As discussed above, individuals with high levels of SCT were identified using clinical cutoffs. For each rater, cutoffs were created so that if adolescents or their parent reported three or more symptoms of SCT at "often" or "very often," they would be identified as having high levels of

SCT. Once this group is determined, repeated measures random intercepts and slopes MLM were re-run with the high SCT group only following the same steps as laid out above for full sample. To calculate the magnitude of these effects, repeated measures ANOVAs were run. Means and standard deviations were used to calculate Cohen's *d* effect sizes for pre- to post-intervention.

Aim 3. The third aim examined whether change in inattentive symptoms, EF, and motivation were associated with change in SCT symptoms. First, it would be important to determine if the waitlist group should be included in these analyses. If slopes are significant for both waitlist and intervention groups in Aim 1, then we would examine Aim 3 with an interaction between group status (e.g., waitlist and intervention group) and the time varying variables. If the slope of the waitlist group is non-significant in Aim 1, then Aim 3 analyses would draw data from the intervention groups only and group status would not be included as a predictor variable. Separate models were run for each rater if significant results were found in Aim 1 or Aim 2. Each model included a time varying variable (i.e., inattentive symptoms, behavioral regulation EF, metacognitive EF, motivation) as a predictor variable based on time (e.g., pre- and post-intervention time points). These continuous predictor variables would each be included in separate repeated measures random intercepts and slopes MLM using MIXED command in SPSS to examine the main effects and interaction of each of the time varying variables and SCT by time. Main effects of the association between the slopes for the time varying variables (i.e., inattentive symptoms, metacognitive EF, behavior regulation EF, and motivation) and time with SCT symptoms were examined. Interactions for each of the predictor variables by time on SCT symptoms were also examined. To calculate the magnitude of these effects, repeated measures ANOVAs were run. Means and standard deviations were used to calculate Cohen's *d* effect sizes for pre- to post-intervention.

Results

Aim 1. The first repeated measures random intercepts and slopes MLM was run to determine differences in SCT symptom reduction between HOPS and CHIEF. It resulted in a non-significant result of group and group x time interaction and significant main effect of time ($t = -7.67$, $p < .001$; $t = -2.91$, $p = .004$) for both parent- and self-report SCT respectively. It indicated that both interventions decreased SCT symptoms over time, but at the same rates. Thus, HOPS and CHIEF did not differentially reduce SCT symptoms and were combined as an intervention variable in both the parent- and self-report subsequent analyses.

For parent-reported SCT, there was a significant effect of time ($t = -6.55$, $p < .001$) and group by time interaction ($t = 3.033$, $p = .003$) and non-significant effect of group. As such, there were no differences between the intervention and comparison group on baseline SCT symptoms, but for the intervention group, SCT symptoms decreased by approximately one symptom ($\gamma = -1.78$, $p < .001$). The waitlist group SCT symptoms did not significantly change ($\gamma = .13$, $p = .816$). See Figure 1 for interaction. For self-reported SCT, there was no significant main effect of time ($p = .430$) or group ($p = .605$) nor an interaction of group x time ($p = .665$). Next, repeated measures ANOVAS were run to determine effect size. Cohen's *d* effect sizes were calculated with means and standard deviations, showing a small effect size for both parent-reported SCT ($d = .410$) and self-reported SCT ($d = .313$). See Table 3 for more details.

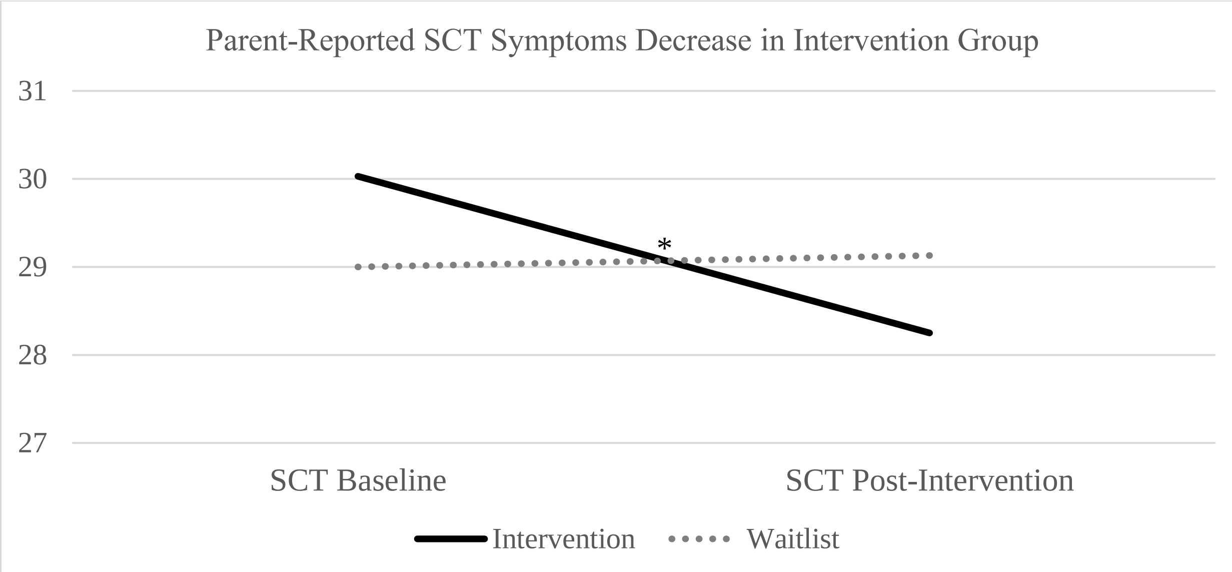

Figure 1. Parent-reported SCT repeated measures random intercepts and slopes multilevel model with solid line showing significant intervention group change ($\gamma = -1.78$, $p < .001$).

Aim 2. A repeated measures random intercepts and slopes MLM was run to determine whether HOPS and CHIEF changed SCT symptoms at similar rates for the SCT only group. For both parent- and self-report of SCT respectively, there were no significant effects of group (p = .902, p = .574) or group by time interactions (p = .727, p = .621), suggesting HOPS and CHIEF could be combined into a single intervention variable. Separate repeated measures random intercepts and slopes MLMs were run for parent- and self-report in the SCT only group. For parent-report, there was a significant effect of time ($t = -9.16$, $p < .001$) and group by time interaction ($t = 2.41$, $p = .017$), with no significant group effect (i.e., groups did not differentiate on baseline SCT).

For the intervention group, SCT symptoms decreased at a rate of $\gamma = -2.91$ ($p < .001$), suggesting that for youth in the high SCT group, receiving intervention decreased SCT by one symptom. For the waitlist control group, the slope was not significant ($p = .111$). See Figure 2. For self-report of SCT, there was no significant main effect of group or group by time interaction, but there was a significant effect of time ($t = -3.64$, $p = .001$). To calculate the magnitude of these effects, repeated measures ANOVAs were run. Effect sizes were then calculated for both parent- and self-report of SCT using means and standard deviations, finding small to moderate effect sizes for both raters. See Table 3 for means, standard deviations, and effect sizes.

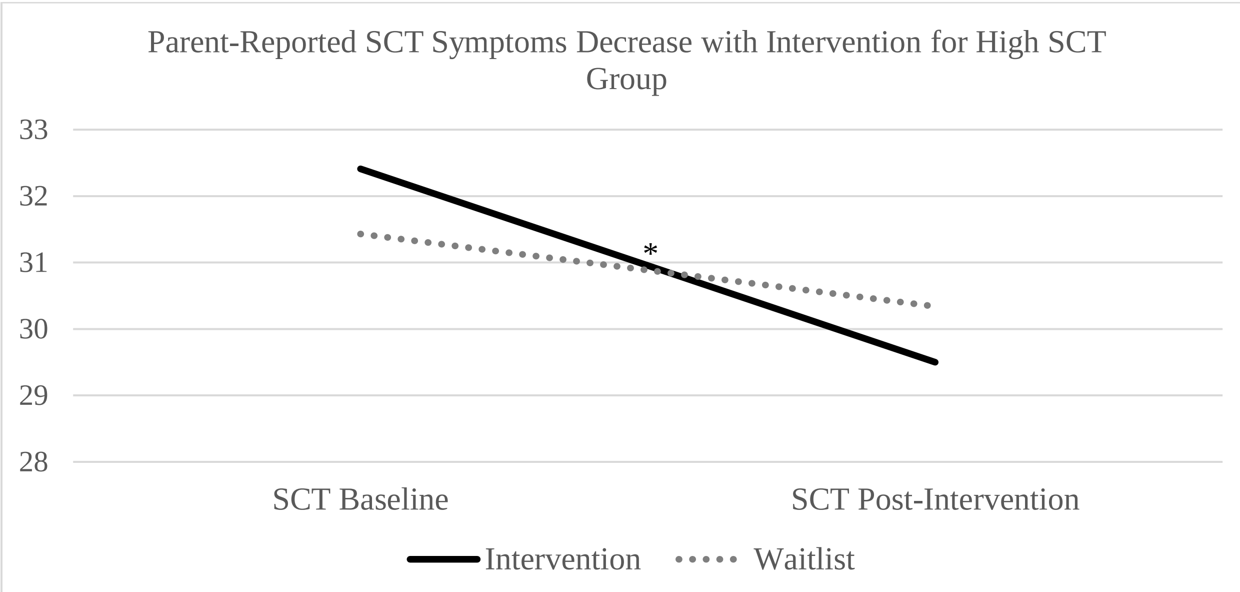

Figure 2. For the high SCT group (i.e., 3 or more symptoms of SCT) parent-reported SCT decreased post-intervention with solid line showing significant intervention group change in symptoms ($\gamma = -2.91$, $p < .001$).

For both parent- and self-reported SCT in the intervention group, clinical levels of SCT decreased from baseline (parent-report $n = 166$; self-report $n = 125$) to post-intervention (parent-report $n = 77$; self-report $n = 82$). At baseline, parents and youth agreed on a diagnosis (i.e., either both reported no diagnosis or both reported three or more symptoms of SCT) 49.5% of the time, suggesting there is a fair amount of disagreement on SCT symptoms between raters.

Table 3. *Intervention effects by rater.*

Rater	Intervention Group Baseline *Mean* (*SD*)	Intervention Group Post *Mean* (*SD*)	Waitlist Group Baseline *Mean* (*SD*)	Waitlist Group Post *Mean* (*SD*)	Cohen's *d*
Parent-Report Full Sample	30.03 (7.11)	26.60 (6.48)	28.98 (7.03)	28.46 (5.98)	.410
Parent-Report High SCT Group	32.28 (6.19)	27.21 (7.39)	30.35 (5.09)	28.42 (4.61)	.517
Self-Report Full Sample	14.05 (7.48)	13.43 (7.94)	13.85 (7.87)	15.59 (9.13)	.313
Self-Report High SCT Group	16.82 (6.77)	13.98 (8.23)	17.11 (7.01)	16.89 (6.44)	.384

Note. *SD* = standard deviation. d = .20 is small, d = .50 is medium, and d = .80 is large.

Table 4. *Bivariate Correlations.*

Variables	SCT PR	SCT SR	Motivation	BRI EF	MI EF	Inattentive Symptoms
SCT PR	--	.039	-.127	.155*	.435**	.410**
SCT SR	.247**	--	-.465**	-.075	.023	-.023
Motivation	-.211**	-.474**	--	.094	-.073	-.069
BRI EF	.295**	0.060	0.032	--	.491**	.150*
MI EF	.598**	.238**	-.174**	.541**	--	.525**
Inattentive Symptoms	.538**	.193**	-.189**	.303**	.657**	--

Note. Correlations below the diagonal are full sample, correlations above the diagonal are for the high SCT group. SCT = Sluggish Cognitive Tempo, PR = Parent-Report, SR = Self-Report, BRI = Behavioral Regulation Index, MI = Metacognitive Index, EF = Executive Functioning.
* indicates $p < .05$, ** indicates $p < .01$

Aim 3. Table 4 shows the bivariate correlations between SCT and the variables of change. In the full group, bivariate associations between parent-reported SCT and each time varying variable were significantly associated, while self-reported SCT was not associated with behavior regulation EF. For the SCT only group, all variables except for homework motivation were significantly associated with parent-reported SCT, while self-reported SCT was only correlated with homework motivation. As self-reported SCT did not show a significant decrease in symptoms for the intervention group, change variables were not explored.

Four separate repeated measures random intercepts and slopes MLMs were run to understand whether inattentive symptoms, behavior regulation EF, metacognitive EF, and/or motivation predicted change in parent-reported SCT symptoms in the intervention group. For the full group, only a reduction in behavior regulation EF predicted a reduction in SCT symptoms with main effects of time (t = -4.00, p < .001) and behavior regulation EF (t = 3.15, p = .002) and a time by behavior regulation EF interaction (t = 3.00, p = .003; d = .271). For the high SCT group, however, reduction in inattentive symptoms, metacognitive EF, and behavior regulation EF each predicted a reduction in SCT symptoms. See Table 5 for results. Change in motivation did not predict change in SCT for either group (*p*s > .1).

Time Varying Variables	*t* (*df*)	*p*-value	Cohen's *d*
DV: SCT			
Time	-2.62* (134.28)	.010	
Inattentive Symptoms	4.11*** (163.25)	<.001	
Time x IA	2.18* (158.23)	.031	.230
DV: SCT			
Time	-4.61*** (31.20)	<.001	
BRI	2.70* (19.05)	.014	
Time x BRI	2.97** (38.13)	.005	.247
DV: SCT			
Time	-2.33* (118.78)	.021	
MI	6.13*** (222.86)	<.001	
Time x MI	1.99* (112.89)	.049	.346

Table 5. *Predictors of change in high SCT group*.

Note. Separate repeated measures random intercepts and slopes MLMs were run with parent-reported SCT in the high SCT group. DV = dependent variable, SCT= sluggish cognitive tempo, IA = inattentive symptoms, BRI = behavior regulation index, EF = executive functioning, MI = metacognitive index, * p < .05, ** p < .01, *** p <.001

Discussion

These findings suggest that academic interventions created for adolescents with ADHD partially alleviate symptoms of SCT. Specifically, parent-reported SCT symptoms decreased significantly pre- to post-intervention (d = .410), whereas self-reported SCT symptoms did not demonstrate a significant decrease. Prevalence rates for SCT in this sample were quite high, with 74% of adolescents at baseline meeting the cutoff criteria for clinical levels of SCT based on parent-report. Post-intervention, SCT prevalence rates decreased to 47%. As hypothesized, improvements for the high SCT group were larger than with the full sample, with parent- and self-report showing moderate and small effect sizes (d = .587, d = .384), respectively. Surprisingly, only behavior regulation EF predicted change in SCT symptoms for the full sample (d = .271), while behavior regulation EF (d = .247), metacognitive EF (d = .346), and inattentive symptoms (d = .230) predicted change in parent-reported SCT symptoms for the high SCT group. These variables may be important to consider in the development of new interventions for individuals with high levels of SCT. Study findings, implications, and future directions are discussed in more detail below.

This study builds on prior literature in multiple ways, including focusing on young adolescents with ADHD and measuring SCT from both the parent- and self-perspective. Consistent with prior research, parent-reported SCT was significantly associated with parent-reported ADHD symptoms of inattention (r = .538). This association was weaker, but still significant, for self-report of SCT (r = .193). Interestingly, SCT prevalence rates were somewhat higher than found in previous studies, with 74% of parents reporting high levels of SCT. SCT prevalence rates in ADHD samples typically range from 30-63%, but these have all been in samples of children with ADHD (Barkley, 2018; Markovich-Pilon et al., 2017). It is likely that the higher prevalence rates in this sample are because this is one of the few studies of adolescents and SCT. Specifically, a recent meta-analysis found a significant positive association between SCT and age (Becker, Leopold et al., 2016). Further, Leopold and colleagues (2016) found that the magnitude of change in SCT symptoms from childhood to adolescence was d = .31. Thus, it is possible that prevalence rates for clinical levels of SCT are higher in samples of adolescents with ADHD, but this finding needs to be replicated.

No previous study has examined the prevalence rate of self-reported SCT. In this sample, 54.4% of adolescents reported high levels of SCT at baseline. Specifically, at baseline, 125 intervention participants met criteria for self-reported high SCT, and at post-intervention, 82 participants met criteria for high levels of SCT according to self-report. Thus, although we did not find significant results for self-report of SCT in the continuous analyses, it appears that there was some decline in symptoms. Interestingly, categorical agreement about SCT symptoms (i.e., both said SCT was or was not present) only occurred in 49.5% of the sample. Previous work has found parent- and self-report of SCT to be invariant (Smith, Becker, et al., 2018), suggesting both raters provide unique information on SCT symptoms. It is possible that youth are better at accurately identifying some of the more covert aspects of SCT (e.g., daydreaming, motivation, apathy; Klein, Dougherty, & Olino, 2005; Silverman & Ollendick, 2005), whereas parents are better at reporting on more overt behaviors, such as appearing sleepy or slow (Smith, Becker, et al., 2018).

Intervention Effects

As expected, HOPS and CHIEF did not differ on how they decreased SCT symptoms ($p > .1$). This suggests that both an OTMP skills intervention and behavioral homework intervention similarly decrease SCT symptoms in adolescents with ADHD. In the combined intervention group, SCT symptoms decreased by almost one (γ = -1.78, p < .001; d = .410). In the high SCT group, parent-reported SCT decreased by one symptom with a moderate effect of treatment (d = .517). As these interventions were not specifically designed for individuals with SCT, it is impressive that symptoms improved at this level. Even with school-based interventions that are specifically designed for youth with ADHD, effect sizes for ADHD symptom reduction are typically small to moderate (effect sizes range from d = .37 to .87; inattentive symptoms d = 0.52, hyperactive/impulsive symptoms d = .57, combined symptoms d = .57; Fabiano et al., 2009; Hodgson, Hutchinson, & Denson, 2014; Van der Oord et al., 2008). For self-report of SCT, multilevel modeling did not find a significant decrease in SCT symptoms, but effect sizes suggest a small effect of intervention (full sample d = .313, high SCT d = .384). Only one other study to date has examined the effect of psychosocial treatment for ADHD on SCT symptoms, finding a large effect size (d = 1.07) for treatment effects on SCT (Pfiffner et al., 2007). The Pfiffner et al. (2007) intervention was more intensive than HOPS or CHIEF, including parent training, teacher consultation, and a child skills group, all implemented by a trained therapist. Further, analyses were not run to explore which treatment components were most associated with decreases in SCT symptoms. Understanding predictors of change will be important for helping to refine ADHD interventions for youth with high levels of SCT.

Predictors of Change

Counter to hypotheses, in the full sample only behavior regulation EF predicted change in SCT symptoms (d = .271). This was unexpected, as previous work has found metacognitive EF to be more strongly associated with SCT than behavioral regulation EF (Becker & Barkley, 2018; Becker & Langberg, 2013). Notably, in the bivariate associations, and consistent with prior work (Barkley, 2013; Becker & Langberg, 2013; Jarret et al., 2014; Jiménez et al., 2015), parent-reported SCT was strongly associated with metacognitive EF, but only weakly correlated with behavior regulation EF. However, prior studies have found SCT to be closely associated with symptoms of anxiety and depression (Becker, Leopold, et al., 2016; Smith, Eadeh, et al., 2018; Ward et al., 2019). Thus, it may be that the emotion regulation aspects of behavioral regulation EF, which overlap with symptoms of anxiety and depression, are important in predicting change in SCT.

Although important to probe intervention effects in the full sample, it is most important to understand what predicts symptom reduction in the high SCT group, as these are the individuals who would be targeted with SCT intervention. In the SCT sample, not only did behavior regulation EF predict decreases in SCT symptoms (d = .247), but metacognitive EF (d = .346) and inattentive symptoms (d = .230) also predicted change. Clearly, given high associations between inattentive and SCT symptoms, difficulties with attention are paramount in youth with ADHD and high levels of SCT. However, for treatment development, it is important to consider the specific aspects of inattention where these youth have difficulty. Theoretical models of attention suggest that there are four components, including orienting/alertness (ability to increase level of activation following high priority stimulus; Tucha et al., 2006), selective/focused attention (ability to process one source of environmental information while attenuating the processing of other information; Huang-Pollock, Nigg, & Carr, 2005), divided attention (ability to simultaneously attend and respond to multiples tasks or task demands; Odegaard, Wozny, & Shams, 2012), and vigilance/sustained attention (ability to maintain prolonged state of alertness and mental activity; Denney, Rapport, & Chung, 2005). Interestingly, a recent study found that preschoolers with high SCT ratings were most impaired in sustained and selective attention (Tamm, Brenner, Bamberger, & Becker, 2018). Additional research is needed to determine whether attention deficits are different in youth with ADHD and youth with SCT as this level of specificity will be most useful in intervention development.

The studies that have examined SCT and EF have found that SCT is significantly associated with a few specific aspects of EF (i.e., metacognitive EF, planning and problem solving; Barkley, 2013; Becker & Langberg, 2014). However, it is still unclear whether EF, like ADHD, is a core deficit for youth with SCT. For youth with ADHD, there is strong evidence and theoretical understanding that EF, particularly inhibition and working memory, are core etiologic aspects of ADHD and may lead to the development of ADHD (Barkley, 1997; Willcutt, 2015). For SCT, the findings are much less robust, with little variance of SCT being explained by EF (Barkley, 2018). However, the fact that both aspects of EF tested in this study, metacognitive EF and behavior regulation EF, predicted change in SCT symptoms suggests that these constructs, or at least aspects of what they represent, are important targets for treatment. Overall, these findings suggest that ADHD interventions that decrease problems with inattention and EF may also decrease SCT symptoms.

Limitations

This study is not without limitations. Importantly, although the Penny et al. (2009) SCT measures have been validated in both typically developing and ADHD samples and found to be reliable, a recent meta-analysis suggests the need to modify this measure to remove and add some of the items (Becker, Leopold, et al., 2016). Specifically, the measure used in this study includes an item that shows poor discriminant validity from ADHD (e.g., "is slow in completing tasks"; Becker et al., 2016; Sáez, Servera, Burns, & Becker, 2019). As such, our findings may not generalize to a treatment study including measurement of all 13 symptoms found to be optimal in assessing SCT (Becker, Leopold, et al., 2016; Sáez et al., 2019). In addition, although this study sought to use a clinically useful cutoff for SCT, this cutoff has not been validated with the Penny et al. (2009) measure.

Although it is important to study SCT in ADHD samples, SCT may have etiological differences in ADHD versus typically developing samples (Barkley, 2014). As such, the results of this study and the intervention implications may not generalize to non-ADHD samples with high levels of SCT. Examining SCT in larger, community-based samples is needed to understand whether these interventions would work for youth with SCT without ADHD. In addition, as the means were lower for self-reported SCT as compared to parent-report, there may have been a floor effect with self-report of SCT. Thus, although the current study did not find significant intervention effects with self-report of SCT, it is still important to continue gathering self-report measures as youth provide additional important information about their symptoms. It may also be that the interventions evaluated in this study did not adequately address the covert/internalizing aspects of SCT, which youth are better able to report (Zahn-Waxler, Klimes-Dougan, & Slattery, 2000). Thus, cognitive-behavioral interventions that include treatment components that target the internalizing aspects of SCT may find significant movement in these symptoms.

Although we expected homework motivation to be associated with change in SCT symptoms there were no significant effects. Likely, this is due to the homework specificity of the motivation measure used in this study. Research on motivation and ADHD supports the examination of broader academic motivation in understanding intervention effects, particularly for academic based interventions (Smith & Langberg, 2018). Given that the SCT symptom set includes apathy and appearance of being poorly motivated, it remains likely that working to increase motivation will be an important component of SCT intervention. To truly understand how motivation interacts with SCT and whether motivation-based interventions are needed to address SCT, broader assessment of motivation (e.g., achievement goal orientation, intrinsic, and extrinsic motivation) is warranted (Martin 2012; Sibley et al., 2016; Smith & Langberg, 2018). Finally, it is possible that, shared method variance is partially responsible for the significant predictor effects in this study. Future work will need to include self-report of EF and inattention to understand if these findings are consistent across raters.

Clinical Implications and Future Directions

There are a number of important implications for future work and clinical practice. It will be important to understand how person level characteristics (e.g., baseline EF profiles, sex, ADHD symptom severity, ADHD presentation, academic impairment) predict intervention outcomes (Kazdin, 2016; Kreuter & Skinner, 2000). This will help parents, teachers, and clinicians understand which interventions to choose for youth presenting with certain symptoms or impairment profiles. As such, studies using latent profile analysis may be beneficial in understanding if there are different profiles or clusters of comorbidities that predict impairment. It may be that youth with high levels of SCT and low baseline metacognitive EF may have more academic problems, but having strong metacognitive EF skills may be protective. In addition, studying other predictors associated with SCT, such as internalizing symptoms, will help to determine whether interventions such as CBT could be effective for youth with SCT.

It is important to understand that, like youth with ADHD, youth with high levels of SCT are likely a heterogeneous group, and that one single intervention approach is unlikely to be sufficient. The findings from this study show that academic interventions created for adolescents with ADHD decrease SCT symptoms, however, development of more targeted interventions is still warranted. In contrast to HOPS and CHIEF, Pffifner and colleagues (2007; 2014) specifically created CLAS for children diagnosed with ADHD-IA, adding components of self-awareness, goal setting, behavior parent training, attention checks, and skills for independence to address difficulties with attention. With this comprehensive intervention, inattentive symptoms decreased by greater than 50% (d = .950). As symptoms of SCT include daydreaminess and adolescents with SCT can appear to be "in a fog" and unmotivated, it is likely that the self-monitoring, attention checks, and goal-setting intervention components of CLAS will be important intervention components to consider in future work.

SCT is also associated with impairment domains outside of academics, with studies finding high levels of comorbidity with internalizing symptoms, social skills deficits, and struggles with motivation (Becker, Burns, et al., 2017; Becker, Leopold et al., 2016; Mikami et al., 2007; Smith & Langberg, 2017; Smith, Breaux, et al., 2018; Ward et al., 2019). To address these deficits, interventions that include increased motivation, cognitive behavioral therapy, and social skills training should be examined to determine whether they affect SCT symptoms. Sibley and colleagues (2013; 2016) were the first to incorporate motivational interviewing into an OTMP and conflict resolution intervention for youth with ADHD. Motivational interviewing helped to facilitate communication and problem solving between adolescents and their parents by increasing intervention engagement, affirming adolescent strengths, and promoting autonomy and adolescent initiative (Sibley et al., 2013; 2016). In another intervention specifically targeting motivation, Martin (2012; 2013) helped students create personal best goals, finding when they identified specific, achievable goals for academic assignments, their growth mindset and GPA increased. Although only a few studies have examined SCT and motivation, the symptom profile suggests that youth with SCT may struggle to maintain motivation to focus on tasks that are challenging.

In adolescents with ADHD, Ward and colleagues (2019) found that elevated depression symptoms were associated with higher SCT symptom severity, higher parental conflict, and higher social impairments. As youth with SCT identify high levels of "fearfulness" and SCT symptoms are associated with anxiety and depression (Becker, Leopold, et al., 2016; Sáez et al., 2019; Smith & Langberg, 2017; Ward et al., 2019), evaluation of the impact of CBT interventions on SCT symptoms is warranted. In addition, youth with SCT tend to be more withdrawn and are socially excluded despite being interested in engaging in social relationships (Becker et al., 2013; Becker, Leopold et al., 2016; Becker, Garner, Tamm, Antonini, & Epstein, 2019; Bernad, Servera, Becker, & Burns, 2016; Ward et al., 2019). This impairment may be due to negative cognitive beliefs, but it also has been suggested that youth with high levels of SCT may have social skills deficits. Importantly, although social skills training for youth with ADHD is not associated with robust effects, it is most effective for youth who are withdrawn (DuPaul & Eckert, 1994; Mikami et al., 2015), and could be beneficial for youth with SCT. Social skills training includes practicing initiating and maintaining conversations, assertiveness, paying and accepting compliments, making and keeping friends, and exposure therapy to social situations (Olivares-Olivares, Ortiz-González, & Olivares, 2019). For socially withdrawn youth, practicing coping skills for social situations and enhancing interpersonal skills are particularly important (Li & Wong, 2015). Thus, including a combination of CBT and social skills training (e.g., initiating conversations, assertiveness) should be considered when adapting interventions for youth with high levels of SCT.

Conclusions

Although not specifically designed to decrease SCT symptoms, the ADHD interventions evaluated in this study resulted in significant improvements in SCT with small to moderate effect sizes (*d*s range = .313 - .517). In fact, in the high SCT group, symptoms decreased on average by one symptom. As symptoms of SCT lead to significant impairment above and beyond other disorders, additional ADHD interventions need to be evaluated to understand how they affect SCT, and what specific aspects of these interventions decrease symptoms. This study indicates the importance of interventions focusing on EF and attention, however, effect sizes were small, suggesting that other predictors, such as internalizing symptoms and broader aspects of motivation (e.g., intrinsic, extrinsic, academic motivation, achievement goal orientation) should also be examined. As noted earlier, this is one of only two studies that have evaluated how existing psychosocial interventions impact SCT symptoms. At this point, creating a new intervention for youth with high levels of SCT may be unwise before determining which aspects of current interventions are most beneficial.

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Vita

Zoe R. Smith was born on October 29, 1992 in Palos Heights, IL and is a current U.S. citizen. She graduated from Wheaton Warrenville South High School in 2011. She received her Bachelor of Arts in Psychology from Kenyon College in 2015. She began the doctoral program in Clinical Psychology at Virginia Commonwealth University (VCU) in August of 2015. She received a Master of Science in Psychology from VCU in May of 2017. After completing her internship at University of Chicago Medicine, Zoe will graduate with her doctorate in Clinical Psychology from VCU.