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Sluggish Cognitive Tempo in Adults Referred for an ADHD Evaluation: A Psychometric Analysis of Self and Collateral Report

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Abstract

Objective: Sluggish Cognitive Tempo (SCT) symptoms uniquely contribute to psychiatric and functional outcomes in child samples; however, the psychometric properties of SCT measures among adult outpatients are unknown.

Method: Adults (n=124) presenting for an attention-deficit/hyperactivity disorder (ADHD) evaluation provided self- and collateral report of SCT symptoms.

Results: The SCT scale had good internal consistency and yielded three factors across raters: Slow/Daydreamy, Sleepy/Sluggish, and Low Initiation/Persistence. SCT scores exhibited convergent validity with ADHD symptoms across raters. Individuals with ADHD received higher SCT ratings than those without ADHD via collateral report, a pattern that was similar when comorbidity was considered. SCT was associated with poorer functioning after accounting for ADHD symptoms with some differential effects based on reporting source.

Conclusion: Findings support the internal consistency and validity of a three-factor SCT scale among adult outpatients. Differential results between self- and collateral report demonstrate the importance of multiple reporters of SCT in clinical settings.

Introduction

Rapidly accumulating research in recent years has focused on the substantial impact of sluggish cognitive tempo (SCT) symptoms on psychiatric health and functional outcomes (Becker & Barkley, in press). Characterized by symptoms such as daydreaming, mental foginess, and slowed cognition and behavior, SCT is currently conceptualized as a distinct constellation of symptoms, separable from both internalizing and externalizing disorders (Barkley, 2014; Becker, Marshall, & McBurnett, 2014), that uniquely contributes to worsened mental health functioning, including increased anxiety and depression severity

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(Becker et al., 2016), as well as greater stress (Combs, Canu, Broman-Fulks, Rocheleau, & Nieman, 2015), academic and social impairment (Becker et al., 2016), and poorer quality of life (Combs, Canu, Fulks, & Nieman, 2014). Although it is currently unclear whether SCT is best described as a distinct diagnostic entity or a transdiagnostic construct, SCT symptoms frequently occur in clinical populations, and in particular, are often reported in samples with attention-deficit/hyperactivity disorder (ADHD) (Becker & Barkley, in press).

Given the unique contributions of SCT to mental health and functional presentations, the development and evaluation of measurement tools to assess the presence and severity of this construct in clinical settings is of high importance to the field. To date, several SCT measures have been developed separately for children and adults. Studies relying on predominantly child and adolescent samples have demonstrated reliability and validity for use of these scales in the research setting. Indeed, a recent meta-analysis revealed strong support for the internal validity, internal consistency, and test-retest and inter-rater reliability, and promising preliminary support for the external validity, of SCT measures among youth. The factor structure associated with SCT measures has been less clear, with one to three SCT factors identified across studies, although there is consensus that SCT factor(s) are distinguishable from ADHD and other psychiatric disorders (see Becker et al., 2016 for a review).

In terms of translation for use in clinical settings, studies completed with children referred for an outpatient evaluation or treatment support the reliability and validity of SCT measures in applied contexts. Specifically, prior research with clinically-referred children has indicated adequate to good internal consistency of both parent- and teacher-report SCT measures (for a review, see Becker et al., 2016). The factor structure of SCT measures is variable in child clinical samples and may depend on the SCT measure used and the number of items assessed. For example, studies utilizing the Child Behavior Checklist (3-4 SCT items) have found evidence for a single SCT factor (Becker, Luebke, Fite, Stoppelbein, & Greening, 2014; Garner, Marceaux, Mrug, Patterson, & Hodgins, 2010; Garner et al., 2017), whereas studies using expanded measures with more SCT items, such as the Child and Adolescent Disruptive Behavior Inventory (7 SCT items), Kiddie Sluggish Cognitive Tempo Scale (15 SCT items), and the SCT scale developed by Penny and colleagues (14 SCT items), have supported 2 to 3 SCT factors among clinically-referred children (Cortes, Servera, Becker, & Burns, 2017; Jacobson et al., 2012; McBurnett et al., 2014).

In general, the psychometric properties of SCT measures have been less frequently investigated in adults, and to date, these studies have been conducted in research rather than applied settings. The most commonly investigated measure is the Barkley Adult ADHD Rating Scale – 4th Edition (BAARS-IV; 9 SCT items) (Barkley, 2011), which has been shown to be reliable, valid, and distinct from ADHD measures in population-based (Barkley, 2012) and college student (Becker, Langberg, Luebke, Dvorsky, & Flannery, 2014) samples. More recently, psychometric properties of the 10-item Adult Concentration Inventory (Becker, Burns, & Willcutt, 2015) were reported in a college student sample, and identified a single SCT factor associated with strong internal consistency, convergent and divergent validity from ADHD, anxiety, and depression, and unique associations with poorer socioemotional adjustment (Becker et al., 2017). Finally, although a formal SCT measure

was not utilized, Leopold and colleagues (2015) found evidence for convergent and divergent validity of self- and parent-report SCT items among college students, with low-to-moderate reliability across raters.

Despite the promising preliminary evidence for the validity and reliability of SCT measures in adults, to date, no studies have investigated the psychometric properties of a SCT instrument in an adult clinical sample. In addition, there are no studies that have examined the reliability and validity of a formal SCT measure (e.g., BAARS-IV) obtained from a collateral reporter (e.g., spouse, parent) in an adult clinical sample. These are critical gaps in the literature, as SCT measures may inform the differential diagnosis and targeted treatment of individuals presenting with a range of psychiatric concerns. The aims of the current study were to examine (1) the psychometric profile, including the internal consistency, factor structure, and convergent validity, of the 9-item BAARS-IV SCT subscale in a clinically-referred sample of adults using both self- and collateral report, (2) group differences in SCT scores between individuals with ADHD and a psychiatric control group (individuals with primary diagnoses other than ADHD), and (3) unique associations between self- and collateral reported SCT severity and functional impairment over and above the impact of ADHD symptoms.

Based on prior research (e.g., Becker et al., 2016), we hypothesized that the BAARS-IV SCT subscale would be associated with good internal consistency and convergent validity with a commonly-used ADHD measure within our sample, and we anticipated that SCT severity ratings would be higher among adults receiving an ADHD diagnosis as compared to the psychiatric control group. Given the variability in factor structure of SCT measures in prior studies, we did not have an *a priori* hypothesis and therefore conducted an exploratory factor analysis. Finally, given prior findings in college student samples (Becker, Langberg, et al., 2014; Flannery, Becker, & Luebbe, 2016; Langberg, Becker, Dvorsky, & Luebbe, 2014; Wood, Lewandowski, Lovett, & Antshel, 2017), we hypothesized that SCT severity would uniquely contribute to functional deficits over and above the impact of ADHD among clinically-referred adults.

Methods

Participants

One-hundred and twenty-four adults aged 18-67 years participated. All participants were physician- or self-referred to a medical center outpatient specialty clinic for evaluation of ADHD. Participants and a collateral reporter each completed measures of SCT (BAARS-IV SCT subscale; self- and other-report versions) and ADHD symptom severity (CAARS; self- and observer-report versions) described below. Collateral reporters included spouses/partners (n = 51), parents (n = 45), friends (n = 14), and others (e.g., sibling, grandparent; n = 9); five participants did not provide a collateral report of symptoms. In addition, participants also completed a thorough psychiatric evaluation administered or supervised by a licensed doctoral-level clinician, including: a computerized Structured Clinical Interview for the DSM (SCID) (First & National Institute of Mental Health (U.S.), 1997); the Conners' Adult ADHD Interview for the DSM (CAADID), Parts I and II (Epstein, Johnson, &

Conners, 2001); a semi-structured clinical interview; and review of medical/school records and prior psychiatric or psychoeducational evaluation reports as available.

Eighty participants met criteria for ADHD (primary diagnosis for 79 and secondary diagnosis for 1) and 44 received other DSM diagnoses ($n = 37$) or no DSM diagnosis ($n = 7$). See Table 1 for participant demographics. It is notable that rates of comorbidity were high among clinically-referred adults, with 42 (53%) of adults with ADHD and 17 (39%) of adults without ADHD presenting with at least one comorbid diagnosis. Among individuals with an ADHD diagnosis, the most common comorbidities were a depressive disorder (i.e., major depressive disorder, persistent depressive disorder; $n = 24$), generalized anxiety disorder ($n = 13$), anxiety disorder not otherwise specified ($n = 7$), and social phobia ($n = 5$).

Measures

Barkley Adult ADHD Rating Scale-IV (BAARS-IV) Sluggish Cognitive Tempo Subscale.—SCT symptoms were assessed using the 9-item SCT subscale of the BAARS-IV (Barkley, 2011), which has good internal consistency and test-retest reliability in a nationally representative adult sample (Barkley, 2012). In addition, the factor structure of the BAARS-IV, which distinguishes the SCT subscale from ADHD symptom subscales, has been confirmed in both a national sample (Barkley, 2012) and college students (Becker, Langberg, et al., 2014). The SCT subscale assesses the frequency of SCT-related behaviors (e.g., daydreaming, lethargy, easily bored) over the past 6 months using a four-point scale (1 = “rarely or never”; 2 = “sometimes”; 3 = “often”; 4 = “very often”). In addition to the 9 SCT symptoms assessed, the BAARS-IV asks about current functional impairment in 5 settings: home, social relations, school, community settings, and work, with each item endorsed as present (“yes”) or absent (“no”). The self- and other-report SCT subscale items are identical.

Conners’ Adult ADHD Rating Scale (CAARS).—The CAARS is a standardized 66-item scale that provides eight subscales corresponding to DSM diagnostic criteria for ADHD as well as associated symptoms, including: Inattention/Memory Problems, Hyperactivity/Restlessness, Impulsivity/Emotional Lability, Problems with Self-Concept, ADHD Index, DSM Inattentive Symptoms, DSM Hyperactive-Impulsive Symptoms, and DSM ADHD Total Symptoms (Conners, Erhardt, & Sparrow, 1999). The self- and observer- versions are comprised of identical items rated on a four-point scale (0 = “not at all, never”; 1 = “just a little, once in a while”; 3 = “pretty much, often”; 4 = “very much, very frequently”). The CAARS is a reliable, valid measure which distinguishes individuals with ADHD from healthy controls (Erhardt, Epstein, Conners, Parker, & Sitarenios, 1999).

Psychiatric Diagnoses.—The CAADID was used to diagnose ADHD and is comprised of two parts (Epstein et al., 2001). Part I is a questionnaire collecting information about early development, psychiatric history, and past and current family, academic, occupational, and personal functioning. In this study, Part I was completed by the participant prior to their diagnostic evaluation and jointly reviewed with the clinician as part of the assessment. Part II is administered by the clinician and consists of a semi-structured interview that assesses the presence, persistence, severity, and age of onset for each of the 18 ADHD symptoms separately in childhood and adulthood. Specific examples of existing symptoms are

documented for both current and childhood functioning. ADHD diagnoses provided by the CAADID are associated with satisfactory interrater reliability and concurrent validity (Epstein & Kollins, 2006). Additional psychiatric disorders were assessed using a computerized screening version of the SCID (First & National Institute of Mental Health (U.S.), 1997). Participants responded to DSM screening items using a tablet, and clinicians followed up using a semi-structured interview format as directed by the SCID to determine any additional DSM diagnoses.

Data Analysis

Data analyses were completed using SPSS Statistics version 23 and two-tailed tests. First, the internal consistency of the BAARS-IV SCT subscale in this clinical sample was assessed using Cronbach's alpha, and the correlation between self- and collateral report of SCT was evaluated with a partial Pearson correlation controlling for age and sex. Second, principal components analysis using a varimax rotation evaluated the factor structure of the BAARS-IV SCT subscale. Third, partial Pearson coefficients covarying for age and sex assessed the convergent validity of the BAARS-IV SCT subscale and the derived BAARS-IV SCT factors with each of the symptom and DSM diagnostic subscales of the CAARS.

Fourth, group differences in BAARS-IV SCT subscale and factor scores between individuals with and without an ADHD diagnosis were evaluated using ANCOVAs which covaried age and sex. ANCOVAs covarying for age and sex were also used to examine group differences in BAARS-IV SCT subscale and factor scores between individuals with ADHD with at least one comorbidity (ADHD+Comorbidity), ADHD without comorbidity (ADHD –Comorbidity), and without ADHD. Finally, logistic regressions controlling for age, sex, CAARS DSM Inattention, and CAARS DSM Hyperactivity/Impulsivity assessed the unique contributions of SCT severity scores on ratings of functional impairment in home, social relations, school, community activity, and work domains. Each of these analyses was completed separately for self- and collateral-report measures. Age and sex were selected as covariates based on prior research suggesting differences in SCT ratings based on these demographic variables (Becker et al., 2016).

Results

Descriptive SCT Characteristics

Self-reported BAARS-IV SCT subscale scores ranged from 11 to 36 with a mean of 24.01 ($SD = 5.33$) and scores from the collateral report ranged from 9 to 36 with a mean of 20.91 ($SD = 6.08$). Self-reported BAARS-IV SCT subscale severity was negatively correlated with age in the current sample, such that increasing age was associated with decreasing SCT severity ($r = -.25, p = .005$). Age was not significantly related to collateral report on the BAARS-IV SCT subscale ($r = -.14, p = .14$). BAARS-IV SCT subscale severity did not differ between men and women via self-report ($t(122) = -.05, p = .96$) or collateral-report ($t(117) = -.74, p = .46$). Self-report and collateral report on the BAARS-IV SCT subscale were significantly, moderately correlated after covarying for age and sex ($r = .41, p < .001$).

Internal Consistency

The self- and collateral-report versions of the BAARS-IV SCT subscale each demonstrated good internal consistency (i.e., self-report Cronbach's $\alpha = .79$, collateral-report Cronbach's $\alpha = .82$).

Exploratory Factor Analysis

Principal components analysis using a varimax rotation identified three primary factors within the self-report version of the BAARS-IV SCT subscale, which accounted for 70.02% of the total variance: "Slow/Daydreamy," comprised of 4 items and accounting for 27.89% of the variance (eigenvalue = 2.51); "Sleepy/Sluggish," comprised of 3 items and accounting for 25.77% of the variance (eigenvalue = 2.32); and "Low Initiation/Persistence," comprised of 2 items and accounting for 16.36% of the variance (eigenvalue = 1.47) (see Table 2). These same three factors (containing identical items) were identified using the other-version of the BAARS-IV SCT subscale and accounted for 72.16% of the total variance; Slow/Daydreamy, Sleepy/Sluggish, and Low Initiation/Persistence accounted for 25.69% (eigenvalue = 2.31), 26.13% (eigenvalue = 2.35), and 20.34% (eigenvalue = 1.83) of the variance respectively. The factors' names were selected in accordance with SCT factors previously identified in child clinical samples (e.g., Jacobson et al., 2012). All other eigenvalues for both self- and collateral report were less than 0.75.

Convergent Validity of the BAARS-IV SCT subscale with the CAARS

The BAARS-IV SCT subscale total score was highly, significantly associated with all subscales assessed by the CAARS, and this pattern is consistent across self- and collateral-reports (see Table 3; p 's ranged from $< .001$ to $< .05$). For the most part, the BAARS-IV SCT derived factors were also significantly associated with the CAARS subscales with several exceptions. Specifically, the Sleepy/Sluggish SCT factor was not associated with Hyperactivity/Restlessness or DSM Hyperactivity/Impulsivity as assessed by either reporter or with the DSM Total Symptoms subscale according to self-report (p 's $> .10$). Similarly, relationships between the Sleepy/Sluggish SCT factor and the CAARS Impulsivity/Emotional Lability ($p < .10$) and DSM Total Symptoms ($p = .08$) subscales were at the trend level per collateral report and did not reach significance. The Low Initiation/Persistence SCT factor was not correlated with Inattention/Memory Problems or Problems with Self-Concept per self-report (p 's $> .10$), and the association between the Slow/Daydreamy SCT factor and DSM Hyperactivity was at the trend level as assessed by self-report and did not reach significance ($p = .08$).

Group Comparisons in BAARS-IV SCT Subscale Scores between Adults with and without ADHD

Individuals with an ADHD diagnosis received significantly higher ratings on the BAARS-IV SCT subscale total score from the collateral reporter compared to individuals with other primary DSM diagnoses or no diagnosis ($p < .001$) (see Table 4). A similar pattern was observed on the self-report version of the subscale total scores, with individuals with ADHD endorsing a higher frequency of SCT behaviors than those without ADHD at the trend level ($p = .09$).

Group Comparisons in BAARS-IV SCT Factor Scores between Adults with and without ADHD

Regarding group differences in factor scores, adults with ADHD indicated a higher frequency of Slow/Daydreamy items than individuals without ADHD at the trend level ($p = .07$). Self-reported ratings of the frequency of Sleepy/Sluggish and Low Initiation/Persistence items did not differ between groups. In terms of collateral report, individuals with ADHD were rated more highly on Slow/Daydreamy items ($p < .001$) and Low Initiation/Persistence ($p = .003$) items than participants without ADHD. In addition, collateral reporters rated individuals with ADHD as displaying more Sleepy/Sluggish behaviors than individuals without ADHD at the trend level ($p = .08$).

Group Comparisons in BAARS-IV SCT Subscale Scores between Adults with ADHD + Comorbidity, ADHD – Comorbidity, and no ADHD diagnosis

When the sample was divided into three groups (ADHD+comorbidity, ADHD–comorbidity, no ADHD diagnosis), the group effect on self-reported SCT severity was significant ($p = .02$; see Table 5). Pairwise comparisons revealed that individuals with ADHD +comorbidity rated themselves higher on the BAARS-IV SCT subscale than individuals with no ADHD diagnosis ($p = .03$) and ADHD–comorbidity at the trend level ($p = .07$). Per collateral report, the effect of group on SCT severity was also significant ($p < .001$). Pairwise comparisons indicated that individuals with ADHD+comorbidity ($p < .001$) and ADHD–comorbidity ($p = .04$) were rated more highly on the SCT measure by collateral-report than individuals with no ADHD diagnosis.

Group Comparisons in BAARS-IV SCT Factor Scores between Adults with ADHD + Comorbidity, ADHD – Comorbidity, and no ADHD diagnosis

In terms of SCT factor scores, the group effect on self-reported Slow/Daydreamy symptoms did not quite reach significance ($p = .07$), and this trend was driven by somewhat higher ratings from individuals in the ADHD+comorbidity group compared to individuals with no ADHD diagnosis ($p = .07$). Groups did significantly differ on the self-rated Sleepy/Sluggish factor ($p = .003$), with the ADHD+comorbidity group rating themselves more highly than the ADHD–comorbidity ($p = .03$) and no ADHD diagnosis ($p = .005$) groups. There were no significant group differences in the self-rated Low Initiation/Persistence symptom scores (p 's $> .10$).

Per collateral report, the main effect of group was statistically significant for the Slow/Daydreamy ($p < .001$), Sleepy/Sluggish ($p = .04$), and Low Initiation/Persistence factors ($p = .01$). Post-hoc pairwise comparisons indicated that individuals in the ADHD+Comorbidity and ADHD–comorbidity groups were rated more highly by observers on the Slow/Daydreamy factor compared to individuals with no ADHD diagnosis (p 's $< .001$ and $< .01$, respectively). In addition, adults in the ADHD+Comorbidity group received higher ratings on the Sleepy/Sluggish ($p < .05$) and Low Initiation/Persistence ($p = .02$) factors compared to individuals with no ADHD diagnosis. Finally, collateral reporters indicated greater severity on the Low Initiation/Persistence factor for individuals with ADHD–comorbidity than adults without an ADHD diagnosis at the trend level ($p = .05$).

Associations between the BAARS-IV SCT Subscale and Functioning

Per collateral report, higher SCT scores was the only significant predictor of greater rates of endorsement of functional impairment at home, social relations, school, and community activities in models controlling for age, sex, CAARS DSM Inattention, and CAARS DSM Hyperactivity/Impulsivity (see Table 6 for a summary). Greater rates of functional impairment at work was associated with age (Wald $\chi^2 = 4.31$, $\beta = .04$, $p = .04$), but not with SCT scores, per collateral report.

Greater self-reported SCT severity was the sole significant predictor of rates of social impairment endorsement after covarying for the effects of age, sex, CAARS DSM Inattention, and CAARS DSM Hyperactivity/Impulsivity, and greater rates of functional impairment in community activities were associated with greater self-reported SCT severity as well as DSM Hyperactivity/Impulsivity (Wald $\chi^2 = 3.87$, $\beta = .08$, $p < .05$). Per self-report, greater rates of home impairment were significantly related to increasing age (Wald $\chi^2 = 6.12$, $\beta = .05$, $p = .01$), and greater rates of school impairment were associated with decreasing age (Wald $\chi^2 = 9.77$, $\beta = -.07$, $p = .002$). Self-reported SCT severity was not significantly associated with greater rates of home, school, or work impairment after controlling for age, sex, DSM Inattention, and DSM Hyperactivity/Impulsivity.

Discussion

This study extends the current SCT literature by examining the reliability, convergent validity, factor structure, and association with functional outcomes of an SCT scale in an adult clinical sample seeking an evaluation for ADHD. In addition, we considered reporting source by examining self-report and collateral report of SCT symptoms. This is the first study to examine the psychometric properties of an SCT scale as well as associations between SCT and functional outcomes in an adult clinical sample. In addition, this is the first investigation of the reliability and validity of a formal SCT scale using collateral report with an adult sample. Results indicated good internal consistency for both self- and collateral report, which is consistent with prior research in research settings (Becker et al., 2016). In addition, self- and collateral report of SCT were significantly, if moderately, correlated in adults presenting for clinical evaluation, which is similar to a previous finding among college students, which also indicated moderate correlations between self- and parent-report of SCT items (Leopold et al., 2015). Agreement between self- and other-report is also consistent with longitudinal studies showing that self-awareness of ADHD symptoms and related problems develops across adulthood. Although young adults underreport ADHD severity and impairment compared to their parents, by age 27, self- and parent-reported ratings begin to converge (Barkley, Murphy, & Fischer, 2008).

Three distinct SCT factors were identified across raters in the current study: Slow/Daydreamy, Sleepy/Sluggish, and Low Initiation/Persistence. This finding supports a multidimensional SCT construct among adults in a clinical context and is in contrast to previous results with adults in research settings, which have identified a single SCT factor (for a review, see Becker et al., 2016). However, the current results are similar to the factor structure found in child clinical samples, particularly those that have utilized comprehensive SCT measures with a greater number of items, which have also identified two or three

factors (Cortes et al., 2017; Jacobson et al., 2012; McBurnett et al., 2014). Future studies examining the factor analytic structure of SCT symptoms in adult samples should consider their hierarchical structure. Although our results were exploratory, if future studies replicate the factor structure we identified, it could be that lower order factors load onto a higher order factor.

Across raters, the total score of the BAARS-IV SCT subscale was significantly related to subscales measuring both DSM ADHD diagnostic criteria as well as associated symptoms on the CAARS, suggesting a high degree of convergent validity of the SCT subscale among clinically-referred adults. In addition, relationships between SCT and ADHD symptoms were stronger for inattentive than hyperactive/impulsive symptoms, an overall pattern that is consistent with prior findings in research contexts (see Becker et al., 2016 for a review). Regarding specific SCT factors, Slow/Daydreamy symptoms were related to CAARS subscale scores across raters. Likewise, ratings of Low Initiation/Persistence were correlated with CAARS subscales with the exception of self-reported Inattention/Memory Problems and Problems with Self-Concept. In contrast, Sleepy/Sluggish symptoms were associated with some CAARS subscales but not others; specifically, ratings of Hyperactivity/Restlessness, DSM Hyperactivity, and DSM total were not related to Sleepy/Sluggish symptom severity by either reporter.

Similarly, results of the current study indicated that adults with ADHD were rated more highly on SCT measures, including Slow/Daydreamy, Sleepy/Sluggish, and Low Initiation/Persistence symptoms, by individuals who know them well than those without ADHD, and this pattern was consistent when comorbidity was considered. In contrast, while individuals with ADHD rated themselves somewhat higher on the full SCT measure, particularly in regard to Slow/Daydreamy symptoms, than those without ADHD, this difference did not reach statistical significance. Notably, when comorbidity was considered, individuals with ADHD rated themselves more highly on SCT measures, particularly Sleepy/Sluggish symptoms, than those without ADHD, but only if comorbidity was present. Therefore, in clinical settings, differences in SCT symptom severity rates should be considered in the context of reporting source where adults with ADHD may be rated higher in SCT symptom severity based on collateral reporters. Our analysis of SCT scores in relation to functional outcomes, discussed below, demonstrate that collateral reporters may provide greater clinical utility given that they are in general more strongly associated with negative functional outcomes.

Finally, SCT symptom severity was uniquely associated with endorsement of impairment across home, social relations, school, and community activities by collateral reporters, and with deficits in social relations and community activity functioning by self-report, after accounting for the impact of inattentive and hyperactive/impulsive symptoms on functional outcomes. This suggests that SCT is an important clinical construct, distinct from ADHD, impacting adults' functional performance. These findings are similar to prior evidence for unique relationships between self-reported SCT severity and global, academic, and social functional impairment found primarily in college student samples (Barkley, 2012; Becker, Langberg, et al., 2014; Flannery, Becker, & Luebke, 2016; Langberg, Becker, Dvorsky, & Luebke, 2014; Wood, Lewandowski, Lovett, & Antshel, 2017), but also suggests that

collateral report may be a better indicator of SCT-related impairment more broadly than self-report in the clinical setting.

The findings of this study have several important clinical implications. First, results suggest that information about SCT symptoms can be reliably and validly collected in clinical settings using the BAARS-IV SCT subscale and provide clinical information related to poorer functional outcomes over and above assessment of ADHD. Second, the factor structure found in the current study suggests that there are three distinct dimensions of SCT which may inform clinical impressions and treatment recommendations for individuals presenting for psychological evaluation, although additional research is necessary to determine how these different dimensions, as well as SCT more generally, respond to intervention (Becker & Barkley, in press). Third, this study underscores the importance of obtaining information about SCT from both the patient and someone who knows them well, such as a spouse/partner or parent.

The current study is not without limitations. Most notably, the measure of functional impairment used in this study was limited (i.e., five yes/no questions querying five functional domains); future research of SCT in adult clinical samples would benefit from inclusion of more detailed measures of psychosocial functioning. In addition, the current study was cross-sectional in nature and as a result, relationships between SCT severity, ADHD symptoms, and functional outcomes over time among clinically-referred adults remain unknown. Future studies should examine the predictive validity of SCT measures in adult clinical populations. Finally, it is notable that there has been a recent effort to develop a unified SCT scale for use with adults (i.e., Adult Concentration Inventory; Becker et al., 2017), which may be useful for consideration in future studies of SCT in clinical settings.

Conclusion

This study provides the first empirical support for the reliability and validity of a three-factor SCT scale in an adult clinical population. The current investigation also expands on prior research through the inclusion of collateral report using a formal SCT measure, and indeed, suggests that seeking SCT assessment from individuals with close relationships to the patient provides additional information about symptoms and functioning not captured when querying the patient alone. These results add to a rapidly growing literature suggesting that SCT is an important clinical construct to be evaluated in adults presenting for evaluation of ADHD and other psychiatric conditions.

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Biography

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References

- Barkley RA (2011). *Barkley Adult ADHD Rating Scale-IV (BAARS-IV)*. New York, NY: Guilford.
- Barkley RA (2012). Distinguishing sluggish cognitive tempo from attention-deficit/hyperactivity disorder in adults. *J Abnorm Psychol*, 121(4), 978–990. doi:10.1037/a0023961 [PubMed: 21604823]
- Barkley RA (2014). Sluggish cognitive tempo (concentration deficit disorder?): current status, future directions, and a plea to change the name. *J Abnorm Child Psychol*, 42(1), 117–125. doi:10.1007/s10802-013-9824-y [PubMed: 24234590]
- Barkley RA, Murphy KR, & Fischer M (2008). *ADHD in adults : what the science says*. New York, NY: Guilford Press.
- Becker SP, & Barkley RA (in press). Sluggish Cognitive Tempo In Banaschewski T, Coghill D, & Zuddas A (Eds.), *Oxford Textbook of Attention Deficit Hyperactivity Disorder*. Oxford, England: Oxford University Press.
- Becker SP, Burns GL, Garner AA, Jarrett MA, Luebke AM, Epstein JN, & Willcutt EG (2017). Sluggish Cognitive Tempo in Adults: Psychometric Validation of the Adult Concentration Inventory. *Psychol Assess*. doi:10.1037/pas0000476
- Becker SP, Burns GL, & Willcutt EG (2015). *Adult Concentration Inventory (ACI)*. Cincinnati, OH: Author.
- Becker SP, Langberg JM, Luebke AM, Dvorsky MR, & Flannery AJ (2014). Sluggish cognitive tempo is associated with academic functioning and internalizing symptoms in college students with and without attention-deficit/hyperactivity disorder. *J Clin Psychol*, 70(4), 388–403. doi:10.1002/jclp.22046 [PubMed: 24114716]
- Becker SP, Leopold DR, Burns GL, Jarrett MA, Langberg JM, Marshall SA, ... Willcutt EG (2016). The Internal, External, and Diagnostic Validity of Sluggish Cognitive Tempo: A Meta-Analysis and Critical Review. *Journal of the American Academy of Child and Adolescent Psychiatry*, 55(3), 163–178. doi:10.1016/j.jaac.2015.12.006 [PubMed: 26903250]
- Becker SP, Luebke AM, Fite PJ, Stoppelbein L, & Greening L (2014). Sluggish cognitive tempo in psychiatrically hospitalized children: factor structure and relations to internalizing symptoms, social problems, and observed behavioral dysregulation. *J Abnorm Child Psychol*, 42(1), 49–62. doi:10.1007/s10802-013-9719-y [PubMed: 23359144]
- Becker SP, Marshall SA, & McBurnett K (2014). Sluggish cognitive tempo in abnormal child psychology: an historical overview and introduction to the special section. *J Abnorm Child Psychol*, 42(1), 1–6. doi:10.1007/s10802-013-9825-x [PubMed: 24272365]

- Combs MA, Canu WH, Broman-Fulks JJ, Rocheleau CA, & Nieman DC (2015). Perceived stress and ADHD symptoms in adults. *Journal of Attention Disorders*, 19(5), 425–434. doi:10.1177/1087054712459558 [PubMed: 23034340]
- Combs MA, Canu WH, Fulks JJB, & Nieman DC (2014). Impact of Sluggish Cognitive Tempo and Attention-Deficit/Hyperactivity Disorder Symptoms on Adults' Quality of Life. *Applied Research in Quality of Life*, 9(4), 981–995. doi:10.1007/s11482-013-9281-3
- Conners CK, Erhardt D, & Sparrow E (1999). *Conners' Adult ADHD Rating Scales (CAARS) Technical Manual*. North Tonawanda, NY: Multi-Health Systems.
- Cortes JF, Servera M, Becker SP, & Burns GL (2017). External Validity of ADHD Inattention and Sluggish Cognitive Tempo Dimensions in Spanish Children With ADHD. *Journal of Attention Disorders*, 21(8), 655–666. doi:10.1177/1087054714548033 [PubMed: 25189871]
- Epstein JN, Johnson D, & Conners CK (2001). *Conners' adult ADHD diagnostic interview for DSM-IV (CAADID) technical manual*. North Tonawanda, NY: Multi-Health Systems.
- Epstein JN, & Kollins SH (2006). Psychometric properties of an adult ADHD diagnostic interview. *Journal of Attention Disorders*, 9(3), 504–514. doi:10.1177/1087054705283575 [PubMed: 16481667]
- Erhardt D, Epstein JN, Conners CK, Parker JDA, & Sitarenios G (1999). Self-ratings of ADHD symptoms in adults II: Reliability, validity, and diagnostic sensitivity. *Journal of Attention Disorders*, 3, 153–158.
- First MB, & National Institute of Mental Health (U.S.). (1997). *User's guide for the Structured clinical interview for DSM-IV axis I disorders SCID-I : clinician version*. Washington, DC: American Psychiatric Press.
- Flannery AJ, Becker SP, & Luebke AM (2016). Does Emotion Dysregulation Mediate the Association Between Sluggish Cognitive Tempo and College Students' Social Impairment? *Journal of Attention Disorders*, 20(9), 802–812. doi:10.1177/1087054714527794 [PubMed: 24691529]
- Garner AA, Marceaux JC, Mrug S, Patterson C, & Hodgins B (2010). Dimensions and correlates of attention deficit/hyperactivity disorder and Sluggish Cognitive Tempo. *J Abnorm Child Psychol*, 38(8), 1097–1107. doi:10.1007/s10802-010-9436-8 [PubMed: 20644992]
- Garner AA, Peugh J, Becker SP, Kingery KM, Tamm L, Vaughn AJ, ... Epstein JN (2017). Does Sluggish Cognitive Tempo Fit Within a Bi-Factor Model of ADHD? *Journal of Attention Disorders*, 21(8), 642–654. doi:10.1177/1087054714539995 [PubMed: 25005039]
- Jacobson LA, Murphy-Bowman SC, Pritchard AE, Tart-Zelvin A, Zabel TA, & Mahone EM (2012). Factor structure of a sluggish cognitive tempo scale in clinically-referred children. *J Abnorm Child Psychol*, 40(8), 1327–1337. doi:10.1007/s10802-012-9643-6 [PubMed: 22566025]
- Langberg JM, Becker SP, Dvorsky MR, & Luebke AM (2014). Are sluggish cognitive tempo and daytime sleepiness distinct constructs? *Psychol Assess*, 26(2), 586–597. doi:10.1037/a0036276 [PubMed: 24611789]
- Leopold DR, Bryan AD, Pennington BF, & Willcutt EG (2015). Evaluating the Construct Validity of Adult ADHD and SCT Among College Students: A Multitrait-Multimethod Analysis of Convergent and Discriminant Validity. *Journal of Attention Disorders*, 19(3), 200–210. doi:10.1177/1087054714553051 [PubMed: 25304149]
- McBurnett K, Villodas M, Burns GL, Hinshaw SP, Beaulieu A, & Pfiffner LJ (2014). Structure and Validity of Sluggish Cognitive Tempo Using an Expanded Item Pool in Children with Attention-Deficit/Hyperactivity Disorder. *Journal of Abnormal Child Psychology*, 42(1), 37–48. doi:10.1007/s10802-013-9801-5 [PubMed: 24258302]
- Wood WLM, Lewandowski LJ, Lovett BJ, & Antshel KM (2017). Executive Dysfunction and Functional Impairment Associated With Sluggish Cognitive Tempo in Emerging Adulthood. *Journal of Attention Disorders*, 21(8), 691–700. doi:10.1177/1087054714560822 [PubMed: 25520166]

Table 1.

Demographics of the study sample.

	Mean	Standard Deviation
Age	31.13	11.47
BAARS-IV SCT – Self	24.01	5.33
BAARS-IV SCT – Other	20.91	6.08
	Number	Percentage
Sex (Female)	62	50%
Race		
African American	8	7%
Caucasian	89	72%
Asian America	14	11%
Biracial or Other	13	10%
Ethnicity		
Hispanic	12	10%
Non-Hispanic	96	77%
Not Indicated	16	13%
Primary Diagnosis		
ADHD – Combined	36	29%
ADHD – Inattentive	40	32%
ADHD – Hyperactive/Impulsive	1	<1%
ADHD – NOS	3	2%
Mood Disorder, Any Type	15	12%
Anxiety Disorder, Any Type	8	6%
Other diagnosis	14	11%
No diagnosis	7	6%

Abbreviations. BAARS-IV, Barkley Adult ADHD Rating Scale – 4th Edition; SCT, Sluggish Cognitive Tempo; ADHD, Attention-Deficit / Hyperactivity Disorder; NOS, Not Otherwise Specified.

Note. One individual received a primary diagnosis of an anxiety disorder and a secondary diagnosis of ADHD-Combined. For ease of interpretation of analyses, this individual is counted under the “ADHD–Combined” heading.

Table 2.

Principal Components Analysis of the BAARS SCT Subscale

	Component (Self)			Component (Observer)		
BAARS-IV SCT Items	1	2	3	1	2	3
<i>Slow/Daydreamy Items</i>						
Prone to daydreaming when I should be concentrating on something or working	.66	-	-	.62	-	-
Easily confused	.85	-	-	.83	-	-
Spacey or “in a fog”	.77	-	-	.68	-	-
I don’t seem to process information as quickly or as accurately as others	.75	-	-	.82	-	-
<i>Sleepy/Sluggish Items</i>						
Slow moving	-	.75	-	-	.73	-
Lethargic, more tired than others	-	.88	-	-	.89	-
Underactive or have less energy than others	-	.92	-	-	.92	-
<i>Low Initiation/Persistence Items</i>						
Easily bored	-	-	.87	-	-	.86
Have trouble staying alert or awake in boring situations	-	-	.77	-	-	.87

Note. BAARS-IV = Barkley Adult ADHD Rating Scale – 4th Edition; SCT = Sluggish Cognitive Tempo. All cross factor loadings .48 are suppressed.

Table 3.

Relationships between the BAARS-IV SCT subscale, BAARS-IV SCT factors, and the CAARS subscales

BAARS-IV SCT Subscale				
CAARS: Self	Slow/Daydreamy	Sleepy/Sluggish	Low Initiation/Persistence	SCT Total
Inattention	.48 ***	.28 **	.12	.45 ***
Hyperactivity	.26 **	-.03	.44 ***	.25 **
Impulsivity	.28 **	.25 *	.25 **	.36 ***
Problems with Self-Concept	.38 ***	.43 ***	.12	.47 ***
DSM Inattention	.61 ***	.28 **	.26 **	.56 ***
DSM Hyperactivity	.17 ⁺	.01	.40 ***	.21 *
DSM Total	.42 ***	.12	.38 ***	.41 ***
ADHD Index	.47 ***	.28 **	.28 **	.48 ***
CAARS: Observer				
Inattention	.70 ***	.28 **	.32 **	.59 ***
Hyperactivity	.37 ***	.07	.49 ***	.37 ***
Impulsivity	.36 ***	.16 ⁺	.45 ***	.40 ***
Problems with Self-Concept	.47 ***	.38 ***	.24 *	.49 ***
DSM Inattention	.70 ***	.24 *	.40 ***	.60 ***
DSM Hyperactivity	.36 ***	.11	.48 ***	.38 ***
DSM Total	.58 ***	.17 ⁺	.51 ***	.53 ***
ADHD Index	.53 ***	.28 **	.50 ***	.55 ***

Note. BAARS-IV = Barkley Adult ADHD Rating Scale – 4th Edition; SCT = Sluggish Cognitive Tempo; CAARS = Conners Adult ADHD Rating Scale, Long Version.

⁺ = $p < .10$

* = $p < .05$

** = $p < .01$

*** = $p < .001$

Table 4.

Group differences in BAARS-IV SCT symptom severity among adults with and without ADHD

SCT Measure	ADHD (n = 80)		No ADHD (n = 44)		df	F	p	<i>d</i>
	M	SD	M	SD				
Self								
Total	24.64	5.30	22.86	5.25	3,120	2.96	.09	.34
Slow/Daydreamy	11.20	3.06	10.16	2.81	3,120	3.34	.07	.35
Sleepy/Sluggish	7.16	2.69	6.52	2.71	3,120	1.51	.22	.24
Low Initiation/Persistence	6.27	1.57	6.18	1.50	3,120	0.31	.86	.06
Other								
Total	22.53	5.82	18.14	5.54	3,115	16.32	< .001	.77
Slow/daydreamy	9.95	2.92	7.57	3.00	3,115	18.25	< .001	.80
Sleepy/Sluggish	6.84	2.89	5.86	2.89	3,115	3.24	.08	.34
Low Initiation/Persistence	5.76	1.73	4.70	1.84	3,115	9.46	.003	.59

Note. BAARS-IV = Barkley Adult ADHD Rating Scale – 4th Edition; SCT = Sluggish Cognitive Tempo; ADHD = Attention-Deficit / Hyperactivity Disorder. All analyses are adjusted for age and sex.

Table 5.

Group differences in BAARS-IV SCT symptom severity among adults with ADHD+Comorbidity, ADHD-Comorbidity, and no ADHD diagnosis

SCT Measure	(1) ADHD+C (n=44)				(2) ADHD-C (n = 36)				(3) No ADHD (n = 44)				Cohen's <i>d</i>			
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	ADHD+C vs. No ADHD	ADHD-C vs. No ADHD	ADHD+C vs. No ADHD	ADHD-C vs. No ADHD
													ADHD+C vs. ADHD-C	ADHD-C vs. ADHD-C	ADHD+C vs. ADHD-C	ADHD-C vs. ADHD-C
Self																
Total	25.77	4.90	23.35	5.51	22.86	5.25	4,119	4.23	.02	1 > 3	.46	.57	.09			
Slow/Daydreamy	11.61	2.66	10.69	3.45	10.16	2.81	4,119	2.73	.07	ns	.30	.53	.17			
Sleepy/Sluggish	8.00	2.34	6.14	2.77	6.52	2.71	4,119	6.03	.003	1 > 2, 3	.73	.58	-.14			
Low Initiation/Persistence	6.16	1.63	6.42	1.52	6.18	1.50	4,119	.20	.82	ns	-.16	-.01	.16			
Other																
Total	23.41	5.81	21.47	5.72	18.14	5.54	4,114	9.30	<.001	1, 2 > 3	.34	.93	.59			
Slow/daydreamy	10.24	2.92	9.59	2.91	7.57	3.00	4,114	9.53	<.001	1, 2 > 3	.22	.90	.68			
Sleepy/Sluggish	7.41	3.07	6.15	2.54	5.86	2.89	4,114	3.32	.04	1 > 3	.45	.52	.11			
Low Initiation/Persistence	5.78	1.80	5.74	1.66	4.70	1.84	4,114	4.72	.01	1 > 3	.02	.59	.59			

Note. BAARS-IV = Barkley Adult ADHD Rating Scale – 4th Edition; SCT = Sluggish Cognitive Tempo; ADHD = Attention-Deficit/Hyperactivity Disorder, ns = non-significant. All analyses are adjusted for age and sex.

Table 6.

Associations between SCT symptoms and functional outcomes by collateral and self-report

Functional Domain	SCT Collateral Report			SCT Self-Report		
	Wald χ^2	β	<i>p</i>	Wald χ^2	β	<i>p</i>
Home	4.67	.10	.03	1.65	.07	.20
Work	1.90	.06	.17	.98	.06	.32
Academic	4.45	.10	.04	.67	.05	.41
Social Relations	13.27	.21	< .001	6.47	.13	.01
Community Activities	10.50	.17	.001	6.42	.14	.01

Note. SCT = Sluggish Cognitive Tempo. All analyses are adjusted for age, sex, CAARS DSM Inattention, and CAARS DSM Hyperactivity/Impulsivity