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Dimensions and Correlates of Attention Deficit/Hyperactivity Disorder and Sluggish Cognitive Tempo

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Abstract

The present study examined Sluggish Cognitive Tempo (SCT) in relation to ADHD symptoms, clinical diagnosis, and multiple aspects of adjustment in a clinical sample. Parent and teacher reports were gathered for 322 children and adolescents evaluated for behavioral, emotional, and/or learning problems at a university clinic. Confirmatory factor analyses (CFA) supported the presence of three separate, but correlated factors (SCT, inattention, and hyperactivity/impulsivity) in both parent and teacher ratings. As expected, SCT symptoms were greatest in youth with ADHD Inattentive type, but were also found in non-ADHD clinical groups. SCT symptoms were related to inattention, internalizing, and social problems across both parent and teacher informants; for parent reports, SCT was also related to more externalizing problems. Findings support the statistical validity of the SCT construct, but its clinical utility is still unclear.

Keywords

Sluggish cognitive tempo; Factor analysis; Attention deficit/hyperactivity disorder; Clinical population

A longstanding debate has centered on the core deficits of Attention Deficit Hyperactivity Disorder (ADHD), with the diagnostic criteria changing with each edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM). Currently, the DSM-IV-TR distinguishes between two symptom dimensions of ADHD, inattention and hyperactivity/impulsivity (American Psychiatric Association 2000). While this factor structure has been

confirmed in multiple investigations (Bauermeister et al. 1995; Brito et al. 1995; Lahey et al. 1988), studies have identified an additional factor, Sluggish Cognitive Tempo (SCT) (Hartman et al. 2004; Lahey et al. 1994). The characteristics of SCT include decreased alertness and orientation, as well as confusion and physical underactivity. Although these symptoms are related to ADHD symptoms of inattention, they may represent a separate dimension of ADHD or behavioral syndrome present across other clinical populations. Better understanding of the SCT phenotype would assist in determining whether these characteristics are unique to ADHD or if they represent an independent behavioral dimension contributing to overall impairment across a variety of psychopathological conditions. The present study sought to provide additional support for the validity of the SCT dimension and to determine its relationship to clinical diagnoses and adjustment problems, thus helping to determine the clinical utility of the SCT construct.

Relationship Between SCT and ADHD

Historically, DSM criteria for ADHD have progressed from a disorder of over-activity to the current conceptualization of ADHD as a disorder characterized by two symptom types. However, factor analytic techniques conducted during the field trials for the DSM-IV identified an additional cluster of symptoms termed SCT which was distinct from both the inattentive and hyperactive symptoms that were included in DSM-III (Lahey et al. 1994). The SCT factor comprised symptoms such as *daydreaming*, *a tendency to become confused*, *a lack of alertness*, and *physical hypoactivity*. Lahey and colleagues found that although these symptoms best predicted the Attention Deficit Disorder-Without Hyperactivity subtype, they were not predictive of ADHD for the majority of individuals with the disorder, especially for those who presented with hyperactivity (Hartman et al. 2004). Because SCT symptoms would be diagnostically useful only for individuals with attention difficulties in the absence of hyperactivity, but not those who presented with both inattention and hyperactivity, the DSM would require two sets of inattention symptom clusters that would not be applicable to all subtypes of ADHD (Milich et al. 2001). In order to simplify the diagnostic process and maintain ADHD as a single disorder with two subtypes rather than two distinct disorders, SCT symptoms were not included in the DSM-IV criteria (Milich et al. 2001).

Despite its exclusion from the DSM-IV, the continued study of the SCT factor is essential for developing appropriate nosology for ADHD and its subtypes. Some have argued that the decision to exclude SCT symptoms has resulted in a more heterogeneous inattentive group (Milich et al. 2001). This heterogeneity is due to greater variability in clinical presentation, as some individuals have SCT symptoms along with the DSM symptoms of inattention. In fact, it is estimated that 30 to 50% of those diagnosed with ADHD-Inattentive type (ADHD-I) also have symptoms of SCT (Carlson and Mann 2002; McBurnett et al. 2001). Another source of heterogeneity within the ADHD-I subtype is the presence of up to five hyperactive symptoms in individuals with “subclinical” ADHD-Combined type (ADHD-C), who do not meet the criteria for ADHD-C. Rather than relying on the absence of hyperactivity/impulsivity to identify individuals whose primary deficit is in inattention (i.e., ADHD-I), it has been proposed that symptoms of SCT may be used as a marker of ADHD-I (Milich et al. 2001). However, it is possible that SCT symptoms are present in individuals even in the absence of any ADHD symptoms. For instance, one study identified high symptoms of SCT in a pediatric sample of leukemia survivors (Reeves et al. 2007). Thus, the present investigation aims to extend this work by examining SCT symptoms not only in relation to ADHD, but also other non-ADHD clinical groups.

Statistical Validity of SCT

Only few studies have explicitly explored the SCT factor. Lahey et al. (1988) first introduced the SCT cluster by factor analyzing symptoms of Attention Deficit Disorder as defined in DSM-III and three SCT items (*sluggishness*, *drowsiness*, and *apparent daydreaming*) in a clinical sample of school age children. Exploratory factor analysis revealed three distinct factors: hyperactivity/impulsivity, inattention/disorganization, and SCT. Another factor analytic study with a clinic-referred sample of children and adolescents employed parent and teacher ratings of DSM-IV symptoms of ADHD and two SCT symptoms (*Daydreams a lot* and *Often is sluggish or drowsy*), finding the SCT factor to be independent of the inattentive symptoms only when the hyperactivity/impulsivity symptoms were not included in the factor analysis (McBurnett et al. 2001). One implication of these findings is that inattention alone does not have the same features (i.e., the presence of SCT symptoms) when symptoms of hyperactivity/impulsivity are also present. Both of these studies were limited by the small number of SCT symptoms analyzed (three and two, respectively). Ideally, five to 10 items should be used when assessing the validity of a potential construct (Kline 2005).

Addressing this limitation, Hartman et al. (2004) utilized five items to define the SCT construct. This study conducted Confirmatory Factor Analysis (CFA) with a community sample of 8 to 18 year old twins using parent and teacher ratings of DSM-IV ADHD symptoms and six SCT items (Hartman et al. 2004). All items were rated on a four-point Likert scale. SCT items were developed based on items used in previous studies (Achenbach 1991; McBurnett et al. 2001): *seems to be in a fog*, *drowsy or sleepy*, *easily confused*, *daydreams/stares into space*, and *sluggish/slow to respond*. Separate CFAs of teacher and parent symptom ratings compared the fit of three models: 1) one-factor model, where all symptoms (SCT, inattention, and hyperactivity/impulsivity) loaded on a single factor; 2) two-factor model, where SCT and inattentive symptoms loaded on the same factor while hyperactivity/impulsivity loaded on a separate, but correlated factor; and 3) three-factor model, where symptoms from each of the three dimensions loaded on a separate factor. The three-factor model had the best fit to the data for both parent and teacher ratings, indicating that SCT, inattentive, and hyperactive-impulsive symptoms indeed represent distinct factors. Furthermore, this study found that the SCT factor was highly correlated with the inattentive factor for both parent and teacher ratings, but only moderately correlated with parent-reported hyperactivity and not related to teacher-reported hyperactivity.

Although the above studies have provided support for the SCT construct as distinct from inattention and hyperactivity/impulsivity, contradictory findings have also been reported. In a population-based sample of twins, two items (*daydreams* and *low energy*) were factor analyzed together with ADHD symptoms using a principal component analysis (Todd et al. 2004). While SCT emerged as a distinct factor in males, it loaded on the same factor as inattentive symptoms of ADHD in females. Additionally, the SCT item *daydreams* was endorsed at similar frequencies across ADHD-I (34%) and ADHD-C (32%) subtypes, whereas the *low energy* item was infrequently endorsed across the entire sample. Based on this observation, the authors concluded that SCT symptoms did not sufficiently discriminate among the three DSM-IV ADHD subtypes and that the construct of SCT had limited clinical utility. Given that their measurement of SCT relied only upon two parent-reported items, one of which was endorsed for only 3.1% of the sample, these conclusions seem premature.

In summary, existing studies suggest that SCT may be a distinct construct from ADHD dimensions of inattention and hyperactivity/impulsivity, and that it is important to measure this construct with more than two or three items. Although one study has done so in a community-based sample (Hartman et al. 2004), no studies have evaluated the factor

structure of DSM-IV ADHD symptoms and a sufficient number of SCT symptoms in a clinical sample.

SCT and Other Psychopathology

In addition to evaluating the statistical validity of SCT symptoms, it is important to understand the relationship between SCT and adjustment. To date, only two published studies have investigated the comorbidity patterns of internalizing and externalizing problems in children with ADHD and SCT. Using students recruited from an elementary school, one study found that children with high levels of SCT as reported by their teachers were more likely to display lower levels of teacher reported externalizing problems and higher levels of internalizing problems, such as withdrawal, somaticizing, anxious depressed behavior, and social problems, than children with low levels of SCT symptomology (Carlson and Mann 2002). Although this study reported important results, it was limited by using only two items to measure SCT and by relying on a single informant (teachers) for all constructs. As a result of this shared-method variance, the relationships between SCT and children's internalizing and externalizing problems may have been inflated.

Hartman et al. (2004) addressed both of these limitations in their study of community sample of 8–18 years old twins. Specifically, this study related SCT symptoms to broadly defined internalizing and externalizing problems, using information collected from parents and teachers. Consistent with the results of Carlson and Mann (2002), parent- and teacher-rated SCT symptoms in children were positively correlated with internalizing problems and negatively correlated with externalizing problems. These findings were consistent within informants, but did not always replicate when SCT symptoms and externalizing or internalizing problems were reported by different informants.

Although both of these studies suggest that SCT symptoms are positively associated with internalizing and negatively related to externalizing problems (at least when reported by the same informant), both studies were conducted with community samples. Because clinical populations have higher rates of both externalizing and internalizing psychopathology that often co-occur, it is unclear how SCT would relate to these and other dimensions of psychosocial adjustment in clinical samples.

Present Study

The present study addresses gaps in existing research by examining the distinctiveness of SCT from ADHD and its relationship to adjustment problems in a clinical sample. To address limitations in previous research, we utilize a sufficient number of SCT items and collect information from multiple informants (parents, teachers). We also extend existing research by examining levels of SCT in children diagnosed with Learning Disability and Language Disorders, diagnoses that commonly overlap with ADHD (Biderman et al. 1991; Cohen et al. 2000). Based on previous research, we hypothesize that: 1) SCT would emerge as a distinct factor that is related to inattention; 2) levels of SCT would be the highest in ADHD-I subtype compared to other diagnostic groups; 3) greater SCT symptomology would be associated with more internalizing and fewer externalizing difficulties.

Method

Participants

Data for this study were obtained from a clinical database of children and adolescents (5- to 17-years-old) evaluated for behavioral, emotional, and/or learning problems at Sparks Clinics at the University of Alabama at Birmingham between 1999 and 2007. Prior to

creating the database, Institutional Review Board approval was obtained from the University of Alabama at Birmingham, which included a waiver of consent and assent.

Of the 322 children in the database, 212 (66%) had both parent and teacher report of the variables used in this study; additional 46 (14%) had complete data for teacher reports and 64 (20%) had complete data for parent reports. Thus, the analytical samples included up to 276 children for teacher-reported variables and 258 children for parent reported variables. Both subsamples included 77 females (30% vs. 28%) and had a mean age of 9 years, 5–6 months ($SD = 2$ months). The overall sample included 66% Caucasians, 32% African Americans, and 2% other races. There were no differences in age, ethnicity, and gender among those who had parent and teacher data, teacher data only, or parent data only. Additionally, one-way analyses of variance (ANOVAs) showed no significant differences among these three groups on mean SCT, inattention, and hyperactivity/impulsivity scores.

Diagnostic Groups

Children were referred to the clinic from a variety of sources, including local pediatricians, schools, and parent-referral. DSM-IV diagnoses were given by a team of a licensed clinical psychologist, a doctoral student in clinical psychology, a developmental pediatrician, and a speech/language pathologist. Diagnoses were based on information gathered from parent and child interviews conducted by a licensed clinical psychologist or doctoral student in clinical psychology, rating scales completed by parents and teachers (e.g., Disruptive Behavior Rating Scale, Child Behavior Checklist), and a direct behavioral observation of the child using the Restricted Academic Task which reliably discriminates between ADHD and non-ADHD individuals (Milich et al. 1982).

For the present study, children were categorized into four mutually exclusive diagnostic groups: No Diagnosis ($n = 44$); ADHD-Inattentive subtype (ADHD-I; $n = 40$); ADHD-Combined or Hyperactive subtype (ADHD-C/H; $n = 90$); and Learning Disability or Language Disorder ($n = 32$). The ADHD-Combined and Hyperactive subtypes were combined because the latter group was very small and previous research suggested similar levels of SCT symptoms in these two diagnostic categories (Carlson and Mann 2002). The No Diagnosis group included individuals who did not meet diagnostic criteria for any DSM disorder at the time of their evaluation. Approximately 4% of the total sample did not meet criteria for any of the study diagnostic groups but did meet criteria for other DSM disorders (e.g., mood disorders, autism spectrum disorders, posttraumatic stress disorder) and were excluded from the analyses involving comparisons of diagnostic groups.

Measures

ADHD Symptoms—Parents and teachers completed the Disruptive Behavior Ratings Scale (DBRS; DuPaul et al. 1998), an 18-item measure of ADHD symptoms in children ages 5 to 18 years old. The items correspond directly to the 18 DSM-IV symptoms of inattention and hyperactivity/impulsivity, with factor analytic studies supporting this two-factor solution (DuPaul et al. 1998). Children's behavior is rated on a 4-point Likert scale ranging from 'never or rarely' (0) to 'very often' (3). Items were averaged to create the inattention and hyperactivity/impulsivity scale scores, with a possible range from 0 to 3. Internal consistency was high for both teacher and parent reports of both subscales (Cronbach's α 's ranged from 0.89 to 0.92).

SCT Symptoms—Five items from the Child Behavior Checklist (CBCL; Achenbach 1991), a measure of childhood disruptive behaviors, emotional difficulties, and social competencies, were used to measure SCT symptoms. Parents and teachers rated each item on a 3-point scale ranging from 'not true' (0) to 'very true or often true' (2). We selected

items frequently used to measure SCT in previous studies (Carlson and Mann 2002; Hartman et al. 2004; McBurnett et al. 2001): *confused or seems to be in a fog*, *daydreams*, *stares blankly*, and *underactive*. Teacher ratings included an additional item, *apathetic or unmotivated*, which is not present in the parent-report version of the CBCL.

Adjustment Problems—The syndromes scales of the CBCL (Achenbach 1991), completed by parents and teachers, were utilized to investigate the relationship between SCT and specific types of adjustment problems. The CBCL includes three internalizing subscales: Anxious/Depressed (13 items), Withdrawn (8 items), and Somatic Complaints (11 items); two externalizing subscales: Rule-Breaking Behavior (17 items) and Aggressive Behavior (18 items); and three additional syndrome scales: Social Problems (11 items), Thought Problems (15 items), and Attention Problems (10 items). These scales are identical across parent and teacher versions of the measure. All items were rated on a 3-point scale ranging from ‘not true’ (0) to ‘very true or often true’ (2). Scale scores were converted to T-scores using age and gender-based norms.

Seven of the eight subscales (all but Withdrawn) were significantly positively correlated across parent and teacher reports ($r = 0.17$ to 0.39 , $p < 0.05$). In order to reduce the number of analyses and eliminate the problem of shared-method-variance, T-scores for these seven scales were averaged across both informants. The Withdrawn subscale was not used because of the lack of correlation across teacher and parent ratings ($r = 0.10$, $p = 0.06$).

Results

Data Analytic Plan

To determine the factor structure of ADHD and SCT symptoms, a CFA was conducted on ratings of SCT and ADHD symptoms provided by parents and teachers, respectively, using Mplus version 4.2 (Muthén and Muthén 1998–2009). This analysis determined the items that best represented the SCT construct and formed the rationale for a final SCT measure to be used in further analyses. The CFA addressed a notable limitation of all previous factor analytic studies of SCT which applied a general linear model procedure (with its assumptions of multivariate normality) to dichotomous or ordinal item-level data that are rarely normally distributed (Bernstein and Teng 1989). To address this problem, we analyzed polychoric correlation matrices (which estimate correlations of latent continuous variables underlying ordinal data) using the WLSMV estimator, as recommended by the methodological literature (Muthén et al. 1997; Panter et al. 1997). The CFA estimated and compared: 1) single-factor model, where all SCT and ADHD symptoms loaded on one factor; 2) two-factor model, where SCT and inattentive symptoms loaded on the same factor while hyperactivity/impulsivity formed a separate factor; and 3) three-factor model, where SCT, inattention, and hyperactivity/impulsivity symptoms loaded on distinct factors. As typically done in CFA, item loadings on other factors were fixed at 0. The latent factors were allowed to correlate with one another in all models. Because the three models were nested, they were compared directly using the chi-squared difference test.

Next, Pearson’s correlations and t-tests were conducted to examine associations of all variables of interest, including SCT and ADHD, with demographic variables (race, gender and age) to identify potential covariates for subsequent analyses. The relationship between SCT and DSM-IV diagnostic groups was then examined in two ways: 1) dimensionally, using Analysis of Covariance (ANCOVA), analyzing differences in levels of SCT symptoms across diagnostic groups; and 2) categorically, using a chi-square analysis of High vs. Low SCT and diagnostic groups. Finally, the relationship between SCT and externalizing and internalizing problems was assessed with Pearson’s correlations.

Factor Structure of SCT and DSM-IV ADHD Symptoms

The means and standard deviations of all SCT and ADHD symptoms, separately by informant, are reported in Table 1. The *underactive* SCT item was excluded from analyses because it was not as strongly correlated with the other SCT items (r ranged from 0.17 to 0.41 across parent and teacher reports, p ranged from 0.02 to 0.000), it did not load on the SCT factor, and its exclusion significantly improved all CFA models, as well as the internal consistency of the SCT scale. The low utility of this item may be partly explained by lower frequency of its endorsement compared with the other SCT items (see Table 1). Goodness of fit statistics for the six CFA models (one-, two-, and three-factor models for each parent and teacher ratings) are presented in Table 2. For both informants, the three-factor model had the best fit as indicated by the chi-square difference tests as well as other fit indices (CFI, RMSEA; see Table 2). Specifically, the two-factor model was a significant improvement in fit from the single-factor model, and the three-factor model was significantly better than the two-factor model. In the best fitting, three-factor model, inattention and hyperactivity/impulsivity were highly correlated with each other ($r = 0.70$ and 0.67 , both $p < 0.001$, for parent and teacher reports, respectively). Consistent with previous studies, the SCT factor had higher correlations with the inattentive factor than with the hyperactivity/impulsivity factor ($r = 0.54$, $p < 0.01$ vs. $r = 0.33$, $p < 0.01$, for parent; $r = 0.65$, $p < 0.001$ vs. $r = 0.05$, ns , for teacher report). The standardized factor loadings from the three-factor model are listed in Table 3 (note that item loadings not listed in the table were set to zero). In order to validate the CFA findings, exploratory factor analyses were conducted for parent and teacher ratings. Both yielded three factor models, confirming that SCT items loaded on a separate factor from inattention and hyperactivity/impulsivity items.

Based on the results of the CFA, scale scores were created by averaging ratings of items loading on each factor (i.e., SCT, Inattentive and Hyperactive/Impulsive). Separate scale scores were created for each rater (parents, teachers). Individuals were further categorized as either high or low on SCT symptoms (High SCT and Low SCT) using a median split on the SCT scale scores (Median = 0.67 for parent and 0.75 for teacher report). Specifically, those at or below the median were categorized as Low SCT, and those above the median were categorized as High SCT. This resulted in ranges of scores from 0 to 0.67 (parent) and 0 to 0.75 (teacher) for individuals categorized as Low SCT, and scores ranging from 1 to 2 (both parent and teacher reports) in the High SCT group (i.e., all symptoms rated as at least “sometimes” present on average). No scores fell between 0.67 and 1 for parent ratings and 0.75 to 1 for teacher ratings.

Relationship between SCT, Demographics, DSM-IV Diagnoses, and Adjustment

Demographic Differences—There was no significant relationship between age and parent or teacher SCT scores ($r = 0.00$ – 0.02 , ns). Similarly, SCT scores did not significantly differ across minority and Caucasian participants (parent: $M_{\text{Caucasian}} = 0.88$, $M_{\text{Minority}} = 0.79$, $t(256) = -1.17$, $p = 0.24$; teacher: $M_{\text{Caucasian}} = 0.85$, $M_{\text{Minority}} = 0.88$, $t(274) = 0.47$, $p = 0.64$). Although parent SCT scores did not vary by gender ($M_{\text{males}} = 0.80$, $M_{\text{females}} = 0.85$, $t(256) = 0.47$, $p = 0.56$), teachers rated males as more sluggish than females ($M_{\text{males}} = 0.92$, $M_{\text{females}} = 0.73$, $t(274) = -2.46$, $p < 0.05$). Because of this difference, gender was used as a covariate in subsequent analyses using teacher ratings of SCT. A chi-square test examining whether the four diagnostic groups (ADHD-C/H, ADHD-I, Learning/Language Disorder, and No Diagnosis) differed on demographic variables revealed no differences in race or gender composition. However, an ANOVA indicated significant age differences [$F(3, 255) = 2.95$, $p < 0.05$]. Tukey’s post hoc analyses revealed that the No Diagnosis group ($M = 8.88$, $SD = 2.25$) was significantly younger than the ADHD-I group ($M = 10.14$, $SD = 2.38$). Hence, age was used as a covariate in all analyses involving diagnostic grouping.

SCT and DSM-IV Diagnoses—ANCOVAs revealed significant difference in SCT symptomology for both parent and teacher ratings across the four diagnostic groups [$F(3, 203) = 3.41, p < 0.05$ and $F(3, 218) = 3.43, p < 0.05$, respectively]. Table 4 depicts the means and standard deviations of SCT symptom ratings across parents and teachers as well as significant comparisons. On parent ratings, the ADHD-I group had the highest SCT scores, followed closely by ADHD-C/H, Learning/Language Disorder, and No Diagnosis groups. The two ADHD groups (ADHD-I and ADHD-C/H) had significantly higher SCT symptoms than the No Diagnosis group. There were no significant differences in SCT among the three clinical groups. On teacher ratings, the ADHD-I group had the highest SCT scores, followed by Learning/Language Disorder, ADHD-C/H and No Diagnosis groups. As with parent ratings, teacher ratings of SCT in the ADHD-I group were significantly higher compared to the No Diagnosis group; however, unlike parent ratings, teacher ratings of SCT in the ADHD-I group were also significantly higher than those in the ADHD-C/H group.

Comparing the High vs. Low SCT categories across diagnostic groups, chi-square tests were significant for both parent and teacher ratings of SCT ($\chi^2(3, N = 203) = 8.64, p < 0.05$ and $\chi^2(3, N = 223) = 7.12, p < 0.05$, respectively). Consistent with the dimensional comparisons, the highest proportions of High SCT individuals were present in the ADHD-I group (53–66%), while the lowest proportions were observed in the No Diagnosis group (24–38%) across both parent and teacher ratings (Table 5). Follow-up chi-square analyses were performed to determine which diagnostic groups (i.e., ADHD-I, ADHD-C/H and Language/Learning Disorder) significantly differed from one another in the proportions of High SCT individuals. To adjust for conducting multiple follow-up comparisons, the Bonferroni correction was employed, resulting in an adjusted α level of 0.0125 for each follow-up test. Using parent report, ADHD subtypes did not differ significantly from one another, $\chi^2(1, N = 130) = 0.25, p = 0.62$, nor did they differ from the Learning/Language Disorder group (ADHD-I vs. Learning/Language Disorder: $\chi^2(1, N = 72) = 0.55, p = 0.46$; ADHD-C/H vs. Learning/Language Disorder: $\chi^2(1, N = 122) = 0.15, p = 0.70$). Similarly, using teacher report, the two ADHD groups and the Learning/Language Disorder group did not differ significantly from one another (ADHD-I vs. Learning/Language Disorder: $\chi^2(1, N = 77) = 2.36, p = 0.13$; ADHD-C/H vs. Learning/Language Disorder: $\chi^2(1, N = 139) = 0.10, p = 0.75$). However, using teacher report, the ADHD-I group had a significantly greater portion of High SCT individuals than the ADHD-C/H group, $\chi^2(1, N = 150) = 5.30, p = 0.009$.

SCT and ADHD Symptoms and Adjustment—Table 6 depicts the correlations between SCT, ADHD inattentive and hyperactive/impulsive symptoms, and the seven syndrome scales of the CBCL. Because of the large number of correlation analyses performed, Bonferroni correction was used to adjust the α level to 0.0038 for each test. As expected, parent and teacher rated SCT symptoms were moderately positively correlated with Attention Problems and weakly positively related to the Anxious/Depressed scale. Only teacher-, but not parent-rated SCT was related to more Somatic Complaints. In contrast, the Aggressive subscale was positively correlated with parent- but not teacher-reported SCT symptoms. Finally, both parent and teacher reported SCT symptoms were positively related to Social Problems and Thought Problems. Note that the Attention Problems subscale and the SCT measure share three items. We computed raw scores on the Attention Problems scale with and without the shared SCT items and then correlated the two scores with the SCT scores. Correlations between the SCT and original Attention Problems scale were highly positively related ($r = 0.72$ and $0.75, p$'s = 0.000 for parent and teacher report, respectively). The exclusion of the shared SCT items reduced the strength of the correlations ($r = 0.33$ and 0.48 for parent and teacher report, p 's = 0.000); however, they remained significantly positively related. Parent and teacher reported inattentive symptoms were positively related to internalizing and externalizing difficulties, while hyperactive/impulsive

symptoms were associated with greater externalizing difficulties and less internalizing difficulties.

Discussion

The present study provides empirical support for the validity of the SCT construct in a clinical sample of children and adolescents. A confirmatory factor analysis confirmed that SCT symptoms form a distinct factor from symptoms of inattention and hyperactivity. Additionally, SCT symptoms were greater among males and individuals with a clinical diagnosis of ADHD-I. However, relatively high levels of SCT symptoms were present among all diagnostic groups, including clinic-referred children who did not meet criteria for any clinical diagnosis. Finally, parent and teacher ratings of SCT were related to multiple aspects of adjustment, including internalizing problems, thought problems and social problems.

Factor Structure of SCT and DSM-IV ADHD Symptoms

Consistent with previous research with community samples (Hartman et al. 2004), confirmatory factor analyses of both parent and teacher reports supported a three-factor model where SCT items formed a construct distinct from inattention and hyperactivity/impulsivity. This model was validated in a secondary exploratory factor analysis. Although SCT emerged as a separate construct, it was moderately correlated with the inattentive factor. This finding is consistent with other studies reporting some overlap between inattention and SCT (Hartman et al. 2004; Lahey et al. 1988; McBurnett et al. 2001). Furthermore, the SCT items included in the analyses were highly intercorrelated in both parent and teacher models, and both SCT scales achieved adequate levels of internal consistency. These results suggest that SCT is a valid and cohesive construct in clinical populations of children and adolescents.

Our findings support the use of the four CBCL items (*confused or seems to be in a fog*, *daydreams*, *stares blankly*, and *apathetic or unmotivated*) in further assessments of SCT symptoms. These items are similar to items used in previous factor analytic studies (Hartman et al. 2004; McBurnett et al. 2001) to form the SCT factor. By contrast, the current results do not support the utility of the CBCL item *underactive* that has been used in previous SCT research (Carlson and Mann 2002). This item received lower levels of endorsement in the present clinical sample, and may not be a useful indicator of SCT in clinical populations. However, this item may still be useful in conceptualizing SCT in normative samples.

Although the SCT items discussed above may not be the only symptoms of the SCT construct, they seem to be, at present, the most feasibly-replicable measure of SCT. The CBCL is a commonly used and easily administered measure, and its most recent version contains an SCT scale with available norms. This SCT scale (which includes the same items as those examined in the present study) thus provides researchers and clinicians with a tool that can easily identify individuals with high levels of SCT. This is important, particularly for research, as there has not been consistency in terms of SCT measurement. It should be noted that preliminary evidence has also supported another recently developed 14-item measure of SCT, which may prove useful in future studies of SCT (Penny et al. 2009). Unfortunately, at the time of the present study this measure was not yet available. It would be helpful for future research to examine the factor structure of ADHD and SCT symptoms using the 14 item measure of SCT developed by Penny et al., and to directly compare the diagnostic and predictive utility of both measures of SCT.

SCT, ADHD Subtypes, and Clinical Diagnoses

Interestingly, teacher ratings of SCT showed a clearer distinction between ADHD subtypes than parent ratings. Specifically, the ADHD-Inattentive subtype was characterized by higher levels of SCT than the ADHD-Combined and Hyperactive subtypes, but only when using teacher report of SCT. By contrast, the ADHD subtypes did not differ in parent-rated SCT symptoms. This discrepancy suggests that each informant has a unique perspective, likely due to differences in the demands of the home versus the school environment. It is possible that teacher reports of SCT are more accurate than parent reports, since these symptoms may be more apparent in structured settings such as the classroom. As a result, teachers may be better able to differentiate between SCT and inattentive symptoms. Consistent with this proposition, one previous factor analysis (McBurnett et al. 2001) found stronger evidence for SCT when using teacher versus parent report. The manifestations and validity of SCT across the school and home settings constitute important issues to be addressed in further research. One avenue to pursue could include assessing whether this discrepancy exists when using a more extensive (and perhaps multifaceted) measure of SCT, such as the 14-item measure developed by Penny et al. (2009). If teacher ratings of SCT still appear superior to parent ratings, future research and clinical work should utilize teacher reports of SCT.

Another novel contribution of this study was examining the relationship between SCT and other clinical diagnoses beyond ADHD subtypes. Findings indicated high levels of SCT symptomology among all ADHD subtypes but also among individuals with a diagnosis of Learning and Language disorders, compared to clinically referred children with no diagnosis. However, many individuals who did not meet criteria for a clinical diagnosis still demonstrated high levels of SCT symptoms, suggesting that endorsement of SCT symptoms may be quite common in children and adolescents presenting with a variety of behavioral, emotional, and/or learning problems. These findings contradict the proposition presented by Milich et al. (2001) that SCT symptoms could be used as a marker for the ADHD-I subtype. Our results, together with evidence of high levels of SCT symptoms in a pediatric sample (Reeves et al. 2007), suggest that SCT symptoms are exhibited on a continuum and are not specific to the ADHD-I subtype. Future studies would benefit from including even more diverse clinical and pediatric samples to investigate the relationship between SCT and other childhood disorders.

SCT and Adjustment

Understanding the relationship between SCT and broader dimensions of adjustment, as opposed to clinical diagnostic categories, was a third aim of the present study. To reduce problems with shared method variance, we related SCT symptoms to combined parent and teacher reports of multiple adjustment dimensions. Our findings corroborate previous results showing that SCT is more strongly related to internalizing difficulties, including somatization, anxiety and depression, than externalizing problems (Carlson and Mann 2002). However, in contrast to previous studies with community samples that found SCT negatively related to externalizing problems (Carlson and Mann 2002; Hartman et al. 2004), our findings indicate a positive relationship between parent (although not teacher) rated SCT symptoms and externalizing difficulties (i.e., Aggression). It is possible that the high levels of impairment present in clinic-referred vs. community populations are responsible for these discrepancies, as in clinical populations multiple problems types (e.g., SCT, internalizing, and externalizing) may be more likely to co-occur.

In comparing patterns of correlations with adjustment across SCT and ADHD symptoms, SCT symptoms appeared more strongly related to internalizing problems, less strongly related to externalizing and social problems, and similarly related to attention and thought

problems. These patterns of correlations suggest that individuals with SCT but few ADHD symptoms may be more prone to experience internalizing problems, but less at risk for externalizing comorbidities and social difficulties common in children with ADHD (Hoza et al. 2005). Future research should examine the differential relationships of SCT and ADHD to other internalizing and externalizing disorders, as well as social problems (e.g., peer rejection, conflicts with parents and teachers).

Limitations

One limitation of the current study was the use of only three or four items as a measure of SCT. In comparison, nine items were used to measure the inattentive and hyperactive/impulsive dimensions of ADHD. Although the four SCT items used here may not be the best measure of the SCT construct, they have been widely used in existing research and until recently were the most feasibly-replicable measure of the SCT construct. Another limitation of the study is that not all participants had data from both parents and teachers. This may have affected the results as slightly different subgroups of youth were analyzed when using parent vs. teacher ratings. However, because no differences in demographics, SCT, or ADHD dimension scores were found among those with data from different combinations of informants, substantial bias appears unlikely. Furthermore, there was a partial measurement overlap between the SCT and Attention Problems, with three items being present on both scales. Although this overlap inflated the association between the two scales, exclusion of the shared items from Attention Problems did not completely eliminate its the significant association with SCT. Finally, we were not able to link SCT symptoms to other types of adjustment problems, such as academic functioning or more specific impairments in relationships with peers and adults. It would be helpful for future studies to evaluate SCT using more SCT items, include complete data from multiple informant, avoid measurement overlap between SCT and adjustment, and consider a broader range of adjustment outcomes.

Conclusions

Although this study provides evidence for the validity of the SCT construct, it is unclear to what extent the SCT construct is clinically and diagnostically meaningful. That is, does knowing that individual experiences symptoms of SCT provide a better understanding of the individual's areas of impairment or clinical presentation? Since multiple studies point to attention problems as the primary area of impairment for individuals with SCT, future studies should address whether the attention difficulties associated with SCT are different from attention difficulties seen in individuals with ADHD. Neuropsychological measures of attention, neuroimaging, and EEG techniques may provide insights into potential differences in attention problems present in individuals with SCT vs. ADHD.

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Table 1

Means and Standard Deviation of Parent and Teacher SCT and ADHD Ratings

Item	Parent		Teacher	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
SCT (range 0–2)				
Confused or seems to be in a fog	0.75	0.75	0.78	0.78
Daydreams/gets lost in thoughts	1.05	0.77	1.04	0.78
Stares blankly	0.63	0.73	0.70	0.73
Underactive	0.41	0.70	0.45	0.68
Apathetic/unmotivated (teacher only)	–	–	0.83	0.80
Inattention (range 0–3)				
Fails to give close attention to details	2.15	0.88	1.93	0.92
Difficulty sustaining attention	1.86	1.02	1.71	1.1
Doesn't listen	1.67	0.97	1.15	0.96
Doesn't follow instructions	2.04	0.92	1.8	1.06
Difficulty organizing tasks/activities	1.82	1.04	1.84	1.02
Avoids/dislikes/reluctant to engage in work	1.96	1.04	1.75	1.11
Loses things necessary for tasks/activities	1.59	1.06	1.28	1.04
Is easily distracted	2.34	0.90	2.14	1.05
Is forgetful in daily activities	1.79	0.96	1.47	1.03
Hyperactivity/impulsivity (range 0–3)				
Fidgets	1.92	1.07	1.57	1.16
Leaves seat	1.46	1.09	1.35	1.15
Seems restless	1.57	1.02	1.36	1.08
Difficulty engaging in activities quietly	1.22	0.99	0.72	0.91
“On the go”/“driven by a motor”	1.51	1.19	0.98	1.14
Talks excessively	1.68	1.16	1.21	1.12
Blurts out answers	1.22	1.11	1.08	1.09
Difficulty awaiting turn	1.52	1.06	1.13	1.03
Interrupts or intrudes on others	1.76	1.05	1.32	1.11

N ranged from 337 to 348 for parent and 332 to 350 for teacher ratings

Table 2

Fit Indices from Confirmatory Factor Analyses of Parent and Teacher Ratings of ADHD and SCT Symptoms

Model	$\chi^2(df)$	CFI	RMSEA	$\chi^2_{diff}(df)$
Parent ratings				
1. Single-factor model (SCT + I + H/I)	475.83 (42) *	0.726	0.200	
2. Two-factor model (SCT + I, H/I)	352.65 (53) *	0.811	0.148	
Difference between model 1 and model 2				123.178(1) *
3. Three-factor model (SCT, I, H/I)	291.00 (55) *	0.851	0.129	
Difference between model 2 and model 3				61.649(2) *
Teacher ratings				
1. Single-factor model (SCT + I + H/I)	805.25 (38) *	0.735	0.270	
2. Two-factor model (SCT + I, H/I)	549.53 (50) *	0.827	0.190	
Difference between model 1 and model 2				255.713(1) *
3. Three-factor model (SCT, I, H/I)	284.42 (51) *	0.919	0.129	
Difference between model 2 and model 3				265.118(2) *

CFI Comparative Fit Index, RMSEA root mean square error of approximation

* $p < 0.001$

Table 3
Standardized Loadings for the 3-Factor CFA Model of ADHD and SCT Symptoms

Item	SCT		Inattentive		Hyperactive/impulsive	
	Parent	Teacher	Parent	Teacher	Parent	Teacher
Confused or seems to be in a fog	0.87	0.71				
Daydreams/gets lost in thoughts	0.71	0.86				
Stares blankly	0.73	0.73				
Apathetic/unmotivated (teacher only)	–	0.77				
Fails to give close attention to details			0.69	0.75		
Difficulty sustaining attention			0.82	0.83		
Doesn't listen			0.76	0.78		
Doesn't follow instructions			0.81	0.84		
Difficulty organizing tasks/activities			0.79	0.81		
Avoids/dislikes/reliant to engage in work			0.73	0.81		
Loses things necessary for tasks/activities			0.67	0.78		
Is easily distracted			0.84	0.90		
Is forgetful in daily activities			0.76	0.79		
Fidgets					0.72	0.86
Leaves seat					0.80	0.85
Seems restless					0.84	0.88
Difficulty engaging in activities quietly					0.79	0.64
“On the go”/“driven by a motor”					0.77	0.80
Talks excessively					0.74	0.82
Blurts out answers					0.69	0.83
Difficulty awaiting turn					0.78	0.89
Interrupts or intrudes on other					0.87	0.91

Table 4
Mean and Standard Deviations of SCT Symptoms Across DSM-IV Diagnostic Groups

Diagnostic group	Parent		Teacher		Significant comparisons	
	M	SD	M	SD	Parent	Teacher
1. No diagnosis (ND)	0.58	0.09	0.71	0.64	ND < I, CH*	ND < I**
2. ADHD-I (I)	0.95	0.10	1.12	0.63		I > CH*
3. ADHD-C/H (CH)	0.85	0.06	0.86	0.58		
4. Learning/language disorder (LLD)	0.81	0.11	0.94	0.54		

* $p < 0.05$,

** $p < 0.01$

Table 5

Frequency of Low vs. High SCT Scores Across Diagnoses

Diagnostic group	Parent		Teacher	
	<i>N</i>	%	<i>N</i>	%
No diagnosis				
Low SCT	34	75.6	25	62.5
High SCT	11	24.4	15	37.5
ADHD-I				
Low SCT	19	47.5	15	34.1
High SCT	21	52.5	29	65.9
ADHD-C/H				
Low SCT	47	52.2	58	54.7
High SCT	43	47.8	48	45.3
Learning/language disorder				
Low SCT	18	56.3	17	51.5
High SCT	14	43.8	16	48.5

Low and High groups defined by a median split

Table 6

Relationship Between SCT and ADHD Symptoms and Adjustment

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Parent rated SCT	–	0.33*	0.42*	0.31*	0.25*	0.04	0.15	0.28*	0.24*	0.33*	0.50*	0.17	0.20*
2. Teacher rated SCT		–	0.17	0.55*	0.10	0.03	0.22*	0.22*	0.22*	0.28*	0.55*	0.10	0.04
3. Parent rated inattentive			–	0.31*	0.60*	0.20	0.16	0.18	0.35*	0.32*	0.50*	0.27*	0.29*
4. Teacher rated inattentive				–	0.21*	0.59*	0.14	0.23*	0.44*	0.45*	0.69*	0.28*	0.32*
5. Parent rated hyperactive/impulsive					–	0.47*	0.12	0.16	0.37*	0.35*	0.43*	0.49*	0.61*
6. Teacher rated hyperactive/impulsive						–	0.04	0.19*	0.45*	0.44*	0.50*	0.46*	0.63*
7. Somatic complaints							–	0.45*	0.42*	0.28*	0.27*	0.25*	0.24*
8. Anxious/depressed								–	0.53*	0.40*	0.31*	0.25*	0.24*
9. Social problems									–	0.57*	0.62*	0.43*	0.57*
10. Thought problems										–	0.57*	0.41*	0.45*
11. Attention problems											–	0.41*	0.49*
12. Rule-breaking behavior												–	0.72*
13. Aggressive behavior													–

* $p < 0.0038$