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Sluggish Cognitive Tempo in Psychiatrically Hospitalized Children: Factor Structure and Relations to Internalizing Symptoms, Social Problems, and Observed Behavioral Dysregulation

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Abstract As research examining sluggish cognitive tempo (SCT) advances, it is important to examine the structure and validity of SCT in a variety of samples, including samples of children who are clinically-distressed but not referred specifically for attention-deficit/hyperactivity disorder (ADHD). The present study used a large sample of psychiatrically hospitalized children (N=680; 73 % male; 66 % African American) between the ages of 6 and 12 to examine the latent structure of SCT, ADHD, oppositional defiant disorder (ODD), depression, and anxiety using confirmatory factor analysis (CFA). Results of the CFA analyses demonstrated that SCT is distinct from these other dimensions of child psychopathology, including ADHD inattention, depression, and anxiety. Regression analyses indicated that SCT symptoms were positively associated with depression and, to a lesser degree, anxiety. SCT symptoms were also *positively* associated with children's general social problems, whereas SCT symptoms were *negatively* associated with an observational measure of behavioral dysregulation (i.e., frequency of time-outs received as a part of a manualized behavior modification program). These associations were significant above and beyond relevant child demographic variables (i.e., age, sex, race), children's other mental health symptoms (i.e., ADHD, ODD, depression, anxiety symptoms), and, for all relations except child anxiety, parents' own anxiety and depression symptoms.

Keywords ADHD · Anxiety · Attention deficit disorder · Attention-deficit/hyperactivity disorder · Comorbidity · Depression · SCT · Sluggish cognitive tempo · Social functioning

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There has been ongoing debate regarding the most empirically valid and clinically useful way to conceptualize and categorize developmentally inappropriate symptoms of inattention, hyperactivity, and impulsivity. These symptoms are currently captured by the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV; American Psychiatric Association [APA] 1994) category of Attention-Deficit/Hyperactivity Disorder (ADHD), which includes three subtypes: Predominantly Inattentive Type (ADHD-I), Predominantly Hyperactive-Impulsive Type (ADHD-HI), and Combined Type for cases with both inattention and hyperactivity-impulsivity (ADHD-C). As researchers and clinicians prepare for the publication of *DSM-5*, significant interest in the classification of ADHD remains (Adams et al. 2010; Diamond 2005; Willcutt et al. 2012).

Recently, there has been a renewal of interest in the construct of sluggish cognitive tempo (SCT) in relation to ADHD. SCT is defined by a range of symptoms including confusion, drowsiness, daydreaming, physical hypoactivity, and lethargy. Two symptoms of SCT, daydreamy and sluggish/drowsy, were evaluated as potential inattentive

symptoms in the *DSM-IV* field trials but were ultimately discarded because of their poor negative predictive power (Frick et al. 1994). It has since been argued that the presence of SCT symptoms may be used to identify a distinct form of ADHD-I (Carlson and Mann 2002; McBurnett et al. 2001), or even be a distinct disorder that is separate from, although comorbid with, ADHD (Barkley 2012; Bauermeister et al. 2012).

In line with either of these possibilities, researchers have sought to show that SCT is empirically distinct from ADHD and is a valid construct that is itself related to psychosocial impairment. As an initial step in this line of inquiry, multiple studies using exploratory and confirmatory factor analytic techniques have found that SCT symptoms form a separate factor from ADHD symptoms (see Willcutt et al. 2012, Supplement Table 15). Further, researchers have examined the validity of SCT by evaluating whether SCT symptoms have additive or differential utility in predicting a range of psychosocial impairments. Given the hypoactive, lethargic, and daydreamy characteristics of SCT, as well as earlier research showing children with attention deficit disorder without hyperactivity to have higher rates of comorbid internalizing disorders than children with attention deficit disorder with hyperactivity (Lahey et al. 1997; Lahey et al. 1987), much of the research to date has examined whether SCT symptoms are associated with children's internalizing mental health symptoms (i.e., anxiety, depression) or social problems.

As reviewed in more detail below, the present study sought to extend findings for these domains in four important ways. First, Adams and colleagues (2010) emphasized the need for more SCT-related research to occur "outside the confines" of typical ADHD research (p. 4), which includes samples of children not primarily characterized by ADHD diagnoses (also Barkley 2012). Toward this end, we examined the factor structure and clinical correlates of SCT symptoms in a large sample of psychiatrically hospitalized children with a wide range of mental health problems (including, but not limited to, ADHD), which allowed for the opportunity to extend the extant findings that are based predominantly on either community or clinic-referred (largely ADHD-referred) youth. Second, despite the frequent link between SCT and internalizing symptoms of depression and anxiety, we are aware of only one factor analytic study that has including these internalizing domains along with SCT and ADHD (Lahey et al. 2004), and so we included not only SCT and ADHD in our factor analysis but also childhood symptoms of oppositional defiant disorder (ODD), depression, and anxiety. Third, we sought to replicate the finding that SCT symptoms are associated with child internalizing symptoms and also extend previous research by examining this association while also controlling for the overlap of anxiety and depression as well as parents' own anxiety and depression symptoms. Fourth, we evaluated whether SCT would not only be positively associated with a broadband measure of social functioning, as has been demonstrated in previous research, but would also be negatively associated with observed behavioral dysregulation (e.g., aggression, hostility), as assessed by the frequency in which children received time-outs as part of the psychiatric inpatient behavior modification treatment program for such behaviors.

SCT and Internalizing Symptoms

Among children and adolescents, studies consistently demonstrate that SCT symptoms are significantly associated with internalizing symptoms (Bauermeister et al. 2012; Becker and Langberg 2012; Carlson and Mann 2002; Garner et al. 2010; Penny et al. 2009), and children diagnosed with both ADHD and an anxiety disorder display higher rates of SCT symptoms compared to children with a diagnosis of either ADHD or anxiety in isolation (Skirbekk et al. 2011). Crucially, SCT symptoms are associated with internalizing symptoms even after controlling for ADHD (Bauermeister et al. 2012; Penny et al. 2009) and ODD/Conduct Disorder (CD) symptoms (Becker and Langberg 2012). Further, a growing body of research suggests that SCT is more strongly associated with depression than with anxiety (Barkley 2012; Garner et al. 2011; Hartman et al. 2004; Jacobson et al. 2012).

Although SCT and internalizing symptoms do not appear to be simply overlapping constructs (Garner et al. 2011), the only factor analytic study that included internalizing symptoms along with SCT and disruptive behavior disorder symptoms did not find that SCT formed a distinct factor but generally loaded with ADHD inattention (Lahey et al. 2004). This study is in contrast to most other studies showing SCT to be distinct from ADHD (see Willcutt et al. 2012), and so it remains unclear if the contrasting results reported by Lahey et al. (2004) are due to the inclusion of other psychopathology symptoms (e.g., depression, anxiety) in addition to ADHD. Just as the factor structure of ADHD may change when other disruptive behavior symptoms are included in the model (Pillow et al. 1998), so too may the structure of SCT change when internalizing symptoms are included in the model. It is therefore critical that studies examine not only the factor structure of SCT and ADHD but also include other facets of child psychopathology such as ODD, depression, and anxiety.

Further, although a link between SCT and internalizing symptoms has been established, no study has taken into account the overlap between anxiety and depression. It is possible that the links between SCT and depression or SCT and anxiety is attributable to the high degree of overlap

between anxiety and depression (Brady and Kendall 1992; Garber and Weersing 2010). To account for this overlap, we controlled for anxiety in our model examining SCT in relation to depression and likewise controlled for depression in our model examining SCT in relation to anxiety. Moreover, parents' own internalizing symptoms, and depression especially, may bias their ratings of child psychopathology (Briggs-Gowan et al. 1996; Fergusson et al. 1993). Therefore, we also examined models that controlled for parents' own internalizing symptoms when elucidating the relation between child SCT and child internalizing symptoms.

SCT and Social Functioning

Although less research has examined the relation between SCT and children's social functioning compared to children's internalizing symptoms, recent research generally suggests a positive association between SCT symptoms and social problems. Importantly, SCT symptoms are not only correlated with social problems (Garner et al. 2010), but remain associated with social problems even after controlling for ADHD and ODD/CD symptom severity (Becker and Langberg 2012). SCT symptoms are also negatively associated with teacher-reported social skills, but not parent-reported social skills, after controlling for ADHD symptoms (Bauermeister et al. 2012).

It appears that the social impairments associated with SCT differ from the types of social impairments typically associated with hyperactivity and impulsivity (Diamond 2005). For instance, Carlson and Mann (2002) found that children with ADHD-I + High SCT had higher rates of withdrawal than children with either ADHD-C or ADHD-I + Low SCT. Furthermore, the ADHD-I + High SCT group had lower rates of aggression than children with ADHD-I + Low SCT, who in turn had lower rates of aggression than children with ADHD-C. Using a novel laboratory-based computerized chat room task, Mikami et al. (2007) examined whether SCT symptoms would be associated with chat room performance after controlling for child diagnostic status (i.e., ADHD-C, ADHD-I, or comparison youth) and pertinent child characteristics (i.e., typing skill, IQ, reading achievement). Consistent with the findings of Carlson and Mann (2002), Mikami and colleagues (2007) found that SCT symptoms predicted fewer chat room responses, less perception of subtle social cues, less memory for the chat room conversation, and fewer hostile responses. In conclusion, research to date suggests that SCT symptoms impair children's general functioning due to withdrawal and passivity, even as children with SCT display lower rates of the aggressive and hostile behaviors that are linked to behavioral and disciplinary issues in classroom and clinical contexts. In fact, in settings like child psychiatric inpatient units where high rates of disruptive and dysregulated behaviors are common, it is possible that SCT symptoms will be associated with *lower* rates of behavioral dysregulation.

The Present Study

Using a large sample of psychiatrically hospitalized children, the present study had three purposes. First, we used confirmatory factor analysis (CFA) to investigate the underlying factor structure of SCT alongside other childhood psychopathology dimensions of ADHD, ODD, anxiety, and depression. Second, we wanted to replicate previous research showing a significant relation between SCT and child anxiety and depression, and importantly, to examine whether SCT would predict child internalizing symptoms while controlling for child ADHD and ODD symptoms, the overlap between depression and anxiety (e.g., does SCT predict depression after controlling for anxiety?), as well as parent anxiety and depression. Finally, we hypothesized that SCT would be positively associated with children's broadband social problems above and beyond demographics and ODD/ADHD symptoms, but would be negatively associated with children's observed behavioral dysregulation (e.g., aggression, hostility) as measured by the frequency of time-outs received as a part of the behavioral modification program implemented during the children's psychiatric hospitalization.

Method

Participants

Participants included 680 children consecutively admitted for psychiatric inpatient treatment over a 3-year period. Children were excluded from participation if their caregiver declined to allow the child's clinical data to be used in a research database or the child (a) had experienced traumatic brain injury, (b) was diagnosed with an autism spectrum disorder or psychosis, (c) was <6 years old (the unit provides services for 4- to 12-year-old children), or (d) was in the custody of the Department of Human Services (for whom there was no consenting caregiver with sufficient knowledge of symptoms).

The participants ranged from 6 to 12 years of age (M= 9.20, SD= 1.93) and most were male (73 %, n=494). Per caregiver report, more than half of the participants were African American (n=386), and the remaining youth were Caucasian (n=267), Biracial (n=15), Hispanic (n=5), or Other (n=4; race information was unavailable for three participants). All respondents were the primary caregiver,

and most were mothers (78 %); the remaining were grandparents (7 %), or fathers (7 %) or others (e.g., aunt, uncle; 8 %). For ease of presentation, "parent" will be used hereafter to indicate the primary caregiver. The length of stay for children in the present study ranged from 0 days to 30 days (M=7.93, SD=4.24). Generally, 84 % of children admitted to this particular facility are covered by Medicaid and of low socioeconomic status, which is consistent with the population of the region.

Although diagnostic information derived from clinical interviews was unavailable for the full sample used in the present study, general rates of consensus team diagnoses in the psychiatric inpatient unit (including diagnoses by history established upon admittance to the unit) are: ADHD only (15 %), ODD only (9 %), CD only (6 %), anxiety disorder only (8 %), mood disorder only (6 %), ADHD+ODD (28 %), ADHD+CD (5 %), ADHD+anxiety (12 %), and ADHD+mood (11 %). It is important to note that although ADHD is a common comorbidity among children admitted to the unit (and some children on the unit have been formally diagnosed with only ADHD), ADHD symptoms alone are not a reason for admittance to the unit but may co-occur along with typical reasons for admittance such as aggression and/or suicidality.

Measures

Child Mental Health Symptoms and Social Problems ADHD, SCT, anxiety, depression, and ODD symptoms, as well as social problems, were assessed using the *Child Behavior Checklist for Ages 6–18* (CBCL/6–18; Achenbach 2001). The CBCL/6–18 is a caregiver-report measure of emotional and behavioral problems for children ranging from 6 to 18 years of age. Respondents rate on a 3-point scale (0=*not true*, 1=*somewhat or sometimes true*, 2=*very true or often true*) how true each item is for their child. In the present study, the SCT and social problems scales were utilized in addition to the *DSM*-oriented ADHD, ODD, anxiety, and affective (depression) scales (Achenbach and Rescorla 2001). The *DSM*-oriented scales have demonstrated good internal consistency (e.g., αs>0.70) as well as convergent and discriminant validity with other parent- and self-report symptom scales and with *DSM-IV* diagnoses as determined by clinical interviews (Achenbach and Rescorla 2001; Nakamura et al. 2009). The CBCL SCT scale is a commonly-used measure of SCT in children and adolescents (e.g., Bauermeister et al. 2012; Becker et al. 2012b; Garner et al. 2010). One item ("*clings to adults or too dependent*") loads onto both the social problems and anxiety scales; therefore, this item was removed from the social problems scale. Raw data (as opposed to *T*-scores) were used for scales in order to examine the latent structure of these constructs, and then mean scale scores were created based on the results of the CFA described below. In the present study, internal consistencies were 0.79, 0.65, 0.66, 0.77, 0.76, and 0.70 for the ADHD, SCT, anxiety, affective (depression), ODD, and social problems scales, respectively.

Parent Anxiety and Depression Symptoms Parent anxiety and depression symptoms were assessed with the Hopkins Symptom Checklist (HSCL; Derogatis et al. 1974). The HSCL is a 58-item measure of psychological symptoms experienced in "the past 7 days." Participants indicated on a four-point scale ranging from 0 (*not at all*) to 3 (*extreme*) their level of distress for each item. Although the HSCL is comprised of five subscales, to be consistent with measures of youth symptomatology used, only the anxiety (6 items; α =0.76; e.g., "heart pounding or racing") and depression (11 items; α=0.83; e.g., "feeling blue") subscales were used in the current study. The HSCL is a widely-used measure that has been found to be internally reliable and demonstrates good test-retest reliability (e.g., one-week stability coefficients range from r=0.75 to 0.81 for anxiety and depression, respectively). The anxiety and depression subscales have been found to correlate with interviewer ratings of symptomatology. Caregiver scores on the HSCL anxiety and depression scales did not differ as a function of whether or not the respondent was the child's parent or a different caregiver (e.g., grandparent), ps>0.05. Notably, the HSCL was added to the survey battery approximately midway into the present period of time for data collection for youth. As such, a subset of 325 parents provided data on this measure. Importantly, children of parents with and without HSCL data did not differ on demographic variables or other measures of interest (i.e., ADHD, SCT, ODD, anxiety, depression symptoms, social problems).

Observed Behavioral Dysregulation As part of the inpatient treatment protocol, all youth were placed on a behavior modification program upon entry to the inpatient unit whereby children earned incentives for following specified unit rules and staff directions as well as consequences for instances of non-compliance. When milieu rules were broken (e.g., verbal threats to others, uncontrolled emotional outbursts, failing to follow staff directions) and children did not respond appropriately to staff redirection, they were administered a time-out. In these instances, the child was removed from the stimulating environment and had to remain quiet during the duration of their time-out (typically, 1 minute per child's age in years). All time-outs were documented in the child's medical records.

Upon their hire, all staff were trained on how to implement the behavior modification program which included a manualized training program that explained the basic tenants of behavior therapy, the use of reinforcement and punishment to promote and extinguish various behaviors,

and the appropriate use of a standard behavioral program consisting of a sticker/reward program and use of time-outs. Following training, new hires shadowed a senior staff member for 2 weeks and were then supervised for an additional week of one-to-one training with a senior staff member as they implemented the program on the unit. Staff engaged in regular continuing education sessions to maintain fidelity. Because the duration of hospitalization varied for each participant, the mean number of time-outs received *per day of hospitalization* was used in the current study as the measure of observed behavioral dysregulation.

Procedure

All procedures were approved by the hospital's Institutional Review Board. Data were collected for each child and parent as part of the inpatient unit's standard assessment process. Upon the child's admission for inpatient treatment, parents were asked for written consent to include their own and their child's clinical data in the research database used in the present study (consent rate >95 %). Parents were informed that their child's clinical care would neither be contingent upon nor affected by their participation. Parents who consented completed a standard battery of paper-and-pencil questionnaires, with staff members available to answer any questions.

Data Analyses

First, the latent structure of SCT, ADHD-I, ADHD-HI, ODD, anxiety (ANX), and depression (DEP) symptoms were examined in a confirmatory factor analysis (CFA) model using Mplus Version 5.1 (Muthén and Muthén 1998–2007). The initial six-factor CFA model included each hypothesized latent construct (i.e., SCT, ADHD-I, ADHD-HI, ODD, ANX, DEP) predicting its respective indicators and included correlations among the latent constructs. Theory, previous CFA analyses, and modification indices were then used to prune the model for optimal fit. Multiple indices were used to test overall model fit, with the following indicating acceptable fit: comparative fit index (CFI) > 0.90, Tucker-Lewis Index (TLI) > 0.90, and root mean square error of approximation (RMSEA) <0.08 (Kline 1998). We then examined in subsequent models whether SCT was distinct from ADHD-I, DEP, and ANX. A χ^2 difference test was used to determine whether the hypothesized six-factor solution or an alternative five-factor model (separate models constraining SCT to be equal to ADHD-I, to depression, and to anxiety) was optimal, with a significant decrease in χ^2 considered evidence of significantly better model fit.

Next, using scale scores determined from the CFA results (mean scores of the scale items were used), correlation analyses were conducted, followed by hierarchical regression analyses in order to examine whether SCT predicted child internalizing symptoms, child social problems, and child observed behavioral dysregulation above and beyond other child psychopathology domains. Although child age, sex, and race/ethnicity are not typically correlated with SCT (Becker and Langberg 2012; Garner et al. 2010; Jacobson et al. 2012), we examined these demographic characteristics for possible significant associations with our outcome variables, and any significantly correlated demographic characteristics were also entered as covariates in the regression models. Specifically, any significantly correlated demographic characteristics were entered on Step 1, along with ODD, ADHD-I, and ADHD-HI symptoms. Next, SCT symptoms were entered on Step 2. In the model predicting anxiety we also controlled for depression, and similarly controlled for anxiety in the model predicting depression. We controlled for both anxiety and depression in the models predicting social problems and observed behavioral dysregulation. Finally, models were re-run to examine whether effects remained significant when also controlling for parents' own anxiety and depressive symptoms.

Results

Confirmatory Factor Analysis

In the initial measurement model, the four SCT items, three ADHD-I items, four ADHD-HI items, five ODD items, six ANX items, and 13 DEP items were each predicted by their respective latent constructs, and correlations were allowed among the six latent constructs. One item ("*underactive, slow moving, or lacks energy*") loads onto both the CBCL SCT and DEP scales, and so it was predicted by both of these latent constructs in the initial measurement model. The initial model fit was poor, $\chi^2(511)=2100.75$, $p<0.001$; CFI =0.75; TLI=0.72; RMSEA=0.068 (90 % confidence interval: 0.065–0.071). The "underactive, slow moving, or lacks energy" item had an appreciably lower and nonsignificant factor loading (standardized loading=0.10, $p=0.07$) on the SCT factor compared to the other three SCT items which had significant loadings on the SCT factor (standardized loadings=0.57–0.68, $ps<0.001$). This item did significantly load on the DEP factor (standardized loading=0.38, $p<$ 0.001). Given these results and that other factor analytic work examining the CBCL SCT scale also found a poor loading for this item on the SCT scale (Garner et al. 2010, who did not include DEP in their CFA), a second measurement model was examined with the "underactive" item removed from SCT but allowed to load on DEP, $\chi^2(512)=$

2103.91, $p<0.001$; CFI=0.75; TLI=0.72; RMSEA=0.068 (90 % confidence interval: 0.065–0.071). This model had marginally better fit compared to the model that included the "underactive" item, $\Delta\chi^2(1)=3.17$, $p=0.075$, but overall model fit was still poor.

Theory and modification indices were used to prune the model using a two-step approach. First, we examined item factor loadings and modification indices to remove items that had a low factor loading (e.g., "*sleeps more than most kids*" had a standardized loading of 0.23 on DEP) or had modification indices suggesting strong cross-loadings that would reduce parsimony among the psychopathology dimensions (e.g., "*disobedient at school*" would significantly load on ODD, ANX, and DEP). Four items were removed (one from ODD, one from DEP, and two from ANX). Second, within- and between-factor correlated residuals were considered when the items were theoretically and conceptually very similar (e.g., "*deliberately harms self or attempts suicide*" with "*talks about killing self*"; "*trouble sleeping*" with "*sleeps less than most kids*") or orthogonal (e.g., "*can't sit still, restless, or hyperactive*" with "*underactive, slow moving, or lacks energy*"). Six within-factor and three between-factor correlated residuals were added to the measurement model. Importantly, none of the three remaining SCT items were affected by these modifications. This measurement model demonstrated acceptable fit, $\chi^2(381)=842.70$, $p<0.001$; CFI=0.91; TLI=0.90; RMSEA=0.042 (90 % confidence interval: 0.038–0.046). Factor loadings and latent variable correlations of this optimal model are displayed in Fig. 1.[1]

[1] Measurement invariance was tested to investigate if CFA results were consistent between boys and girls. At the outset, our model demonstrated adequate configural invariance ($\chi^2=1426.41$, $p<0.001$, $\chi^2/df=1.75$; CFI=0.89; TLI=0.88; RMSEA=0.04, 90%CI 0.04, 0.05), suggesting that the pattern of free and fixed loadings was invariant across genders. Using the configural model as a baseline, we tested weak invariance of factor loadings across participant gender. Given our focus on SCT, we first tested whether constraining the factor loadings of the three SCT items to be equal across gender significantly worsened fit compared to a model in which these loadings were allowed to freely vary (i.e., partial invariance: Bryne et al. 1989). The constrained model was not significantly different from the unconstrained model ($\Delta\chi^2(3)=0.12$, *n.s.*; ΔCFI=0.00; RMSEA=0.04), suggesting invariance for the SCT items. We next tested weak invariance across all factor loadings. Although the chi-square difference test was significant ($\Delta\chi^2(30)=45.27$, $p=0.03$), such tests may be too strict for testing full invariance given the large sample size and other indices suggesting invariance (ΔCFI=0.00; RMSEA=0.05 falls within the 95 % CI of the configural model). Examination of specific items indicated that item 24 ("*Doesn't eat well*") loaded on the DEP factor for boys (λ=0.27) but not for girls (λ=0.12). As a check, allowing this item to freely vary while constraining all others to be equal did, in fact, indicate weak invariance ($\Delta\chi^2(29)=41.37$, *n.s.*; ΔCFI=0.00; RMSEA=0.05). Finally, tests of strong factorial invariance were conducted, with results suggesting invariant factor intercepts across gender ($\Delta\chi^2(6)=7.05$, *n.s.*; ΔCFI=0.00; RMSEA=0.05). Given these results, the full model collapsed across gender is presented.

Given the consistently strong association SCT has with ADHD-I, DEP, and ANX and questions in the literature regarding the possibility that SCT overlaps with these constructs, we examined whether a series of five-factor models fit better than the six-factor model displayed in Fig. 1. The five-factor model constraining SCT and ADHD-I to be equal had poor model fit, $\chi^2(395)=1291.39$, $p<0.001$; CFI=0.83; TLI=0.82; RMSEA=0.058 (90 % confidence interval: 0.054–0.061); hence, it is not surprising that the this five-factor model was significantly inferior to the six-factor model that did not constrain SCT and ADHD-I to be equal, $\Delta\chi^2(14)=448.69$, $p<0.001$. The five-factor model constraining SCT and DEP to be equal also had poor model fit, $\chi^2(395)=1349.68$, $p<0.001$; CFI=0.82; TLI=0.80; RMSEA=0.060 (90 % confidence interval: 0.056–0.063) and was significantly inferior to the six-factor model that did not constrain SCT and DEP to be equal, $\Delta\chi^2(14)=506.98$, $p<0.001$. Similarly, the five-factor model constraining SCT and ANX to be equal had poor model fit, $\chi^2(395)=1320.79$, $p<0.001$; CFI=0.83; TLI=0.81; RMSEA=0.059 (90 % confidence interval: 0.055–0.062) and was significantly inferior to the six-factor model that did not constrain SCT and ANX to be equal, $\Delta\chi^2(14)=478.09$, $p<0.001$. These findings suggests that SCT is a distinct construct from ADHD-I, DEP, and ANX, even though these constructs are correlated. Finally, although the latent ADHD-I and ADHD-HI variables we created from the CBCL ADHD scale were highly correlated (0.85), a five-factor model constraining ADHD-I and ADHD-HI to be equal also had poor model fit, $\chi^2(395)=1132.72$, $p<0.001$; CFI=0.86; TLI=0.85; RMSEA=0.052 (90 % confidence interval: 0.049–0.056) and was significantly inferior to the six-factor model that did not constrain ADHD-I and ADHD-HI to be equal, $\Delta\chi^2(14)=290.02$, $p<0.001$. All subsequent analyses used scales created from the six psychopathology factors as indicated by the CFA results (see Fig. 1).

Correlation Analyses

The absolute values of skewness and kurtosis were below 1.5 for all variables, with the exception of the time-out variable. The time-out variable was positively skewed (2.69) and had a leptokurtic distribution (12.62). Following a square root transformation, both skew and kurtosis for the time-out variable were in an acceptable range (0.56 and −0.06, respectively).

Variable means, standard deviations, and intercorrelations are displayed in Table 1. Child age was negatively correlated with both ADHD-I and ADHD-HI symptoms, but was not associated with SCT symptoms. Higher rates of ADHD-I symptoms were found among boys ($M=1.54$, $SD=0.50$) than girls ($M=1.38$, $SD=0.56$). Boys and girls did not differ on ADHD-HI symptoms ($M=1.33$, $SD=0.53$ and

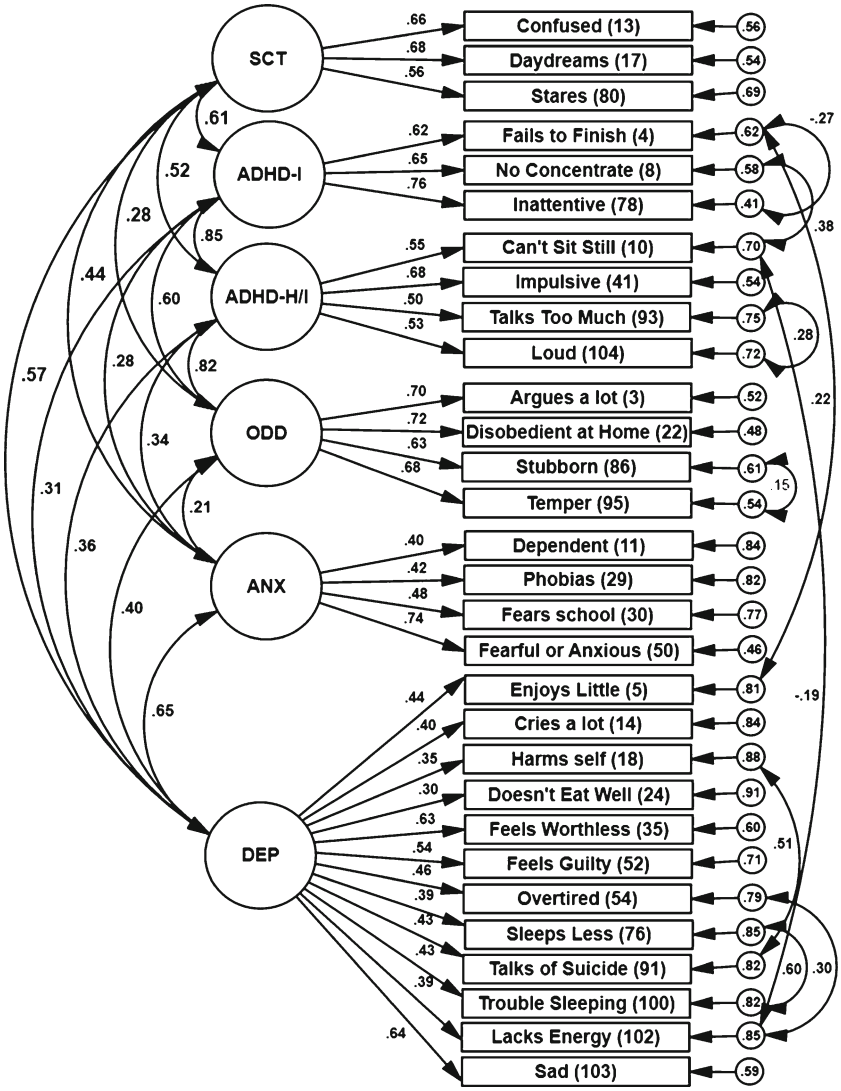

Fig. 1 Six-factor model of symptoms. Numbers in parentheses are Child Behavior Checklist item numbers. All pathways shown are significant, $p<.05$. Standardized estimates shown. *ADHD-I* attention-deficit/hyperactivity disorder inattention; *ADHD-HI* attention-deficit/hyperactivity disorder hyperactivity/impulsivity; *ANX* anxiety; *DEP* depression; *ODD* oppositional defiant disorder; *SCT* sluggish cognitive tempo

$M=1.29$, $SD=0.58$, respectively) or SCT symptoms ($M=0.79$, $SD=0.58$ and $M=0.82$, $SD=0.61$, respectively). Parent anxiety and depression were significantly associated with all child psychopathology dimensions and ratings of children's general social problems. Finally, ADHD-I, ADHD-HI, and ODD symptoms were significantly positively associated with behavioral dysregulation and depressive symptoms were negatively associated with behavioral dysregulation, whereas SCT symptoms were not bivariately associated with behavioral dysregulation.

SCT in Relation to Anxiety and Depression Symptoms

As described earlier, hierarchical regression analyses were conducted to examine whether SCT offered a unique contribution in predicting children's anxiety and depression symptoms above and beyond any significantly correlated child demographic variables (i.e., age, sex, race), ODD and ADHD symptoms, and the overlap of anxiety and depression (i.e., controlling for depression in the model predicting anxiety and vice versa). As summarized in Table 2 (top panel), over and above demographic variables, depression was a consistently strong predictor of anxiety. ADHD-HI and ODD symptoms were significantly associated (positively and negatively, respectively) with anxiety symptoms at Step 1, but when SCT was added to the model at Step 2, ADHD-HI and ODD were reduced to nonsignificance and SCT was a significant predictor of anxiety. For the model predicting depression, anxiety and ODD symptoms were consistently associated with depression. Still, SCT symptoms were strongly associated with depressive symptoms above and beyond child demographics and other child psychopathology dimensions (see Table 2, bottom panel).

Given that parent anxiety and depression were both correlated with child anxiety and depression, both parent psychopathology dimensions were included as covariates in the regression models predicting child anxiety and depression.

Table 1 Means, standard deviations, and bivariate correlations of study variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age[a]	–	0.13**	0.05	−0.01	−0.10**	−0.17***	−0.09*	0.09*	−0.08*	0.03*	−0.09	0.02	−0.34***
2. Sex[b]		–	0.07	0.02	−0.14***	−0.03	0.09*	0.12**	−0.02	0.05	−0.02	−0.01	−0.19***
3. Race[c]			–	−0.004	0.04	0.08*	0.15***	0.19***	0.25***	0.12**	0.08	0.17**	−0.05
4. Child SCT Symptoms				–	0.44***	0.34***	0.27***	0.41***	0.21***	0.48***	0.22***	0.26***	−0.07
5. Child ADHD-I Symptoms					–	0.59***	0.18***	0.24***	0.45***	0.41***	0.20***	0.27***	0.14***
6. Child ADHD-HI Symptoms						–	0.21***	0.27***	0.54***	0.49***	0.21***	0.27***	0.20***
7. Child Anxiety Symptoms							–	0.43***	0.14***	0.39***	0.44***	0.30***	0.01
8. Child Depression Symptoms								–	0.31***	0.54***	0.42***	0.49***	−0.11**
9. Child ODD Symptoms									–	0.40***	0.14*	0.29***	0.13**
10. Child Social Problems										–	0.35***	0.36***	0.02
11. Parent Anxiety Symptoms											–	0.70***	−0.02
12. Parent Depression Symptoms												–	0.01
13. Behavioral Dysregulation													–
Mean	9.20	–	–	0.80	1.50	1.32	1.54	0.63	0.61	0.77	3.45	8.45	0.54
Standard Deviation	1.93	–	–	0.59	0.52	0.54	0.53	0.50	0.39	0.39	3.72	6.91	0.46

CBCL psychopathology scales were created as indicated by the confirmatory factor analysis results (see text and Fig. 1)

ADHD-I attention-deficit/hyperactivity disorder hyperactive-impulsive symptoms; *ADHD-I* attention-deficit/hyperactivity disorder inattentive symptoms; *ODD* oppositional defiant disorder; *SCT* sluggish cognitive tempo

*$p<0.05$. **$p<0.01$. ***$p<0.001$

[a] Age is calculated in years

[b] For sex, boys=0, girls=1

[c] For race, non-Caucasian=0, Caucasian=1

Table 2 Multiple regression models predicting child anxiety and depression symptoms

	Step 1 Model summary				Step 2 Model summary			
	B	*SE*	*β*	*t*	*B*	*SE*	*β*	*t*
DV: Anxiety Symptoms	$\Delta F(7,672)=27.55^{***}$, $R^2=0.22$.				$\Delta F(1,671)=5.30^{*}$, $R^2=0.23$, $\Delta R^2=0.01$.			
Age	−0.03	0.01	−0.12	−3.52***	−0.03	0.01	−0.12	−3.56***
Sex	0.07	0.04	0.07	1.88	0.07	0.04	0.06	1.79
Race	0.09	0.04	0.09	2.42*	0.10	0.04	0.09	2.61**
Depression Symptoms	0.52	0.05	0.41	10.94***	0.48	0.05	0.38	9.54***
ODD Symptoms	−0.08	0.04	−0.09	−2.02*	−0.08	0.04	−0.08	−1.85
ADHD-HI Symptoms	0.09	0.04	0.09	1.01*	0.08	0.04	0.08	1.82
ADHD-I Symptoms	0.06	0.04	0.06	1.32	0.02	0.04	0.03	0.54
SCT Symptoms	–	–	–	–	0.08	0.04	0.09	2.30*
DV: Depression Symptoms	$\Delta F(7,672)=38.53^{***}$, $R^2=0.29$.				$\Delta F(1,671)=60.45^{***}$, $R^2=0.35$, $\Delta R^2=0.06$.			
Age	0.03	0.01	0.14	4.23***	0.03	0.01	0.12	3.87***
Sex	0.07	0.03	0.07	2.20*	0.05	0.03	0.06	1.84
Race	0.06	0.03	0.07	2.12*	0.07	0.03	0.09	2.69**
Anxiety Symptoms	0.29	0.03	0.37	10.94***	0.25	0.03	0.32	9.54***
ODD Symptoms	0.13	0.03	0.18	4.37***	0.14	0.03	0.18	4.69***
ADHD-HI Symptoms	0.05	0.03	0.06	1.42	0.03	0.03	0.03	0.80
ADHD-I Symptoms	0.06	0.03	0.08	1.93	−0.02	0.03	−0.02	−0.56
SCT Symptoms	–	–	–	–	0.19	0.02	0.28	7.78***

ADHD attention-deficit/hyperactivity disorder symptoms. *ODD* oppositional defiant disorder symptoms. *SCT* sluggish cognitive tempo symptoms. For ethnicity, non-Caucasian=0, Caucasian=1. For sex, boys=0, girls=1. Age is calculated in years

*$p<0.05$. **$p<0.01$. ***$p<0.001$

When controlling for parent internalizing symptoms (as well as the other predictors summarized in Table 2), SCT was no longer significantly associated with child anxiety ($b=0.05$, $SE=0.05$, $\beta=0.06$, $p=0.30$) but remained significantly associated with child depression ($b=0.16$, $SE=0.03$, $\beta=0.24$, $p<0.001$).

SCT in Relation to Social Problems and Observed Behavioral Dysregulation

As displayed in Table 3 (top panel), children's anxiety, depression, ODD, and ADHD-HI symptoms were each significantly associated with parent-reported social problems. Although ADHD-I symptoms were associated with social problems at Step 1, this relation was reduced to nonsignificance when SCT was added to the model at Step 2. Child SCT symptoms were found to be positively related to social problems above and beyond child demographic variables and the other psychopathology symptom domains. Supplemental analyses demonstrated that the positive association between SCT and parent-reported social problems remained significant when also controlling for controlling for parent internalizing symptoms ($b=0.17$, $SE=0.03$, $\beta=0.24$, $p<0.001$).

Finally, we examined whether, after accounting for demographic variables and child ADHD, ODD, anxiety, and depression symptoms, SCT would negatively predict observed behavioral dysregulation (i.e., number of time-outs received per day). As displayed in Table 3 (bottom panel), boys displayed more behavioral dysregulation than girls, and child age negatively predicted behavioral dysregulation. ADHD-HI symptoms were significantly *positively* associated with behavioral dysregulation. Although depression was *negatively* associated with social problems at Step 1, this relation was reduced to nonsignificance when SCT was added to the model at Step 2. Above and beyond the other variables, SCT symptoms significantly *negatively* predicted children's observed behavioral dysregulation, indicating that higher SCT symptoms predicted *fewer* time-outs.

Discussion

There has been growing interest in the degree to which SCT symptoms are not only distinct from ADHD (especially inattention), but also constitute a clinically valid and meaningful construct distinct from internalizing symptoms of anxiety and depression. The present study examined the latent factor structure of SCT and other childhood psychopathologies, including ADHD, ODD, depression and anxiety. The association of SCT to internalizing mental health

Table 3 Multiple regression models predicting child social problems and observed behavioral dysregulation

	Step 1 Model summary				Step 2 Model summary			
	B	*SE*	*β*	*t*	*B*	*SE*	*β*	*t*
DV: Social Problems	$\Delta F(7,672) = 80.04$***, $R^2=0.46$.				$\Delta F(1,671) = 35.23$***, $R^2=0.48$, $\Delta R^2=0.03$.			
Age	0.02	0.01	0.08	2.77**	0.02	0.01	0.08	2.68**
Race	−0.02	0.02	−0.02	−0.75	−0.01	0.02	−0.01	−0.25
Anxiety Symptoms	0.13	0.03	0.17	5.28***	0.12	0.03	0.15	4.85***
Depression Symptoms	0.33	0.03	0.34	10.00***	0.28	0.03	0.28	8.08***
ODD Symptoms	0.07	0.03	0.09	2.51*	0.08	0.03	0.11	2.97**
ADHD-HI Symptoms	0.19	0.03	0.26	6.77***	0.18	0.03	0.25	6.48***
ADHD-I Symptoms	0.08	0.03	0.11	2.97**	0.03	0.03	0.04	1.07
SCT Symptoms	–	–	–	–	0.13	0.02	0.20	5.94***
DV: Behavioral Dysregulation [a]	$\Delta F(7,591) = 17.66$***, $R^2=0.17$.				$\Delta F(1,590) = 8.91$**, $R^2=0.19$, $\Delta R^2=0.01$.			
Age	−0.07	0.01	−0.29	−7.31***	−0.07	0.01	−0.29	−7.34***
Sex	−0.14	0.04	−0.14	−3.55***	−0.14	0.04	−0.13	−3.45**
Anxiety Symptoms	0.01	0.04	0.01	0.12	0.01	0.04	0.01	0.32
Depression Symptoms	−0.15	0.05	−0.13	−2.86**	−0.10	0.05	−0.09	−1.91
ODD Symptoms	0.06	0.04	0.07	1.48	0.05	0.04	0.05	1.19
ADHD-HI Symptoms	0.10	0.04	0.12	2.36*	0.12	0.04	0.14	2.66**
ADHD-I Symptoms	0.01	0.04	0.01	0.25	0.05	0.05	0.06	1.18
SCT Symptoms	–	–	–	–	−0.11	0.04	−0.13	−2.99**

ADHD attention-deficit/hyperactivity disorder symptoms. *ODD* oppositional defiant disorder symptoms. *SCT* sluggish cognitive tempo symptoms. For ethnicity, non-Caucasian = 0, Caucasian = 1. For sex, boys = 0, girls = 1. Age is calculated in years

*$p<0.05$. **$p<0.01$. ***$p<0.001$

[a] Due to missing data, $N=599$ for the behavioral dysregulation analyses

and social functioning domains was also examined, after controlling for important covariates not considered in previous research. As such, this study replicates and extends previous research in several important ways. First, by using a large sample of children admitted to an acute psychiatric inpatient unit, the latent structure of SCT and other child psychopathology dimensions was examined in a sample of clinically-distressed children who were not referred specifically for ADHD-related problems. This is an important contribution since previous studies have typically relied on clinic-referred (largely ADHD) or population- or community-based samples. If SCT is indeed clinically distinct from other child psychopathologies, it is necessary to determine this across a range of nonclinical and clinical populations. Second, we not only replicated previous research by examining the relation between SCT symptoms and children's anxiety and depression symptoms, but also examined these relations while also controlling for the overlap of anxiety and depression as well as parents' own anxiety and depressive symptoms. Finally, the present study incorporated a broadband measure of social problems in addition to an observational measure of behavioral dysregulation that optimizes ecological validity. Specifically, we tested the hypothesis that SCT symptoms would be *positively* associated with children's general social problems but *negatively* associated with the frequency in which children received time-outs, a commonly-used behavioral management measure in clinical care.

Results of the CFA analyses demonstrated that SCT symptoms are associated with, but statistically distinct from, other domains of child psychopathology, including ADHD inattention, depression, and anxiety. That is, poorer model fit was evidenced when SCT was constrained to load on a common factor with either ADHD-I, depression, or anxiety items. The present study adds to a growing body of literature documenting that SCT symptoms covary in such a way as to be considered a distinct factor separate from ADHD (Willcutt et al. 2012), but is only the second study to examine SCT in relation to depression and anxiety symptoms as well. Specifically, Lahey et al. (2004) did not find SCT to be distinct from ADHD-I when internalizing symptoms were also included in a factor analysis. Our results differ from those reported by Lahey and colleagues (2004), although it is not immediately clear why this is the case. It is possible that analytic and sample differences contributed to the divergent findings. Lahey and colleagues utilized exploratory factor analytic techniques with a representative sample of children and adolescents whereas we utilized

confirmatory factor analytic techniques with a sample of clinically-distressed children. Clearly, additional studies are needed that not only examine the factor structure of SCT and ADHD, but also incorporate other related domains of child psychopathology.

Similar to Garner et al. (2010), we did not find the CBCL item "*underactive, slow moving, or lacks energy*" to load on the SCT scale, but this item did significantly load with the depression items in the present study. Additional research is needed to clarify the role that such behaviors have in the conceptualization and measurement of SCT. Although slow behaviors have often been included in descriptions of SCT, emerging research suggests that slowness may be more closely linked to *DSM-IV* ADHD inattention (Jacobson et al. 2012; Lahey et al. 2004; Penny et al. 2009) or, as this study suggests, depression. Still, this single CBCL item that has since been included in other SCT scales (Jacobson et al. 2012; Penny et al. 2009) includes three potentially distinct behaviors (underactive, slow moving, and lacks energy), and so it is unclear if the multicomponent nature of the item contributes to its poor loading with the other SCT items and its significant loading in the present study with the depression items (particularly the "lacks energy" component). Nonetheless, other items assessing slow behaviors have also loaded with ADHD inattention in recent studies (Jacobson et al. 2012; Lahey et al. 2004; Penny et al. 2009), suggesting that it may not only be this single multicomponent CBCL item that does not load with other SCT items but rather the slow component more broadly. In sum, although work is needed to determine the degree to which slow behaviors are inherent to SCT, this study suggests that SCT is not wholly defined by its connection to ADHD or internalizing symptoms, but rather, is a statistically distinct construct even among children who experience a wide range of emotional and behavioral difficulties severe enough to warrant inpatient hospitalization (e.g., aggression, suicidality).

After establishing the distinctiveness of SCT from other child psychopathologies in the CFA, the present study demonstrated that SCT is strongly related to both internalizing mental health problems and social functioning. Multiple studies have found a positive relation between SCT and internalizing symptoms in children (Bauermeister et al. 2012; Becker and Langberg 2012; Carlson and Mann 2002; Garner et al. 2010; Penny et al. 2009; Skirbekk et al. 2011). This association was supported in the present study, as SCT was associated with children's anxiety and depressive symptoms above and beyond child demographic variables (i.e., age, sex, race), and ADHD/ODD symptoms. The present study also extended previous research by showing SCT to be significantly associated with these internalizing domains even after controlling for the high degree of overlap between anxiety and depression. Consistent with other research (Barkley 2012; Garner et al. 2011; Hartman et al. 2004; Jacobson et al. 2012), it appears that SCT is more strongly associated with depression than with anxiety: when parents' own anxiety and depressive symptoms were controlled for (albeit with a reduced sample size), SCT remained robustly associated with children's depression but was no longer a significant predictor of children's anxiety.

Since relations between SCT and both ADHD and internalizing problems are emerging as consistent research findings, it will now be important for research to consider moderators and mediators of these associations, ideally using longitudinal data (see Becker et al. 2012c). For instance, several studies, including the present one, have found SCT to be related to depression, and to a lesser degree, anxiety. Research examining the pathways by which SCT is linked to either depression or anxiety is needed. It is possible that SCT symptoms, particularly those characterized by apathy and low motivation, contribute to increases in depression, which in turn confers risk for heightened anxiety among some children. Alternatively, other symptoms of SCT, such as getting lost in one's thoughts, may be linked directly to both depression and anxiety. No research to date has sought to test hypotheses regarding specific dimensions of SCT as either differential or common predictors of child anxiety and depression.

Consistent with previous research (Becker and Langberg 2012; Carlson and Mann 2002), we found that SCT symptoms were positively associated with children's general social problems. This is likely attributable to the passivity and withdrawal associated with SCT and is consistent with a recent study that documented greater social impairment (across peer, parent, and sibling domains) among children with ADHD who were also diagnosed with a comorbid psychiatric disorder in comparison to children diagnosed with ADHD alone (Becker et al. 2012a). However, it seems that SCT may exacerbate certain domains of social functioning while simultaneously attenuating other areas of social functioning in certain contexts. Specifically, SCT is associated with higher rates of passivity and withdrawal and lower rates of aggression and hostility among children with and without ADHD (Carlson and Mann 2002; Mikami et al. 2007). In line with this distinction, the present study is the first to test the hypothesis that SCT symptoms would be *negatively* associated with an ecologically-valid, observed measure of aggression and hostility. That is, we examined whether SCT would negatively predict the frequency in which children receive time-outs, a measure of behavioral dysregulation commonly used in behavior management interventions, while receiving inpatient psychiatric care. This hypothesis was supported, and a nuanced understanding of the relation between SCT symptoms and behavioral

dysregulation emerged. Specifically, SCT symptoms were not correlated with observed behavioral dysregulation at the bivariate level but were significantly (negatively) associated with behavioral dysregulation when controlling for child characteristics and other psychopathology symptoms such as ADHD, ODD, anxiety, and depression. In contrast, ODD, ADHD-HI, and ADHD-I symptoms were each positively associated, and depression negatively associated, with behavioral dysregulation at the bivariate level, but ADHD-HI remained the only significant predictor along with SCT in the final regression model. Hence, conduct problem severity may be important in understanding the link between SCT symptoms and behavioral dysregulation, especially in samples characterized by high rates of aggression. Future research is recommended to test the possibility that SCT plays a buffering role in children displaying high rates of hyperactive, impulsive, and aggressive behaviors, but not among children with low rates of these disruptive behaviors. That is, although SCT symptoms are expected to confer risk in most contexts (e.g., daydreaming in class), it is plausible that SCT symptoms are protective in contexts that are characterized by high rates of disruption. Compared to other children receiving inpatient care, children with high levels of SCT may be less likely to exhibit the disruptive behaviors that lead to more frequent time-outs. In sum, our results are the first to demonstrate that SCT can have both a negative and buffering role in terms of children's social functioning, at least among psychiatrically hospitalized children.

Of course, the present findings should be considered in light of several important study limitations. As already noted, the cross-sectional nature of the present study precludes drawing causal inferences. There is a clear need for longitudinal research, particularly in considering the likely cascading interrelations of SCT, internalizing symptoms, and social problems. For instance, the present study joins a growing number of studies in showing SCT to be related to both internalizing symptoms (especially depression) and social problems, and it is interesting to hypothesize that SCT symptoms contribute to increased social passivity and withdrawal, which in turn contributes to anxiety and depression. That is, increased social impairment may mediate the relation between SCT symptoms and internalizing symptoms. Another intriguing possibility is that children develop SCT symptoms as a result of the rumination and worry associated with anxiety and depression (Muris et al. 2005), with SCT symptoms and internalizing symptoms then having a synergistic effect in increasing children's social withdrawal. Although these possibilities must remain speculative given the absence of longitudinal data, such theory-driven hypotheses are needed in order to advance the theory and clinical relevance of SCT research.

A second limitation is our use of the CBCL SCT and ADHD scales. Although used in multiple studies (e.g., Bauermeister et al. 2012; Becker et al. 2012d; Garner et al. 2010, 2011), these scales are relatively brief and do not capture all facets of SCT or ADHD. In particular, future studies should replicate our findings by using a well-validated, multidimensional measure of SCT (e.g., Penny et al. 2009). In addition, aside from the observational measure of behavioral dysregulation, all measures were parent-report, and so results may be subject to mono-informant biases. However, our results showing parent ratings of SCT to predict an observational measure of behavioral dysregulation, as well as our inclusion of parents' anxiety and depressive symptoms as covariates in supplemental regression analyses, bolsters confidence in our results based on parent ratings. In terms of our measure of behavioral dysregulation, all inpatient unit staff underwent systematic and ongoing training in the implementation of the manualized behavior modification protocol, but unfortunately, additional reliability and validity data for this measure are unavailable. Furthermore, timeout data capture frequency, but not severity of problematic behaviors. Finally, although our use of an acute psychiatric inpatient sample is a strength of the present study, this does limit generalization to community or clinic-referred youth. In particular, results may not apply to less severely disturbed children referred to school-based or outpatient clinics (for ADHD or otherwise).

Despite these limitations, the present study offers a significant contribution to the available SCT literature. Specifically, SCT was found to be distinct from other child psychopathology dimensions in a large sample of psychiatrically hospitalized children. Conducting SCT-related research in both ADHD and non-ADHD samples is essential given the finding that SCT is distinct from ADHD and may be a unique clinical entity with important clinical implications outside of ADHD-specific samples (e.g., Barkley 2012). The present findings also extend previous research showing SCT symptoms to be related to child internalizing symptoms by considering the overlap between anxiety and depression as well as parents' own anxiety and depressive symptomatology. SCT symptoms were also shown to be positively and uniquely related to children's general social problems while also having a buffering effect in terms of observed behavioral dysregulation. Finally, the present study provides empirical support for conducting more SCT-related research outside of the confines of traditional ADHD research. Such research is needed to

increase our understanding of the developmental pathways and processes by which SCT is associated with either adaptation or maladaptation.

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