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Can Sluggish Cognitive Tempo be Distinguished from ADHD Inattention in Very Young Children? Evidence from a Sample of Korean Preschool Children

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Abstract

Objective: This study evaluated whether SCT is separable from attention-deficit/hyperactivity disorder (ADHD) inattention (IN), and uniquely associated with internalizing dimensions, in preschool children in South Korea.

Method: Mothers of 172 preschool children (ages 4–6 years; 52% girls) rated children's SCT, ADHD-IN, ADHD-hyperactivity/impulsivity (HI), oppositional defiant disorder (ODD), aggression, emotional reactivity, anxiety/depression, somatic complaints, withdrawal, and sleep problems.

Results: Eight of ten SCT symptoms showed convergent and discriminant validity with ADHD-IN. ADHD-IN remained significantly positively associated with ADHD-HI, ODD, and aggressive behavior after controlling for SCT, whereas SCT was no longer positively associated with these externalizing behaviors after controlling for ADHD-IN. Both SCT and ADHD-IN were uniquely associated with greater emotional reactivity, anxiety/depression, and withdrawal. Only SCT was uniquely associated with somatic complaints and only ADHD-IN was uniquely associated with sleep problems.

Conclusion: Findings replicate results with children and adolescents, thus expanding evidence for the validity of SCT in early development.

Keywords

attention problems; sluggish cognitive tempo; ADHD; preschool children; South Korea

Sluggish cognitive tempo (SCT) is characterized by inconsistent alertness, slow thinking/slow behavior, drowsiness, and a lack of energy. A recent meta-analysis supports the internal

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and external validity of the SCT symptom dimension (Becker, Leopold, et al., 2016). In terms of internal validity, SCT is a different symptom dimension from the ADHD-IN symptom dimension. In terms of external validity, SCT and ADHD-IN have different unique relationships with externalizing behaviors. Whereas ADHD-IN continues to show a significant positive relationship with externalizing behaviors after controlling for SCT, SCT's bivariate positive association with externalizing behaviors either becomes non-significant or significantly negative after controlling for ADHD-IN. SCT still predicts, however, internalizing behaviors as well as academic and social impairment after controlling for ADHD-IN (Becker, Leopold, et al., 2016; Burns, Becker, Servera, Bernad, & Garcia-Banda, 2016).

While a growing body of research provides support for the validity of the SCT construct, almost all studies to date have been conducted in school-aged children, adolescents, or adults. Evaluating SCT in very young children has been identified as an important area for investigation (Becker & Barkley, in press). We are aware of only two studies that have specifically examined SCT in very young children (Leopold et al., 2016; Tamm, Brenner, Bamberger, & Becker, 2016). As part of a longitudinal study spanning ten years, Leopold et al. (2016) found that seven SCT symptoms loaded together on a factor (convergent validity) that was separable from the ADHD-IN and ADHD-HI factors (discriminant validity) in a sample of 489 preschool children ($M_{age} = 4.89$; $SD_{age} = 0.49$) from the United States. In a sample of 61 four-year-old children at risk for ADHD from the United States, Tamm et al. (2016) found that SCT, especially teachers' rating of SCT, was uniquely related to poorer performance on tasks assessing visual-perceptual ability and attention, as well as slower processing speed. A limitation of this study, as noted by the authors, was the use of only three SCT symptoms to define the SCT construct. In addition, Leopold et al. (2016) focused on internal validity of SCT whereas Tamm et al. (2016) focused on external correlates of SCT; no study has examined both the internal validity and external validity of SCT in the same sample of very young children.

As only two studies have examined SCT in preschool-aged children, the robustness of the internal validity of SCT symptoms with preschool children remains unknown. Will similar results occur with another sample of preschool children, especially children from a culture different from the United States? Furthermore, it is entirely unknown if SCT is related to preschoolers' mental health symptoms (i.e., externalizing behaviors, anxiety/depression), social functioning, or sleep problems as has been demonstrated in older children and adolescents (Becker, Garner, & Byars, 2016; Becker, Leopold, et al., 2016). Determining whether SCT can be distinguished from ADHD in very young children – and is also related to domains of functioning – has important implications for understanding SCT across the life course and, ultimately, preventive and intervention efforts.

Objectives

The first objective was to determine the internal validity of SCT symptoms relative to ADHD-IN symptoms for 4 to 6 year old children. More specifically, we evaluated whether the SCT symptoms would show substantial loadings on the SCT factor (convergent validity) as well as much higher loadings on the SCT factor than the ADHD-IN factor (discriminant

validity). As noted above, the current study is only the second study to examine the internal validity of SCT symptoms with children this young (Leopold et al., 2016) and the first study to do so with Korean preschool children. An earlier study with Korean children in first through sixth grades found support for the convergent and discriminant validity of SCT with ratings by mothers, fathers, and teachers (Lee, Burns, & Becker, 2016). The current study extends these findings in evaluating whether similar results occur with preschool children from Korea.

The second objective was to determine the external validity of SCT relative to ADHD-IN. The main purpose of this objective was to determine if the external validity results for SCT from a recent meta-analysis with children, adolescents, and adults also occur with very young children (Becker, Leopold, et al., 2016). This objective first examined the bivariate associations of SCT and ADHD-IN in relation to externalizing behaviors (ADHD-hyperactivity/impulsivity [HI], oppositional defiant disorder [ODD], and aggression), socio-emotional adjustment (emotional reactivity, anxiety/depression, somatic complaints, and withdrawal), and nighttime sleep problems. First, higher scores on SCT and ADHD-IN measures were both expected to be associated with higher scores on all the measures. Second, it was predicted that ADHD-IN would show a stronger association than SCT with externalizing behaviors (i.e., ADHD-HI, ODD, and aggression). Third, SCT and ADHD-IN measures were both expected to demonstrate approximately equal bivariate associations with emotionally reactivity, anxiety/depression, somatic complaints, withdrawal, and sleep problems.

The next aspect of this second objective was to determine the unique associations of SCT and ADHD-IN measures with the external correlate domains. Based on findings from the recent meta-analysis (Becker, Leopold, et al., 2016), we first hypothesized that higher scores on ADHD-IN would remain significantly associated with greater externalizing behaviors (i.e., ADHD-HI, ODD, and aggression) even after controlling for SCT, whereas SCT would be non-significantly or negatively associated with externalizing behaviors after controlling for ADHD-IN (i.e., a double dissociation) (Barkley, 2014).

The second set of hypotheses concerned the unique associations of SCT and ADHD-IN measures with socio-emotional adjustment (i.e., emotional reactivity, anxiety/depression, somatic complaints, and withdrawal). First, it was expected from the research with older children and adolescents that both SCT and ADHD-IN would show unique associations with the emotional reactivity, anxiety/depression, and withdrawal measures. However, based on the heterogeneous nature of the *Child Behavior Checklist* (CBCL) withdrawn subscale used in this study, and evidence linking SCT to withdrawal specifically (Becker, Luebke, Fite, Stoppelbein, & Greening, 2014; Carlson & Mann, 2002; Marshall, Evans, Eiraldi, Becker, & Power, 2014; Willcutt et al., 2014), we also tested this hypothesis with the individual item from the CBCL withdrawn scale that directly assesses withdrawal and isolation from social interactions ('withdrawn, doesn't get involved with others'). The prior research clearly predicts that SCT should show a unique association with the withdrawal item relative to ADHD-IN while the prediction for the CBCL subscale is more tentative given the heterogeneous nature of the withdrawal subscale (e.g., acts young, little affect, little interest, withdrawn).

To the best of our knowledge, no prior study has examined the unique association of SCT relative to ADHD-IN with somatic complaints (e.g., aches, pains, headaches, nausea, stomach aches). However, given that daydreaming is a core feature of SCT and daydreaming appears linked to ruminative processes (Becker, Withrow, et al., 2016) and, given the unique relationship of SCT to anxiety and depression (Becker, Leopold, et al., 2016), we tentatively hypothesized that SCT would also have a unique association relative to ADHD-IN with somatic problems.

The final measure from the CBCL was the sleep problems subscale (e.g., nightmares, wakes often, talks in sleep, resists going to sleep, does not sleep alone). Previous research has shown SCT to be uniquely related to sleep difficulties in young adults (Becker, Luebke, & Langberg, 2014) and school-aged children (Becker, Garner, et al., 2016). There also appears to be an association between ADHD and sleep difficulties in preschool-aged children specifically (DeVincent, Gadow, Delosh, & Geller, 2007; Hiscock, Canterford, Ukoumunne, & Wake, 2007). We thus hypothesized that both SCT and ADHD-IN would be uniquely associated with sleep problems.

If our hypotheses are supported and a similar pattern of internal and external validity results occur with preschool children as with children and adolescents found in previous studies (Becker, Leopold, et al., 2016), then such results would further expand the validity of the SCT construct, especially since the current study is only the third study to evaluate the validity of SCT in children from Asia (Khadka, Burns, & Becker, 2016; Lee et al., 2016).

Method

Participants and Procedures

With approval of the childcare centers and university institutional review board, 300 mothers from seven childcare centers in Seoul were invited to participate in the study. All childcare centers met licensing and early educational Korean accreditation requirements and were government-funded. These seven childcare centers represented a sample of convenience. Teachers gave the 300 children an envelope with the materials to give to mothers. Participation was voluntary and anonymous. A total of 172 mothers returned the scales with the mean age of these children being 5.13 ($SD = 0.79$, range 4 to 6, 52% girls). Most of the children were Korean (less than 0.5% of the children in this preschool district were from multinational families). Ethnicity information was not available for individual children.

Measures

Child and Adolescent Disruptive Behavior Inventory (CADBI) Sluggish Cognitive Tempo Module (Burns, Lee, Becker, Servera, & McBurnett, 2014).—

The SCT module from the CADBI has ten SCT items (i.e., [1] behavior is slow, [2] drowsy or sleepy during the day, [3] daydreams, [4] loses train of thought, [5] low level of activity, [6] gets lost in own thoughts, [7] forgets what was going to say, [8] easily confused, [9] spaces or zones out, and [10] thinking is slow). Mothers rated the items on a 6-point scale (0 = *almost never* [*never or about once per month*] to 5 = *almost always* [*many times per day*]). These items showed convergent (high loadings on the SCT factor) validity and discriminant

validity (low loadings on the ADHD-IN factor) in an earlier study with first to sixth grade (ages 6 to 13) Korean children (Lee et al., 2016). Given the younger age range of the Korean children in the current study than the earlier study, the convergent and discriminant validity of these ten SCT items with the nine ADHD-IN items were evaluated in an initial analysis prior to the main analyses of the study. The reliability of the scores for the SCT items is reported in a subsequent section.

ADHD Rating Scale (DuPaul et al., 1998).—Mothers rated the occurrence of the nine ADHD-IN and nine ADHD-HI items on a 4-point scale (0 = *never or rarely* to 3 = *very often*). The ADHD-IN and ADHD-HI scores have demonstrated adequate psychometric properties with American (DuPaul et al., 1998) and Korean children (Kim et al., 2003). For Korean preschoolers (ages 4 to 6 years) some of the items were slightly revised to make these developmentally relevant (Chi & Kim, 2013). For example, the ADHD-IN item “loses things necessary for activities” was amended to include the following parenthetical text: “(e.g., toys, crayons).” Reliability coefficients (alpha) for the ADHD-IN and ADHD-HI scores were .90 and .86, respectively, in the present study.

Child Behavior Checklist (CBCL/1.5–5) (Achenbach & Rescorla, 2000).—The Emotionally Reactive (9 items), Anxious/Depressed (8 items), Somatic Complaints (11 items), Withdrawn (8 items), Sleep Problems (7 items), Aggressive Behavior (19 items) subscales, and the DSM-oriented ODD (6 items) scale of the CBCL/1.5–5 were used in the current study. Note that while the CBCL/1.5–5 does include two items that have previously been used as SCT items (i.e., *stares into space* and *underactive, slow moving or lacks energy*), neither of these items is included in any of the seven CBCL subscales above. Mothers rated the occurrence of each item on a 3-point scale (0 = *not true*, 1 = *somewhat or sometimes true*, and 2 = *very true or often true*). The scores on these scales have demonstrated adequate psychometric properties in diverse cultures (Ivanova et al., 2010) with the scales also having been validated in Korea (Kim, Lee, Moon, Kim, & Oh, 2009). The reliability coefficients (alpha) were .68, .70, .50, .63, .61, .90, and .73 for the scores on the Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn, Sleep Problems, Aggressive Behavior, and ODD subscales, respectively, in this study.

Analytic Strategy

The first analysis applied a two-factor model with cross-loadings to the ten SCT items and nine ADHD-IN items. The purpose of this analysis was to identify SCT symptoms with substantial loadings on the SCT factor (i.e., convergent validity) and substantially higher loadings on the SCT factor than the ADHD-IN factor (i.e., discriminant validity). SCT items were required to load higher than .60 on the SCT factor and lower than .30 on the ADHD-IN factor to be retained as indicators of the SCT construct. This analysis treated SCT and ADHD-IN item ratings as ordered-categories and used the robust weighted least squares (WLSMV) estimator (Mplus v.7.4) (Muthén & Muthén, 1998–2012).

The second analysis calculated the correlations among the measures. This analysis focused on the relationships of SCT and ADHD-IN measures with ADHD-HI, ODD, Aggressive Behavior, Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn, and

Sleep Problems measures. The third analysis used a multiple regression analysis to determine the unique associations of SCT and ADHD-IN with the symptom measures. The second and third analyses treated the measures as manifest variables rather than latent variables due to the large number of items relative to sample size. The correlation and regression analyses used the robust maximum likelihood estimator (MLR estimator). Covariance coverage was 98% or higher for the items so there were very few items left blank. The Mplus model constraint procedure was used to determine if correlations differed significantly. The regression of the individual withdrawn item on the SCT and IN measures was an ordinal logistic regression (i.e., the item was treated as categorical outcome variable [3 categories] and the analysis used the MLR estimator).

Results

Convergent and Discriminant Validity of SCT and ADHD-IN Symptoms

Eight of ten SCT items showed convergent validity (loadings from 0.62 to 0.82 on SCT; $M = .71$, $SD = .09$) and discriminant validity (loadings from -0.17 to 0.18 on ADHD-IN; $M = .08$, $SD = .07$). Two SCT items, *drowsy or sleepy when he or she has had a good night's sleep* and *loses train of thought*, were not used in subsequent analyses due to low convergent (loadings = $.39$ and $.58$, respectively) and discriminant validity (loadings = $.02$ and $.31$, respectively). The SCT dimension was thus defined by eight SCT items in this study—(1) behavior is slow, (2) daydreams, (3) low level of activity, (4) gets lost in own thoughts, (5) forgets what was going to say, (6) easily confused, (7) spaces or zones out, and (8) thinking is slow. The reliability coefficient (alpha) for scores on the eight SCT items was $.71$. All nine ADHD-IN symptoms showed reasonable to excellent convergent validity (loadings from 0.44 to 0.99 on ADHD-IN; $M = .77$, $SD = .19$) and discriminant validity (loadings from 0.23 to 0.34 on SCT; $M = .13$, $SD = .11$). All nine ADHD-IN items were retained for subsequent analyses in order to be consistent with the *DSM* ADHD-IN symptom set.

Correlation Analyses

Table 1 shows the descriptive information and correlations among the measures. Higher scores on SCT and ADHD-IN measures were significantly ($ps < .01$) associated with higher scores on ADHD-HI, ODD, Aggressive Behavior, Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn, and Sleep Problems measures, as well the specific “withdrawn” item (SCT with withdrawn item: $r = .30$, $SE = .09$, $p < .01$; ADHD-IN with withdrawn item: $r = .26$, $SE = .09$, $p < .01$). As predicted, ADHD-IN had significantly ($ps < .05$) higher correlation than SCT with externalizing behaviors (i.e., ADHD-HI, ODD, aggression). SCT and ADHD-IN measures did not differ significantly ($ps > .05$) in their correlations with the Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn, and Sleep Problems measures.

Multiple Regression Analyses

Table 2 shows the standardized partial regression coefficients for the regression of the symptom measures on SCT and ADHD-IN measures. Higher scores on the ADHD-IN measure continued to predict significantly ($ps < .001$) higher scores on the ADHD-HI, ODD, and Aggressive Behavior measures even after controlling for SCT, whereas the SCT measure

was no longer significantly associated with ODD and Aggressive Behavior measures and was now negatively associated ($p < .01$) with the ADHD-HI measure after controlling for ADHD-IN.

Higher scores on SCT and ADHD-IN measures both uniquely predicted ($ps < .05$) greater emotional reactivity and anxiety/depression. Only ADHD-IN uniquely predicted higher scores on the Withdrawn measure ($ps < .05$), though there was a tendency for higher scores on the SCT measure to also predict higher scores on the Withdrawn measure after controlling for ADHD-IN ($p = .08$). In line with our expectations, when the unique association of the SCT and ADHD-IN measures was determined for the single item directly assessing social withdrawal ('withdrawn, doesn't get involved with others') as opposed to the heterogeneous Withdrawn subscale, only SCT showed a significant unique association (i.e., SCT: $\beta = 0.33$, $SE = .15$, $p < .05$, ADHD-IN: $\beta = 0.15$, $SE = .16$, ns). Finally, only the ADHD-IN measure showed a unique association ($p < .01$) with Sleep Problems while only the SCT measure showed a unique association ($p < .001$) association with Somatic Complaints.

Discussion

Although a recent meta-analysis summarizes the increasing evidence for the internal and external validity of SCT with children, adolescents, and adults (Becker, Leopold, et al., 2016), currently there is only one study that examined the internal validity of SCT with preschool children specifically (Leopold et al., 2016) and only one study that examined the neuropsychological external correlates of SCT with preschool children (Tamm et al., 2016). Given no prior research has examined both the internal and external validity of SCT within a single study of young children, and no study has examined the external validity of SCT with externalizing and internalizing symptom dimensions with preschool children, it was important to determine if validity results for preschool children would be similar to findings with school-aged children, adolescents, and adults. In addition, only two prior studies have examined the validity of SCT with children from Asian countries (Khadka et al., 2016; Lee et al., 2016), making additional studies evaluating the validity of SCT in studies in cultural contexts outside of North America and Western Europe a clear research priority.

Internal Validity of SCT and ADHD-IN Symptoms in Preschool Children

Eight of the ten SCT symptoms showed strong convergent validity (substantial loadings on the SCT factor) and excellent discriminant validity (substantially higher loadings on the SCT factor than the ADHD-IN factor). These eight symptoms were: (1) *behavior is slow*, (2) *daydreams*, (3) *low level of activity*, (4) *gets lost in own thoughts*, (5) *forgets what was going to say*, (6) *easily confused*, (7) *spaces or zones out*, and (8) *thinking is slow*. In addition, although the ninth SCT symptom, *loses train of thought*, was not used to define the SCT construct in this study, this symptom still came close to meeting the study's criteria for convergent and discriminant validity. Only the *drowsy/sleepy* SCT symptom failed to show a strong relationship with the SCT factor (loading of .39 on the SCT factor). These nine SCT symptoms are nearly identical to the SCT symptoms demonstrating convergent and discriminant validity with children, adolescents, and adults from Chile, Korea, Nepal, Spain,

and the United States (Barkley, 2012, 2013; Becker, Langberg, Luebbe, Dvorsky, & Flannery, 2014; Becker, Luebbe, & Joyce, 2015; Belmar, Servera, Becker, & Burns, 2015; Burns et al., 2016; Fenollar Cortés, Servera, Becker, & Burns, 2014; Lee et al., 2016; Lee, Burns, Snell, & McBurnett, 2014). Although an ideal set of SCT symptoms has yet to emerge from this research (see Table 3 in Becker, Leopold, et al., 2016), there is increasing evidence for a common set of SCT symptoms with convergent validity as well as discriminant validity from ADHD-IN from preschool to adulthood. This common set of symptoms also appears to consistently reflect inconsistent alertness and slow thinking/behavior characteristics. It will be important, however, to further examine the internal validity of the drowsy/sleepy aspect of SCT in young children, particularly as it has been questioned whether SCT symptoms are overly redundant with daytime sleepiness (Langberg, Becker, Dvorsky, & Luebbe, 2014). It may be that the drowsy/sleepy aspect of SCT is less useful as an SCT item, both in relation to ADHD-IN as well as daytime sleepiness, but more research is needed to further untangle associations among these constructs (Becker & Barkley, in press).

External Validity of the SCT and ADHD-IN Symptom Dimensions in Preschool Children

Higher levels of SCT and ADHD-IN were bivariate associated with higher levels of ADHD-HI, ODD, aggression, emotional reactivity, anxiety/depression, somatic complaints, withdrawal, and sleep problems. Consistent with the earlier research with older children and adolescents, ADHD-IN showed a stronger bivariate association than SCT with the externalizing dimensions (ADHD-HI, ODD, and aggression) whereas their bivariate associations did not differ significantly with the internalizing dimensions (emotional reactivity, anxiety/depression, somatic complaints, and withdrawal) and sleep problems. Even though these findings are important, a more stringent test of the external validity of SCT occurs through an evaluation of its associations with the symptom dimensions after controlling for ADHD-IN. We now turn to these findings.

Consistent with the results from older children and adolescents, ADHD-IN continued to show a positive association with ADHD-HI, ODD, and aggression even after controlling for SCT, whereas SCT was no longer associated with ODD and aggression and showed a negative association with ADHD-HI after controlling. SCT thus demonstrated a *different* unique association with the externalizing symptom dimensions than ADHD-IN. This represents a double dissociation (Barkley, 2014) and this double dissociation has now been found in a number of studies with older children and adolescents, including both cross-sectional studies (Becker & Langberg, 2013; Becker, Luebbe, Fite, et al., 2014; Burns, Servera, D., Carrillo, & Cardo, 2013; Fenollar Cortés et al., 2014; Khadka et al., 2016; Lee, Burns, Beauchaine, & Becker, 2015; Lee et al., 2016; McBurnett et al., 2014; Penny, Waschbusch, Klein, Corkum, & Eskes, 2009) and longitudinal studies of up to two years (Bernad, Servera, Becker, & Burns, 2016; Bernad, Servera, Grases, Collado, & Burns, 2014; Servera, Bernad, Carrillo, Collado, & Burns, 2016). This consistent finding across this wider age range, and with a range of sample types, provides strong support for SCT and ADHD-IN being differentially associated with externalizing psychopathology and behaviors.

Even within this preschool sample, SCT remained positively associated with internalizing dimensions (emotional reactivity, anxiety/depressed, somatic complaints, and withdrawal), even after controlling for ADHD-IN. An association between SCT and internalizing symptoms of anxiety and depression has been well-documented in studies of school-aged children and adults (Becker, Leopold, et al., 2016). Likewise, extant studies have linked SCT to emotion regulation difficulties in children (Barkley, 2013; Becker et al., 2015) and adults (Barkley, 2012; Flannery, Becker, & Luebke, 2016; Jarrett, Rapport, Rondon, & Becker, 2014). Likewise, and again consistent with previous research (Carlson & Mann, 2002; Marshall et al., 2014; Willcutt et al., 2014), we found a clear association between SCT and increased social withdrawal and isolation. This finding likely goes hand in hand with the finding that SCT is unassociated (or negatively associated with) with externalizing behaviors – children displaying high levels of SCT are likely to withdraw from social interactions as opposed to engaging in externalizing behaviors such as aggression. Intriguingly, both SCT and ADHD-IN were uniquely associated with internalizing symptoms in this study. In a number of previous studies, in at least some analyses SCT alone (and not ADHD-IN) was uniquely associated with internalizing symptoms or withdrawal (Becker & Langberg, 2013; Becker, Langberg, et al., 2014; Khadka et al., 2016; Penny et al., 2009; Willcutt et al., 2014). While there are also exceptions to this pattern of findings (Bauermeister, Barkley, Bauermeister, Martinez, & McBurnett, 2012; Burns et al., 2016; Servera et al., 2016) it is nevertheless possible that SCT becomes more strongly associated with internalizing maladjustment across development. Of course, this possibility is speculative in the absence of direct empirical evidence and is an important area for future work. In addition, the fact that SCT was associated with the single item assessing withdrawal, but not the “Withdrawn” scale that includes a heterogeneous mix of behaviors, underscores the importance of using measures that offer precision in the construct being assessed as a potential external correlate of SCT.

Finally, for the first time, we documented an association between SCT symptoms and increased somatic complaints, above and beyond ADHD inattention. This finding is in line with expectations, as somatization is generally conceptualized as falling within the internalizing domain of psychopathology (including on the CBCL). Furthermore, it is possible that SCT – characterized by daydreaming and getting lost in one’s thoughts – is associated with ruminative cognitive processes (Becker, Withrow, et al., 2016), and SCT is clearly associated with negative affect such as depressive and anxiety symptomatology (Becker, Leopold, et al., 2016). Both rumination and negative affect are themselves associated with somatic complaints (Miers, Rieffe, Meerum Terwogt, Cowan, & Linden, 2007; Saps et al., 2009; Vassend, 1989), so it is not surprising that SCT was associated with somatic complaints in the present study. Nevertheless, future studies should evaluate the association between SCT and somatic complaints in more detail, in part by including measures that directly assess rumination and worry. Findings stemming from such studies may be especially informative since there is some evidence that worry reduction interventions may reduce somatic complaints in youth (Brosschot & van der Doef, 2006).

Taken together, findings from the current study suggests that SCT can be distinguished from ADHD inattentive symptoms in early childhood, and that the association between SCT and internalizing adjustment is also present quite early in childhood. This is an important

finding, as it suggests it may be important to assess for SCT when screening or assessing for mental health difficulties in preschool-aged children. In addition, early prevention and intervention efforts may be effective at reducing SCT symptoms and impacting associated correlates such as social withdrawal, and could potentially alter the subsequent course of SCT and associated impairments.

Limitations and Future Directions

Several limitations of the present study should be noted and point to important directions for future research. First, only mother's ratings were considered in this study, and only one time-point was available. There is a clear need for additional studies that evaluate SCT within a multi-source, multi-method, multi-occasion framework. This is especially critical since there is emerging evidence that teachers may be particularly important when assessing for SCT and associated impairments (Burns et al., 2016; Tamm et al., 2016). In addition, there is some evidence that SCT is relatively stable – though increases slightly – from preschool through adolescence (Leopold et al., 2016), and additional studies are needed to evaluate the developmental trajectory of SCT. Such studies should also examine the possible developmental cascades linking SCT, ADHD, and internalizing symptoms. As noted above, it would also be beneficial for studies to increase specificity when examining external correlates of SCT, including constructs related to internalizing symptoms such as rumination and shyness. Findings pertaining to these and other domains would be highly informative in advancing theory related to SCT, and in turn point to key considerations for prevention and intervention efforts. Such efforts seem to be particularly important given the quickly growing body of research linking SCT to a range of adjustment difficulties, which as shown in this study may be present even in early childhood.

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Table 1

Descriptive Statistics and Correlations for Measures

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Sex ^a	–										
2. SCT	.12	–									
3. ADHD-IN	.16*	.64***	–								
4. ADHD-HI	.24**	.43***	.82***	–							
5. CBCL ODD	.13	.39***	.59***	.62***	–						
6. CBCL Aggressive Behavior	.13	.47***	.66***	.67***	.93***	–					
7. CBCL Emotionally Reactive	.08	.49***	.48***	.43***	.70***	.73***	–				
8. CBCL Anxious/Depressed	.09	.44***	.48***	.40***	.64***	.67***	.76***	–			
9. CBCL Somatic Complaints	.06	.37***	.23**	.27***	.37***	.38***	.45***	.40***	–		
10. CBCL Withdrawn	.15*	.49***	.61***	.50***	.64***	.68***	.56***	.63***	.27***	–	
11. CBCL Sleep Problems	.05	.28***	.33***	.33***	.39***	.44***	.53***	.49***	.32***	.35***	–
Mean	–	.33	.48	.49	.25	.18	.26	.11	.15	.27	.24
Standard Deviation	–	.38	.48	.47	.29	.22	.26	.13	.20	.26	.27

Note. SCT=Sluggish Cognitive Tempo; ADHD-IN=Attention-deficit/hyperactivity disorder-inattention; ADHD-HI=attention-deficit/hyperactivity disorder-hyperactivity/impulsivity; CBCL=Child Behavioral Checklist; ODD=Oppositional Defiant Disorder.

^aFor sex, girls=0, boys=1.

*
 $p < .05$,

**
 $p < .01$,

 $p < .001$.

Table 2
Unique Associations (Partial Standardized Regression Coefficients) of SCT and ADHD-IN with Symptom and Impairment Measures

	ADHD-HI		CBCL ODD		CBCL Aggressive Behavior		CBCL Emotionally Reactive		CBCL Anxious/Depressed		CBCL Somatic Complaints		CBCL Withdrawn		CBCL Sleep Problems	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
SCT	-.15 ^{**}	.06	.03 ^{ns}	.10	.08 ^{ns}	.10	.31 [*]	.13	.23 [*]	.11	.39 ^{***}	.11	.17 [†]	.10	.12 ^{ns}	.11
ADHD-IN	.91 ^{***}	.04	.57 ^{***}	.11	.61 ^{***}	.11	.28 [*]	.11	.33 ^{**}	.12	-.02 ^{ns}	.08	.50 ^{***}	.10	.26 ^{**}	.08

Note. SCT=sluggish cognitive tempo; ADHD-IN=attention-deficit/hyperactivity disorder-inattention; HI= hyperactivity/impulsivity; CBCL=Child Behavioral Checklist; ODD=Oppositional Defiant Disorder.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

ns = nonsignificant.