J Psychopathol Behav Assess (2016) 38:433–442
DOI 10.1007/s10862-015-9534-6

Internal and External Validity of Sluggish Cognitive Tempo and ADHD Inattention Dimensions with Teacher Ratings of Nepali Children

Girwan Khadka[1] · **G. Leonard Burns**[2] · **Stephen P. Becker**[3]

Published online: 16 December 2015

Abstract The objective was to evaluate the validity of sluggish cognitive tempo (SCT) and ADHD-inattention (IN) symptoms in children from Nepal. Teachers rated SCT, ADHD-IN, ADHD-hyperactivity/impulsivity (HI), oppositional defiant disorder (ODD), anxiety, depression, academic impairment, social impairment, and peer rejection dimensions in 366 children (50 % girls) in first through sixth grades (M_{age} = 9.35, SD_{age} = 1.96) on two separate occasions separated by 4-weeks. Seven of the eight SCT symptoms and all nine ADHD-IN symptoms showed convergent validity (substantial loadings on their respective factors) and discriminant validity (higher loadings on their respective factor than the alternative factor) at both time-points. Across all three separate analyses (assessment 1, assessment 2, and from assessment 1 to assessment 2), higher SCT scores were associated with *lower* ADHD-HI scores and higher depression, academic impairment, and social impairment scores after controlling for ADHD-IN while higher ADHD-IN scores were associated with higher ADHD-HI, ODD, academic impairment, and peer rejection scores after controlling for SCT. Also, as hypothesized, SCT scores were not related to ODD scores after controlling for ADHD-IN. The study provides the first evidence for the internal and external validity of the SCT dimension relative to the ADHD-IN dimension with teacher ratings of children from Nepal, thereby increasing the validity of the SCT construct beyond North America, Western Europe, South America, and South Korea.

✉ G. Leonard Burns
glburns@wsu.edu

[1] Children's Mercy Hospital, Kansas City, MO, USA

[2] Department of Psychology, Washington State University, Pullman, WA 99164-4820, USA

[3] Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

Keywords Attention-deficit/hyperactivity disorder · Culture · Factor structure · Nepal · Sluggish cognitive tempo · Validity

Sluggish cognitive tempo (SCT) is characterized by inconsistent alertness, slow thinking/slow behavior, drowsiness, and lack of energy (Becker 2013). Although the SCT construct has been of interest for some time (Becker et al. 2014a), only recently have traditional psychometric procedures been used to develop measures of SCT (Barkley 2013; Becker et al. 2015; Lee et al. 2014; McBurnett et al. 2014; Penny et al. 2009). These new measures have led to a series of recent studies on SCT's validity. We summarize these findings to provide the basis for our study.

First, the SCT dimension has *internal validity* relative to the ADHD-IN dimension. That is, studies have identified SCT symptoms that load much more strongly on an SCT factor than the ADHD-IN factor (Barkley 2013; Burns et al. 2013; Lee et al. 2014; McBurnett et al. 2014; Penny et al. 2009; Willcutt et al. 2014). Other findings show SCT to be distinct from anxiety, depression, and daytime sleepiness (Becker et al. 2014b, 2015, 2014b; Lee et al. 2014; Willcutt et al. 2014). Second, these studies support SCT's *external validity*. For instance, ADHD-IN is consistently associated with higher levels of externalizing behaviors, and this association is unchanged when controlling for SCT; in contrast, SCT is unassociated (parent ratings) or negatively associated (teacher ratings) with externalizing behaviors when controlling for ADHD-IN (Bernad et al. 2014, 2015; Lee et al. 2014; McBurnett et al. 2014). Additional evidence is found for SCT's external validity in that higher levels of SCT predict higher levels of anxiety, depression, academic impairment, and social impairment even after controlling for ADHD-IN (Becker 2014; Becker et al. 2014a, 2015; Bernad et al. 2014, 2015; Lee et al. 2015; Servera et al. 2015; Willcutt et al. 2014).

Four short-term longitudinal studies (i.e., 6- to 24-months) also found similar external correlates of SCT relative to ADHD-IN (Becker 2014; Bernad et al. 2014, 2015; Servera et al. 2015).

Thus, even though the findings vary some from study to study, there is an emerging body of evidence for the internal and external validity of SCT symptom dimension relative to the ADHD-IN symptom dimension, indicating that SCT and ADHD-IN represent different attention problems (see Becker et al. under review, for a meta-analytic review). These studies, however, have two significant limitations. First, all the studies but one were conducted in North America (mostly the United States) and Western Europe (mostly Spain). The two exceptions are recent studies conducted with South Korean children (described below) and Chilean children (Belmar et al. 2015). For ratings by mothers and teachers, the Chilean study replicated the findings from the original study in the United States (Lee et al. 2014) with the significant exception being that SCT was no longer related to academic and social impairment after controlling for ADHD-IN (ADHD-IN remained significantly related to academic and social impairment after controlling for SCT). The failure to find SCT uniquely related to academic impairment was a major difference from earlier studies using the same measure of SCT (Bernad et al. 2014, 2015; Burns et al. 2013; Lee et al. 2014; Servera et al. 2015).

The second limitation is that the four studies examining the factor structure of SCT and ADHD-IN symptoms in Spanish children only found a subset of the eight SCT symptoms (i.e., five with mothers and fathers and three with primary and secondary teachers) to show discriminant validity with the ADHD-IN symptoms (Bernad et al. 2014, 2015; Burns et al. 2013; Servera et al. 2015). This outcome appears due to the narrow age range of the children (children restricted to a single grade, either the first or second grade) in the Spanish studies since the Belmar et al. (2015) study in Chile (using the same Spanish translation of the measure as used in the Spain studies) found all eight SCT symptoms to show convergent validity along with discriminant validity with ADHD-IN with a broader age range of children (first to eighth grade). Nevertheless, it remains possible that the differing findings between these studies conducted in Spain and the majority of other SCT studies that have been conducted in North America are due to cross-cultural differences in the presentation of SCT symptoms. Thus, the narrow age range of the studies conducted in Spain as well as the limited number of studies examining the validity of SCT relative to ADHD-IN in cultural contexts outside of North America or Western Europe are weaknesses of the extant SCT validity research.

These two limitations can be addressed with the examination of the validity of the SCT dimension relative to the ADHD-IN dimension in other cultural contexts such as Asia. That is, do the findings with samples of children from Asian countries replicate the original findings from the United States and clarify the findings with the children from Spain? In addition, the evaluation of the validity of SCT within Asian countries allows for a broader evaluation of SCT's validity (i.e., Does SCT represent a transcultural construct or does it reflect a construct more specific to western cultures?). An evaluation of the internal and external validity of SCT in cultures different from the original studies in North America and Western Europe provides a way to begin to answer these questions.

At this time, only one study has examined SCT in a sample of children from an Asian country. With ratings by mothers, fathers, and teachers of children from South Korea (Lee et al. under review), all the SCT symptoms showed internal validity relative to the ADHD-IN symptoms (i.e., SCT symptoms had a substantial loadings on the SCT factor with these loadings being higher than the loadings of the SCT symptoms on the ADHD-IN factor). For all three sources, higher ADHD-IN scores were still associated with higher scores on ADHD-HI and ODD after controlling for SCT while SCT was not related (parents) or showed a negative relationship (teachers) to ADHD-HI and ODD after controlling for ADHD-IN. In addition, for all three sources, higher SCT scores were still associated with higher anxiety and depression scores after controlling for ADHD-IN. Higher levels of SCT, however, only predicted higher levels of academic and social impairment for teachers after controlling for ADHD-IN (i.e., these unique effects were not significant for ratings by mothers and fathers).

Although this study from South Korea provides promising initial evidence for the transcultural validity of SCT, there is tremendous heterogeneity both within and across cultures and additional studies are needed. For instance, in contrast to South Korea, Nepal is strongly influenced by Hinduism and associated cultural norms and practices (e.g., caste system; Kohrt et al. 2009, 2011). The purpose of this study was to evaluate the validity of SCT relative to ADHD-IN with teacher ratings of children from Kathmandu, Nepal. Extending SCT research to a second Asian country is an important next step in examining the validity of the SCT construct, particularly since culture plays an important role in the development and expression of childhood externalizing and internalizing behaviors (López and Guarnaccia 2000). If similar internal and external validity results occur for the SCT dimension relative to the ADHD-IN dimension with children from Nepal, Korea (Lee et al. under review), and the United States (Lee et al. 2014), then such would strengthen the transcultural validity of the SCT construct. Also, if all eight of the SCT symptoms show internal validity relative to the ADHD-IN symptoms with the broader age range of the Nepali children as also occurred with the children from South Korea and the United States, then such would suggest that the weaker internal validity for the Spanish children was probably due to the narrow age range of the Spanish children. We now note the three objectives along with the hypotheses for each objective.

Objectives of Study

Lee et al. (2014) identified eight SCT symptoms with good convergent validity as well as discriminant validity with the ADHD-IN dimension with parent and teacher ratings in children from the United States. These eight SCT symptoms are shown in Table 1. The first objective of the current study was to determine if the eight SCT and nine *Diagnostic and Statistical Manual of Mental Disorders*, *Fifth Edition* (DSM-5) ADHD-IN symptoms have convergent validity (substantial loadings on their respective factors) and discriminant validity (higher loadings on their respective factors than the alternative factors). In other words, for the SCT symptoms to have internal validity relative to the ADHD-IN symptom dimension, the SCT symptoms need to have substantial loadings on the SCT factor (convergent validity) in conjunction with higher loadings on the SCT factor than on the ADHD-IN factor (discriminant validity). It was predicted that the eight SCT and nine ADHD-IN symptoms would demonstrate convergent and discriminant validity at the first assessment and at a second assessment four weeks later for teacher ratings of Nepali children. Replication of the results across the two assessments would increase our confidence in the internal validity of the SCT and ADHD-IN symptoms.

The second objective was to determine the correlations of SCT and ADHD-IN dimensions with the ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection dimensions. It was predicted that higher scores on the SCT and ADHD-IN dimensions would be bivariately associated with higher scores on the ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection dimensions. It was also predicted that ADHD-IN would have a significantly stronger correlation than SCT with ADHD-HI and ODD. In contrast, it was predicted that the correlations of ADHD-IN and SCT with anxiety, depression, academic impairment, social impairment, and peer rejection would not differ significantly. These hypotheses were evaluated within the first and second assessments as well as from the first to second assessment (i.e., SCT and ADHD-IN from the first assessment correlated with the outcomes from the second assessment).

The third objective was to determine the unique relationships of SCT and ADHD-IN dimensions with ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection dimensions (i.e., SCT's relationships with these measures after controlling for ADHD-IN and ADHD-IN's relationships with these measures after controlling for SCT). SCT was expected to show a *negative* relationship with ADHD-HI and ODD (or non-significant negative relationship for ODD) after controlling for ADHD-IN while ADHD-IN was expected to show a *positive* relationship with ADHD-HI and ODD after controlling for SCT. Both SCT and ADHD-IN, however, were expected to show positive unique relationships with anxiety, depression, academic impairment, social impairment, and peer rejection (i.e., higher levels of SCT would be associated with higher levels of anxiety,

Table 1 Sluggish Cognitive Tempo, Anxiety, and Depression Items on Teacher Scale

Sluggish Cognitive Tempo Items

1. Daydreams during classroom activities (e.g., stares off during activities; lost in his or her own thoughts during activities)
2. Alertness changes from moment to moment during classroom activities (e.g., spaces in and out during activities; mind seems to drift off during activities and then return; zones in and out)
3. Absent-minded during classroom activities (e.g., unaware of current activities or events going on in the classroom)
4. Loses train of thought during classroom activities (e.g., suddenly seems to have lost what he or she was about to say or do during activities)
5. Easily confused during classroom activities (e.g., gets confused working on activities; starts activities over again due to confusion)
6. Looks drowsy during classroom activities even when he or she has had a good night's sleep (e.g., seems sleepy, yawns) (NOTE: to the best of your knowledge, drowsiness is NOT due to sleep problems at night)
7. Thinking seems slow during classroom activities (e.g., mind seems sluggish; slow to respond to questions; slow to make decisions or choices)
8. Behavior is slow classroom activities (e.g., moves at a slow pace; last to finish the activity; slow at routine activities)

Anxiety Items

1. Seems anxious about separation from parents (e.g., distressed when separated from parents; worries about parents' safety when separated from parents; worries about getting lost or separated from parents)
2. Seems anxious about many things (e.g., worries about nearly everything; worries about many things such as not being good enough, being teased by others, making mistakes, not doing well in school, being in an accident)
3. Seems anxious about specific objects or situations (e.g., excessively fearful of dogs, insects, storms, getting shots, sight of blood, heights, or enclosed places)
4. Seems anxious about contamination (e.g., anxious about germs or dirt; anxious about getting sick; worries about how clean the classroom, bathroom, or lunchroom is)
5. Seems anxious about being in social situations (e.g., worries about performance in front of others; worries about being embarrassed when doing something in front of others such as talking in front of a group; worries about behavior being observed by peers)
6. Reports feeling physically uncomfortable when there is not an apparent cause (e.g., reports having headaches, stomachaches, feeling sick, feeling tense, nausea, dizziness)

Depression Items

1. Seems sad, unhappy, or depressed or expresses feelings of sadness, unhappiness, or depression (e.g., "I feel so sad")
2. Seems to feel worthless or expresses feelings of worthlessness (e.g., "I am stupid," "I can't do anything right")

3 Seems lonely or expresses feelings of loneliness (e.g., "I don't have any friends," "No one ever wants to play with me")

4. Seems not to enjoy school activities any more (e.g., does not enjoy activities he or she previously thought were fun; says school activities are no longer fun)
5. Seems to feel hopeless about things or expresses feelings of hopelessness (e.g., "I'll never be able to do that," "I could never be as good as other kids")
6. Seems to lack energy necessary to complete tasks or participate in activities (e.g., reports not having energy to do things; seems more fatigued than usual)

depression, academic impairment, social impairment, and peer rejection after controlling for ADHD-IN while higher levels of ADHD-IN would be associated with higher levels of anxiety, depression, academic impairment, social impairment, and peer rejection after controlling for SCT). These outcomes were expected within the first and second assessment as well as from the first to second assessments (i.e., SCT and ADHD-IN from first assessment predicting the outcomes from the second assessment).

The current study represents the first evaluation of the internal and external validity of the SCT dimension relative to the ADHD-IN dimension with teacher ratings of Nepali children. If support occurs for our hypotheses with teacher ratings of Nepali children, then such would replicate the findings with ratings by teachers from South Korea (Lee et al. under review) and the United States (Lee et al. 2014). In addition, we are aware of only one other study to date that has evaluated the structure of ADHD symptoms with Nepali children (i.e., a factor analysis of the Conners Parent and Teacher Rating Scales; Pendergast et al. 2014). Thus, the current study contributes to the literature on SCT as well as the structure of psychopathology more broadly (i.e., ADHD, ODD, anxiety, depression) in Nepali children.

Method

Participants and Procedures

With the approval of the three elementary schools and Washington State University's Department of Psychology (the University IRB ruled the study exempt from IRB review), all of the teachers in three English-speaking elementary schools in Kathmandu, Nepal were invited to participate in the study. Each of the 61 teachers invited to participate in the study volunteered to do so with each teacher compensated US$25 for their participation in the study. Although the teachers and children were Nepali, the language of instruction in the three schools was English (i.e., the teachers were fluent in English and instruction was in English). Each of the 61 teachers completed the measures on six children randomly selected by the researchers from their class lists ($N = 366$ children, $M_{age} = 9.35$, $SD_{age} = 1.96$, 50 % girls, first through six grades). The teachers then completed the measures a second time four weeks later in reference to the same children. Teachers had been interacting with the children for approximately 7 months at the time of the study. Students from the three participating schools come from families that in the context of Nepali society largely fall in the lower-middle class to upper-middle class in terms of socio-economic status.

Appropriateness of the Measures for Nepali Culture

Although the measures were completed in schools whose primary mode of instruction was English (the measures were in English), various steps were taken to ensure the cultural appropriateness of the items. Prior to the administration of the measures, Nepali graduate students from Washington State University and the University of Idaho, two Nepali elementary school teachers from Kathmandu, and the principals of the three elementary schools in Kathmandu reviewed the measures. All these sources viewed the measures as understandable and appropriate for the Nepali school setting. In addition, the first author of the study is Nepali and had taught in one of the three schools prior to obtaining his doctoral degree in clinical psychology, thus further increasingly the likelihood of the cultural appropriateness of the items on the measures.

Measures

Child and Adolescent Disruptive Behavior Inventory (CADBI; Burns et al. 2014). The participants completed the teacher version of the CADBI. The CADBI measures SCT (eight symptoms), ADHD-IN (nine symptoms), ADHD-HI (nine symptoms), ODD toward peers (e.g., argues with peers; eight symptoms), anxiety (six symptoms), depression (six symptoms), academic impairment (four items: completion of homework, reading skills, arithmetic skills, and writing skills), and social impairment (four items: quality of interactions with teacher, quality of interactions with other adults at school, quality of interactions with peers in the classroom, and quality of interactions with peers outside of the classroom at school). The ODD toward adults (e.g., argues with adults) scale was not included because principals and teachers informed us that oppositional-defiant behavior toward teachers was low frequency behavior. The wording of the eight SCT, six anxiety, and six depression symptoms is shown in Table 1. The wording of the ADHD and ODD symptoms was based on *DSM-5* descriptions.

The symptoms were rated on a 6-point frequency of occurrence scale (i.e., almost never [never or about once per month], seldom [about once per week], sometimes [several times per week], often [about once per day], very often [several times per day], and almost always [many times per day]). A 7-point scale was used for the four academic and four social impairment items (severe difficulty, moderate difficulty, slight difficulty, average performance [average interactions] for grade level, slightly above average, moderately above average, and excellent performance [excellent interactions] for grade level). The academic and social impairment items were reversed keyed so higher scores represent higher levels of impairment. Earlier studies provide evidence for the internal consistency, stability, and inter-rater agreement for the scores from the CADBI scales (Belmar et al. 2015; Burns et al. 2013;

Bernad et al. 2014, 2015; Lee et al. 2014; Servera et al. 2015). Table 2 shows the means, standard deviations, reliability coefficients, and 4-week stability correlations (test-retest) for scores for the CADBI scales for the current study.[1]

Dishion Social Acceptance Scale (DSAS; Dishion 1990). The DSAS is a three-item teacher rating scale that assesses a child's social status. Teachers rated the proportion of classmates who "dislike," "like," and "ignore" the target child on a 5-point scale (very few [less than 25 %]; some [25 to 49 %]; about half [50 %]; many [51 to 75 %]; and almost all [greater than 75 %]). The like-item was reversed keyed to create the three-item peer rejection measure. This is a well-validated measure with scores being associated with peer sociometric nominations (Dishion 1990). Table 2 also shows the descriptive statistics along with the reliability and stability coefficients for the scores for the DSAS scale for this study.

Analytic Strategy

The first set of analyses applied an exploratory two-factor model to SCT and ADHD-IN symptom ratings at assessments one and two (these analyses allowed cross-loadings) in order to identify SCT symptoms with substantial loadings on the SCT factor (i.e., convergent validity) and substantially higher loadings on the SCT than the ADHD-IN factor (i.e., discriminant validity). SCT symptoms with convergent validity and discriminant validity with ADHD-IN were used to define the SCT dimension.

The second set of analyses calculated the correlations of the SCT and ADHD-IN dimensions with the ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection dimensions within assessments one and two as well as from assessment one to two (i.e., correlations of SCT and IN from the first assessment with the measures from the second assessment). The third set of analyses determined the unique associations (i.e., partial standardized regression coefficients) of the SCT and ADHD-IN dimensions with ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment and peer rejection dimensions within assessments one and two as well as from assessment one to two (i.e., do SCT and ADHD-IN from assessment one uniquely predict the measures from assessment two?).

The first set of analyses (i.e., the exploratory factor analyses on the SCT and ADHD-IN symptoms) treated the symptom ratings as ordered-categories and used the robust weighted least squares (WLSMV) estimator (Mplus Version 7.3; Muthén and Muthén 2012). Analyses two (correlations) and three (partial standardized regression coefficients) used robust full information maximum likelihood estimator (MLR estimator). The Mplus model constraint procedure was used to determine if the SCT and ADHD-IN correlations with the other measures differed significantly. A two-level multiple regression analysis was used to regress the ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection measures on SCT and ADHD-IN measures. The regression analyses were two-level because students were nested within teachers (i.e., each teacher rated six children). Analyses two and three treated the measures as manifest variables rather than latent variables due to the large number of items relative to sample size (i.e., the manifest variables for analyses two and three were the mean scores on the measures). Covariance coverage was 99 % or higher for the items so there were very few items left blank.

Results

Convergent and Discriminant Validity of SCT and ADHD-IN Symptoms

At assessments one *and* two, seven of the eight SCT symptoms showed good to excellent convergent validity (i.e., loadings from .55 to .96 on the SCT factor, $M = .75$, $SD = .12$) and excellent discriminant validity (i.e., loadings from -.12 to .28 on the ADHD-IN factor, $M = .09$, $SD = .13$). Only the 'alertness changes' SCT symptom at assessment two failed to show good convergent (i.e., loading of .46 at assessment two) and discriminant validity (i.e., loading of .36 on the ADHD-IN factor at assessment two). The SCT construct was therefore defined by the seven SCT symptoms with good convergent and discriminant validity (Table 1 list the eight SCT symptoms). All nine ADHD-IN symptoms showed good to excellent convergent validity (i.e., loadings from .54 to .96 on the ADHD-IN factor, $M = .74$, $SD = .13$) and discriminant validity (i.e., loadings from -.24 to .31 on the SCT factor, $M = .06$, $SD = .15$).

[1] Confirmatory factor analytic procedures were used to calculate the reliability coefficients (i.e., true score variance in each subscale, see Brown, 2015, pp. 305-321) along with the stability coefficient for the scales across the 4-week interval (Brown, 2015, pp. 221-233). The SCT, ADHD-IN, ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection nine-factor model also resulted in a good global fit at assessments one and two (assessment one: χ^2 (1448) = 2088, CFI = .945, TLI = .941, RMSEA = .035 (90 % CI .031, .038); assessment two: χ^2 (1448) = 2006, CFI = .964, TLI = .962, RMSEA = .032 (90 % CI .029, .036). In addition, the item factor loadings were substantial (all > .70 with most > .80) on their respective factors with the exception of three anxiety items at assessment one and four at assessment two (loadings from .32 to .61) and one peer rejection item at assessment two (loading of .63). The factors also showed discriminant validity with each other. Although these results should be considered preliminary due to the large number of items (56 manifest variables) relative to the small number of participants (366 children rated by 61 teachers), these findings do replicate and extend the factor analytic results from the first study with teacher ratings of Nepali children (Pendergast et al. 2014). These results are not reported in greater detail due to the large number of manifest variables relative to sample size. This was also the reason the correlational and regression analyses used manifest rather than latent variables. The CFA findings are available from the second author.

Table 2 Descriptive Information for Measures

Measures	Assessment 1			Assessment 2			Test-Retest Correlations
	M	*SD*	*RC*	*M*	*SD*	*RC*	
Sluggish Cognitive Tempo	1.21	0.98	0.91	1.05	0.86	0.92	0.74
Inattention	1.25	0.97	0.94	1.09	0.85	0.93	0.72
Hyperactivity/Impulsivity	1.10	1.05	0.92	0.98	0.91	0.93	0.68
ODD	1.15	0.93	0.92	1.07	0.93	0.94	0.61
Anxiety	1.32	0.84	0.76	1.16	0.73	0.73	0.53
Depression	0.75	0.81	0.88	0.69	0.69	0.87	0.63
Academic Impairment	2.00	1.36	0.92	2.21	1.49	0.95	0.61
Social Impairment	2.29	1.46	0.91	2.51	1.42	0.91	0.65
Peer Rejection	1.61	0.77	0.67	1.67	0.74	0.66	0.59

There was a 4-week interval for the test-retest correlations. Skewness values ranged from 0.19 to 1.67 ($M = 0.80$, $SD = 0.34$) and kurtosis values from -0.82 to 3.32 ($M = 0.49$, $SD = .91$) for the measures. RC = reliability coefficient (true score variance in the measure); ODD = oppositional defiant disorder

SCT and ADHD-IN Correlations with Symptom and Impairment Dimensions Within and Across Assessments

Table 3 shows the within and across assessments correlations of SCT and ADHD-IN with ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection. Higher scores on SCT and ADHD-IN were significantly ($ps < .01$) associated with higher scores on ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection at assessments one and two as well as from assessment one to two. In addition, as predicted, ADHD-IN was more strongly ($ps < .05$) correlated than SCT with ADHD-HI and ODD at assessments one and two as well as from assessment one to two with one exception; ADHD-IN did not show a significantly ($p > .05$) stronger correlation than SCT with ODD across the 4-week interval. As also predicted, SCT and ADHD-IN correlations did not differ significantly ($ps > .05$) with anxiety, depression, academic impairment, social impairment, and peer rejection within and across the assessments with two exceptions. At assessment one, ADHD-IN had a stronger ($p = .03$) correlation than SCT with peer rejection while at assessment two, SCT had a stronger ($p = .001$) correlation than ADHD-IN with social impairment.

Unique Relationships of SCT and ADHD-IN with Symptom and Impairment Dimensions Within and Across Assessments

Table 4 shows the within and across assessments unique relationships (standardized partial regression coefficients) of SCT and ADHD-IN with the symptom and impairment dimensions.

Within Assessment Unique Relationships

Within assessments one and two, higher levels of SCT predicted significantly ($p < .001$) *lower* levels of ADHD-HI and significantly ($ps < .05$) *higher* levels of anxiety, depression, academic impairment, social impairment, and peer rejection (assessment two only) even after controlling for ADHD-IN. SCT was no longer significantly ($ps > .05$) related to ODD (as predicted) or peer rejection (assessment one only) after controlling for ADHD-IN. Higher levels of ADHD-IN predicted significantly ($ps < .05$) higher levels of ADHD-HI, ODD, depression (assessment one only), academic impairment, and peer rejection after controlling for SCT. ADHD-IN was not uniquely related to anxiety, depression (assessment two only), or social impairment.

Across Assessments Unique Relationships

From assessment one to assessment two, higher levels of SCT at assessment one predicted significantly ($p < .05$) *lower* levels of ADHD-HI and significantly ($ps < .05$) *higher* levels of depression, academic impairment, and social impairment at assessment two even after controlling for ADHD-IN at assessment one. SCT at assessment one was not uniquely related to ODD (as predicted), anxiety, or peer rejection at assessment two. Higher levels of ADHD-IN at assessment one predicted significantly ($ps < .05$) higher levels ADHD-HI, ODD, academic impairment and peer rejection at assessment two after controlling for SCT at assessment one. ADHD-IN at assessment one was not uniquely ($ps > .05$) related to anxiety, depression, or social impairment at assessment two.

Table 3 Pearson Correlations of Sluggish Cognitive Tempo and ADHD-IN with ADHD-HI, ODD, Anxiety, Depression, Academic Impairment, Social Impairment and Peer Rejection Within and Across Assessments

	HI		ODD		Anxiety		Depression		Academic Impairment		Social Impairment		Peer Rejection	
	r	*SE*	*r*	*SE*	*r*	*SE*	*r*	*SE*	*r*	*SE*	*r*	*SE*	*r*	*SE*
Assessment 1 Correlations														
SCT	0.40**	0.06	0.39**	0.06	0.37**	0.06	0.58**	0.06	0.63**	0.05	0.40**	0.07	0.39**	0.06
IN	0.61**	0.04	0.55**	0.05	0.37**	0.06	0.62**	0.05	0.67**	0.04	0.37**	0.06	0.47**	0.05
Assessment 2 Correlations														
SCT	0.46**	0.05	0.43**	0.05	0.39**	0.08	0.57**	0.06	0.60**	0.06	0.38**	0.06	0.50**	0.05
IN	0.65**	0.04	0.60**	0.04	0.39**	0.08	0.49**	0.06	0.62**	0.06	0.23**	0.06	0.49**	0.06
Assessment 1 to Assessment 2 Correlations														
SCT	0.28**	0.05	0.28**	0.06	0.22*	0.07	0.40**	0.07	0.50**	0.05	0.30**	0.05	0.36**	0.06
IN	0.38**	0.05	0.32**	0.06	0.24*	0.07	0.34**	0.07	0.49**	0.06	0.24**	0.05	0.38**	0.08

SCT sluggish cognitive tempo; *IN* inattention; *HI* hyperactivity/impulsivity; *ODD* oppositional defiant disorder

*$p < .002$. **$p < .001$

Unique Relationships of SCT with other Measures Controlling for ADHD-IN, Sex, and Age

All the regression analyses were repeated controlling also for sex and age (i.e., the measures were regressed on SCT, ADHD-IN, sex, and age). All the significant and non-significant unique relationships for SCT and ADHD-IN remained the same after also controlling for sex and age.[2]

Discussion

Although the last few years has witnessed an increasing number of studies examining the validity of the SCT construct (Becker et al. 2014c), all of these studies with the exception of one study in Chile (Belmar et al. 2015) and South Korea (Lee et al. under review) used samples of children and adults from North America and Western Europe (e.g., Barkley 2013; Bernad et al. 2014, 2015; Becker and Langberg 2013; Becker et al. 2014b, 2015; Belmar et al. 2015; Burns et al. 2013; Fenollar Cortés et al. 2014; Jacobson et al. 2012; Langberg et al. 2014; Lee et al. 2014; McBurnett et al. 2014; Penny et al. 2009; Servera et al. 2015; Willcutt et al. 2014). In addition, probably due to the restriction of the children to a narrow age range (a single grade), studies examining the internal validity of SCT among children in Spain only found a subset of the eight SCT symptoms to demonstrate internal validity relative to the ADHD-IN dimension (Bernad et al. 2014; Bernad et al. 2015; Burns et al. 2013; Servera et al. 2015). It was thus important to further evaluate the construct validity of SCT symptom dimension relative to ADHD-IN symptom dimension outside of North America and Western Europe. It was also important to determine if the original findings on the validity of the eight SCT symptoms with the United States sample in the Lee et al. (2014) study could be replicated with teacher ratings of a broad age range of children – an age range similar to the original factor analytic study of the CABDI SCT measure conducted by Lee et al. (2014). Our study sought to address these issues with teacher ratings of Nepali elementary school children.

Internal Validity of the SCT and ADHD-IN Symptoms

Seven of the eight SCT symptoms showed good to excellent convergent validity (high loadings on the SCT factor) and discriminant validity (higher loadings on the SCT factor than the ADHD-IN factor) at the first and second assessments. Only the SCT symptom "alertness changes" (see Table 1) failed to show convergent and discriminant and this was only at assessment two. It was encouraging that seven of the eight SCT symptoms showed internal validity relative to the ADHD-IN dimension over the two assessments within such a different cultural context than the original Lee et al. (2014) study with the current results also replicating the findings with ratings by mothers, fathers, and teachers with a sample of children from South Korea (Lee et al. under review). It was also encouraging that all nine of the ADHD-IN symptoms showed internal validity with SCT. This is the first study to

[2] Neither SCT nor ADHD-IN was significantly correlated with age (assessment one: $r_{SCT} = .06$, $SE_{SCT} = .05$, *ns*; $r_{ADHD\text{-}IN} = .05$, $SE_{ADHD\text{-}IN} = .07$, *ns*; assessment two: $r_{SCT} = .13$, $SE_{SCT} = .07$, *ns*; $r_{ADHD\text{-}IN} = .10$, $SE_{ADHD\text{-}IN} = .09$, *ns*). Boys had significantly higher ADHD-IN scores than girls at both assessments (assessment one: $r = .18$, $SE = .05$, $p < .001$; assessment two: $r = .10$, $SE = .05$, $p < .05$). In contrast, boys had significantly higher SCT scores than girls only at assessment one (assessment one: $r = .12$, $SE = .04$, $p < .05$; assessment two: $r = .06$, $SE = .04$, *ns*).

Table 4 Unique Association of SCT (Controlling for ADHD-IN) and ADHD-IN (Controlling for SCT) with ADHD-HI, ODD, Anxiety, Depression, Academic Impairment, Social Impairment, and Peer Rejection

	ADHD-HI		ODD		Anxiety		Depression		Academic Impairment		Social Impairment		Peer Rejection	
	SE	β	*SE*	β	*SE*	β	*SE*	β	*SE*	β	*SE*	β	*SE*	β
Assessment 1 Partial Standardized Regression Coefficients														
SCT	-0.34^{**}	0.08	-0.19^{ns}	0.11	0.34^{*}	0.13	0.35^{**}	0.08	0.35^{**}	0.08	0.42^{**}	0.09	0.02^{ns}	0.09
IN	0.90^{**}	0.06	0.71^{**}	0.10	0.06^{ns}	0.13	0.39^{**}	0.09	0.49^{**}	0.07	0.17^{ns}	0.09	0.53^{**}	0.08
Assessment 2 Partial Standardized Regression Coefficients														
SCT	-0.16^{*}	0.08	-0.14^{ns}	0.12	0.31^{*}	0.16	0.61^{**}	0.10	0.39^{**}	0.10	0.56^{**}	0.11	0.28^{*}	0.10
IN	0.75^{**}	0.07	0.70^{**}	0.09	0.21^{ns}	0.12	0.04^{ns}	0.11	0.45^{**}	0.10	-0.09^{ns}	0.09	0.32^{**}	0.09
Assessment 1 to Assessment 2 Partial Standardized Regression Coefficients														
SCT	-0.23^{*}	0.10	-0.08^{ns}	0.13	0.12^{ns}	0.12	0.40^{**}	0.08	0.38^{**}	0.09	0.36^{**}	0.10	0.16^{ns}	0.10
IN	0.50^{**}	0.11	0.37^{*}	0.11	0.21^{ns}	0.11	0.10^{ns}	0.08	0.25^{*}	0.04	0.01^{ns}	0.10	0.31^{*}	0.10

SCT sluggish cognitive tempo; *IN* inattention; *ADHD-HI* hyperactivity/impulsivity; *ODD* oppositional defiant disorder

$^{*}p < .05$. $^{**}p < .001$

demonstrate the internal validity of the SCT symptoms relative to the ADHD-IN symptoms with Nepali children and only the second study to our knowledge to evaluate the structure of ADHD symptoms with teacher ratings of Nepali children (Pendergast et al. 2014, see also our footnote 1). Although additional research needs to occur, these findings suggest that the eight SCT symptoms and examples shown in Table 1 may approximate the core features of the SCT construct as evidenced across differing contexts (see also Lee et al. under review).

Correlations of SCT and ADHD-IN with Symptom and Impairment Dimensions Within- and Across-Assessments

Within assessments one and two as well as across the 4-week interval, higher scores on SCT and ADHD-IN were correlated with higher scores on ADHD-HI, ODD, anxiety, depression, academic impairment, social impairment, and peer rejection. In addition, as predicted from prior research, SCT showed a significantly smaller correlation than ADHD-IN with ADHD-HI and ODD with one exception (SCT's relationship with ODD across the 4-week interval was not significantly smaller than for ADHD-IN with ODD across the interval). Also, as predicted, SCT and ADHD-IN correlations with anxiety, depression, academic impairment, social impairment, and peer rejection did not differ significantly with only two exceptions (at assessment one ADHD-IN had a significantly stronger correlation than SCT with peer rejection and at assessment two SCT had a significantly stronger correlation than ADHD-IN with social impairment). These findings further establish SCT's weaker correlation than ADHD-IN with externalizing problems and also further establish SCT and ADHD-IN approximately equal correlations with internalizing problems, academic impairment, social impairment, and peer rejection–findings that are consistent with several previous studies (Becker and Langberg 2013; Becker et al. 2014c; Bernad et al. 2014, 2015; Burns et al. 2013; Lee et al. 2014; Penny et al. 2009; Willcutt et al. 2014; see Becker et al. under review, for a review). However, a more important question concerns SCT's association with symptom and impairment dimensions after controlling for ADHD-IN's relationships with these symptom and impairment dimensions. If SCT was not associated with other symptom and impairment dimensions, especially impairment dimensions, after controlling for its overlap with ADHD-IN, then such would call into question the utility of the SCT construct.

Unique Relationships of SCT and ADHD-IN with Symptom and Impairment Dimensions Within and Across Assessments

With regression analyses at assessments one and two as well as a regression analysis across the 4-week interval, it was possible to identify the unique external correlates of the SCT and ADHD-IN dimensions that occurred in all three analyses (i.e., the same effect occurred three separate times, thus indicating a robust unique effect). SCT showed a significant negative relationship with ADHD-HI along with a non-significant negative relationship with ODD after controlling for ADHD-IN while ADHD-IN still showed a significant positive relationship with ADHD-HI and ODD even after controlling for SCT. Thus, when the overlap between SCT and ADHD-IN is taken into account, SCT no longer showed a positive relationship with externalizing behaviors (became either significantly negative or non-significantly negative from a significant

positive first order correlations) while ADHD-IN continued to show a positive relationship with externalizing behaviors. These findings are consistent with a growing body of research conducted in other cultural contexts (Becker et al. 2014c; Belmar et al. 2015; Bernad et al. 2014, 2015; McBurnett et al. 2014; Lee et al. 2014; Penny et al. 2009; Servera et al. 2015). In addition, and also consistent with previous research in other cultural settings (Becker et al. 2014a, 2015; Belmar et al. 2015; Bernad et al. 2014, 2015; Langberg et al. 2014; McBurnett et al. 2014; Penny et al. 2009; Servera et al. 2015), higher scores on the SCT dimension predicted higher scores on the depression, academic impairment, and social impairment dimensions even after controlling for ADHD-IN at all three assessments. Since some previous studies have not found SCT to remain associated with academic impairment when controlling for ADHD-IN (e.g., Becker and Langberg 2013; Belmar et al. 2015; Watabe et al. 2014), the significant unique association of SCT with academic impairment in the current study is especially important to note. In addition, higher scores on the ADHD-IN dimension predicted higher scores on academic impairment and peer rejection dimensions even after controlling for SCT at all three assessments. The teacher ratings thus suggest that SCT has a stronger unique relationship with global social impairment while ADHD-IN has a stronger unique relationship with peer rejection. Although there is some indication in the literature that SCT is more closely related to social withdrawal whereas ADHD is more closely related to peer rejection (e.g., Carlson and Mann 2002; Marshall et al. 2014; Willcutt et al. 2014), the differential findings in the current study need to be followed-up in studies that include a broader range of social impairment measures in order to understand better the social difficulties unique to SCT relative to ADHD-IN.

Study Limitations

Findings from this study should be considered in light of several limitations. First, we were unable to collect parent of child self-report ratings and thus the findings reported herein are restricted to teacher ratings. In addition, at this time the results should be considered specific to English-speaking elementary schools in Nepal—although the findings with teacher ratings from Pendergast et al. (2014) suggest similar results might have occurred in Nepali-speaking schools. Also our use of a single method, rating scales, is a limitation. Relatedly, it would be helpful for future research to include more fine-grained measures of functioning and impairment (e.g., social withdrawal, school grades) as well as general clinical samples. Finally, although we included two assessment points, the span between time-points was short (4 weeks), and there is a clear need for additional longitudinal research examining the developmental progression and consequences of SCT.

Conclusion

This is the first study to evaluate the internal and external validity of the SCT dimension relative to the ADHD-IN dimension with teacher ratings of Nepali children. The findings with teacher ratings in the current study replicated and extended the findings from the original study in the United States with these eight SCT symptoms (Lee et al. 2014) as well as the results with teacher ratings of Korean children (Lee et al. under review). It was encouraging to find such similar results across such different cultural settings. These findings also further increase the validity of the SCT construct and also provide additional support for the clinical importance of the SCT symptom dimension (see also Becker et al. 2014c). Additional research is needed to examine the SCT in other cultural contexts and its longitudinal impact on a range of functioning and impairment domains.

Compliance with Ethical Standards

Conflict of Interest Girwan Khadka, G. Leonard Burns, and Stephen P. Becker declare that they have no conflict of interest.

Experiment Participants The current study was conducted with the informed consent of all participants. Washington State University's Department of Psychology (the University IRB ruled the study exempt from IRB review) approved the study's protocol along with the three elementary schools.

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