



# Sluggish cognitive tempo in children referred to a pediatric Sleep Disorders Center: Examining possible overlap with sleep problems and associations with impairment



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## ABSTRACT

Research supports the distinctness of sluggish cognitive tempo (SCT) (e.g., mental confusion and slowed behavior/thinking) from other psychopathologies. However, the relation between SCT and sleep functioning has not been adequately studied. We examined the association between SCT and sleep functioning in 325 children (62% male) ages 6–10 years referred to a pulmonary-based, accredited Sleep Disorders Center. Correlations between caregiver ratings of SCT, other psychopathologies (i.e., inattention/hyperactivity, oppositionality, depression, anxiety), sleep functioning (both behavioral and organic symptoms), as well as sleep disorder diagnoses, were examined. Unique effects of SCT and other psychopathologies on sleep problem severity controlling for child demographics were assessed using regressions. Regression analyses were also conducted to examine the unique effects of SCT on impairment (i.e., academic difficulties, parenting stress, and other psychopathologies) controlling for child demographics, sleep problem severity, and other psychopathology symptoms. SCT was weakly to moderately correlated with most measures of sleep ( $r_s = .07-.39$ ) and moderately to strongly correlated with measures of daytime sleepiness ( $r_s = .33$  and  $.53$ ). In the regression analyses, SCT was uniquely associated with greater sleep functioning severity and impairment in academic functioning. SCT was also uniquely associated with higher levels of depression and inattention/hyperactivity, but not anxiety, and negatively associated with oppositionality. Finally, SCT symptoms were uniquely associated with greater parent-child dysfunctional interaction. Findings demonstrate that SCT is related to, but not redundant with, sleep problems and daytime sleepiness specifically. Further, SCT remained associated with several domains of functional impairment in sleep-disordered children after controlling for clinically-relevant variables, highlighting the potential value in assessing SCT symptoms in children with sleep problems.

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## 1. Introduction

There is increasing interest in understanding sluggish cognitive tempo (SCT), a behavioral construct characterized by excessive daydreaming, mental confusion or seeming to be “in a fog,” and slowed behavior or thinking (Barkley, 2014; Becker et al., 2014c).

SCT was initially examined within the context of attention-deficit/hyperactivity disorder (ADHD) (Carlson and Mann, 2002; Milich et al., 2001). However, recent studies have shown SCT to be statistically distinct from ADHD, as well as other psychopathologies such as depression and anxiety (Becker et al., 2016). These studies also demonstrate that SCT is uniquely associated with a range of adverse outcomes, including academic problems, peer difficulties, loneliness, and emotion dysregulation (Becker et al., 2016). Thus, there is growing support for the distinctiveness of SCT from other psychopathologies that indicates SCT is an important dimension for understanding youth adjustment (Becker and Barkley, in press).

Understanding the relation between SCT and sleep is of

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particular relevance given that some investigators have questioned whether SCT is merely a proxy for sleep problems, and daytime sleepiness in particular. For instance, Willoughby et al. (2008) observed that “many of the items that are used to define SCT ... are synonyms for the behavioral indicators of daytime sleepiness” (p. 1092), and Cortese et al. (2009) noted a similar apparent overlap. However, only five studies have directly examined the association between SCT and sleep, three of which were conducted in adult samples. Two studies conducted with college students with and without ADHD demonstrated that SCT was statistically distinct from, but also strongly associated with, daytime sleepiness ( $r_s = .40-.51$ ) (Becker et al., 2014b; Langberg et al., 2014b), and SCT was also significantly associated with poorer nighttime sleep quality and sleep disturbances (e.g., night wakings). The third study found that adults with insomnia or probable ADHD had higher rates of SCT symptoms in comparison to other adults (Voinescu et al., 2012). These adult-focused studies provided initial empirical support for an association between SCT and sleep.

Only two studies have examined SCT and sleep in children. In a sample of 746 children referred for neuropsychological assessment, Koriakin et al. (2015) found that parent ratings of their child's sleep problems (i.e., difficulty falling asleep, difficulty waking, restless sleep) were significantly correlated with parent-rated SCT symptoms. However, the magnitude of the correlations was modest ( $r_s = .12-.24$ ), and only difficulty waking remained significantly associated with greater SCT symptoms when controlling for ADHD and internalizing symptoms (Koriakin et al., 2015). Similarly, Becker et al. (2015c) found that SCT was only modestly associated with sleep functioning in a sample of 147 children diagnosed with ADHD Predominantly Inattentive Type.

Although these two child studies demonstrated modest associations between SCT and sleep (Becker et al., 2015c; Koriakin et al., 2015), several methodological considerations should be noted. First, both studies relied on single-item, non-validated measures of sleep. It is thus difficult to compare results across studies, and the degree to which SCT is associated with validated measures of children's sleep remains unknown. Second, neither study included a measure of daytime sleepiness. Daytime sleepiness specifically has been hypothesized to be redundant with SCT (Willoughby et al., 2008), and empirical research with adults indicates that SCT is more strongly associated with daytime sleepiness as compared to other domains of sleep (Becker et al., 2014b). There is a clear need for studies that examine the relation between SCT and daytime sleepiness in pediatric samples, particularly since separate lines of research have shown both SCT (Becker et al., 2016; Bernad et al., 2015; Langberg et al., 2014a; Lee et al., 2015; Willcutt et al., 2014) and daytime sleepiness (Bruni et al., 2006; Dewald et al., 2010; Langberg et al., 2013, 2014c; Meijer, 2008) to be associated with poorer academic functioning. Finally, the Becker et al. (2015c) study included only children with ADHD, and examining SCT in non-ADHD clinical samples has been identified as a research priority (Barkley, 2014; Becker, 2013; Becker et al., 2016).

The current study adds to the preliminary research examining the association between SCT and sleep and addresses several limitations of previous studies conducted with children. Specifically, we examined the association between SCT and sleep in a large sample of children referred to a pulmonary-based, accredited Sleep Disorders Center (SDC). Thus, while the types of sleep difficulties leading to referral were wide-ranging, all children were experiencing some degree of sleep disruption and were seen by a clinician with expertise in behavioral sleep medicine. Validated parent-report measures of sleep were collected as part of routine clinical care, and thus allowed for examination of SCT in relation to behavioral and organic sleep disorder symptoms, including daytime sleepiness. Associations between SCT and sleep disorder

diagnoses were also examined. The magnitude of correlations was examined to evaluate (1) sleep domains most strongly associated with SCT, and (2) whether any association was so strong ( $r > .85$ ) (Brown, 2015; Little, 2013) to suggest that SCT and sleep may be redundant constructs. Finally, since studies have found both SCT and sleep to be associated with functional impairment (Barkley, 2014; Becker et al., 2015a, 2016; Beebe, 2011; Gregory and Sadeh, 2015; Kirov and Brand, 2014), we examined whether SCT would be associated with impairment in academic, social, and mental health domains after controlling for demographics, psychopathology symptoms (i.e., ADHD, oppositionality, depression, anxiety) as well as both behavioral and organic sleep problem severity. This provides a stringent test of whether SCT is associated with impairment in sleep-disordered children, thus making an important contribution to the extant literature by examining SCT in relation to impairment in a non-ADHD clinical sample. Based on previous research (Becker et al., 2016), we hypothesized that SCT would remain associated with poorer academic functioning, greater ADHD and internalizing symptom severity, and less oppositionality after controlling for demographics, sleep problem severity, and other psychopathology symptoms. Although previous research has found an association between SCT and interpersonal problems, these studies have focused on general social problems or peer problems specifically (Bauermeister et al., 2012; Becker, 2014; Khadka et al., 2015; Willcutt et al., 2014); we extend the available interpersonal functioning research by examining SCT in relation to the parent–child relationship and parenting stress. Since SCT is linked to social problems and peer difficulties, we hypothesized that SCT would be associated with difficulties in the parent–child relationship. However, given the established link between oppositionality and parenting stress (Reitman et al., 2002) we expected oppositional symptoms to be more consistently and strongly associated than SCT symptoms with parenting stress.

## 2. Material and methods

### 2.1. Participants

The sample included 325 youth (202 boys, 123 girls) ages 6–10 years ( $M = 7.93$ ,  $SD = 1.40$ ) and their caregiver(s). The majority of children were non-Hispanic White (79%), with remaining participants Black (11%), Hispanic (2%), Asian/Asian American (2%), or Multiracial/Other (6%). Based on parent-report, the majority of participants ( $n = 234$ , 72%) had been previously diagnosed with a mental health disorder, including ADHD ( $n = 159$ , 49%), anxiety ( $n = 94$ , 29%), oppositional defiant disorder ( $n = 37$ , 11%), autism spectrum disorder ( $n = 25$ , 8%), depression ( $n = 15$ , 5%), and/or bipolar disorder ( $n = 10$ , 3%). In terms of parents' marital status, 60% were married, 19% were unmarried, 12% were divorced, 5% were separated, 3% were remarried, and 1% were widowed. Annual family income was spread across four categories: 26% reported annual income <\$20,000, 27% reported annual income of \$20,000–49,000, 25% reported annual income of \$50,000–99,000, and 22% reported an annual income >\$100,000.

Sleep diagnoses were given according to *International Classification of Sleep Disorders Diagnostic and Coding Manual, 2nd Edition* (ICSD-2) (American Academy of Sleep Medicine, 2005) criteria. Primary diagnoses were as follows: 213 participants (66%) were diagnosed with a behavioral insomnia of childhood (67 with sleep-onset association type, 70 with limit-setting type, and 76 with combined type), 83 participants (26%) were diagnosed with psychophysiological insomnia, 14 participants (4%) were diagnosed with a parasomnia, 7 participants (2%) were diagnosed with delayed sleep phase syndrome (DSPS), 4 participants (1%) were diagnosed with hypersomnia, 2 participants (.6%) were diagnosed

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