

PEDIATRIC SLEEP AND PSYCHOPATHOLOGY: THE DAILY, SEQUENTIAL
RELATIONSHIP BETWEEN SLEEP AND EMOTIONAL/BEHAVIORAL
FUNCTIONING IN YOUTH

by

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Sleep problems are prevalent in youth with behavioral and emotional problems which is concerning considering the associated negative consequences found in nonclinical populations, including a decline in behavioral and emotional functioning. Despite research suggesting a dynamic relationship between sleep, mood, and behavior in nonclinical youth, there has been relatively little examination of these relationships, particularly at the daily level, in clinical samples. Thus, the primary aim of the present study was to examine the daily, sequential relationship between sleep and psychopathology in a clinical sample of youth.

Youth aged 6 to 11 (36% female, 44% European American) presenting to outpatient behavioral health treatment ($N = 25$) were recruited to participate in the study. Baseline measures of sleep and emotional and behavioral functioning were collected. Additionally, children and parents completed daily questionnaires regarding the child's sleep, mood, and behavior for a 14 day period while youth wore an actigraph watch to objectively measure sleep.

Multilevel models were estimated to deconstruct the between and within person variance in the relationship between sleep and mental health. Overall, results indicate that these youth had poor sleep duration and quality and that sleep and psychopathology

were highly related at baseline and at the daily-level. Between-person effects were found to be most important and significant sequential relationships between average daily mental health and sleep were found. Further, baseline moderators of this relationship were explored.

Results indicate that identifying and addressing sleep problems in the context of mental health treatment is important as sleep is associated with worse psychopathology and may contribute to exacerbated mental health symptoms. Beyond treatment implications, results provide a stepping stone for future research to examine mechanisms and intervention strategies for this relationship.

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DISCLOSURES

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TABLE OF CONTENTS

Chapter 1: Introduction	1
Chapter 2: Primary Purpose and Research Hypotheses	18
Chapter 3: Method	23
Chapter 4: Analytic Rationale	32
Chapter 5: Results	34
Chapter 6: Discussion	87
Chapter 7: References	108
Table 1. Descriptive statistics on sample demographics	118
Table 2. Descriptive statistics for baseline and daily-level sleep variables	119
Table 3. Descriptive statistics for baseline and daily-level emotion/behavior variables	120
Table 4. Bivariate correlations of baseline sleep and psychopathology symptoms	122
Table 5. Bivariate correlations of daily-level sleep and psychopathology symptoms ...	123
Table 6. Examination of alternative covariance structures	124
Tables 7-17. Parameter estimates for final unconditional models	129-139
Figure 1. Conceptual model of the relationship between poor sleep and emotional and behavioral functioning	140

CHAPTER 1: INTRODUCTION

Sleep problems are highly prevalent in youth with behavioral and emotional problems, with research suggesting poor sleep may be up to six times more common in youth clinical populations compared to community samples (Reigstad, Jorgensen, Sund, & Windstrom, 2010). Poor sleep is characteristic of many youth mental health problems, including anxiety (Alfano, Ginsberg, & Kingery, 2007), depression (Chorney, Detweiler, Morris, & Kuhn, 2008), ADHD (Cortese, Faraone, Konofal, & Lecendreux, 2009), and conduct problems (Chevrin, Dillon, Hedger Archbold, & Ruzicka, 2003). Inadequate sleep in these populations is particularly alarming considering the growing evidence that poor sleep can compromise mental and physical functioning (Buckhalt, El-Sheikh, & Keller, 2007; Smaldone, Honig, & Byrne, 2007), creating the possibility of a “vicious cycle” in which sleep problems could exacerbate existing disruptions for at-risk youth with significant psychopathology. However, limited research has focused on how sleep and mental health symptoms interact in youth with psychopathology, and the few studies in this area have important limitations (Gregory & Sadeh, 2012). Research aimed at better understanding this complex interplay is a critical need and has the potential to have a substantial impact on youth mental health services.

Research has consistently found that sleep is fundamental to nearly every aspect of optimal functioning in youth (Beebe, 2011). In regards to cognition, there has been a breadth of literature examining the detrimental impact of poor sleep. Overall, research suggests that poor sleep specifically targets higher-level cognitive skills (i.e., executive functions; Beebe, 2011) that are essential in youth learning and memory. Relatedly, studies have found that insufficient sleep is related to inattention, poor judgment and

decision making skills, and a lack of motivation (Owens, 2014). Additionally, sleep plays a critical role in youth physical health. For example, researchers found that there was an 80% increase in the odds of being obese for each hour of sleep lost in a sample of adolescents (Gupta, Mueller, Chan, & Meininger, 2002). Finally, poor sleep has also been related to several negative behavioral outcomes. Insufficient sleep in youth has been associated with increased risk taking behaviors such as alcohol and drug use in addition to a likely increased risk for motor vehicle accidents in adolescents (Owens, 2014). In sum, sleep plays an important role in health, development, cognition, and behavior making it an important construct to consider in youth (Beebe, 2011; Byars et al., 2012; Owens, 2014).

Considering the negative consequences of poor sleep, the high prevalence rates of sleep problems in children is alarming, with estimates for inadequate sleep and/or sleep problems ranging from 10 to 40 percent in normally developing, nonclinical youth (Byars et al., 2012; Owens & Mindell, 2011). Further, sleep problems are highly prevalent in youth with poor emotional, behavioral, and psychological functioning (Reigstad et al., 2010). Inadequate sleep in these already at-risk populations is particularly concerning considering the multitude of negative consequences associated with poor sleep quality and/or duration.

Perhaps most relevant to youth presenting to mental health treatment is the relationship between sleep problems and mood that has been found in nonclinical populations. For example, in a cross-sectional examination of a large sample of youth from the general population, emotional, conduct, and hyperactivity symptoms were significantly predictive of time in bed and insufficient sleep (Fosse, Pallesen, Hysing, &

Morten Stormark, 2011). Further, in a study examining a community sample of children longitudinally from ages 8 to 13 years, there was a reciprocal relationship between sleep and internalizing and externalizing symptoms. More specifically, results indicated that reduced sleep duration and quality predicted greater symptoms and that (to a lesser extent) adjustment predicted changes in sleep (Kelly & El-Sheikh, 2013). Finally, a consistent relationship between sleep and emotional functioning has been found in healthy youth when using an experimental design and objective measurements (Vriend et al., 2013). When sleep was experimentally manipulated (i.e., 1-hour sleep extension versus 1-hour sleep restriction) and objectively measured with actigraphy, youth demonstrated decreased positive affect, poor emotion regulation, and worse attention when experiencing only a modest decrease in sleep duration. Clinical populations of youth may be particularly vulnerable to the disruptions associated with sleep loss as they have a higher incidence of emotional and behavioral symptoms and may lack appropriate coping skills for effectively dealing with insufficient sleep. Therefore, this relationship found in nonclinical populations may be augmented in youth already demonstrating disrupted emotional, behavior, or psychological functioning.

Theoretical Context

In examining the relationship between sleep and psychopathology in youth with emotional and/or behavioral problems, the biopsychosocial model provides a useful theoretical context. This model posits that biological, psychological, and social factors dynamically interact to influence mental and physical health outcomes, allowing researchers and clinicians to use a multilevel, multisystem approach to normal and abnormal functioning (Engel, 1977; Suls & Rothman, 2004). The model's multifaceted

approach is well-suited for the study of pediatric sleep and its reciprocal relationship with psychopathology as it views these constructs not as separate but as having shared effects. Previous research focused on sleep, psychopathology, and their relationship highlight how these processes develop within the biopsychosocial model. For example, sleep and psychopathology share important biological mechanisms (e.g., neurotransmitter systems – see below; Harvey, Murray, Chandler, & Adriane, 2011), suggesting a disruption caused by dysfunction in one domain is likely to trigger problems within the other, supporting a reciprocal relationship between mental and physical health and behaviors. Relatedly, as will be discussed in further detail below, significant research has found disruptions in sleep to be commonly associated with psychological functioning, either as a precursor (Roberts, Roberts, & Duong, 2008) or consequence of clinical mental health symptoms (Dahl & Harvey, 2007) indicating a close relationship between these factors. Additionally, neither sleep nor psychopathology can be examined without regard to family, peer, and cultural influences. For example, socioeconomic status, parent characteristics and parenting styles, and cultural factors have all been found to be related to sleep and mental health in youth (Boergers & Koinis-Mitchell, 2010; El-Sheikh et al., 2013; El-Sheikh, Kelly, Buckhalt, & Hinnant, 2010; Repetti, Taylor, & Seeman, 2002; Riley et al., 2009; Sadeh, Tikotzky, & Scher, 2010; Samaan, 2000; Sheridan et al., 2013; Short et al., 2011; Smaldone et al., 2007). It is likely that these social influences attenuate or exacerbate the relationship between sleep and psychopathology. As is evident, previous research has established biological, psychological, and social factors to be closely involved with both sleep and psychopathology and to likely play a part in the mechanisms facilitating the relationship between these two variables. Overall, when

examining the relationship between sleep and psychopathology in youth, it is important to consider all contributing factors (i.e., biological, psychological, social) and how interactions within and between these levels may influence this dynamic relationship making the biopsychosocial model an ideal context for this study.

Sleep and Psychopathology in Youth

A significant body of literature exists describing the sleep of youth with mental health problems. For example, in comparison to nonclinical populations, research has found youth with anxiety disorders tend to go to bed later, have a more difficult time falling asleep (Rapoport et al., 1981), and display greater daytime sleepiness (Storch et al., 2008). In examining a large sample of youth with anxiety, Alfano and colleagues (2007) found that most youth (88%) reported at least one sleep-related problem (e.g., insomnia, nightmares, sleepiness) with 55% reporting three or more sleep symptoms. Further, there was a clear relationship between sleep and anxiety with more sleep problems being significantly associated with worse anxiety severity and decreases in family functioning (Alfano et al., 2007). Sleep has also been frequently examined in youth with affective symptomology or depression (Chorney et al., 2008; Gregory, Rijdsdijk, Dahl, McGuffin, & Eley, 2006). Research suggests that dysregulated sleep has been associated with longer lasting and more severe symptomology in depressed youth (Liu, Liu, Owens, & Kaplan, 2007). This is concerning considering problems with sleep have been found to be highly prevalent in youth presenting with depression, with rates as high as 73% (Liu et al., 2007). Further, studies have found that problems with sleep, particularly shorter sleep duration, has been associated with increased risk of suicidal ideation and suicidal attempts (Owens, 2014).

In addition to anxiety and mood dysregulation, research suggests that youth with ADHD tend to have a variety of sleep problems including difficulty falling asleep, frequent nightwakings, restless sleep, and an increased risk for specific sleep disorders such as periodic limb movement disorder and sleep-disordered breathing (Alfano & Gamble, 2009). Differences in sleep in youth with ADHD have not only been found when examining subjective measures such as bedtime resistance, difficulties with morning awakenings and daytime sleepiness, but have also consistently appeared when objective measures of sleep are examined (Cortese et al., 2009). In a meta-analysis examining sleep differences between youth with ADHD and healthy controls, when examining objective measures, youth with ADHD had greater sleep onset latency and actual sleep time (measured with actigraphy), worse sleep efficiency (measured with polysomnography), and lower average times to fall asleep (using the Multiple Sleep Latency Test) indicating greater sleepiness (Cortese et al., 2009). Finally, research has also found youth with ADHD to have greater instability (i.e., nightly variability) in sleep onset, sleep duration, and actual sleep when compared to healthy controls (Gruber, Sadeh, & Raviv, 2000). Although these findings clearly indicate greater variability in sleep for those with ADHD, more research is needed to understand what the implications are of greater inconsistency in the sleep-wake system as it is possible that increased instability in sleep has considerable effects on daytime functioning and emotional and behavioral symptoms. To date, the daily-level, dynamic interaction between sleep, mood, and behavior has yet to be systematically explored in a clinical sample of youth with ADHD. Overall, literature indicates that poor sleep is common among youth with emotional and behavioral difficulties; however, the role of sleep in youth mental health

problems is less understood. More research is needed to further understand the contemporaneous influence of one upon the other.

Along these lines, recent research suggests that there is a complex and likely dynamic, sequential relationship between sleep and mental health in youth (Alfano & Gamble, 2009; Gregory & Sadeh, 2012; Kelly & El-Sheikh, 2013; Walker & Harvey, 2010). For example, literature has found that sleep problems may predate and contribute to mental health problems in youth (Roberts et al., 2008), whereas other research suggests mental health problems negatively impact sleep (Dahl & Harvey, 2007), highlighting this complex and bidirectional relationship. It is well known that sleep problems are a common symptom associated with many different mental health disorders in youth, including depression, anxiety, ADHD and conduct problems (e.g., Alfano et al., 2007; Alfano & Gamble, 2009; Chorney et al., 2008; Cortese et al., 2009; Chevrin et al., 2003; Fosse et al., 2011 Gregory & Sadeh, 2012); however, recent research provides evidence that sleep problems are not necessarily a result of mental health problems, but rather a contributing factor (Alfano & Gamble, 2009; Harvey, 2001). For example, in a large-scale, prospective study of youth 11 to 17 years of age, the presence of chronic insomnia (assessed using DSM-IV symptom criteria) significantly increased risk for psychological problems a year later (Roberts et al., 2008). Further, in a study examining sleep, affect, and depressive symptoms at the daily-level in a non-clinical sample of adolescents, researchers found that there was a bidirectional relationship between sleep quality and affect (van Zundert, van Roekel, Engels, & Scholte, 2013). In this sample, poor sleep quality predicted greater negative affect and less positive affect the next day, and conversely, greater negative and less positive affect predicted sleep quality the following

night. Although examining a non-clinical sample of youth, results also indicated that this relationship was stronger for those reporting more depressive symptoms (van Zundert et al., 2013). In a similar study, Kouros and El-Sheikh (2015) found that there was a significant within-person relationship between sleep and mood on a daily-level in a nonclinical sample. Specifically, it was found that greater daily negative mood significantly predicted worse sleep quality and latency the subsequent night. Results from these studies highlight the importance of examining the daily-level interaction of sleep, mood and behavior in clinical populations where fluctuation in mood, behavior, and sleep may be more common and have even greater implications for functioning.

In fact, researchers are just beginning to explore sleep and psychopathology symptoms within clinical populations at the daily level to better understand the directionality and distinct contribution of each. To date, there is only one known study examining daily variation in mood (more specifically positive and negative affect) and sleep in youth with a diagnosed affective disorder (either depression or anxiety; Cousins et al., 2011). In this study, Cousins and colleagues (2011) found a bidirectional relationship between daytime affect and sleep for youth with an affective disorder. For those diagnosed with depression, more positive affect was related to more time in bed the following night and more time asleep was associated with more positive affect the next day. For those with anxiety, increased positive affect was related to *less* time in bed but more time asleep was still subsequently associated with more positive affect.

Taken together, these findings suggest a complex relationship between sleep and mental health in youth. In fact, the symbiotic relationship between mood, behavior, and sleep is becoming so important within the field of psychology that Walker and Harvey

(2010) have suggested there exists a major paradigm shift from the traditional idea that difficulties with sleep are nothing more than a symptom of psychopathology, to the more current view (backed by recent research) that sleep is not just a symptom but likely a mechanistic contributor to the cause and/or maintenance of emotional and behavioral disorders (discussed further below). Thus, just as important as identifying this sequential relationship is the examination of *how* these constructs interact and *what* the implications of this relationship are (Walker & Harvey, 2010).

Mechanisms of the Sleep-Psychopathology Relationship

Research is beginning to explore potential mechanisms of this sequential relationship. One of the most widely studied mechanisms of the relationship between sleep and mental health is the role of emotion regulation. Research with children and adults has consistently found sleep deprivation to be associated with increased irritability and negative mood (Harvey et al., 2011; El-Sheikh, Buckhalt, Cummings, & Keller, 2007). Studies have found that, in general, sleep deprivation is related to increased emotional lability so that sleep deprived youth not only demonstrate increased irritability but also experience a wider and more unpredictable range of emotions (e.g., inappropriate silliness, increased likelihood of crying; Dahl & Lewin, 2002). Further, the relationship between sleep and emotionality not only appears in childhood, adolescents, and adults, but is present in very young children. For example, in a study examining the effect of acute sleep restriction (i.e., nap versus no nap) on toddlers' emotional expression, emotional stimuli elicited more negativity to negative stimuli and less positivity to positive stimuli when youth were sleep deprived (Berger, Miller, Seifer, Cares, & LeBourgeois, 2012). These results indicate that even acute sleep restriction in young

children impacts emotional responses and the ability to manage emotion regulation challenges effectively.

Relatedly, at a neurobiological level, decreased sleep in adults has been associated with increased amygdala activation which is responsible for emotional regulation (Yoo, Gujar, Hu, Jolesz, & Walker, 2007). More specifically, in relation to amygdala activation, in an acute, severe sleep deprivation study (35 total hours of sleep loss), Yoo and colleagues (2007) found those who were sleep deprived demonstrated greater amygdala activation (measured with an fMRI task) in response to negative stimuli and decreased connectivity between the amygdala and medial prefrontal cortex, which is related to inhibiting signals to the amygdala and in turn regulating emotion.

Alternatively, there was greater connectivity between the amygdala and locus coeruleus for those sleep-deprived which may indicate a greater stress/distress response. In sum, these findings indicate that sleep deprivation may cause amygdala dysfunction which in turn may lead to the emotion dysregulation that is common to many mental health conditions. Relatedly, the locus coeruleus has also been associated with not only regulation of sleep, but also control of arousal, modulation of stress responses, and emotional dysregulation (Dahl, 1996), indicating that sleep and emotional regulation share many neurobiological functions.

Poor sleep has also been associated with compromised emotional information processing in adolescents (Soffer-Dudek, Sadeh, Dahl, & Rosenblat-Stein, 2011) and increased negative reactivity to negative stimuli (Franzen, Buysse, Dahl, Thompson, & Siegle, 2009), negatively biased emotional attribution to neutral stimuli (Tempesta et al., 2010), and decreased emotional intelligence (Killgore et al., 2008) in adults. Relatedly, to

explain the role of emotional information processing, Walker and colleagues (2009) proposed the “Sleep to Remember and Sleep to Forget” hypothesis that posits there are specific brain mechanisms that allow us to decrease the affective tone of emotionally salient memories. More specifically, they pose this occurs by the reactivation of memories during REM sleep in the presence of decreased aminergic activation and increased cholinergic activation. This allows for the reprocessing and encoding of the emotional memory with a depotentiation of the affective tone while still consolidating the information. In effect, sleeping to “forget” the emotionality associated with the memory while remembering the memory itself. According to this theory (Walker et al., 2009), impairment in sleep would be associated with the maintenance of distressing emotion tied to memories which could facilitate the maintenance of psychopathology (e.g., depressive disorders) as experiences would be perceived as more negative. The development of this hypothesis is based off of previous literature examining the neurobiological effects of sleep and emotion and has been supported more directly by experimental studies. For example, Sterpenich and colleagues (2007) found that after exposure to emotionally arousing images, those who were sleep deprived immediately after exposure had poorer recall of the images (supporting the sleep to remember portion of the hypothesis) and a decreased reduction in amygdala activation when re-exposed to the negative stimuli (supporting the sleep to forget portion of the hypothesis) in comparison to control subjects.

Finally, and relatedly, prefrontal cortical functioning appears to be related to sleep and emotion regulation (specifically that of more externalizing emotions such as aggression and violence). Kamphuis and colleagues (2012) reviewed the role of sleep in

aggression and violence and, more specifically, described prefrontal cortical functioning as a mechanism for this relationship. Research reviewed in this article suggests that sleep loss causes dysfunction within the prefrontal cortical (PFC) area. This is concerning considering this area of the brain is responsible for inhibition and initiation of behavior based on environmental and social cues. Additionally, in regards to emotion regulation, dysfunction in the PFC is associated with instability of emotional responses, including an inability to effectively cope with emotions and environmental demands, reflecting potential impairment within the anterior cingulate cortex portion of the PFC which is associated with both positive (e.g., happiness) and negative (e.g., anger) emotions (Kamphuis et al., 2012). Subsequently, it is possible that sleep deprivation leads to dysfunction within the PFC, causing emotion dysregulation and an inability to behaviorally inhibit socially inappropriate responses. This in turn may lead to impulsive and/or aggressive behaviors that are characteristic of many externalizing mental health problems. Overall, literature in this area indicates that sleep plays an important role in the processing and regulation of emotion, both of which, when not functioning adequately, are implicated in multiple different mental health disorders implying impairment in neurocognitive or neurobiological functioning underlies the relationship between sleep and mental health in youth.

In addition to emotion regulation, other mechanisms are being explored as potentially important factors linking sleep and mental health. Emerging research has found that genes associated with circadian rhythms and sleep are also related to psychiatric disorders characterized by problems with sleep, including mood disorders and schizophrenia (Harvey et al., 2011). Genes associated with sleep and circadian

functioning (e.g., CLOCK, Period, cryptochrome, TIM) are well-established and understood and researchers are beginning to associate some of these same genes with emotional disorders (Harvey et al., 2011). In a study examining 300 8-year-old twin pairs, Gregory and colleagues (2006) found sleep problems and depression to be related and the association between these variables to be primarily explained by genes and less so by environmental factors. More specifically, supporting a genetic component to the association between sleep and mental health, there was a considerable overlap in the genes impacting sleep and those impacting depressive symptoms when comparing monozygotic and dizygotic twin pairs so that genetic influences appeared to be primarily responsible for the relationship between sleep and depression (Gregory et al., 2006). Although these findings are promising, it is noted that this potential mechanism is very much preliminary and requires further research before significant conclusions can be made about a genetic mechanism. Just as there are multiple genes implicated in sleep, there are likely multiple different genes implicated in psychopathology and research does not yet fully understand their relationship and their potential as mechanisms of the sleep-psychopathology relationship.

Another potential mechanism of the sleep-mental health relationship is the functioning of specific neurotransmitters. The role of neurotransmitters, particularly dopamine and serotonin, in mental health has been well-established. However, both dopamine and serotonin also play a role in important biological sleep mechanisms (Espana & Scammell, 2004). For example, these neurotransmitters are involved in the regulation of the circadian rhythm, the sleep-wake cycle, and the transition between phases of sleep (Harvey et al., 2011). The closely tied relationship of neurotransmitters

with both sleep and mental health suggests a possible mechanism for this relationship is the dysregulation of serotonin and/or dopamine.

Finally, there are many characteristics associated with mental health problems that may contribute to the development of sleep problems. One frequently examined characteristic related to youth emotional and behavioral problems that may serve as a common mechanism between sleep and psychopathology is the occurrence of poor bedtime routines and/or sleep hygiene (Alfano & Gamble, 2009). For example, youth with increased behavioral and/or emotional problems often have parents who are over-involved in bedtime routines (resulting in poor self-regulation and soothing during pre-sleep periods; Sheridan et al., 2013) or parents who struggle with limit-setting and/or bedtime resistance (Bos et al., 2009; Short et al., 2011), all of which result in inadequate sleep for the child. Other mental health symptoms that may contribute to poor sleep include increases in stress hormones (e.g., cortisol) during pre-sleep periods (Forbes et al., 2006) and the potential for increased worry and cognitive arousal when attempting sleep (Alfano, Pina, Zerr, & Villalta, 2010). In regards to increased stress hormones, research has found youth with depression and anxiety to have increased cortisol during pre-sleep periods (Forbes et al., 2006). This is concerning considering the initiation of sleep is associated with *decreased* HPA axis functioning and research suggests cortisol may influence the onset and maintenance of sleep (Buckley & Schatzberg, 2005). It is likely that those suffering from emotional and/or behavioral disorders demonstrate increased stress and thus have higher cortisol secretion which in turn may negatively impact sleep (Raikkonen et al., 2010). Overall, research suggests multiple potential mechanisms for the relationship between sleep and psychopathology, indicating there are

likely many important contributing factors, as is consistent with the biopsychosocial model of functioning.

Limitations in Existing Research

Although the field is beginning to explore this relationship, important questions remain about how sleep and mental health interact, and existing research suffers from significant limitations in explicating this dynamic relationship. First, the vast majority of research examining sleep and mental health has been conducted with adults, and the literature on pediatric sleep in relation to psychopathology is much smaller. Further, when sleep has been measured in studies with youth, it has been assessed as a secondary construct and therefore has not been assessed well, making it difficult to draw worthy conclusions (Gregory & Sadeh, 2012). Thus, more research is needed that purposefully and systematically measures sleep in this population. Second, even in the pediatric literature, studies have tended to focus more on healthy (i.e., non-clinical) youth rather than those presenting for clinical issues (e.g., van Zundert et al., 2013). Although these studies with non-clinical samples have been useful first explorations of the relationship between sleep and mental health, studies with clinical populations are needed to understand key clinical mechanisms and inform treatment development. Third, existing pediatric research has rarely used objective measures, despite recognition that parent- and self-reports of sleep have poor validity, and the use of both objective and subjective measures is recommended (Dayyat, Spruy, Molfese, & Gozal, 2011; Gregory & Sadeh, 2012; Owens, 2014). For example, in a study examining the discrepancy between parent-report and objective assessment (i.e., actigraphy) of youth sleep (including normal sleepers, snorers, and primary insomnia patients without psychiatric problems),

researchers found that, on average, parents have a 30 minute error in sleep onset and overestimate sleep duration by about one hour per night (Dayyat et al., 2011). However, although actigraphy may provide a more accurate measurement of sleep duration, it is possible that parent-reports identify important aspects of sleep, such as sleep symptoms and behavior (e.g., sleep hygiene, bedtime resistance; Lewandowski, Toliver-Sokol, & Palermo, 2011). Because there are advantages and weaknesses to each approach, it is recommended that a combination of subjective and objective measures of sleep be used. Further, because discrepancies in parent-report and objective measurement of sleep have primarily been examined in non-clinical youth (Dayyat et al., 2011), it would be useful to understand if this inconsistency exists in clinical populations of youth and, if so, if parents overestimate sleep at similar rates. Fourth, most longitudinal studies of sleep and mental health have focused on *average* sleep and mental health symptoms over time in *unidirectional* analyses (e.g., Gregory & O'Connor, 2002), missing the dynamic and sequential day-to-day interaction between the two constructs. This is despite the fact that research has identified discrepancies when examining averaged versus daily-level sleep symptoms in clinical populations of youth (Gruber et al., 2000). More specifically, when comparing youth with ADHD versus healthy control on objective measures of sleep using actigraphy, Gruber and colleagues (2000) found that although there were no significant differences between groups when actigraphic sleep measures were averaged across days, there were significant and important differences when night-to-night variability was assessed. When examining daily-level sleep, results indicated that those with ADHD had greater instability (i.e., increased within-person variability across days) on measures of sleep duration, actual sleep, and sleep onset time (Gruber et al., 2000). Relatedly,

although it is known that youth with emotional and behavioral problems have poor sleep, we lack an understanding of how within-group, or further, within-person variation impacts differential functioning. For example, research suggests that youth with psychopathology tend to sleep less than healthy youth (e.g., Reigstad et al. 2010); however, the impact of sleeping more or less for an individual child with above average emotional and/or behavioral problems is unknown. Conversely, the effect of having more or less emotional or behavioral symptoms on sleep in a given day is not understood. Overcoming these limitations to better explicate the complex relationship between sleep, mood, and behavior in youth with pre-existing emotional and behavioral problems is critical to facilitate future research and inform effective treatment strategies for youth with clinical emotional and behavioral problems.

CHAPTER 2: PRIMARY PURPOSE AND RESEARCH HYPOTHESES

The overarching goal of the following study is to better understand the relationship between sleep and psychopathology in youth with significant emotional and behavioral problems. To do this, rigorous and innovative methods were employed to capture the complex sequential interplay between sleep and mental health symptoms on a day-to-day basis with a population of youth with pre-existing emotional and behavioral problems. This study provides a sophisticated examination of the mental-physical health connection by examining the interaction between sleep and mental health in youth presenting for treatment. Sleep is an important health behavior that has consequences for both physical (e.g., Raikonen et al., 2010) and psychological functioning (Alfano & Gamble, 2009), making it a critical link connecting physical and mental health, and an important consideration for mental health treatment. In addition to explicating this important and complex relationship, outcomes from this study have and will continue to inform and facilitate future research broadly, and more specifically, within the UNL Pediatric Health Lab to develop and pilot a brief sleep module specifically designed for use with youth presenting for a variety of behavioral and emotional concerns. Information gained from this research has also supported funding proposals to develop, evaluate, and disseminate a transdiagnostic intervention to enhance services for a wide range of youth mental health problems. More specifically, results from the present study have supported the idea that targeting sleep problems early in treatment for youth with emotional and behavioral problems may be an efficient and effective way to ameliorate mental health symptoms.