**Sleep as a Moderator of Links Between Parent-Child Attachment
and Adjustment in Early Adolescence**

by

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Attachment, Sleep, Adolescent, Self-Esteem,
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Abstract

Poor sleep duration and quality are common among typically developing children and are

related to adjustment problems such as internalizing and externalizing symptoms, as well as

lower self-esteem. Attachment, or the bond between children and parents from which children

derive a sense of security, is also related to the development of adjustment problems. The

present study sought to examine the independent and interactive associations among perceived

attachment to mothers and fathers and adolescent sleep as predictors of internalizing and

externalizing symptoms and self-esteem. Participants were 113 adolescents between 11.00 and

14.75 years (28% African Americans, 72% European Americans). Sleep parameters were

measured using actigraphy and subjective reports of sleep. Adolescents reported on perceived

attachment to mothers and fathers, self-esteem, anxiety, and depressive symptoms. Mothers and

fathers reported on adolescents' externalizing symptoms. Regressions examining study aims

revealed main and interactive effects of attachment and sleep in the prediction of adolescent

adjustment. Higher levels of perceived attachment to mothers and fathers were associated with

fewer externalizing, anxiety, and depressive symptoms, and higher self-esteem. After

controlling for perceived attachments, longer duration and higher quality sleep predicted unique

variance in youth's adjustment outcomes. Central to this investigation, actigraphy-based and

subjective sleep moderated associations between attachment and adolescent adjustment, yielding

two patterns of effects. In some cases, poor sleep operated as a risk factor, particularly at low

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levels of attachment, consistent with dual-risk perspectives. In other instances, better sleep

operated as a protective factor. Implications for future research are discussed.

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I. INTRODUCTION

Between 25% and 62% of typically developing children live with sleep insufficiency or poor quality sleep (Fricke-Oerkermann et al., 2007; Spruyt, O'Brien, Cluydts, Verleye, & Ferri, 2005). Poor sleep is a predictor of adjustment problems, such as internalizing and externalizing symptoms (Astill, Van der Heijden, Van Ijzendoorn, & Van Someren, 2012; Sadeh, Tikotzky, & Kahn, 2014) and disrupted cognitive functioning (Sadeh, Gruber, & Raviv, 2002). Investigations of children's sleep in the family context have revealed evidence of interactions between sleep and family environments in predicting children's adjustment in addition to direct links between poor sleep and family dysfunction (Dahl & El-Sheikh, 2007). Extending this literature, the present study examined the role of sleep as a moderator of the association between perceived attachment to parents and adjustment problems (internalizing and externalizing symptoms, self-esteem) in early adolescence.

The primary function of attachment, or the bond between children and parents, is for children to derive a sense of security from parents (Bowlby, 1969). Securely attached children are able to explore their environments and learn from them (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1973; Kochanska, Barry, Stellern, & O'Bleness, 2009), whereas insecurely attached children are unwilling to explore and may feel threatened by their environments, as well as their parents (Colin, 1996). Indeed, insecure attachment has been shown to predict greater maladjustment in children including higher levels of internalizing and externalizing symptoms, and lower self-esteem (Brumariu & Kerns, 2010; Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley, & Roisman, 2010; Wilkinson, 2004). Conversely, adolescents who reported having higher quality of attachment to their mothers and fathers had lower levels of internalizing and externalizing symptoms (Buist, Deković, Meeus, & van Aken, 2004). Of note,

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much of this literature has focused on mother-child attachment, with less attention to father-child attachment (e.g., Fearon et al., 2010; Greenberg, Speltz, DeKlyen, & Endriga, 1991; Lyons-Ruth, Easterbrooks, & Cibelli, 1997). In the proposed investigation, perceived attachments to both mothers and fathers were assessed.

Adjustment problems can have major negative consequences for individuals, families, and society (Nagin & Tremblay, 1999; Stewart, Ricci, Chee, Hahn, & Morganstein, 2003). The identification of variables that can influence children's adjustment and function as vulnerability and protective factors in the context of poor parent-child relationships could clarify for whom and under which conditions maladjustment is likely to occur. Adjustment problems such as internalizing symptoms (e.g., anxiety, depression), externalizing symptoms (e.g., aggression, conduct problems, attention problems), and low self-esteem (Achenbach & Edelbrock, 1978; Zahn–Waxler, Klimes–Dougan, & Slattery, 2000) are common in children (Costello et al., 1996). Further, increases in internalizing and externalizing symptoms, as well as decreases in self-esteem have been shown to coincide with the transition to adolescence (Barber & Olsen, 2004; Deković, Buist, & Reitz, 2004; Twenge & Nolen-Hoeksema, 2002). Thus, understanding processes that ameliorate or contribute to adjustment problems may be particularly important during early adolescence.

A few studies have examined the moderating role of sleep in the context of attachment or perceived attachment. Keller, El-Sheikh, and Buckhalt (2008) found that for children with actigraphy-based shorter sleep duration and reduced sleep efficiency, greater perceived attachment insecurity predicted relatively poor math achievement. Further, stronger associations linking maternal sensitivity with greater attachment security were observed among young children with longer versus shorter sleep duration (Bernier, Bélanger, Tarabulsy, Simard, &

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Carrier, 2014). Longer sleep durations have also been found to protect against internalizing and externalizing in the context of high maternal sensitivity, but not low maternal sensitivity (Bordeleau, Bernier, & Carrier, 2012). In addition, evidence is emerging to support sleep as a moderator in the context of other indices of family functioning (El-Sheikh, Hinnant, Kelly, & Erath, 2010; Lemola, Schwarz, & Siffert, 2012). For instance, longer sleep duration and higher quality sleep protected children against internalizing and externalizing problems in the context of maternal psychological control (among high socioeconomic status or SES children; El-Sheikh, Hinnant, et al., 2010). Conversely, shorter sleep duration across the week functioned as a risk factor for child aggression in the context of marital conflict (Lemola et al., 2012). Furthermore, in this burgeoning literature, sleep is increasingly being identified as a moderator of risk in the context of other child and adolescent outcomes. For example, sleep efficiency moderated the association between negative parenting (harsh parenting and parental psychological control) and adolescents' cognitive functioning (El-Sheikh, Tu, Erath, & Buckhalt, 2014). This is a developing literature, and the moderating role of sleep requires further explication in the context of family functioning.

A central aim of this study was to examine sleep as a moderator of the link between perceived attachment and adjustment among an ethnically and socioeconomically diverse sample of typically developing adolescents. A secondary aim was to examine the additive effects of sleep (after accounting for perceived attachments to parents) in the prediction of adolescents' externalizing and internalizing problems. Although a large literature has established relations between sleep and adjustment outcomes in youth, assessments of direct relations between sleep and adolescents' adaptation after accounting for the effects of attachment to parents is to the best of our knowledge, nonexistent. Consistent with the emotional security theory (Cummings &

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Davies, 2010), which proposes that low levels of security in family relationships increase the risk for maladjustment, and the diathesis stress framework (Sameroff, 1983), which advocates that high-risk contexts coupled with individual risk factors may yield more adjustment problems, it was hypothesized that adolescents with reduced sleep duration and poor quality sleep combined with insecure perceived attachment would have the poorest adjustment outcomes (high levels of internalizing and externalizing symptoms and low self-esteem). Indeed, findings from some studies examining the moderating role of sleep have been consistent with the diathesis stress or dual-risk framework (Keller et al., 2008; Lemola et al., 2012). Yet, other studies have found a dual-protection pattern of effects, such that the benefits of higher quality or longer duration sleep were more evident in the context of low but not high risk (higher maternal sensitivity; Bernier et al., 2014; Bordeleau et al., 2012). Thus, it is possible that both patterns could emerge in the present study.

There are several strengths of the present study, including the use of a multi-method and multi-informant approach. Adolescents reported on their perceived attachments, and sleep quality and duration were assessed with subjective and objective measures, and adolescents, mothers, and fathers reported on adolescents' adjustment. Further, addressing long standing calls in the literature (Belsky, 1997; van IJzendoorn & De Wolff, 1997), the present study examined adolescents' perceived attachment to mothers and fathers. To our knowledge, this is the first study to examine sleep as a moderator of the association between attachment and adjustment problems in adolescence.

II. LITERATURE REVIEW

Adolescents' Sleep

Sleep problems are relatively common among typically developing children, with studies finding estimates ranging from 25% to 62% of children having poor sleep, primarily sleep insufficiency and poor quality sleep (Fricke-Oerkermann et al., 2007; Spruyt et al., 2005). Among adolescents ages 11 to 17, only 20% get the recommended amount of sleep per night (9 hours or more spent in bed), whereas 45% get fewer than 8 hours of sleep (time spent in bed) per night (National Sleep Foundation, 2006). Insufficient and poor quality sleep have been shown to disrupt prefrontal cortex (PFC) functioning, which plays a key role in emotion and behavior regulation, and may place youth at risk for internalizing and externalizing problems (Dahl, 1996). Further, towards explicating sleep in the family context (Dahl & El-Sheikh, 2007; for a review, see Adams, Stoops, & Skomro, 2014), some studies have examined sleep as a moderator of associations between dimensions of family functioning and adjustment outcomes (Bordeleau et al., 2012; El-Sheikh, Hinnant, et al., 2010; Lemola et al., 2012). This line of inquiry may be important for clarifying under which sleep conditions family functioning could impact child adaptation.

The present study examined sleep duration and quality as moderators of the associations between adolescents' perceived attachment to mothers and fathers and their internalizing and externalizing symptoms. Sleep problems were assessed along a continuum and refer to actigraphy-derived shorter sleep duration, reduced sleep efficiency, and greater night wakings, as well as subjective reports of Sleep/Wake problems, in a sample of typically developing youth.

Sleep and Youth Adjustment

Sleep underlies emotion and behavior regulation (Dahl, 1996). Reviews of studies with adolescents and adults provide support for relations between sleep deprivation and difficulties with emotion regulation (Jones & Harrison, 2001; Muzur, Pace-Schott, & Hobson, 2002). For instance, in an experimental study, 7- to 11-year-old children were randomly assigned to either a sleep extension group that slept one hour more than usual or a sleep restriction group that slept one hour less than usual. Teacher reports indicated that children in the sleep restriction condition, in comparison to children in the sleep extension condition, had greater difficulty regulating their emotions and exhibited more impulsive behaviors (Gruber, Cassoff, Frenette, Wiebe, & Carrier, 2012). In an experiment by Baum et al. (2014), adolescents participated in a sleep restriction (in bed for 6.5 hours) and sleep extension (in bed for 10 hours) protocol. When adolescents experienced sleep restriction in comparison to when they experienced sleep extension, they had poorer parent-reported emotion regulation (Baum et al., 2014), similar to findings from Gruber et al. (2012). In addition to studies examining sleep duration, poor sleep quality, in the form of greater actigraphy-derived night wakings and poor sleep efficiency, was related to low levels of emotion information processing among 13-year-olds (Soffer-Dudek, Sadeh, Dahl, & Rosenblat-Stein, 2011).

Similar patterns of associations have been found between sleep problems and youth adjustment problems, including externalizing symptoms such as aggression, delinquency, and hyperactivity; internalizing symptoms such as anxiety and depression (Sadeh et al., 2014); and low self-esteem (Fredriksen, Rhodes, Reddy, & Way, 2004). A meta-analysis found that short sleep duration was related to both externalizing and internalizing symptoms ($r = .08$ and $.09$, respectively; Astill et al., 2012). Sleep quality, in addition to duration, was associated with

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adjustment outcomes, such that children with greater actigraphy-derived nighttime waking minutes, as well as children with poorer sleep efficiency, had greater internalizing and externalizing problems (El-Sheikh, Erath, & Keller, 2007). Additionally, mother-reports of later bedtimes and greater variability in bedtimes and sleep duration have predicted more behavior problems in school in a sample of 5-year-old children (Bates, Viken, Alexander, Beyers, & Stockton, 2002). Further, in a longitudinal study from sixth to eighth grade using subjective reports of sleep and self-esteem using the Self-Esteem Questionnaire (DuBois, Felner, Brand, & Phillips, 1996), Fredriksen et al. (2004) found that greater sleep loss among 11- to 14-year-olds predicted lower initial levels of self-esteem and decreases in self-esteem over time. Given the prevalence of sleep problems among children, the investigation of sleep may provide further insight about conditions in which adolescents experience greater or fewer adjustment problems.

Sleep in the Family Context

The emotional security framework proposes that negative family interactions such as family conflict may contribute to emotional insecurity, which can foster poorer emotional and behavioral regulation (Cummings & Davies, 2010) and poor sleep (El-Sheikh, Buckhalt, Cummings, & Keller, 2007). Because vigilance and sleep are incompatible, a safe and secure environment is necessary for sleep (Dahl, 1996; Dahl & Lewin, 2002). Thus, secure attachments to parents are likely to promote emotional and behavioral regulation as well as better sleep.

Further, examining sleep in the context of parent-child attachment may elucidate for whom secure parent-child attachment is most beneficial or under which conditions sleep may play a role in children's adjustment. In a relatively new line of research, sleep has been examined as a moderator of relations between family functioning and youths' adaptation. For instance, in a study examining interactions between perceived attachment and subjective and

objective measures of sleep as predictors of cognitive functioning in middle childhood, Keller et al. (2008) found that insecure perceived attachment to mothers and fathers, coupled with shorter sleep, predicted lower math achievement scores among 8-year-old children. Additionally, perceived attachment to mothers, but not fathers, coupled with poor sleep quality (low efficiency or high activity) predicted lower math achievement. These findings fit a dual-risk pattern, where a negative attribute (insecure attachment) is linked with worse outcomes, but only in the context of high risk (shorter sleep; Rutter, 1979; Sameroff, 2000).

In contrast to the previous study, dual-protection patterns have emerged in other studies. Dual-protection patterns occur when an attribute predicts more positive outcomes, but only in a low-risk context (Luthar, Cicchetti, & Becker, 2000). In one study, sleep was examined as a moderator of relations between maternal sensitivity, one of the strongest predictors of child attachment (van IJzendoorn, Juffer, & Duyvesteyn, 1995), and adjustment outcomes. Specifically, Bordeleau and colleagues (2012) found that for young children with longer sleep durations, derived from mother-completed sleep diaries at age 1, there was a negative association between maternal sensitivity at age 1 and parent-reported internalizing and externalizing problems at age 4. Children with longer sleep durations and greater maternal sensitivity had fewer adjustment problems than children with longer sleep durations and lower maternal sensitivity. No significant relation between maternal sensitivity and adjustment for children with short sleep durations emerged, suggesting that individuals with poor sleep failed to benefit from maternal sensitivity (Bordeleau et al., 2012). In another relevant study, Bernier et al. (2014) examined how maternal sensitivity and infant sleep interacted to predict attachment security. Attachment security was assessed via the Attachment Behavior Q-Sort (AQS; Waters, 1995). The authors found that longer sleep durations predicted higher levels of child attachment security

in young children, but only in conjunction with greater maternal sensitivity. This dual-protection

pattern was similar to the one reported in Bordeleau et al. (2012). Whereas Keller and

colleagues (2008) found poor sleep to be a vulnerability factor for children with more insecure

attachment, Bordeleau and colleagues (2012) and Bernier and colleagues (2014) found that better

sleep was protective, but only in the context of higher maternal sensitivity.

In addition to parent-child attachment, the moderating role of sleep has been examined

within the context of other family relationships, such as parent psychological control,

interparental conflict, and harsh parenting. A study by El-Sheikh, Hinnant, and colleagues

(2010) examined actigraphy-measured sleep and SES as moderators of links between child-

reported maternal psychological control and child-reported internalizing symptoms from the

second wave of the larger longitudinal study from which the present study is based (the present

study uses data from the third wave). Among children from low SES homes, maternal

psychological control predicted higher levels of internalizing symptoms among 10-year-old

children, regardless of sleep. However, among children from high SES homes, sleep moderated

this association, such that maternal psychological control predicted higher levels of internalizing

symptoms among children with low sleep efficiency, but not among children with high sleep

efficiency. Rather, high sleep efficiency, in concert with high SES, buffered against the negative

effects of maternal psychological control, and at high levels of psychological control, these

children had the lowest levels of internalizing symptoms (El-Sheikh, Hinnant, et al., 2010). This

indicates that only children with two protective factors, high SES and high sleep efficiency, are

shielded from the negative effects of mothers' psychological control. Furthermore, Lemola et al.

(2012) examined subjective reports of sleep as a moderator of relations between parent-reported

interparental conflict and young adolescents' self-reported aggressive behavior. For youth with

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short sleep durations, a positive relation between interparental conflict and aggressive symptoms was found. This relation was not significant for children with longer sleep durations. The findings fit a dual-risk pattern, where greater interparental conflict predicted higher aggressive symptoms, but only in the context of poor sleep. Similar to findings from El-Sheikh, Hinnant, and colleagues (2010), worse sleep appears to be a risk factor for negative family interactions.

Consistent with patterns from Bordeleau et al. (2012), a dual-protection pattern emerged in a recent study by El-Sheikh et al. (2014). The authors investigated actigraphy-based sleep quality as a moderator of links between family stressors (harsh parenting and parental psychological control) and adolescent cognitive functioning. The highest levels of intellectual abilities were predicted for adolescents experiencing lower levels of either harsh parenting or psychological control in conjunction with higher sleep efficiency. These findings were consistent with those of Bordeleau and colleagues (2012), such that youth experienced better functioning in the context of better sleep accompanied by less negative family relationships. Tu, Erath, and El-Sheikh (2015) also found similar dual-protection patterns when examining sleep in the context of peer victimization. Specifically, adolescents with longer or more efficient sleep reported low levels of internalizing symptoms, but only in the context of low peer victimization. At higher levels of peer victimization, adolescents with poorer or better sleep had similar levels of internalizing symptoms.

Collectively, the aforementioned studies provide evidence of the moderating role of sleep across several family and parent-child contexts and suggest that poor sleep can exacerbate negative outcomes (El-Sheikh, Hinnant, et al., 2010; Keller et al., 2008; Lemola et al., 2012), whereas better sleep can facilitate child adaptation (Bernier et al., 2014; Bordeleau et al., 2012; El-Sheikh et al., 2014; Lemola et al., 2012; Tu et al., 2015). Yet, a recent review of the literature

has noted that no studies have examined both sleep and attachment among children between the ages of 12 and 18 (Adams, Stoops, & Skomro, 2014), of which this study would be the first.

Attachment

Attachment is a critical developmental milestone in which infants develop a bond with one or both parental figures (Bowlby, 1969). This bond develops throughout infancy, increasing the connection between children and parents, and contributing to children's sense of security and safety. The safety derived from parents as children develop enables parents to become a secure base, from which children can branch out and explore unfamiliar environments (Ainsworth et al., 1978; Kochanska et al., 2009). Children may return to their parents whenever they feel unsafe, but over time are able to spend more time apart from parents (Cassidy & Shaver, 1999; Colin, 1996). Several categories of attachment have been commonly identified in the literature. Attachment can be divided into two main categories, secure and insecure (Colin, 1996). As typically defined in the literature (Bowlby, 1973), *securely* attached children feel supported by their parents, enough so that they can explore their environments, but return to their parents when they feel threatened. Conversely, *insecurely* attached children find their parents to be lacking in support. They may be unwilling to explore new and possibly threatening environments, but also do not seek support from parents whom they perceive to be threatening.

In order to identify attachment categories, early studies of attachment used Ainsworth's Strange Situation task (Ainsworth et al., 1978), the most common means of assessing infant attachment. During the Strange Situation task, an infant and his/her caregiver go into an unfamiliar room, after which the caregiver leaves temporarily, a stranger enters the room, and finally the caregiver returns after some time. Attachment categories are determined based on infant responses when caregivers return.

Although Ainsworth's Strange Situation task is the most common means of assessing attachment in young children, additional methods have been developed to assess attachment in older children in adolescents. Of relevance, the Inventory of Parent and Peer Attachment (IPPA; Armsden & Greenberg, 1987) is a commonly used assessment of *perceived attachment* for adolescents in which individuals report on levels of trust, communication, and alienation for each parent, as well as peers. In this study, the IPPA was used to examine youths' perceived attachments to mothers and fathers.

Many early studies of attachment focused exclusively on mother-child relations. Bowlby (1969) believed that fathers played a part in parent-child attachment, but that the bond developed later in the child's life and was less significant than mother-child attachment. However, despite the relatively small literature on attachment to fathers, early work by Schaffer and Emerson (1964) found that, according to mothers, infants also protested when separated from their fathers at 18 months old. Further, a review by Lamb (1997) found mixed evidence for whether distressed infants primarily sought comfort from mothers or fathers. Although existing evidence suggests the importance of the father-child attachment relationship for children's indices of adjustment (Buist et al., 2004; Duchesne & Ratelle, 2014; Kochanska & Kim, 2013), this literature is much smaller than that with mothers. Thus, a strength of the current investigation is the inclusion of both mothers and fathers in the study of youths' perceived attachments.

Attachment and youth adjustment

Early attachment between children and caregivers can be influential across the life span (Lerner & Ryff, 1978), and attachment has been found to be associated with many outcomes, including internalizing symptoms (e.g., Buist et al., 2004; Kochanska, 1995) and externalizing symptoms (for a meta-analysis, see Fearon et al., 2010) across the course of children's

development. Insecure attachment in general may fuel beliefs that one is unable to be securely attached to caregivers, or that one is not worthy of being securely attached to caregivers, which may contribute to greater internalizing symptoms and lower self-esteem (Allen, Moore, Kuperminc, & Bell, 1998; Cummings & Cicchetti, 1990). Further, insecurely attached children may develop hostility toward parents, in turn contributing to externalizing symptoms (Allen, Moore, & Kuperminc, 1997; Greenberg & Speltz, 1988; Patterson, DeBaryshe, & Ramsey, 1989).

Multiple studies have found evidence of concurrent connections between attachment and adjustment in children. Granot and Mayseless (2001) examined mother-child attachment and adjustment outcomes in a sample of Israeli elementary school children. They found that children with insecure attachment had higher levels of internalizing and externalizing symptoms, whereas children with secure attachments had the lowest levels of adjustment problems. A longitudinal study that examined links between attachment and adjustment outcomes found that more insecure attachment to mothers, assessed via observations of mother-child play at age 4, was concurrently related to higher mother-reported internalizing and externalizing scores, as well as higher levels of maladjustment at age 8 (Booth, Rose-Krasnor, McKinnon, & Rubin, 1994). A meta-analysis by Fearon and colleagues (2010) found that children with insecure attachment to mothers, in comparison to securely attached children, had higher levels of externalizing symptoms ($d = 0.31$). These studies only examined attachment between mothers and children and found similar patterns of associations linking more insecure attachment with greater internalizing and externalizing symptoms.

Internalizing and externalizing symptoms tend to increase during adolescence (Barber & Olsen, 2004; Deković et al., 2004), therefore it is important to test whether the relationship

between attachment and adjustment differs during adolescence. Granot and Mayseless (2001) examined how perceived attachment to mothers, scored from the Attachment Security Scale (Kerns, Abraham, Schlegelmilch, & Morgan, 2007), and observed attachment to mothers, scored from the Doll Story Completion task (Bretherton, Ridgeway, & Cassidy, 1990), was related to teacher-reported internalizing and externalizing symptoms in young adolescents. Youth with more insecure attachment had higher levels of internalizing and externalizing scores compared to more securely attached adolescents. Allen et al. (1998) examined how adolescent attachment was related to self-reported internalizing symptoms and self- and mother-reported externalizing symptoms. Attachment was assessed with the Adult Attachment Interview and Q-set (George, Kaplan, & Main, 1996; Kobak, Cole, Ferenz-Gillies, Fleming, & Gamble, 1993). The authors found that adolescents with more insecure attachment had higher levels of externalizing symptoms compared to adolescents with more secure attachment, but no associations emerged for internalizing symptoms.

Although multiple studies have examined links between attachment and adjustment in children, and many studies have examined mother-child attachment, fewer studies have examined either adolescent attachment or father-child attachment. In a study examining differences in perceived attachment to fathers compared to mothers, adolescents reported more secure attachment to mothers than fathers (Williams & Kelly, 2005). Additionally, three studies with younger and older adolescents (ranging from 9 to 18 years old), assessed perceived attachment to both parents and found similar patterns of associations between attachment and adjustment for mothers and fathers. Specifically, adolescents with more insecure perceived attachment had greater internalizing and externalizing symptoms compared to adolescents with more secure perceived attachment (Allen, Porter, McFarland, McElhaney, & Marsh, 2007;

Harold, Shelton, Goeke-Morey, & Cummings, 2004; Muris, Meesters, & Berg, 2003).

Additionally, adolescents with more insecure attachment to mothers and fathers have been found

to have lower self-esteem (Wilkinson, 2004). Allen and colleagues (2007) assessed attachment

using the Adult Attachment Interview (AAI; George et al., 1996; Kobak et al., 1993), whereas

Harold et al. (2004) used the Kern's Security Scale (KSS; Kerns et al., 2007), Muris et al. (2003)

used the Attachment Questionnaire for Children (AQC; Muris, Mayer, & Meesters, 2000), and

Wilkinson (2004) used an 8-item scale created by the author.

Although attachment has been associated with adjustment problems throughout the life

span, individual differences and moderators of effects in these associations are likely operative.

For example, antenatal risk (Bergman, Sarkar, Glover, & O'Connor, 2008), economic risk

(Graham & Easterbrooks, 2000), and growth in maternal depressive symptoms (Milan, Snow, &

Belay, 2009) exacerbated the relation between parent-child attachment and adjustment problems.

Further identification of variables that increase vulnerability or offer protection against

adjustment difficulties associated with insecure attachments could shed more light on these

associations. In this study, sleep duration and quality are examined as moderators in the relations

between perceived attachments to mothers and fathers' and adolescents' adjustment.

Adolescent Adjustment

Adjustment problems can have major negative consequences for individuals, families,

and society, such as criminal problems and damage to property (Huesmann, Eron, Lefkowitz, &

Walder, 1984; Stewart et al., 2003). In adulthood, internalizing problems can have major costs

in terms of lost productive time, with an estimated $44 billion lost per year from depression-

related absences and decreased performance in the workforce (Stewart et al., 2003), so finding

ways to identify and possibly prevent these consequences would be beneficial. In the present

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study, two types of adjustment problems were of particular interest, internalizing and externalizing symptoms. Of note is that these symptoms were examined in a community sample.

Internalizing symptoms refer to disordered moods and emotions and are primarily composed of depression and anxiety problems (Kovacs & Devlin, 1998). These symptoms have been shown to increase during the transition to adolescence (Barber & Olsen, 2004; Twenge & Nolen-Hoeksema, 2002). Increased rates of internalizing symptoms coincide with multiple developmental changes, such as physical changes and self-consciousness as a result of pubertal status, salience of peer relationships and peer problems (e.g., rejection, victimization), and school and social transitions (Coie, Terry, Lenox, Lochman, & Hyman, 1995; Ge, Conger, & Elder Jr., 2001). Physical changes and self-consciousness also coincide with changes in self-esteem during adolescence (Kling, Hyde, Showers, & Buswell, 1999; Mendelson, White, & Mendelson, 1996). Girls move further from their ideal body shape during puberty, whereas boys move closer to their ideal body shape, which may account for lower self-esteem among adolescent girls and higher self-esteem among adolescent boys (Harter, 1990). However, boys tend to reach puberty later than girls, and delayed puberty among boys can contribute to worse self-image and lower self-esteem (Simmons, Blyth, Cleave, & Bush, 1979).

Externalizing symptoms refer to dysregulated behavior and are composed of attention difficulties, impulsivity, aggression, and conduct problems, which can include delinquency and rule-breaking behaviors (Achenbach & Edelbrock, 1978; Campbell, Shaw, & Gilliom, 2000). High levels of aggression are a major contributor to peer rejection (for a meta-analysis, see Reijntjes et al., 2011). Externalizing problems are also implicated in injury, theft, property damage, and can have negative effects to both families and society in general (Huesmann et al., 1984; Nagin & Tremblay, 1999). Heightened externalizing problems in adolescence may be

partially due to a greater influence of negative/deviant peers, as well as more unsupervised time, which may in turn accentuate the influence of negative peers (Maggs, Almeida, & Galambos, 1995; Medrich & Marzke, 1991; Pettit, Bates, Dodge, & Meece, 1999).

The Present Study

The present study examined sleep as a moderator of relations between perceived attachment to mothers and fathers and internalizing and externalizing symptoms, as well as self-esteem. Further, a secondary aim was to examine the additive effects of sleep on adjustment, after accounting for perceived attachment. Objective and subjective assessments of sleep were used and each has recognized advantages and disadvantages (Sadeh, 2015). Actigraphy is a relatively low-cost method of assessing sleep objectively and allows participants to sleep in their normal surroundings (Sadeh, 2011b). The use of self-report questionnaires allows participants to describe constructs not assessed by objective methods including satisfaction with one's sleep. Subjective and actigraphy-based measures of sleep assess different constructs, and it has been recommended that they be used jointly (Sadeh, 2011a). Further, it is also ideal to include objective measures of sleep quality (e.g., sleep efficiency) in addition to sleep duration because findings may reveal different associations for sleep duration and quality (Astill et al., 2012).

As noted, prior studies have tended to find two patterns of moderation for the role of sleep in the context of risk, dual-risk (Rutter, 1979; Sameroff, 2000) and dual-protection or protective-reactive moderating process (Luthar et al., 2000). For instance, consistent with dual-risk, poor sleep (e.g., shorter duration, poorer quality), exacerbated the association between insecure attachment and poorer academic outcomes (Keller et al., 2008), marital conflict and aggressive behavior in children (Lemola et al., 2012), and maternal psychological control and depressive symptoms (El-Sheikh, Hinnant, et al., 2010). In these studies, children exposed to

poor sleep and another risk factor had the worst outcomes. Conversely, other studies have also found that longer sleep duration and higher sleep efficiency in conjunction with higher levels of maternal sensitivity (Bordeleau et al., 2012) and lower parental psychological control (El-Sheikh et al., 2014) yielded lower levels of internalizing and externalizing outcomes and higher cognitive functioning, respectively. In these studies, better sleep was more beneficial in the context of lower risk, consistent with dual-protection.

Thus, it is possible that poor sleep may be a vulnerability factor, whereas better sleep may be partially protective, for lower self-esteem and greater internalizing and externalizing symptoms, in the context of lower levels of attachment. Conversely, better sleep may be more protective against adjustment problems in the context of higher levels of attachment, and less protective in the context of lower levels of attachment. There were no hypotheses as to possible differential effects of the sleep parameters, nor to differences in associations by outcome.

III. METHOD

Participants

The sample participated in the third wave (data collection occurred in 2009) of a larger study examining relations among family functioning, children's sleep patterns, and behavioral and physical outcomes. At the first wave (data collection occurred in 2006), participants were recruited from the Alabama public elementary school system. At the first wave only, exclusion criteria required children to be free of any diagnosed chronic illness, mental disability, Attention Deficit Hyperactivity Disorder (ADHD), or a diagnosed sleep disorder. Eligibility criteria required parents to have been married and living in the same home during the first wave of the study, and children had to have lived with both parents for at least two years.

In the current wave, participants included 113 adolescents. Youth ranged in age from 11.00 to 14.75 years, with a mean age of 13.56 years ($SD = 0.73$). Families came from diverse socioeconomic backgrounds. Approximately 5% of families had annual household incomes less than $20,000; 19% earned from $20,000-35,000; 23% had annual incomes from $35,000-50,000; 24% earned from $50,000-75,000; and 29% had incomes over $75,000. The vast majority of participants had biological mothers and fathers reporting (99% and 81%, respectively) on study variables at the third wave. Only families with married parents were included given the focus on perceived attachment to mothers and fathers. Six families experienced divorce between the first and second waves of data collection and were excluded from the current sample. No parents divorced between the second and third waves. One participant did not have any data on the study variables and was removed. The final sample included 106 adolescents (55% girls; 28% African Americans, 72% European Americans).

Procedure

      This study was approved by the university internal review board. Parents and children gave informed consent and assent and received monetary compensation for participating. Sleep was assessed during the school year. Children were instructed to wear actigraphs on their non-dominant wrist from bedtime to waking for 7 consecutive nights. Concurrently, parents kept a sleep diary with records of the child's bedtimes and wake times to corroborate actigraphy data (Acebo & Carskadon, 2001). Research assistants called the family each day to record these times. Participants and their families visited the lab, on average, 0.72 days ($SD = 5.46$) following the final day of wearing the actigraph to complete questionnaires.

Measures (all questionnaires are included in Appendix A)

      Perceived attachment. Children completed the Inventory of Parent and Peer Attachment (IPPA; Armsden & Greenberg, 1987), a reliable and valid measure of perceived attachment to both mothers and fathers (Adam & Chase-Lansdale, 2002; Formoso, Gonzales, & Aiken, 2000; Pavlidis & McCauley, 2001). The IPPA measures the extent to which children consider their parents to be sources of emotional security. The scale consists of 25 items, rated on a five-point scale (1 = *almost never or never true* to 5 = *almost always or always true*). The IPPA is comprised of three subscales: Trust, Communication, and Alienation. A 10-item subscale assesses how much children trust their parents (e.g., "My mother/father respects my feelings," "My mother/father trusts my judgment," and "I trust my mother/father"). A nine-item scale assesses the quality of communication with parents (e.g., "I like to get my mother's/father's point of view on things that I am concerned about," "My mother/father can tell when I'm upset about something," and "My mother/father helps me to talk about my difficulties"). Finally, a six-item scale assesses alienation toward parents (e.g., "Talking over my problems with my

mother/father makes me feel ashamed or foolish," "I get upset easily around my mother/father," and "I don't get much attention from my mother") and items were reverse-coded. Scores across these scales were summed to create a single score of perceived attachment, consistent with what has been done previously in the literature (Fass & Tubman, 2002; Ryan, Solberg, & Brown, 1996; Wilkinson, 2004). High scores indicate higher levels of perceived attachments. Reliability for the present sample was high for perceived attachment to mothers and fathers (α = .91 and .88, respectively). Perceived attachment will be referred to as attachment in the interest of brevity.

Sleep assessments.

Actigraphy. Children's sleep was measured using actigraphs, devices that resemble wristwatches and measure motion. Motionlogger Octagonal Basic actigraphs were used (Ambulatory Monitoring Inc., Ardsley, NY), as well as the Octagonal Motionlogger Interface, ACTme Software, and Analysis Software Packages (ActionW2, 2002; Ambulatory Monitoring Inc., Ardsley, NY). This analysis software was used to convert raw data to the desired sleep variables. Sleep was analyzed in one-minute epochs as sleep or wake states using Sadeh's scoring algorithm (Sadeh, Sharkey, & Carskadon, 1994), which provides good reliability (Acebo et al., 1999) and validity (Sadeh, Acebo, Seifer, Aytur, & Carskadon, 1995; Sadeh et al., 2002) when assessed across multiple consecutive nights. Three well-established sleep variables were examined: (1) total sleep minutes: the number of minutes scored as sleep between falling asleep and waking; (2) sleep efficiency: the percent of minutes between falling asleep and waking that are scored as sleep; and (3) long wake episodes: the number of night wakings lasting 5 minutes or longer. A full 7 nights of valid actigraphy data were available for 55% of the sample. Twenty-three percent of children had 6 nights of actigraphy data, 9% had 5 nights, and 13% had

4 nights or fewer. Missing data was due to malfunctioning equipment, forgetting to wear the actigraph, or the use of medications that affect sleep and exclusion of these nights from analyses. Only data for individuals with 5 nights or more of valid actigraphy data (87%) were included in analyses based on prior recommendation (Meltzer, Montgomery-Downs, Insana, & Walsh, 2012). Data for all available nights were averaged to create the various sleep parameters. Cronbach's alphas assessing stability across all available nights of actigraphy data were .79 for total sleep minutes, .90 for sleep efficiency, and .83 for long wake episodes.

Subjective sleep. In addition to actigraphy, sleep was assessed via child reports on the School Sleep Habits Survey (SSHS; Wolfson & Carskadon, 1998). The SSHS has been shown to have good reliability and validity (Carskadon, Seifer, & Acebo, 1991; Wolfson et al., 2003). The Sleep/Wake Problems scale, consisting of 15 items, measured how often children had irregular sleep schedules, stayed up late at night, overslept in the morning, and had trouble going to sleep or staying asleep during the past two weeks. For each item, children indicated on a 5-point scale how often the situation occurred, from 1 = *never* to 5 = *every day/night*. Reliability was acceptable ($\alpha = .70$).

Externalizing symptoms. Parents completed the 24-item Externalizing scale of the Personality Inventory for children (PIC; Wirt, Lachar, Klinedinst, & Seat, 1990), which is composed of items from the Impulsivity and Distractibility and Delinquency scales. Parents answered "true" or "false" on items describing child behavior (e.g., "My child often disobeys me," and "My child plays with friends who are often in trouble"). Higher scores indicate greater externalizing symptoms. Six percent of youth scored in the borderline or clinical range (*T* scores ≥ 60; (Lachar & Gruber, 1995). Alphas indicated good internal consistency for mother (.93) and

father (.91) reports. Mother and father scores were highly correlated ($r = .85$) and averaged to create a single score for externalizing behaviors.

Internalizing symptoms. Children completed the 37-item Revised Children's Manifest Anxiety Scale (RCMAS; Reynolds & Richmond, 1978). The scale assesses whether participants felt anxious in various situations, with participants responding $0 = no$ or $1 = yes$. Example items include "I get nervous when things do not go the right way for me," "I worry about what is going to happen," and "Often I feel sick in my stomach." Higher scores indicate greater anxiety symptoms. Two items related to sleep problems were removed from the scale. The clinical cutoff level is greater than two standard deviations above the mean score, and 6% of adolescents scored in the clinical range ($n = 6$). The RCMAS has high test-retest reliability, $r = .88$ (Wisniewski, Mulick, Genshaft, & Coury, 1987) and high concurrent validity (James, Reynolds, & Dunbar, 1994). Internal consistency for the RCMAS in the present study was relatively high, $\alpha = .82$

Children also completed the 26-item Childhood Depression Inventory (CDI; Kovacs, 1985) (one item regarding suicidal ideation was excluded, as were two items pertaining to sleep problems). Items each included three possible responses; for example, $0 = I$ am sad once in a while, $1 = I$ am sad many times, and $3 = I$ am sad all the time. Higher scores indicate greater depressive symptoms. The clinical cutoff is at scores of 20 or higher, and no adolescents scored in the clinical range. The CDI has been shown to have high internal consistency ($r = .82$ to $r = .86$) and high test-retest reliability ($r = .82$) (Kovacs, 1985). In this study, internal consistency for the CDI was relatively high, $\alpha = .81$.

Self-Esteem. Children completed the 18-item Global Self-Worth Scale of the Self-Perception Profile for Children (SPPC; Harter, 1985). Items contained two opposing statements

(e.g. "Some kids are often unhappy with themselves BUT Other kids are pretty pleased with themselves," and "Some kids wished that more people their age liked them BUT Other kids feel that most people their age do like them"); children chose between them and rated either the first or second statement as "really true for me" or "sort of true for me." The SPPC has acceptable test-retest reliability ($r = .69$ to $r = .87$), subscale reliability ($r = .73$ to $r = .83$) and validity (Harter, 1982). Internal consistency was good, $\alpha = .81$.

      Control variables. To reduce potential confounds, multiple demographic variables were controlled in analyses. These include child sex (0 = *female* and 1 = *male*), ethnicity (0 = *European American* and 1 = *African American*), family income, and body mass index (BMI). Parents reported on annual household income on a 6-point scale (1 = *less than $10,000* to 6 = *greater than $75,000*). Age was considered as a potential covariate but was not retained because it was unrelated to any of the main study variables. BMI was controlled due to its links with sleep (Cappuccio, Taggart, Kandala, & Currie, 2008), and was calculated based on measurements taken during lab sessions of children's height in inches and weight in pounds. Height and weight were entered into a BMI calculator for children and teenagers (CDC; apps.nccd.cdc.gov/dnpabmi) to derive ratings that were sex- and age-specific.

Analysis Plan

      Study variables were checked for outliers, and control and predictor variables were mean-centered for analyses. Path models were fit in Amos 21 (Arbuckle, 2012), which uses full information maximum likelihood (FIML) estimation to handle missing data (Acock, 2005). Models were fit with perceived attachment to mothers and fathers separately so as not to remove meaningful shared variance between attachment to mothers and fathers. Variables for objective measures of sleep duration and quality, as well as subjective measures of sleep quality were

entered separately to prevent the removal of meaningful shared variance among sleep indices. Control variables, including sex, ethnicity, family income, and child BMI were entered in the first step, followed by main effects of perceived attachment to mothers or fathers in the second step, then each sleep index in the third step, which included total sleep minutes, sleep efficiency, long wake episodes, and Sleep/Wake problems. To examine additive (unique) effects of sleep variables on youth outcomes (e.g., after accounting for the effects of control and attachment variables), sleep indices were entered one at time. To test moderation effects, interactions between perceived attachment and each sleep parameter were tested one at a time in the fourth step. The conceptual model of main and interaction effects on adolescent adjustment is shown in Figure 1.

Recommendations from Aiken and West (1991) were used for calculating simple slopes and intercepts to test for significant interactions. We plotted significant interactions using the Preacher interaction utility (Preacher, Curran, & Bauer, 2006), with associations between attachment and adjustment shown at high and low levels (+1 and –1 *SD*, respectively) of sleep indices.

Preliminary Analyses

Means, standard deviations, and correlations among primary variables are presented in Table 1. All study variables had skewness statistics within an acceptable range (Kline, 2005). Adolescents' attachment to mothers was strongly and positively correlated with attachment to fathers. Higher levels of perceived attachment to mothers and fathers were related to fewer self-reported Sleep/Wake problems; lower externalizing, anxiety, and depressive symptoms; as well as higher self-esteem. Among actigraphy-based sleep parameters, longer sleep was related to higher sleep efficiency, and both were correlated with fewer long wake episodes. Furthermore, more sleep minutes and higher sleep efficiency were related to lower depressive symptoms, whereas greater Sleep/Wake problems were associated with higher externalizing, anxiety, and depressive symptoms, as well as lower self-esteem. All of the outcome variables were associated in the expected directions.

Regarding control variables, none were significantly correlated with either the attachment or outcome variables. T-tests were conducted to examine sex- and ethnicity-related effects. Compared to boys, girls had more sleep minutes ($M_{girls} = 450.90$ minutes, $SD = 65.49$; $M_{boys} = 406.57$ minutes, $SD = 68.29$; $t = 2.96$, $p < .01$), better sleep efficiency ($M_{girls} = 89.53\%$, $SD = 6.49$; $M_{boys} = 84.39\%$, $SD = 9.01$; $t = 2.87$, $p < .01$), and fewer long wake episodes ($M_{girls} = 3.23$ episodes, $SD = 2.07$; $M_{boys} = 4.43$ episodes, $SD = 2.53$; $t = -2.32$, $p < .05$). There were no significant ethnicity-related effects for any of the predictor or outcome variables.

Predicting Externalizing Symptoms

Results from regression analyses examining objective and subjective sleep parameters are presented in Tables 2 and 3, respectively. None of the control variables were significant

predictors of externalizing symptoms in models involving attachment to mothers or fathers. Given the cross-sectional design, prediction is used in the statistical versus causal sense.

Attachment to mothers. As shown in Tables 2 and 3, main effects of adolescent attachment to mothers emerged, such that higher levels of attachment predicted lower externalizing symptoms. Further, after accounting for the effects of the control and attachment variables, higher levels of Sleep/Wake problems were associated with elevated externalizing symptoms (Table 3). In addition, Sleep/Wake problems moderated relations between attachment to mothers and externalizing symptoms at the non-significant trend level ($p < .10$; Table 3).

As shown in Figure 2, perceived attachment to mothers was negatively associated with externalizing symptoms among adolescents with higher but not lower levels of subjective Sleep/Wake problems. Adolescents with fewer sleep problems had relatively lower levels of externalizing symptoms regardless of the level of attachment. Further, at higher levels of perceived attachment, adolescents with greater and fewer sleep problems had similar levels of externalizing symptoms. However, at lower levels of attachment, predicted means of externalizing symptoms are higher for youth with greater in comparison to fewer sleep problems. Finally, the highest predicted level of externalizing behaviors was observed for youth with lower levels of perceived attachment in conjunction with higher sleep problems.

Attachment to fathers. As shown in Tables 2 and 3, main effects of adolescent attachment to fathers emerged, such that higher levels of attachment predicted lower levels of externalizing symptoms. Further, after accounting for control and attachment variables, subjective Sleep/Wake problems were positively associated with externalizing behaviors (Table 3). Neither objective nor subjective sleep variables moderated relations between perceived attachment and externalizing symptoms.

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Predicting Anxiety Symptoms

Results from regression analyses examining actigraphy-based and subjective sleep parameters are presented in Tables 4 and 5, respectively. None of the control variables were significant predictors of anxiety symptoms.

Attachment to mothers. As shown in Tables 4 and 5, higher levels of attachment predicted lower levels of anxiety symptoms. Furthermore, additive effects emerged after accounting for control and attachment variables. Longer sleep duration, higher sleep efficiency, and fewer long wake episodes ($p < .10$) predicted lower levels of anxiety (Table 4). Similarly, higher levels of subjective sleep problems predicted lower levels of anxiety (Table 5). Furthermore, sleep efficiency and long wake episodes moderated the link between perceived attachment and anxiety (Table 4). Graphing of the interaction terms are depicted in Figures 3 and 4.

As shown in Figure 3, there was a negative association between attachment and anxiety among adolescents with lower and higher sleep efficiency, but the association was stronger for the latter. At lower levels of perceived attachment, adolescents had similarly high levels of anxiety symptoms regardless of their sleep efficiency. However, at higher levels of perceived attachment, adolescents with lower sleep efficiency had greater anxiety symptoms than those with higher sleep efficiency. Further, as shown in Figure 4, there was a negative association between attachment and anxiety among adolescents with greater and fewer long wake episodes, but the association was stronger for the latter. At lower levels of perceived attachment, adolescents with fewer long wake episodes had higher predicted means for anxiety symptoms than those with greater long wake episodes, but at higher levels of perceived attachment all youth had similarly low levels of anxiety.

Attachment to fathers. As shown in Tables 4 and 5, higher levels of attachment predicted lower levels of anxiety symptoms. Additionally, additive effects emerged, where longer sleep duration, higher sleep efficiency, fewer long wake episodes ($p < .10$; Table 4), and fewer Sleep/Wake problems (Table 5) predicted lower levels of anxiety symptoms after accounting for control and attachment variables. Further, sleep efficiency and long wake episodes moderated the link between perceived attachment and anxiety.

As shown in Figure 5, there was a negative relation between perceived attachment and anxiety only for adolescents with higher sleep efficiency. Adolescents with better sleep, compared to their counterparts, had higher anxiety scores at lower levels of perceived attachment and lower anxiety scores at higher levels of perceived attachment. A very similar pattern emerged for long wake episodes, as shown in Figure 6.

Predicting Depressive Symptoms

Results from regression analyses examining actigraphy-based sleep and subjective sleep parameters are presented in Tables 6 and 7, respectively. Among control variables, ethnicity was significantly associated with depressive symptoms, such that European Americans reported greater depressive symptoms. Income was negatively related to depressive symptoms at a non-significant trend level, such that adolescents from families with lower incomes reported greater depressive symptoms than those from families with higher incomes.

Attachment to mothers. As shown in Tables 6 and 7, in addition to the effects of higher perceived attachment predicting lower depressive symptoms, unique (additive) effects of objective and subjective sleep also emerged. Specifically, longer sleep, higher sleep efficiency, fewer long wake episodes ($p < .10$; Table 6), and fewer Sleep/Wake problems (Table 7) also predicted lower levels of depressive symptoms. There were no significant moderation effects.

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Attachment to fathers. As shown in Tables 6 and 7, higher levels of attachment predicted lower depressive symptoms. Further, after controlling for control and attachment variables, longer sleep duration, higher sleep efficiency, fewer long wake episodes ($p < .10$; Table 6), and fewer Sleep/Wake problems (Table 7) predicted lower depressive symptoms. Only subjective Sleep/Wake problems moderated the link between perceived attachment and depressive symptoms at a non-significant trend level ($p < .10$; Table 7).

As shown in Figure 7, there was a significant negative association between perceived attachment and depressive symptoms for adolescents with more Sleep/Wake problems. At lower levels of perceived attachment, adolescents with worse sleep had higher depressive symptoms than adolescents with better sleep, whereas at higher levels of perceived attachment, both groups had nearly identical predicted levels of depressive symptoms.

Predicting Self-Esteem

Results from regression analyses examining actigraphy-based and subjective sleep parameters are presented in Tables 8 and 9, respectively. Regarding control variables, higher income was associated with higher self-esteem.

Attachment to mothers. As shown in Tables 8 and 9, main effects of adolescent attachment to mother emerged, such that higher levels of attachment to mothers predicted higher self-esteem. Further, additive effects of sleep were evident. Specifically, longer sleep duration (Table 8) and fewer Sleep/Wake problems (Table 9) predicted higher self-esteem. Yet, only sleep efficiency moderated the link between perceived attachment and self-esteem.

As shown in Figure 8, there was a significant positive relation between perceived attachment and self-esteem only for adolescents with lower sleep efficiency. At lower levels of perceived attachment, predicted means for self-esteem were higher for adolescents with higher

rather than lower sleep efficiency. At higher levels of perceived attachment, adolescents had similar levels of self-esteem regardless of sleep efficiency.

Attachment to fathers. As shown in Tables 8 and 9, higher attachment to fathers predicted higher self-esteem. Longer sleep durations (Table 8) and fewer Sleep/Wake problems (Table 9) predicted greater self-esteem. Only Sleep/Wake problems moderated the link between perceived attachment and self-esteem.

As shown in Figure 9, there was a significant positive relation between perceived attachment and self-esteem for adolescents with greater Sleep/Wake problems. For youth with fewer sleep problems, relatively high levels of self-esteem were observed regardless of attachment. At lower levels of perceived attachment, adolescents with worse sleep had lower predicted means for self-esteem compared to those with better sleep. At higher levels of perceived attachment, adolescents had similar levels of self-esteem regardless of sleep problems.

V. DISCUSSION

Extending the literature examining sleep as a moderator of relations between adjustment problems and other forms of family functioning (maternal sensitivity, marital conflict, psychological control), the present study sought to examine the role of sleep as a moderator of the link between perceived attachment and internalizing symptoms, externalizing symptoms, and self-esteem in adolescence. A secondary aim was to examine the additive effects of sleep on adjustment problems after accounting for the effects of perceived attachment. Perceived attachment to mothers and fathers were assessed.

As expected, main effects of attachment to mothers and fathers emerged such that higher levels of perceived attachment were associated with lower levels of externalizing, anxiety, and depressive symptoms, as well as higher self-esteem, in line with previous literature (Buist et al., 2004; Fearon et al., 2010; Wilkinson, 2004). After accounting for control and attachment variables, additive effects emerged for sleep variables, in which longer and better quality sleep predicted better adjustment outcomes. No additive effects of actigraphy-based sleep emerged in predicting externalizing symptoms, and only sleep minutes had additive effects in predicting self-esteem. All other additive effects were significant, indicating that sleep is an important factor in the prediction of adjustment outcomes. In addition, actigraphy-based sleep indices moderated associations linking mother- and father-child attachment with anxiety, as well as mother-child attachment with self-esteem. Sleep/Wake problems moderated the association linking father-child attachment with self-esteem and depressive symptoms (trend level), as well as between mother-child attachment and externalizing symptoms (trend level).

The present study's findings highlight the role of both mother-child and father-child attachment, suggesting that attachment to both parents may have an influential role on youth

adjustment. These findings are not only consistent with findings from previous studies

conducted with children (Harold et al., 2004) and older adolescents (Allen et al., 2007; Muris et

al., 2003), but extends the literature by providing evidence of the role of parent-child attachment

in early adolescence (de Minzi, 2006; Roelofs, Meesters, ter Huurne, Bamelis, & Muris, 2006).

Not only did a similar pattern of main and interactive effects emerge for mothers and fathers, but

some interactive associations that were unique to mothers and fathers were also evident. These

findings are suggestive of the need to investigate attachment to both parents (Belsky, 1997; van

IJzendoorn & De Wolff, 1997). The specific patterns of associations for perceived attachment to

mothers and fathers will be discussed further below.

Externalizing Symptoms

Main effects indicated that attachment was negatively related to externalizing symptoms.

When adolescents reported higher levels of attachment to both mothers and fathers, they had

lower externalizing symptoms based on mothers' and fathers' reports. These findings are

consistent with prior findings in the literature on mother and father-child attachment (Allen et al.,

2007; Fearon et al., 2010; Muris et al., 2003), and demontrate that such effects hold for perceived

attachments to mothers and fathers. Higher levels of perceived attachment may allow

adolescents to generalize the ability to interact positively with their parents to a wider range of

social settings (Allen et al., 1998). In contrast, low levels of attachment may foster adolescents'

sense of hostility towards parents, and contribute to externalizing symptoms (Allen et al., 1997;

Greenberg & Speltz, 1988; Patterson et al., 1989).

Additive effects of Sleep/Wake problems were found after accounting for control and

attachment variables, such that adolescents with greater Sleep/Wake problems had higher levels

of externalizing symptoms. Sleep problems have previously been found to be related to

externalizing symptoms (Astill et al., 2012; El-Sheikh, Erath, et al., 2007). This association may be due to sleep problems leading to impulsivity (Chervin, Dillon, Bassetti, Ganoczy, & Pituch, 1997) or contributing to worsening moods or difficulties regulating emotions (Baum et al., 2014; Gruber et al., 2012).

Central to this investigation, and consistent with our hypothesis that better sleep would protect against maladjustment in the context of risk (i.e., lower levels of attachment), Sleep/Wake problems moderated the association between attachment to mothers and externalizing symptoms at the non-significant trend level. Given the novelty of the research questions, we chose to interpret interaction effects at the trend level. However, these effects should be considered preliminary until replicated. Adolescents at greatest risk for externalizing symptoms were those with more Sleep/Wake problems and lower levels of attachment. Conversely, adolescents with at least one protective factor, either higher levels of attachment or fewer Sleep/Wake problems, had similarly low levels of externalizing symptoms. This pattern of effects is consistent with the dual-risk model, where adolescents who experienced two risks factors (i.e., poorer sleep and lower attachment) had the worst outcomes. Although this finding should be interpreted with caution since the effect did not reach conventional levels of significance, there is some evidence in the literature supportive of this pattern of association. For instance, Keller et al. (2008) found a similar pattern of effects, where low levels of attachment combined with poorer sleep predicted lower math scores. Similarly, Lemola and colleagues (2012) found that a combination of poorer sleep and higher interparental conflict resulted in greater aggressive behavior. Whereas higher levels of attachment and/or higher quality sleep may protect adolescents against externalizing symptoms, a combination of lower attachment and poorer sleep may leave them at risk of developing greater externalizing symptoms.

Anxiety Symptoms

Consistent with previous studies including both mothers and fathers (Allen et al., 2007; Harold et al., 2004; Muris et al., 2003), mother- and father-child attachment were negatively related to anxiety symptoms. Adolescents with higher levels of attachment to their parents had lower levels of anxiety symptoms. Some forms of childhood anxiety, particularly separation anxiety, may be related to children's perceptions that parents are not available, and is commonly associated with insecure attachment (Bowlby, 1973). After accounting for control and attachment variables, additive efects of sleep were found. Similar to findings in the literature (Astill et al., 2012; El-Sheikh, Buckhalt, et al., 2007; Sadeh et al., 2014), adolescents with longer sleep durations, higher sleep efficiency, fewer long wake episodes, or fewer Sleep/Wake problems had lower levels of anxiety symptoms. Poorer sleep may interrupt PFC functioning (Dahl, 1996), which in turn may negatively impact processes required for emotion regulation (Jones & Harrison, 2001), leaving adolescents with poorer sleep susceptible to greater anxiety symptoms.

Further, actigraphy-based sleep efficiency and long wake episodes moderated the associations linking attachment to mothers and fathers with anxiety symptoms. Attachment to mothers was negatively associated with anxiety symptoms for all youth, although the association was stronger for adolescents with higher sleep efficiency or fewer long wake episodes. Conversely, attachment to fathers was only significantly and negatively related for adolescents with higher sleep efficiency or fewer long wake episodes. Importantly, youth with both higher levels of attachment to either mothers or fathers accompanied by better sleep had the lowest predicted means for anxiety symptoms.

This pattern of association is consistent with the dual-protection and protective-reactive moderating process (Luthar et al., 2000) model, where adolescents who had both better sleep and high attachment had the lowest levels of anxiety. Better sleep appears to be more beneficial in the context of lower risk (i.e., higher levels of attachment), but less beneficial in the context of higher risk (i.e., lower levels of attachment). Bordeleau and colleagues (2012) also found a pattern of dual-protection, such that infants had lower levels of internalizing symptoms in the context of high maternal sensitivity. Of note, a similar pattern of effects was found for attachment to mothers and fathers, advancing the literature on father-child attachment and suggesting that sleep problems may operate in a similar manner in the context of mother-child and father-child attachment.

Depressive Symptoms

Similar to previous studies (Laible, Carlo, & Raffaelli, 2000; Raja, McGee, & Stanton, 1992), adolescents with higher levels of attachment to mothers and fathers had lower depressive symptoms. Further, similarly to anxiety, additive effects for all actigraphy-based and subjective sleep indices emerged after accounting for control and attachment variables. Adolescents with longer sleep durations, higher sleep efficiency, fewer long wake episodes, or fewer Sleep/Wake problems had fewer depressive symptoms. A meta-analysis by Astill and colleagues (2012) found similar patterns throughout the literature. Similar to the prediction of anxiety, poorer sleep may have a negative impact on PFC activity and executive functioning, which in turn are associated with emotion regulation and adjustment problems (Dahl, 1996). Additionally, experimental studies have found that short sleep and poor sleep quality predict difficulties regulating emotions and more negative moods (Baum et al., 2014; Gruber et al., 2012), which in turn are associated with internalizing symptoms (Eisenberg et al., 2001).

Further, Sleep/Wake problems moderated the association between attachment to fathers and depressive symptoms at the non-significant trend level, where a negative association emerged for adolescents with greater Sleep/Wake problems, but not among adolescents with fewer sleep problems. A dual-risk pattern of effects emerged such that adolescent with greater Sleep/Wake problems in conjunction with lower levels of attachment had the highest predicted means for depressive symptoms. In contrast, adolescents with either higher levels of attachment, better sleep, or both had relatively low levels of depressive symptoms. This finding should be interpreted with caution since it did not reach the traditional level of significance.

Self-Esteem

Perceived attachment to both parents was positively associated with higher self-esteem. Consistent with prior research, attachment to parents may influence how adolescents think of themselves, such that those with higher levels of attachment view themselves more positively (Wilkinson, 2004). Additive effects emerged, with shorter sleep durations and more Sleep/Wake problems predicting lower self-esteem after accounting for control and attachment variables. This is consistent with findings from Fredriksen and colleagues (2004), who also reported that sleep problems predicted lower levels of self-esteem. Adolescents with poor sleep tend to have worse moods than those with better sleep (Baum et al., 2014), and this disposition may make adolescents more likely to view themselves in a negative manner, whereas those with better sleep are more likely to report positive moods, and may feel more positive about themselves. Self-esteem has been found to decrease during adolescence (Robins, Trzesniewski, Tracy, Gosling, & Potter, 2002), which also coincides with changes in adolescent sleep toward shorter durations and poorer quality due to changes in circadian rhythms and increased academic and social activities (Brand & Kirov, 2011; Crowley, Tarokh, & Carskadon, 2014).

Two moderation effects emerged: sleep efficiency interacted with attachment to mothers, and Sleep/Wake problems interacted with attachment to fathers to predict self-esteem. The pattern of associations across these findings was similar, such that there was a positive association linking attachment with self-esteem among adolescents with poor sleep quality (lower sleep efficiency, more subjective sleep problems), but not better sleep quality. Consistent with dual-risk, it was only in the presence of two risk factors (poor sleep quality and lower levels of attachment) that adolescents were suscepible to lower self-esteem. In contrast, at high levels of attachment, adolescents had similar levels of self-worth regardless of sleep quality. These findings are similar to Keller et al. (2008), in which poorer sleep, combined with lower attachment, predicted the lowest math scores.

Summary of Moderation Effects

Both actigraphy-based sleep quality and subjective sleep moderated links between attachment and self-esteem, whereas only actigraphy-based sleep quality moderated associations between attachment and anxiety, and only subjective sleep moderated associations linking attachment with depression and externalizing symptoms (at the non-significant trend level). There were no significant interactions with actigraphy-based sleep minutes, similar to other findings in the literature (Bordeleau et al., 2012). The different interaction patterns from actigraphy-based sleep and subjective sleep illustrate the importance of using multiple methods of sleep assessment. Subjective assessments of sleep are capable of documenting sleep-related behaviors, whereas actigraphy is able to assess sleep quality and quantity over extended periods of time (Sadeh, 2015). The present study assessed sleep in adolescents through objective actigraphy-based measures and subjective self-reports. Actigraphy and self-reports of sleep problems are related yet distinct, and no correlation was found between subjective and objective

reports of sleep, as is consistent with prior literature (El-Sheikh, Kelly, Buckhalt, & Hinnant, 2010; Sadeh, 2004).

The moderation findings yielded two patterns of effects consistent with dual-risk and dual-protection or protective-reactive patterns. Dual-risk refers to patterns in which a negative attribute (insecure attachment) predicts worse outcomes, but only in the context of high risk (Rutter, 1979; Sameroff, 2000), whereas dual-protection refers to patterns in which an attribute is linked to more positive outcomes, but only in a low-risk context (Luthar et al., 2000). Dual-risk patterns of effects were most common and emerged for externalizing symptoms, depressive symptoms, and self-esteem. In particular, dual-risk patterns emerged with Sleep/Wake problems (as well as one interaction with sleep efficiency moderating links between attachment to mothers and self-esteem), suggesting that Sleep/Wake problems operate in a similar manner across a range of outcomes in the context of attachment. However, some of these interactions only existed at a non-significant trend level. There was no consistent pattern as to whether significant interactions emerged for perceived attachment to mothers or fathers. These dual-risk findings were consistent with Lemola et al. (2012), where more marital conflict and poor sleep predicted more aggressive behavior. Tu and colleagues (2015) found one interaction with a similar dual-risk pattern. Adolescents with higher Sleep/Wake problems had greater internalizing symptoms, but only in conjunction with higher levels of peer victimization.

The dual-protection or protective-reactive patterns are similar to those of a recent study examining interactions between maternal sensitivity and sleep durations predicting attachment security (Bernier et al., 2014). Children with longer sleep durations had higher levels of attachment security, but only when maternal sensitivity was also high. Similarly, Bordeleau et al. (2012) found longer duration and higher quality sleep predicted lower levels of adjustment

problems, but only in the presence of high maternal sensitivity. Lemola et al. (2012) also found a similar pattern for the interaction between weekend sleep duration and adolescents' perceived threat ratings predicting aggressive behavior, where adolescents with longer weekend sleep had lower aggressive behaviors, but only at low levels of perceived threat ratings. A dual-protection and protective-reactive pattern also emerged, where an attribute is more protective in low-risk contexts and less protective in high-risk contexts (Luthar et al., 2000). All four significant interactions predicting anxiety symptoms followed this pattern, in which better actigraphy-based sleep quality (i.e., sleep efficiency and long wake episodes) was only protective at higher levels of attachment, and the benefits of better sleep quality were not evidence at low levels of attachment. A similar pattern of effects was found for perceived attachment to mothers and fathers. El-Sheikh and colleagues (2014) found a similar pattern, where higher sleep efficiency and low-risk parenting predicted the highest intellectual ability. Tu et al. (2015) also found dual-protection patterns. Adolescents with longer sleep durations or higher sleep efficiency had lower internalizing symptoms, but only at lower levels of peer victimization. The authors also found that those with low levels of Sleep/Wake problems had lower externalizing symptoms, but again only at lower levels of peer victimization.

Although interaction effects are difficult to replicate, two patterns (dual-risk and dual-protection) of the moderating role of sleep appear to be emerging in the literature and in the current study. Further research is necessary to determine for which predictors and outcome variables such patterns may emerge. Thus, these findings require replication to ascertain the strength robustness of the effects.

Limitations and Future Directions

The present study has several limitations, which need to be considered. First, this study has a relatively small sample size. This may have made it difficult to detect interaction effects, which require more power than direct effects. Furthermore, the present study was cross-sectional, thus we are unable draw conclusions about the direction of associations. However, there is evidence in the literature suggestive of attachment and sleep predicting concurrent and prospective adjustment (Booth et al., 1994; Fredriksen et al., 2004). And although there is some evidence of reciprocal relations between sleep and adjustment, a recent review concludes that sleep appears to be a stronger predictor of adjustment than the reverse (Sadeh et al., 2014). However, little is known about the moderating role of sleep in prospective associations linking attachment to mothers and fathers (and family functioning in general) with adjustment in adolescence. Although the current study did use parent- and child-reports of the outcome variables, this was not done consistently. Parents alone reported on externalizing behavior, whereas children alone reported on internalizing behavior and self-esteem. Furthermore, this study was conducted with youth in mid-adolescence when attachment relationships with peers are beginning to develop (Lapsley, Rice, & FitzGerald, 1990; Raja et al., 1992), but only attachment to parents was examined. Similarly, sibling relationships were not examined. Future research may address the role of sleep in moderating the associations between peer or sibling attachment and adjustment outcomes, and consider developmental effects in the observed relations. The present study examined a community sample with normative levels of adjustment and sleep problems, which poses boundaries for generalizing the findings to clinical samples.

Lastly, the present study examined the effects of mother- and father-child attachment separately, whereas a recent study by Lansford and colleagues examined joint and separate

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effects of mothering and fathering on youth adjustment (Lansford, Laird, Pettit, Bates, & Dodge, 2014). The authors found a similar pattern of effects when mothering and fathering were examined separately, but differences emerged in the effect of parenting on youth adjustment when mothering and fathering were examined simultaneously. Thus, the joint and separate effects of mother-child and father-child attachment should be considered in future studies. Preliminary analyses included attachment to mothers and fathers in the same model, yet there were few statistically significant findings, and they tended to be inconsistent. This lack of consistent or robust findings may have been due to the removal of meaningful shared variance.

Conclusions

Despite these limitations, the multi-informant, multi-method design of the current study advances the literature by establishing sleep as a moderator of links between perceived attachment to both mothers and fathers and self-esteem as well as internalizing and externalizing symptoms in mid-adolescence. Results highlight the protective function of sleep in some contexts. These findings may have implications for prevention and intervention, as adolescents with lower levels of attachment to parents could particularly benefit from sleep education and interventions to protect against adjustment problems. Further, efforts to improve parent-child relations with both mothers and fathers might also protect against poorer adjustment outcomes.

Table 1.

Descriptive Statistics and Correlations among Primary Study Variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Sex	-													
2. Ethnicity	-.04	-												
3. Income	.11	-.45***	-											
4. Body Mass Index	-.08	.04	-.11	-										
5. Attachment to Mothers	-.09	.06	.15	.14	-									
6. Attachment to Fathers	.12	.03	.13	.01	.62***	-								
7. Overall Sleep Minutes	-.32**	-.13	.05	.08	.06	.03	-							
8. Overall Sleep Efficiency	-.32**	.12	-.09	.10	.10	.04	.68***	-						
9. Overall Long Wake Episodes	.25*	-.17	.18	-.10	-.11	-.07	-.43***	-.88***	-					
10. Sleep/Wake Problems	.08	-.11	-.07	.02	-.31**	-.31**	-.04	-.03	-.05	-				
11. Externalizing Composite	-.02	-.04	-.05	-.07	-.29**	-.26*	.07	.02	-.01	.34***	-			
12. Anxiety Symptoms	-.14	.03	-.13	.02	-.43***	-.39***	-.18	-.21˜	.18	.50***	.31**	-		
13. Depressive Symptoms	-.01	-.14	-.15	.08	-.52***	-.51***	-.24*	-.28*	.22˜	.39***	.36***	.62***	-	
14. Self-Esteem	.14	.07	.21˜	-.13	.38***	.53***	.18	.12	-.02	-.36***	-.23*	-.40***	-.63***	-
Mean	-	-	4.07	20.73	4.23	4.06	430.95	87.22	3.77	19.98	47.39	4.99	4.27	21.09
Standard Deviation			1.24	5.00	0.61	0.68	69.95	8.10	2.35	6.76	7.68	4.37	3.80	3.27

Note. Sex coded 0 = girls, 1 = boys; ethnicity coded 0 = European American, 1 = African American.
˜$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 2.

Unstandardized and Standardized Coefficients of Associations Linking Parent-Child Attachment and Objectively Assessed Sleep with Externalizing Symptoms

	Externalizing Behaviors					
	Attachment to Mothers			Attachment to Fathers		
	B (SE)	β	R^2	*B (SE)*	β	R^2
Step 1			.02			.02
Sex (0 = girls; 1 = boys)	-.15 (1.60)	-.01		-.15 (1.60)	-.01	
Ethnicity (0 = EA; 1 = AA)	-1.22 (1.96)	-.07		-1.22 (1.96)	-.07	
Income	-.61 (.75)	-.10		-.61 (.75)	-.10	
BMI	-.13 (.16)	-.09		-.13 (.16)	-.09	
Step 2			.09			.08
Attachment	-3.62** (1.30)	-.29**		-2.96* (1.16)	-.26*	
Step 3						
Sleep Minutes	.01 (.01)	.11	.10	.01 (.01)	.12	.10
Sleep Efficiency	.06 (.11)	.07	.09	.06 (.11)	.07	.09
Long Wake Episodes	-.44 (.37)	-.14	.11	-.45 (.38)	-.14	.11
Step 4						
Attachment x Sleep Minutes	.03 (.02)	.13	.16	.02 (.02)	.10	.18
Attachment x Sleep Efficiency	.14 (18)	.09	.16	.07 (.15)	.06	.16
Attachment x Long Wake Episodes	.03 (.55)	.01	.16	.04 (.46)	.01	.16

Note. EA = European American, AA = African American, BMI = Body Mass Index. For parsimony, the main effects of the sleep variables and the interactions are shown in the same step, but each were examined one at a time in Steps 3 and 4. Significantly correlated exogenous variables were allowed to covary.
*p < .05. **p < .01. ***p < .001.

Table 3.

Unstandardized and Standardized Coefficients of Associations Linking Parent-Child Attachment and Subjective Sleep Problems with Externalizing Symptoms

	Externalizing Behaviors					
	Attachment to Mothers			Attachment to Fathers		
	B (SE)	β	R^2	*B (SE)*	β	R^2
Step 1			.02			.02
Sex (0 = girls; 1 = boys)	-.15 (1.60)	-.01		-.15 (1.60)	-.01	
Ethnicity (0 = EA; 1 = AA)	-1.22 (1.96)	-.07		-1.22 (1.96)	-.07	
Income	-.61 (.75)	-.10		-.61 (.75)	-.10	
BMI	-.13 (.16)	-.09		-.13 (.16)	-.09	
Step 2			.09			.08
Attachment	-3.62** (1.30)	.-.29**		-2.96* (1.16)	-.26*	
Step 3			.12			.12
Sleep/Wake problems	.32** (.11)	.29**		.33** (.11)	.29**	
Step 4			.15			.12
Attachment x Sleep/Wake problems	-.26˜ (.16)	-.18˜		-.11 (.20)	-.06	

Note. EA = European American, AA = African American, BMI = Body Mass Index. For parsimony, the main effects of the sleep variables and the interactions are shown in the same step, but each were examined one at a time in Steps 3 and 4. Significantly correlated exogenous variables were allowed to covary.
˜$p < .10$. *$p < .05$. **$p < .01$.

Table 4.

Unstandardized and Standardized Coefficients of Associations Linking Parent-Child Attachment and Objectively Assessed Sleep with Anxiety Symptoms

	Anxiety Symptoms					
	Attachment to Mothers			Attachment to Fathers		
	B (SE)	β	R^2	*B (SE)*	β	R^2
Step 1			.03			.03
Sex (0 = girls; 1 = boys)	-1.17 (.90)	-.13		-1.17 (.90)	-.13	
Ethnicity (0 = EA; 1 = AA)	-.18 (1.10)	-.02		-.18 (1.10)	-.02	
Income	-.35 (.43)	-.10		-.35 (.43)	-.10	
BMI	-.01 (.09)	-.01		-.01 (.09)	-.01	
Step 2			.24			.15
Attachment	-3.35*** (.69)	-.47***		-2.38*** (.62)	-.37***	
Step 3						
Sleep Minutes	-.02* (.01)	-.24*	.30	-.01* (.01)	-.23*	.20
Sleep Efficiency	-.14* (.06)	-.25*	.30	-.14* (.06)	-.25*	.20
Long Wake Episodes	.36˜ (.20)	.19˜	.28	.37˜ (.20)	.20˜	.18
Step 4						
Attachment x Sleep Minutes	-.02 (.01)	-.13	.32	-.01 (.01)	-.06	.21
Attachment x Sleep Efficiency	-.18* (.09)	-.19*	.35	-.19* (.08)	-.25*	.27
Attachment x Long Wake Episodes	.56* (.27)	.19*	.35	.64** (.23)	.27**	.29

Note. EA = European American, AA = African American, BMI = Body Mass Index. For parsimony, the main effects of the sleep variables and the interactions are shown in the same step, but each were examined one at a time in Steps 3 and 4. Significantly correlated exogenous variables were allowed to covary.
˜*p* < .10. **p* < .05. ***p* < .01. ****p* < .001.

Table 5.

Unstandardized and Standardized Coefficients of Associations Linking Parent-Child Attachment and Subjective Sleep Problems with Anxiety Symptoms

	Anxiety Symptoms					
	Attachment to Mothers			Attachment to Fathers		
	B (SE)	β	R^2	*B (SE)*	β	R
Step 1			.03			.03
Sex (0 = girls; 1 = boys)	-1.17 (.90)	-.13		-1.17 (.90)	-.13	
Ethnicity (0 = EA; 1 = AA)	-.18 (1.10)	-.02		-.18 (1.10)	-.02	
Income	-.35 (.43)	-.10		-.35 (.43)	-.10	
BMI	-.01 (.09)	-.01		-.01 (.09)	-.01	
Step 2			.24			.15
Attachment	-3.35*** (.69)	-.47***		-2.38*** (.62)	-.37***	
Step 3			.42			.35
Sleep/Wake problems	.28*** (.06)	.42***		.29*** (.06)	.45***	
Step 4			.43			.35
Attachment x Sleep/Wake problems	-.07 (.08)	-.08		-.10 (.10)	-.09	

Note. EA = European American, AA = African American, BMI = Body Mass Index. For parsimony, the main effects of the sleep variables and the interactions are shown in the same step, but each were examined one at a time in Steps 3 and 4. Significantly correlated exogenous variables were allowed to covary.
***$p < .001$.

Table 6.

Unstandardized and Standardized Coefficients of Associations Linking Parent-Child Attachment and Objectively Assessed Sleep with Depressive Symptoms

	Depressive Symptoms					
	Attachment to Mothers			Attachment to Fathers		
	B (SE)	β	R^2	*B (SE)*	β	R^2
Step 1			.07			.07
Sex (0 = girls; 1 = boys)	.14 (.76)	.02		.14 (.76)	.02	
Ethnicity (0 = EA; 1 = AA)	-2.02* (.93)	-.25*		-2.02* (.93)	-.25*	
Income	-.68˜ (.36)	-.22˜		-.68˜ (.36)	-.22˜	
BMI	.05 (.08)	.07		.05 (.08)	.07	
Step 2			.32			.31
Attachment	-3.26*** (.56)	-.53***		-2.76*** (.49)	-.49***	
Step 3						
Sleep Minutes	-.01* (.01)	-.25*	.37	-.01* (.01)	-.23*	.36
Sleep Efficiency	-.12** (.05)	-.25**	.36	-.12* (.05)	-.24*	.35
Long Wake Episodes	.29˜ (.16)	.18˜	.34	.28˜ (.16)	.18˜	.33
Step 4						
Attachment x Sleep Minutes	-.01 (.01)	-.06	.39	.01 (.01)	.10	.37
Attachment x Sleep Efficiency	-.02 (.07)	-.03	.38	.01 (.06)	.01	.36
Attachment x Long Wake Episodes	.00 (.14)	.00	.38	.20 (19)	.10	.38

Note. EA = European American, AA = African American, BMI = Body Mass Index. For parsimony, the main effects of the sleep variables and the interactions are shown in the same step, but each were examined one at a time in Steps 3 and 4. Significantly correlated exogenous variables were allowed to covary.
˜$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 7.

Unstandardized and Standardized Coefficients of Associations Linking Parent-Child Attachment and Subjective Sleep Problems with Depressive Symptoms

	Depressive Symptoms					
	Attachment to Mothers			Attachment to Fathers		
	B (SE)	β	R^2	*B (SE)*	β	R^2
Step 1			.07			.07
Sex (0 = girls; 1 = boys)	.14 (.76)	.02		.14 (.76)	.02	
Ethnicity (0 = EA; 1 = AA)	-2.02* (.93)	-.25*		-2.02* (.93)	-.25*	
Income	-.68˜ (.36)	-.22˜		-.68˜ (.36)	-.22˜	
BMI	.05 (.08)	.07		.05 (.08)	.07	
Step 2			.32			.31
Attachment	-3.26*** (.56)	-.53***		-2.76*** (.49)	-.49***	
Step 3			.37			.34
Sleep/Wake problems	.13** (.05)	.24**		.13** (.05)	.23**	
Step 4			.38			.36
Attachment x Sleep/Wake problems	-.08 (.07)	-.11		-.14˜ (.09)	-.15˜	

Note. EA = European American, AA = African American, BMI = Body Mass Index. For parsimony, the main effects of the sleep variables and the interactions are shown in the same step, but each were examined one at a time in Steps 3 and 4. Significantly correlated exogenous variables were allowed to covary.
˜*p* < .10. *p < .05. **p < .01. ***p < .001.

Table 8.

Unstandardized and Standardized Coefficients of Associations Linking Parent-Child Attachment and Objectively Assessed Sleep with Self-Esteem

| | Self-Esteem | | | | | |
| | Attachment to Mothers | | | Attachment to Fathers | | |
	B (SE)	β	R^2	*B (SE)*	β	R^2
Step 1			.08			.08
Sex (0 = girls; 1 = boys)	.64 (.67)	-.10		.64 (.67)	-.10	
Ethnicity (0 = EA; 1 = AA)	1.39˜ (.81)	-.20˜		1.39˜ (.81)	-.20˜	
Income	.68* (.31)	.26*		.68* (.31)	.26*	
BMI	-.07 (.07)	-.11		-.07 (.07)	-.11	
Step 2			.22			.31
Attachment	2.06*** (.53)	.39***		2.41*** (.42)	.51***	
Step 3						
Sleep Minutes	.01* (.01)	.25*	.28	.01* (.01)	.22*	.37
Sleep Efficiency	.06 (.05)	.15	.24	.05 (.04)	.13	.34
Long Wake Episodes	-.03 (.15)	-.02	.22	.00 (.14)	.00	.33
Step 4						
Attachment x Sleep Minutes	-.01 (.01)	-.14	.35	-.01 (.01)	-.09	.41
Attachment x Sleep Efficiency	-.17* (.07)	-.24*	.39	-.03 (.05)	-.05	.40
Attachment x Long Wake Episodes	.26 (.21)	.12	.34	-.01 (.17)	-.01	.40

Note. EA = European American, AA = African American, BMI = Body Mass Index. For parsimony, the main effects of the sleep variables and the interactions are shown in the same step, but each were examined one at a time in Steps 3 and 4. Significantly correlated exogenous variables were allowed to covary.
˜*p* < .10. **p* < .05. ****p* < .001.

Table 9.

Unstandardized and Standardized Coefficients of Associations Linking Parent-Child Attachment and Subjective Sleep Problems with Self-Esteem.

	Self-Esteem					
	Attachment to Mothers			Attachment to Fathers		
	B (SE)	β	R^2	*B (SE)*	β	R^2
Step 1			.08			.08
Sex (0 = girls; 1 = boys)	.64 (.67)	-.10		.64 (.67)	-.10	
Ethnicity (0 = EA; 1 = AA)	1.39˜ (.81)	-.20˜		1.39˜ (.81)	-.20˜	
Income	.68* (.31)	.26*		.68* (.31)	.26*	
BMI	-.07 (.07)	-.11		-.07 (.07)	-.11	
Step 2			.22			.31
Attachment	2.06*** (.53)	.39***		2.41*** (.42)	.51***	
Step 3			.28			.34
Sleep/Wake problems	-.12** (.05)	-.25**		-.10* (.04)	-.21*	
Step 4			.30			.39
Attachment x Sleep/Wake problems	.09 (.06)	.14		.18** (.07)	.23**	

Note. EA = European American, AA = African American, BMI = Body Mass Index. For parsimony, the main effects of the sleep variables and the interactions are shown in the same step, but each were examined one at a time in Steps 3 and 4. Significantly correlated exogenous variables were allowed to covary.
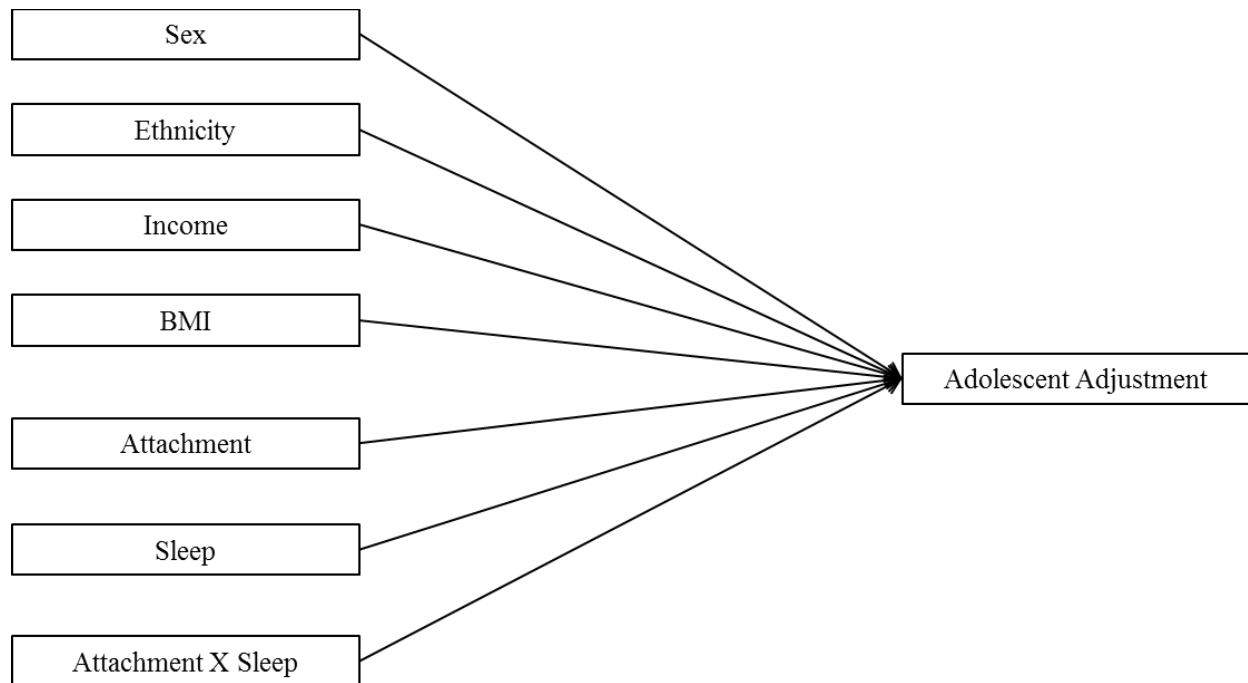˜$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$

Figure 1. Conceptual model depicting main effects and interaction between attachment and sleep in the prediction of adolescent adjustment. Significantly correlated exogenous variables were allowed to covary.
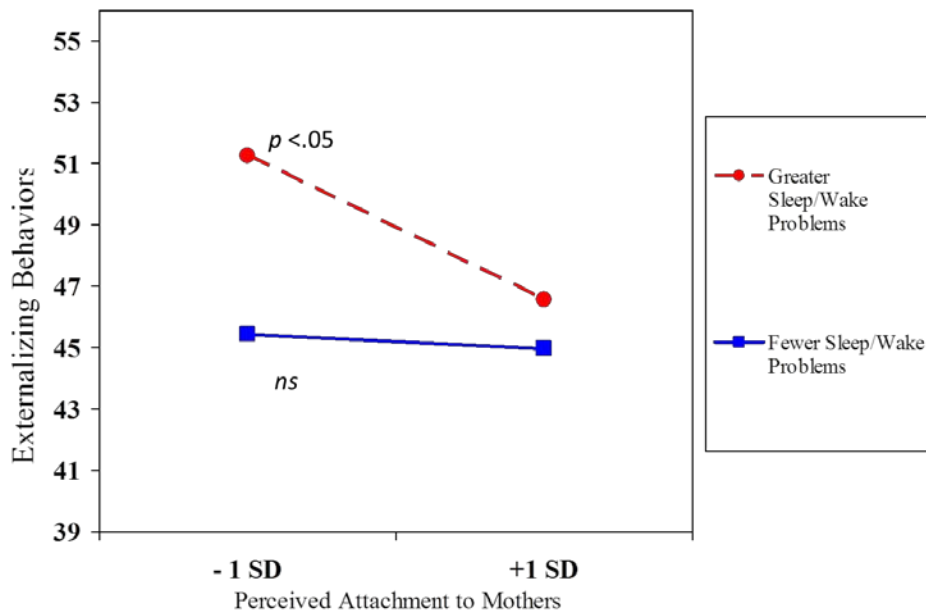

Figure 2. Perceived attachment to mothers predicting externalizing symptoms at lower (-1 *SD*) and higher (+1 *SD*) levels of Sleep/Wake problems.
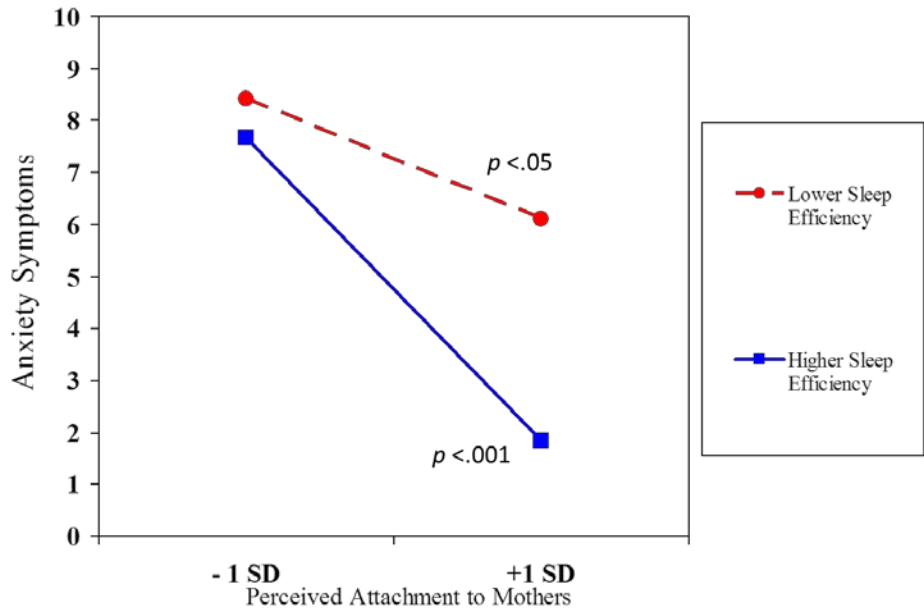
Figure 3. Perceived attachment to mothers predicting anxiety symptoms at lower (-1 *SD*) and higher (+1 *SD*) levels of sleep efficiency.
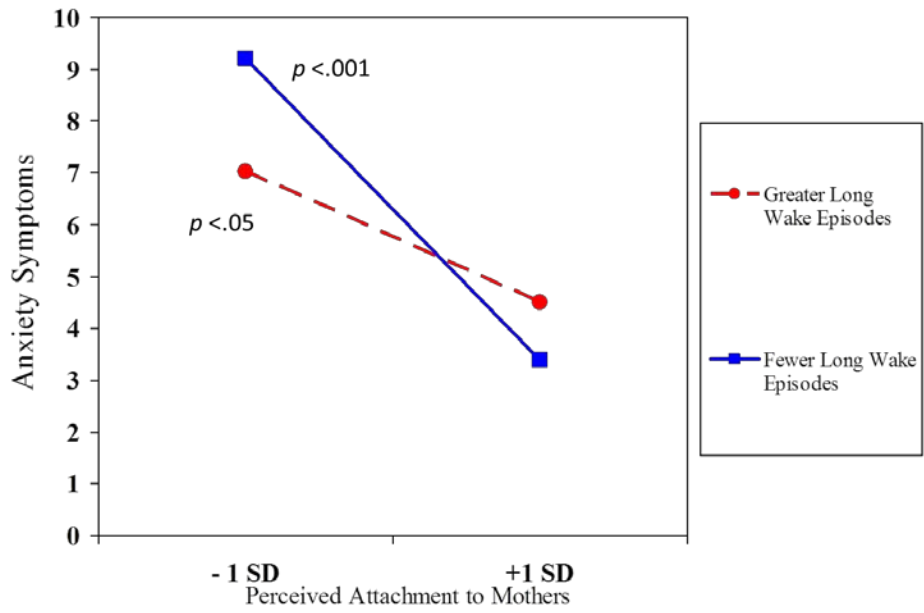

Figure 4. Perceived attachment to mothers predicting anxiety symptoms at lower (-1 *SD*) and higher (+1 *SD*) levels of long wake episodes.
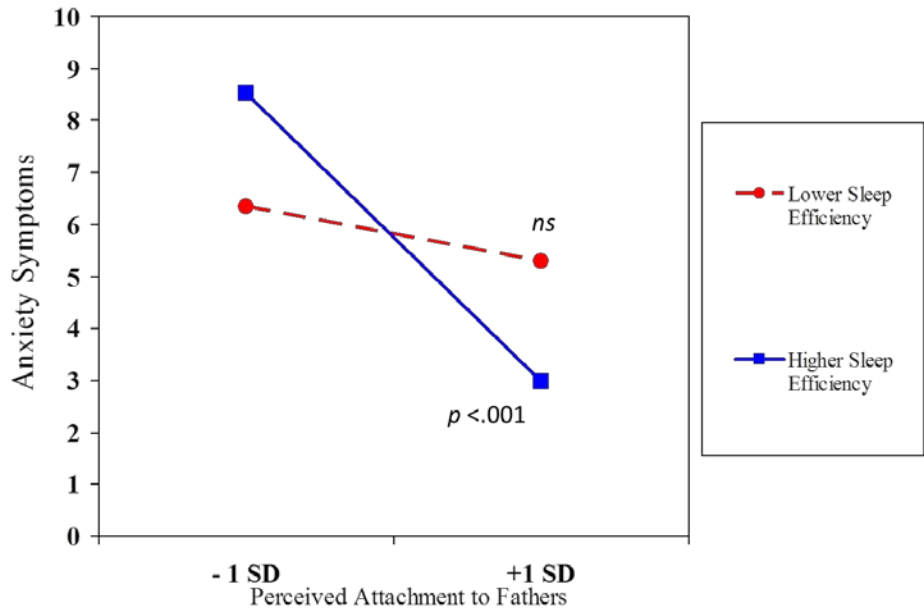
Figure 5. Perceived attachment to fathers predicting anxiety symptoms at lower (-1 *SD*) and higher (+1 *SD*) levels of sleep efficiency.
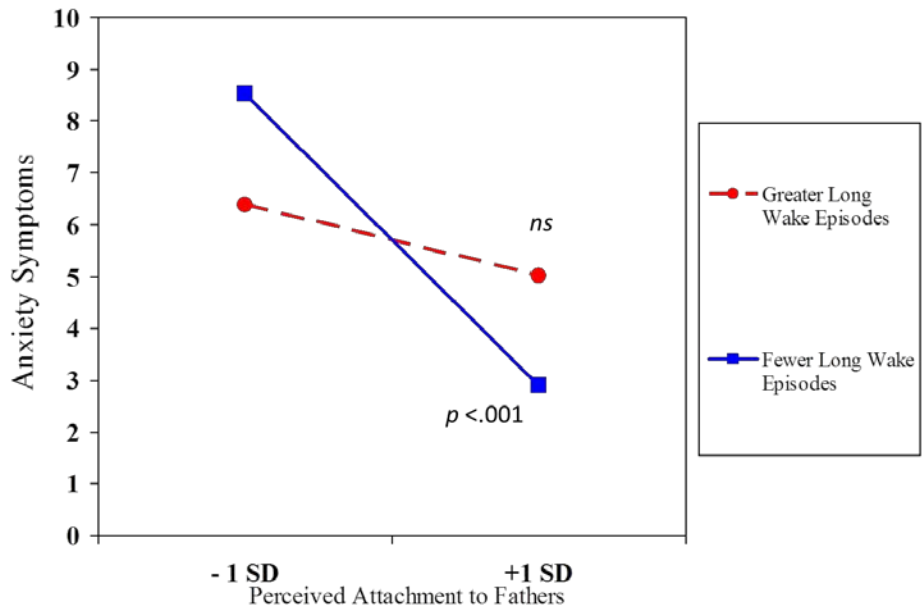

Figure 6. Perceived attachment to fathers predicting anxiety symptoms at lower (-1 *SD*) and higher (+1 *SD*) levels of long wake episodes.

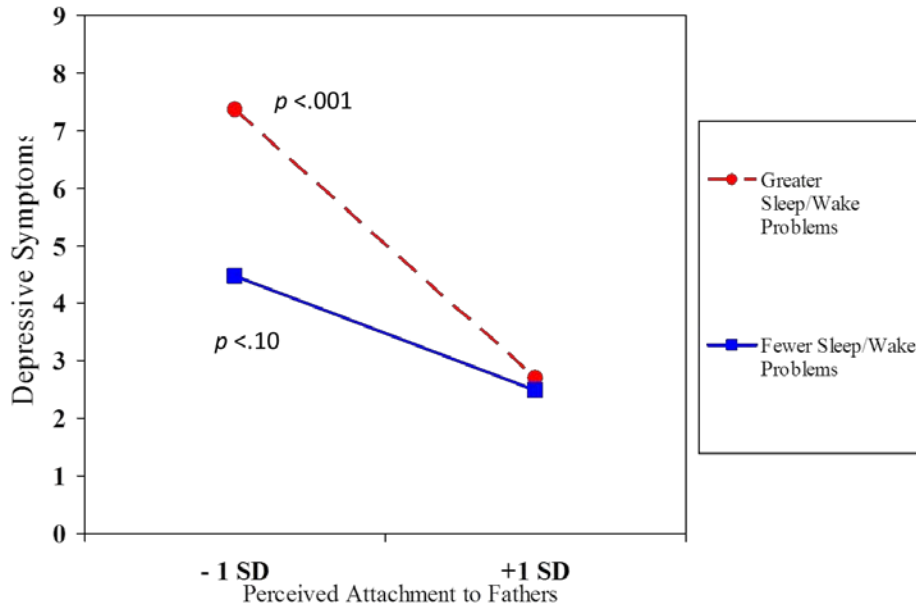*Figure 7.* Perceived attachment to fathers predicting depressive symptoms at lower (-1 *SD*) and higher (+1 *SD*) levels of Sleep/Wake problems.
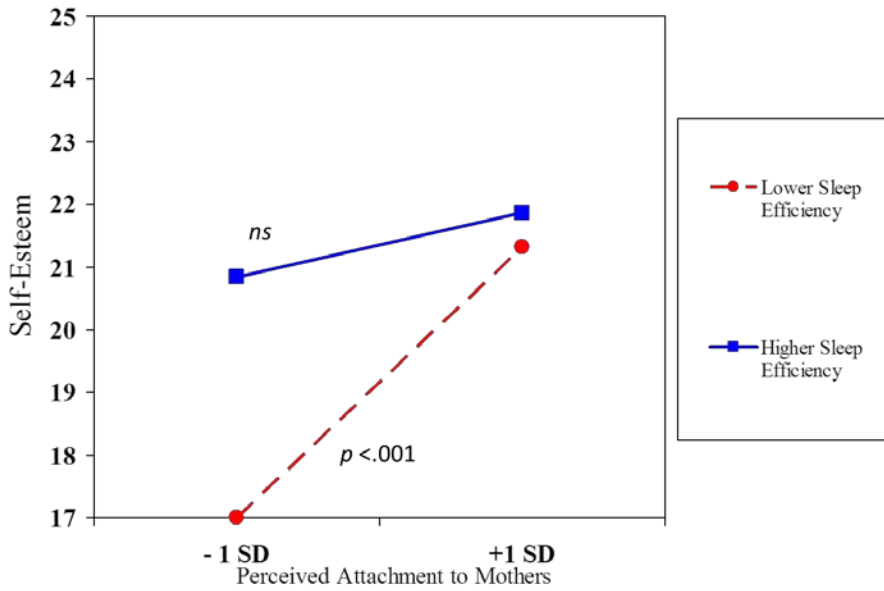

Figure 8. Perceived attachment to mothers predicting self-esteem at lower (-1 *SD*) and higher (+1 *SD*) levels of sleep efficiency.
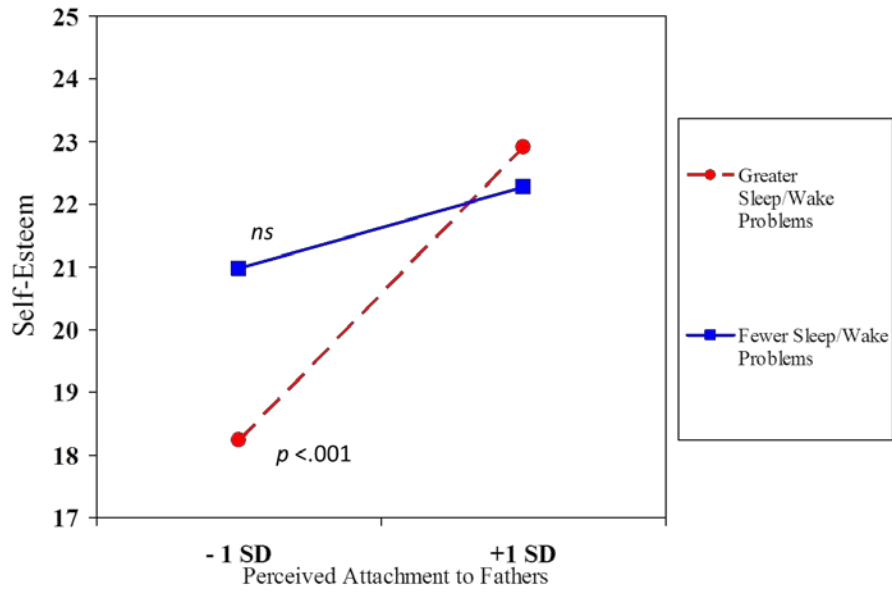
Figure 9. Perceived attachment to fathers predicting self-esteem at lower (-1 *SD*) and higher (+1 *SD*) levels of Sleep/Wake problems.

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APPENDICES

Measures

Inventory of Parent and Peer Attachment (parent version)

This questionnaire asks about your relationships with important people in your life—your mother, your father, and your close friends. Please read the directions to each part carefully.

Part I

Each of the following statements asks about your *mother*, or the woman who as acted as your mother. If you have more than one person acting as your mother (e.g. natural mother and a stepmother) answer the questions for the one you feel has most influenced you.

Please read each statement and circle the *ONE* number that tells how true the statement is for you now.

	Almost never or never true	Not very often true	Sometimes true	Often true	Almost always or always true
1. My mother respects my feelings.	1	2	3	4	5
2. I feel my mother does a good job as my mother.	1	2	3	4	5
3. I wish I had a different mother.	1	2	3	4	5
4. My mother accepts me as I am.	1	2	3	4	5
5. I like to get my mother's point of view on things that I am concerned about.	1	2	3	4	5
6. I feel it's no use letting my feelings show around my mother.	1	2	3	4	5
7. My mother can tell when I'm upset about something.	1	2	3	4	5
8. Talking over my problems with my mother makes me feel ashamed or foolish.	1	2	3	4	5
9. My mother expects too much from me.	1	2	3	4	5

10. I get upset easily around my mother.	1	2	3	4	5
11. I get upset a lot more than my mother knows about.	1	2	3	4	5
12. When we discuss things, my mother cares about my point of view.	1	2	3	4	5
13. My mother trusts my judgment.	1	2	3	4	5
14. My mother has her own problems, so I don't bother her with mine.	1	2	3	4	5
15. My mother helps me to better understand myself.	1	2	3	4	5
16. I tell my mother about my problems and troubles.	1	2	3	4	5
17. I feel angry with my mother.	1	2	3	4	5
18. I don't get much attention from my mother.	1	2	3	4	5
19. My mother helps me to talk about my difficulties.	1	2	3	4	5
20. My mother understands me.	1	2	3	4	5
21. When I am angry about something, my mother tries to be understanding.	1	2	3	4	5
22. I trust my mother.	1	2	3	4	5
23. My mother doesn't understand what I'm going through these days.	1	2	3	4	5
24. I can count on my mother when I need to get something off my chest.	1	2	3	4	5
25. If my mother knows something is bothering me, she asks me about it.	1	2	3	4	5

Part II

This part asks about your feelings about your *father*, or the man who has acted as your father. If you have more than one person acting as your father (e.g. natural and stepfathers) answer the questions for the one you feel has most influenced you.

	Almost never or never true	Not very often true	Sometimes true	Often true	Almost always or always true
1. My father respects my feelings.	1	2	3	4	5
2. I feel my father does a good job as my father.	1	2	3	4	5
3. I wish I had a different father.	1	2	3	4	5
4. My father accepts me as I am.	1	2	3	4	5
5. I like to get my father's point of view on things that I am concerned about.	1	2	3	4	5
6. I feel it's no use letting my feelings show around my father.	1	2	3	4	5
7. My father can tell when I'm upset about something.	1	2	3	4	5
8. Talking over my problems with my father makes me feel ashamed or foolish.	1	2	3	4	5
9. My father expects too much from me.	1	2	3	4	5
10. I get upset easily around my father.	1	2	3	4	5
11. I get upset a lot more than my father knows about.	1	2	3	4	5
12. When we discuss things, my father cares about my point of view.	1	2	3	4	5
13. My father trusts my judgment.	1	2	3	4	5
14. My father has his own problems, so I don't bother	1	2	3	4	5

him with mine.

15. My father helps me to better understand myself.	1	2	3	4	5
16. I tell my father about my problems and troubles.	1	2	3	4	5
17. I feel angry with my father.	1	2	3	4	5
18. I don't get much attention from my father.	1	2	3	4	5
19. My mother helps me to talk about my difficulties.	1	2	3	4	5
20. My father understands me.	1	2	3	4	5
21. When I am angry about something, my father tries to be understanding.	1	2	3	4	5
22. I trust my father.	1	2	3	4	5
23. My father doesn't understand what I'm going through these days.	1	2	3	4	5
24. I can count on my father when I need to get something off my chest.	1	2	3	4	5
25. If my father knows something is bothering me, he asks me about it.	1	2	3	4	5

School Sleep Habits Questionnaire

2 (Sleep/Wake Problems Behavior Scale). In the last 2 weeks how often have you. . .

A. Felt satisfied with your sleep

    Everyday   Several Times   Twice   Once   Never

B. Arrived late to class because you overslept

    Everyday   Several Times   Twice   Once   Never

C. Fallen asleep in a morning class

    Everyday   Several Times   Twice   Once   Never

D. Fallen asleep in an afternoon class

    Everyday   Several Times   Twice   Once   Never

E. Awoken too early in the morning and couldn't get back to sleep

    Everyday   Several Times   Twice   Once   Never

F. Stayed up until at least 3 am

    Everyday   Several Times   Twice   Once   Never

G. Stayed up all night

    Everyday   Several Times   Twice   Once   Never

H. Slept in past noon

    Everyday   Several Times   Twice   Once   Never

I. Felt tired, dragged out, or sleepy during the day

    Everyday   Several Times   Twice   Once   Never

J. Needed more than 1 reminder to get up in the morning

    Everyday   Several Times   Twice   Once   Never

K. Had an extremely hard time falling asleep

    Everyday   Several Times   Twice   Once   Never

L. Had nightmares or bad dreams during the night

    Everyday   Several Times   Twice   Once   Never

M. Gone to bed because you could not stay awake any longer

    Everyday   Several Times   Twice   Once   Never

N. Done dangerous things without thinking

    Everyday   Several Times   Twice   Once   Never

O. Had a good night of sleep

    Everyday   Several Times   Twice   Once   Never

Revised Children's Manifest Anxiety Scale (RCMAS)

Read each question carefully. Put a circle around the word YES if you think it is true about you. Put a circle around NO if you think it is not true about you.

1. I have trouble making up my mind.	YES	NO
2. I get nervous when things do not go the right way for me.	YES	NO
3. Others seem to do things easier than I can.	YES	NO
4. I like everyone I know.	YES	NO
5. Often I have trouble getting my breath.	YES	NO
6. I worry a lot of the time.	YES	NO
7. I am afraid of a lot of things.	YES	NO
8. I am always kind.	YES	NO
9. I get mad easily.	YES	NO
10. I worry what my parents will say to me.	YES	NO
11. I feel that others do not like the way I do things.	YES	NO
12. I always have good manners.	YES	NO
13. It is hard for me to get to sleep at night.	YES	NO
14. I worry about what other people think about me.	YES	NO
15. I feel alone even when there are people around me.	YES	NO
16. I am always good.	YES	NO
17. Often I feel sick in my stomach.	YES	NO
18. My feelings get hurt easily.	YES	NO
19. My hands feel sweaty.	YES	NO
20. I am always nice to everyone.	YES	NO
21. I am tired a lot.	YES	NO
22. I worry about what is going to happen.	YES	NO
23. Other children are happier than I am.	YES	NO
24. I tell the truth every single time.	YES	NO
25. I have bad dreams.	YES	NO
26. My feelings get hurt easily when I am fussed at.	YES	NO
27. I feel someone will tell me I do things the wrong way.	YES	NO
28. I never get angry.	YES	NO
29. I wake up scared some of the time.	YES	NO
30. I worry when I go to bed at night.	YES	NO
31. It is hard for me to keep my mind on schoolwork.	YES	NO
32. I never say things I shouldn't.	YES	NO
33. I wiggle in my seat a lot.	YES	NO
34. I am nervous.	YES	NO
35. A lot of people are against me.	YES	NO
36. I never lie.	YES	NO
37. I often worry about something bad happening to me.	YES	NO

Child Depression Inventory (CDI)

Kids have different feelings and ideas. On these next pages, we have listed groups of sentences and we want you to pick **one** sentence from each group that describes you <u>best</u> for the past two weeks. There is no right or wrong answer. Just pick one sentence from each group that best describes the way you have been recently.

Think about your feelings and ideas for the <u>PAST TWO WEEKS.</u>

Item 1
□ I am sad once in a while.
□ I am sad many times.
□ I am sad all the time.

Item 2
□ Nothing will ever work out for me.
□ I am not sure if things will work out for me.
□ Things will work out for me O.K.

Item 3
□ I do most things O.K.
□ I do many things wrong.
□ I do everything wrong.

Item 4
□ I have fun in many things.
□ I have fun in some things.
□ Nothing is fun at all.

Item 5
□ I am bad all the time.
□ I am bad many times.
□ I am bad once in a while.

Item 6
□ I think about bad things happening to me once in a while.
□ I worry that bad things will happen to me.
□ I am sure that terrible things will happen to me.

Item 7
□ I hate myself.
□ I do not like myself.
□ I like myself.

Item 8

□ All bad things are my fault.
□ Many bad things are my fault.
□ Bad things are not usually my fault.

Item 9
□ I do not think about killing myself.
□ I think about killing myself but I would not do it.
□ I want to kill myself.

Item 10
□ I feel like crying every day.
□ I feel like crying many days.
□ I feel like crying once in a while.

Item 11
□ Things bother me all the time.
□ Things bother me many times.
□ Things bother me once in a while.

Item 12
□ I like being with people
□ I do not like being with people many times.
□ I do not want to be with people at all.

Item 13
□ I cannot make up my mind about things.
□ It is hard to make up my mind about things.
□ I make up my mind about things easily.

Item 14
□ I look O.K.
□ There are some bad things about my looks.
□ I look ugly.

Item 15
□ I have to push myself all the time to do my schoolwork.
□ I have to push myself many times to do my schoolwork.
□ Doing schoolwork is not a big problem.

Item 16
□ I have trouble sleeping every night.
□ I have trouble sleeping many nights.
□ I sleep pretty well.

Item 17
□ I am tired once in a while.

□ I am tired many days.
□ I am tired all the time.

Item 18
□ Most days I do not feel like eating.
□ Many days I do not feel like eating.
□ I eat pretty well.

Item 19
□ I do not worry about aches and pains.
□ I worry about aches and pains many times.
□ I worry about aches and pains all the time.

Item 20
□ I do not feel alone.
□ I feel alone many times.
□ I feel alone all the time.

Item 21
□ I never have fun at school.
□ I have fun at school only once in a while.
□ I have fun at school many times.

Item 22
□ I have plenty of friends.
□ I have some friends but I wish I had more.
□ I do not have any friends.

Item 23
□ My schoolwork is alright.
□ My schoolwork is not as good as before.
□ I do very badly in subjects I used to be good in.

Item 24
□ I can never be as good as other kids.
□ I can be as good as other kids if I want to.
□ I am just as good as other kids.

Item 25
□ Nobody really loves me.
□ I am not sure if anybody loves me.
□ I am sure that somebody loves me.

Item 26
□ I usually do what I am told.
□ I do not do what I am told most times.

□ I never do what I am told.

Item 27
□ I get along with people.
□ I get into fights many times.
□ I get into fights all the time.

Personality Inventory for Children – Externalizing Composite (PIC-2)

Please read each statement below and decide if it is true or false when applied to your child. If a statement is mostly true when applied to your child, circle T (true). If the statement is false or not usually true when applied to your child, circle F (false).

T   F 2. My child's manners sometimes embarrass me.
T   F 4. Schoolteachers complain that my child cannot sit still.
T   F 11. My child often disobeys me.
T   F 12. A scolding is enough to make my child behave.
T   F 17. My child's behavior often makes others angry.
T   F 19. My child often does not finish things that he/she starts.
T   F 22. My child jumps from one activity to another.
T   F 23. My child respects the property of others.
T   F 24. Punishment does not change my child's behavior.
T   F 31. My child likes to "boss" others around.
T   F 42. My child often acts without thinking.
T   F 44. My child is often restless.
T   F 51. My child often breaks the rules.
T   F 52. I cannot get my child to do his/her school lessons.
T   F 57. My child often forgets to do things.
T   F 59. My child often nags and bothers other people.
T   F 62. My child cannot wait for things like other children do.
T   F 63. My child tends to be pretty stubborn.
T   F 64. What people say often makes my child angry.
T   F 71. My child sometimes swears at me.
T   F 82. My child cannot keep attention on anything.
T   F 84. My child does not learn from his/her mistakes.
T   F 91. My child sometimes lies to get out of trouble.
T   F 92. My child tends to see how much he/she can get away with.

Self-Perception Profile for Children (SPPC)

Really true for me	Sort of true for me				Really true for me	Sort of true for me
☐	☐	Some kids find it hard to make friends	BUT	Other kids find it's pretty easy to make friends	☐	☐
☐	☐	Some kids often do not like the way they behave	BUT	Other kids usually like the way they behave	☐	☐
☐	☐	Some kids are often unhappy with themselves	BUT	Other kids are pretty pleased with themselves	☐	☐
☐	☐	Some kids have a lot of friends	BUT	Other kids don't have very many friends	☐	☐
☐	☐	Some kids usually do the right thing	BUT	Other kids often don't do the right thing	☐	☐
☐	☐	Some kids don't like the way they are leading their life	BUT	Other kids do like the way they are leading their life	☐	☐
☐	☐	Some kids would like to have a lot more friends	BUT	Other kids have as many friends as they want	☐	☐
☐	☐	Some kids act the way they are supposed to	BUT	Other kids often don't act the way they are supposed to	☐	☐
☐	☐	Some kids are happy with themselves as a person	BUT	Other kids are often not happy with themselves	☐	☐
☐	☐	Some kids are always doing things with a lot of kids	BUT	Other kids usually do things by themselves	☐	☐
☐	☐	Some kids usually get in trouble because of things they do	BUT	Other kids usually don't do things that get them into trouble	☐	☐
☐	☐	Some kids wished that more people their age liked them	BUT	Other kids feel that most people their age do like them	☐	☐
☐	☐	Some kids do things they know they shouldn't do	BUT	Other kids hardly ever do things they shouldn't do	☐	☐
☐	☐	Some kids are very happy being the way they are do	BUT	Other kids often wish they were someone else	☐	☐
☐	☐	Some kids are popular with other kids their age	BUT	Other kids are not very popular	☐	☐
☐	☐	Some kids behave themselves very well	BUT	Other kids often find it hard to behave themselves	☐	☐
☐	☐	Some kids are not very happy with the way they do a lot of things	BUT	Other kids think the way they do things is fine	☐	☐
☐	☐	Some kids like the kind of person they are	BUT	Other kids wish they were different	☐	☐