Longitudinal Assessment of Sleep–Wake Regulation and Attachment Security with Parents

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The development of sleep–wake regulation occurs within the context of the infant–parent relationship. The present study investigated (1) patterns of change in night waking across infancy and attachment to parents and (2) if dependency, a characteristic of secure subgroup B4 and insecure-resistant infants, accounted for differences in night waking. Forty-six families reported on the number of infant night wakings at 7, 12, and 14 months of age. Attachment was measured at 12 (infant–mother) and 14 (infant–father) months. Findings suggest that infants with a secure (including the dependent-secure, B4) pattern of attachment with mothers decreased in the number of night wakings over time, whereas infants with an insecure-resistant pattern of attachment with mothers continued to wake at night into the second year. Attachment dependency did not account for differences in night waking. These findings are important to understanding the mechanism(s) underlying the relation between attachment and sleep–wake regulation.

Key words: sleep; self-soothe; attachment; night wake; regulation

On average, infants wake between one and three times every night (for review, see Anders, 1994). Infants who wake and signal the parent (e.g. cry) are typically labelled as problem sleepers, whereas infants who wake and return to sleep unknownst to the parent (i.e. self-soothe) are considered good sleepers (Anders, Halpern, & Hua, 1992; Minde et al., 1993; Sadeh, Flint-Ofir, Tirosh, & Tikotzky, 2007). These two types of infants are distinguished, not by their ability to stay asleep but by their ability to self-soothe or self-regulate sleep. The inability to self-soothe (i.e. self-regulate) is considered the most common sleep disorder from

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infancy to school aged (Capp, Pearl, & Lewin, 2005; Johnson, 1991). Although nighttime observations found that, on average, self-soothing increases as infants get older (Burnham, Goodlin-Jones, Gaylor, & Anders, 2002; Goodlin-Jones, Burnham, Gaylor, & Anders, 2001), Burnham et al. (2002) reported that about 43% of infants decreased in their ability to self-soothe across infancy (1 to 12 months of age). Yet, it is unclear why some infants improve their ability to regulate their sleep, whereas others do not.

The present study focused on how the infant–parent attachment relationship relates to night waking. Parent factors have been found to be as predictive and, in some cases, more predictive of night waking than biological factors (Anders et al., 1992; Keener, Zeanah, & Anders, 1988). Patterns of attachment result from a history of the infant–parent relationship and develop over the first year of life (Bowlby 1969/1982). Based on the infant’s response to separations from and reunions with the parent (Ainsworth, Blehar, Waters, & Wall, 1978), the infant–parent relationship can be classified into one of three organized classifications— insecure-avoidant (A), secure (B), and insecure-resistant (C)—or disorganized (D), a later identified classification (Main & Solomon, 1986). Infants classified as having a B pattern of attachment typically exhibit distress at separation in the novel environment, seek proximity and contact with their parent during reunion, and then explore their environment. Infants classified as having an A pattern of attachment look or turn away from their parents at reunion. Infants classified as having a C pattern of attachment typically exhibit distress even prior to separation, show a mixture of anger (e.g. pushing parent away) and contact seeking toward their parent on reunion, and then tend not to explore their environment. Infants classified as having a D pattern of attachment with their parent do not appear to have an organized system of attachment to their parent, instead exhibiting a variety of unusual behaviours, including freezing or contradictory behaviours including approaching their parent while looking away. The various patterns of behaviours exhibited by infants in response to separation from and reunion with their parent have been described as specific emotion regulation strategies that are used with their parent (e.g. Cassidy, 1994; Mikulincer, Shaver, & Peregr, 2003).

Attachment and Infant Sleep–Wake Regulation

Sleep–wake regulation also relates to the attachment relationship (Beijers, Jansen, Riken-Walraven, & de Weerth, 2011; Morrell & Steele, 2003; McNamara, Belsky, & Fearon, 2003). The quality of the infant–mother relationship is related to the number of times the infant woke at night (Beijers et al., 2011; Morrell & Steele, 2003; McNamara et al., 2003). For example, Morrell and Steele (2003) found that infants with a C pattern of attachment were more likely to wake at night than those with B or A patterns. Infants with a D pattern of attachment, however, did not significantly differ from infants with organized attachment classifications. Furthermore, having a C pattern of attachment predicted later sleeping problems (including night waking) at 2 years of age (Morrell & Steele, 2003). Likewise, McNamara, Belsky, and Fearon (2003) investigated parent-reported night waking at two ages, 6 and 15 months, and found that at 6 months, infants with an A pattern of attachment had fewer night wakings than infants with a C pattern. Although at 15 months there was no relation between night waking and attachment, infants with a C pattern of attachment at both ages were more likely than infants classified as A to have sleep problems, broadly defined as multiple

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night wakings, extended waking, or a major disruption. McNamara et al. (2003) treated the two time points as two separate samples to preserve the sample sizes and thus were unable to describe change in sleep patterns over time.

Conversely, Scher and colleagues, using Israeli samples, found no relation between attachment and night wakes (Scher, 2001; Scher & Asher, 2004). Specifically, infants with A, B, and C patterns of attachment had similar numbers of mother-reported night wakes (Scher, 2001; Scher & Asher, 2004). Scher’s research, besides having a culturally different sample, used only the three organized classifications of attachment, in effect, collapsing the D classification into one of the three organized classifications. Similarly, Higley and Dozier (2009) found no relation between attachment and night wakes when they compared infants with B attachments to infants with insecure patterns of attachment, which included infants classified as A, C, or D. Disorganized attachment is identified by the lack of showing a consistent and organized strategy of emotion regulation during the Strange Situation (Main & Solomon, 1990), and this lack of an organized strategy is reflected in research on night waking and attachment. Morrell and Steele (2003; also Beijers et al., 2011) found that infants with a D pattern of attachment did not differ from infants classified as A, B, or C on night waking. Thus, including infants with a D pattern of attachment into one of the organized classifications would likely increase the variability of each organized attachment group, which in turn might reduce differences between the groups. This could explain why differences were only detected in studies distinguishing organized and disorganized classifications. Therefore, it is important to examine the D group separately.

To thoroughly investigate the relation between attachment and sleep–wake regulation, it is necessary to explore changes in sleep–wake regulation within each attachment group, rather than examining single points in time (Keller, 2011). One recent study (Beijers et al., 2011) investigated infant night waking and attachment longitudinally. They found that night waking (defined as a parent physically resettling the infant) during the first 6 months of age predicted attachment with mothers at 12 months of age; however, night waking at 12 months of age did not relate significantly to attachment. The operational definition of night waking in this study, however, may reflect the parent’s decision to respond rather than the infant signalling the parent. For example, if parents let their infant cry-it-out, the measure would indicate that the infant never woke at night.

The attachment relationship between infant and father may also contribute to infant sleep regulation. To date, there has been a lack of research examining the relation between infant–father attachment and sleep–wake regulation. A recent study (Keller & El-Sheikh, 2011) on school-aged children, though, found that attachment security with fathers (assessed using a child interview) related to greater sleep duration for girls, but not for boys. Although mothers are often the primary parents during the day and night (Anders et al., 1992, Goodlin-Jones et al., 2001), more than 30% of fathers were involved in responding to their infants at night (Goodlin-Jones et al., 2001; Keener et al., 1988). Fathers were also more likely to believe that infants should self-soothe rather than be dependent on parents (Sadeh et al., 2007). Thus, it is likely that fathers would impact infant sleep. Moreover, the infant’s internal working model of attachment (Bowlby, 1969/1982) is based on a hierarchy of attachments to parents, which suggests that multiple attachment relationships impact infant behaviour. Therefore, attachment to fathers may be important in the development of sleep–wake regulation, even if fathers are not interacting with their infants at
night. The present study included both mothers and fathers to gain a more comprehensive examination of relations between infant–parent attachment and sleep regulation.

Dependency

An alternate hypothesis on the relation between attachment and sleep is that dependent attachment might explain differences in sleep–wake regulation more than attachment security (Scher, 2001; Scher & Asher, 2004). Dependent attachment, as described by van IJzendoorn and colleagues (van IJzendoorn, Goossens, Kroonenberg, & Tavecchio, 1985; van IJzendoorn, Tavecchio, Goossens, Vergeer, & Swaan, 1983; also see Sagi et al., 1985), is depicted by behaviours exhibited during separations and reunions, such as fear, crying, clinging, resistance, and lack of exploratory behaviour and avoidance behaviours. Dependent behaviours are most commonly observed in infants with C and B4 patterns of attachment. B4 is one of the four secure subgroups in which infants display greater levels of anxiety in the infant–parent relationship than other secure subgroups (Ainsworth et al., 1978). On the basis of the similarities of dependent behaviours in C and B4 groups, some researchers do not consider infants with B4 patterns of attachment completely secure—considering them to be part of either the C group or a distinct group labelled ‘dependent’ (Sagi et al., 1985; van IJzendoorn et al., 1983; van IJzendoorn et al., 1985).

Although both infants with B4 and C patterns of attachment display high levels of distress during separations, differences in regulatory ability should distinguish secure from insecure more than the level of dependency (e.g. Weinfield, Sroufe, Egeland, & Carlson, 1999). Braungart and Stifter (1991) found that although infants with secure (B3 and B4 combined) patterns of attachment and infants with a C pattern of attachment demonstrated high distress during separations, infants with B3/B4 patterns of attachment differed from those in the C group in regulation strategies during the reunion. Conversely, Scher and Asher (2004) found that higher dependency scores from the parent-reported Attachment Q-set related to higher sleep problem scores. It is not clear, however, whether these findings would replicate with a more objective measure of attachment, such as the Strange Situation Paradigm (Ainsworth et al., 1978).

Present Study

Overall, there is some evidence to suggest that infants with a C pattern of attachment, in particular, are more likely to have difficulties regulating their sleep compared with those with other attachment patterns, but the development of these sleep difficulties is less understood. Looking at change in night waking might offer possible explanations as to why there is a relation between night wakes and attachment. In a recent chapter, Keller (2011) discussed three empirically supported conceptual frameworks. First, infants who have more difficulty regulating their sleep could later develop insecure attachments with their parents. Evidence suggests that infants who wake at night are generally fussier than those who do not wake (Scher, 2001), and mothers who report infant sleep problems also tend to be less sensitive (Priddus, 2009). Moreover, fussier infants who also have less sensitive mothers are more likely to develop C attachment relationships than fussier infants who have more sensitive mothers (Braungart-Rieker, Garwood, Powers, & Wang, 2001). Thus, we would expect
that infants who woke frequently early in infancy to be more likely to develop a C pattern of attachment. Second, infant sleep–wake regulation may reflect the attachment relationship. Falling asleep and waking may resemble separations and reunions that activate attachment behaviours (i.e. crying for parent). In this case, we would expect that differences in sleep–wake regulation would depend on the development of the attachment relationship. Specifically, early in infancy—prior to the development of the attachment relationship—infants should wake similarly at night, irrespective of future attachment status (Keller, 2011). As the attachment relationship develops, however, infants with a B pattern of attachment should become less anxious about nighttime separations, developing more confidence in the availability of their parents. Infants with an A pattern of attachment may remain anxious but should be less likely to signal their parents over time given their style of heightened self-reliance (Cassidy, 1994). Infants with a C pattern of attachment, on the other hand, should continue to be anxious about nighttime separations and continue to wake and signal their parents. Third, differences in parenting could predict both sleep–wake regulation and attachment. Parenting includes sensitivity (Priddus, 2009) and bedtime routines (e.g. Morrell & Cortina-Borja, 2002) but also could include encouraging self-regulation. For example, parents of infants with non-C patterns of attachment encourage their infants to self-regulate more as they get older, whereas parents of infants with a C pattern of attachment interfere with their infant’s self-regulation (Ainsworth et al., 1978; Isabella & Belsky, 1991; Miyake, Chen, & Campos, 1985; see Cassidy & Berlin, 1994, for a review). In this case, again we would expect to find few differences in signalling upon waking earlier in infancy, but infants with non-C patterns of attachment should decrease in signalling upon waking over time, whereas infants with a C pattern of attachment should remain stable, continuing to wake and signal parents over time.

By investigating change in infant night waking over three time points (7, 12, and 14 months) and attachment to mothers and fathers, we are able to examine these frameworks. The present study is unique in that it is one of only two studies (Beijers et al., 2011) to investigate the development of sleep–wake regulation in relation to attachment, and it is the only one to use the Strange Situation Paradigm and to investigate attachment to fathers as well as mothers. In addition, the present study attempts to replicate previous findings by Scher (2001; Scher & Asher, 2004), testing whether secure-dependent (B4) infants, during the Strange Situation, are similar to infants with a C pattern of attachment with regard to number of night wakings. Thus, the present study tested two main research questions: (a) how does night waking change over time among attachment classifications to mothers and fathers and (b) do infants with a B4 pattern of attachment appear more like infants with a C pattern of attachment or more like the other three B subgroups, determining whether dependency predicts night waking rather than security?

METHOD

As part of a larger longitudinal study investigating the influence of parents on the development of emotion regulation, a sleep questionnaire was administered to parents when their infant was 3, 5, 7, 12, 14, and 20 months of age. The sleep questionnaire was introduced approximately half way through data collection with ongoing participant recruitment. Thus, missing data on one or more time points for the sleep questionnaire were common for most participants. Attachment
was measured for the majority of participants; however, to investigate change in infant sleep patterns prior to and concurrent with the assessment of attachment, and to maximize the sample size, three waves of data were used: 7, 12, and 14 months. Inclusion in the present study was dependent on having complete sleep measures at all three time points.

**Participants**

The present study included 46 families, which consisted of mother, father, and infant, when the infant was 7, 12, and 14 months (+/−14 days) of age. One father was unavailable within the +/−14 day window at 14 months and thus was not included in the analyses. The families were primarily Caucasian with the exception of four mothers (1 African American and 3 who identified themselves as ‘other’) and four fathers (1 African American, 1 Hispanic, and 2 ‘other’). However, these families were not outliers on measures of night waking at the three ages with mother or father; thus, these families were retained in the study. The sample was primarily middle class based on annual family income and highest level of education. Annual family income for the sample consisted of 11% earning under $30,000, 50% earning between $30,000 and $59,999, and 39% earning at least $60,000. Approximately 9% of the mothers’ (18% of fathers’) highest level of education was a high school degree or less; 61% of the mothers (47% of fathers) had some college or completed a Bachelor’s degree; and 28% of the mothers (36% of fathers) had some or completed a post graduate or professional education. The average age of the parents was 28.8 years for mothers (range: 19–38) and 30.2 years for fathers (range: 21–44). The majority of the sample was married and living together (n = 39), three of the families were married, but living apart, and four of the families were unmarried and living together. The infants in this sample were 52% male and 58% were the first born, 21% had one sibling, and 21% had two or three siblings.

**Procedures**

A questionnaire packet was mailed to families prior to each lab visit at each time point and was returned to the lab at the time of the lab visit. If the questionnaires were not completed prior to the lab visit, extra time was provided before or after the assessment. The Strange Situation assessments took place in a small, carpeted room with brightly coloured, child-friendly pictures on the walls, two chairs, and a variety of toys on the floor. The assessments were recorded using two video cameras positioned behind one-way mirrors. The images were then fed through a split screen generator.

**Measures**

**Night waking**

Mothers and fathers together completed a sleeping and eating checklist when infants were 7, 12, and 14 months. On the basis of a typical day, parents reported what the infant ate and how many times throughout the day; where the infant slept; the number of times the infant woke during the night; who, if anyone, responded to the infant at night; and what, if anything, the parent(s) did when the infant woke at night.1 The number of times the infant woke during the night...
is the focus of the present study, although who responded to the infant will also be reported and discussed.

Previous research found that parent reports of the frequency of infant night waking were lower than objective measures (Anders, 1979, 1994; Minde et al., 1993; Sadeh, 1994, 1996; Scher, 2001; Scher & Asher, 2004); however, parent reports of night waking were more related to attachment than objective sleep measures (Scher, 2001; Scher & Asher, 2004). Parent-reported night waking is most likely based on the number of times the infant signals the parents. It has been suggested that infants who signal parents at night are less able to return to sleep on their own (Anders et al., 1992) and are, in turn, activating the attachment system (Scher, 2002).

**Attachment**

The Strange Situation procedure (Ainsworth et al., 1978) was conducted at 12 months with mothers and 14 months with fathers (+/−14 days). The order of the parents was not counterbalanced, because there has been no evidence of order effects when there is at least a 4-week separation between assessments (e.g. Belsky, Rovine, & Taylor, 1984). The Strange Situation is a well-known, standardized procedure that involves seven 3-min episodes including two infant–parent separations and two reunions. Trained coders are able to determine the infant’s attachment classification with each parent on the basis of the infant’s responses during the procedure.

A two-person coding team from the University of Minnesota, headed by Dr Elizabeth Carlson, coded the Strange Situation procedures. The infants were classified as secure (B1, B2, B3, and B4), insecure-resistant (C), insecure-avoidant (A), or disorganized (D). Inter-rater reliability was calculated on about 16% of the total assessments with mothers and 17% with fathers. There was 90% agreement with $\kappa = .84$ for mothers and 80% agreement with $\kappa = .71$ for fathers.

**RESULTS**

**Descriptive Characteristics**

First, we examined potential relations with demographic variables and age-related characteristics of night waking. Based on chi-square or ANOVA analyses, demographic variables—gender, parental age, parental education level, parental work hours, parental ethnicity, family income, parents living together or apart, and number of children in the family—were not significantly related to night waking at any age or to attachment classification with either parent and thus were excluded from subsequent analyses. A repeated measures ANOVA was conducted to test for average change in night waking over time for the sample. As found in previous studies (e.g. Burnham et al., 2002), a main effect for age was found, $F(1.63, 73.17)=11.19, p < 0.001$ (Greenhouse–Geisser adjusted $df$ reported to control for sphericity), suggesting that night waking on average decreased with age. Specifically, 7-month-old infants woke an average of 1.24 times ($SD = 1.16$), 12-month-old infants woke an average of 0.67 times ($SD = 1.01$), and 14-month-old infants woke an average of 0.52 times ($SD = 0.98$) per night. Mothers and fathers attended to their infants at night, although to a greater extent mothers—7 (85% vs. 30%), 12 (70% vs. 30%), and 14 months (60% vs. 47%), respectively. As described earlier, only families with complete night-wake data were included.
leaving several low group sizes. Infants who were classified as having an A pattern of attachment with mothers or with fathers, or classified as having a C pattern of attachment with fathers were very small (n < 5; Table 1) and were excluded from subsequent analyses. Thus, our results compare infants with B, C, and D patterns of attachment with mothers, and B versus D patterns of attachment with fathers.

**Night Waking by Attachment Classification**

Next, we report analyses involving associations between night waking with infant–mother and infant–father attachment classifications across age and within each age separately using the entire B group (i.e. B1–4). Separate repeated measures ANOVAs were conducted (Greenhouse–Geisser adjusted) for infant–mother and infant–father dyads to investigate how night waking changed during infancy by attachment classification. Although there were no main effects of attachment with mothers, $F(2, 41) = 1.44, p = 0.25$, or with fathers, $F(1, 40) = 1.02, p = 0.32$, there was a significant age by attachment classification interaction effect with mothers, indicating that change in night waking was associated with attachment to mothers, $F(3.42, 70.15) = 2.71, p < 0.05$. Specifically, as can be seen in Figure 1, infants with a C pattern of attachment remained relatively stable across infancy, whereas infants with a B pattern of attachment decreased in night waking by 12 months of age. The

### Table 1. Night waking means by attachment for mothers and fathers at each age

<table>
<thead>
<tr>
<th>Attachment classification</th>
<th>Mother</th>
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<th>Father</th>
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<td></td>
<td>n</td>
<td>7 months</td>
<td>12 months</td>
<td>14 months</td>
<td>n</td>
<td>7 months</td>
<td>12 months</td>
<td>14 months</td>
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<tr>
<td>A</td>
<td>2</td>
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<td>2</td>
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<td>~</td>
<td>~</td>
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<tr>
<td>B1–4</td>
<td>29</td>
<td>1.34 (1.26)</td>
<td>0.41 (0.83)</td>
<td>0.31 (0.66)</td>
<td>33</td>
<td>1.30 (1.21)</td>
<td>0.73 (1.07)</td>
<td>0.64 (1.08)</td>
</tr>
<tr>
<td>B1–3</td>
<td>15</td>
<td>1.13 (1.36)</td>
<td>0.60 (1.06)</td>
<td>0.27 (0.80)</td>
<td>15</td>
<td>1.00 (1.20)</td>
<td>0.73 (1.16)</td>
<td>0.33 (0.62)</td>
</tr>
<tr>
<td>B4</td>
<td>14</td>
<td>1.57 (1.16)</td>
<td>0.21 (0.43)</td>
<td>0.36 (0.50)</td>
<td>18</td>
<td>1.56 (1.20)</td>
<td>0.72 (1.02)</td>
<td>0.89 (1.32)</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>1.14 (1.22)</td>
<td>1.43 (1.51)</td>
<td>1.29 (1.80)</td>
<td>1</td>
<td>~</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>1.25 (0.71)</td>
<td>0.88 (0.84)</td>
<td>0.63 (0.92)</td>
<td>9</td>
<td>0.89 (0.93)</td>
<td>0.56 (1.01)</td>
<td>0.22 (0.67)</td>
</tr>
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</table>

*Note.* Means and standard deviations omitted for n < 5.

![Figure 1. Marginal means of night waking by attachment security to mothers.](image-url)
average slope for the infants with a C pattern of attachment from 7 to 14 months did not significantly differ from zero, $F(2, 12) = 0.24, p = 0.79$, whereas the average slope for the infants with a B pattern of attachment did, $F(2, 56) = 16.91, p < 0.001$, offering further support for differences in change in night waking for infants with a B, but not a C, pattern of attachment. Attachment to fathers, however, was not associated with change in night waking as evidenced by a non-significant age by attachment classification effect, $F(1.61, 64.45) = 0.23, p = 0.74$, although it is important to keep in mind that this comparison involves infants with B and D patterns of attachment only.

Follow-up tests investigated the degree to which differences among attachment groups could be detected at each age with one-way ANOVAS, including planned comparisons of B versus C (mothers only) and B versus D (Table 2). Based on adjusted Levene’s tests,$^2$ equal variances were assumed for all except the 14-month night waking with attachment to mothers. Findings indicated no significant difference in night waking at 7 months among infant–mother attachment classifications, $F(2, 41) = 0.09, p = 0.91$, or infant–father attachment classifications, $F(1, 40) = 0.90, p = 0.35$, suggesting that night waking at 7 months was not related to attachment classification. In other words, 7-month-old infants tended to wake and signal parents, irrespective of their later attachment classification. However, there was a significant difference among the groups for mothers at 12 months, $F(2, 41) = 3.41, p = 0.04$, and a marginally significant difference at 14 months, $F(2, 41) = 2.99, p = 0.06$. The planned comparisons (Table 2) showed a significant difference at 12 months between B and C attachments to mothers, in which infants with a C pattern of attachment had more night wakings on average than infants with a B pattern. Infants with a B pattern of attachment did not differ from infants with a D pattern at any age within infant–mother or infant–father attachment groups.

### Dependency versus Security

Finally, we tested whether attachment classifications identified as dependent (e.g. van IJzendoorn et al., 1985) changed similarly in night waking. The B group was split into two groups on the basis of subgroup classification—B1–3 and B4 (see Table 1 for descriptive statistics). The infants with a B4 pattern of attachment were compared with infants with B1–3 and C patterns of attachment for infant–mother dyads only (father models were not conducted because of the small numbers of Cs for infant–father dyads). A repeated measures ANOVA on

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**Table 2. Planned contrast tests comparing night waking by parental attachment**

<table>
<thead>
<tr>
<th>Contrast</th>
<th>Age (months)</th>
<th>Mothers</th>
<th></th>
<th></th>
<th>Fathers</th>
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<tr>
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<td></td>
<td>$t(41)$</td>
<td>$p$</td>
<td>$t(40)$</td>
<td>$p$</td>
<td></td>
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<tr>
<td>B versus C</td>
<td>7</td>
<td>0.41</td>
<td>0.67</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>–2.52</td>
<td>0.02</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>–1.41</td>
<td>0.02</td>
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<td>–</td>
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<tr>
<td>B versus D</td>
<td>7</td>
<td>0.20</td>
<td>0.84</td>
<td>0.90</td>
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<td></td>
<td>12</td>
<td>–1.21</td>
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<tr>
<td></td>
<td>14</td>
<td>–0.91</td>
<td>0.42</td>
<td>1.18</td>
<td>0.28</td>
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</table>

*Note. Assuming equal variances. Dashes indicate the test was not performed. Bold indicates significance, $p < 0.05$.}

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infants with B1–3, B4, and C attachments to mothers found a significant age by attachment effect, $F(4, 66) = 3.13, p = 0.02$, which suggests that change in night waking is associated with attachment classification. The marginal means are graphed in Figure 2, showing the similarity between the B4 and B1–3 groups, which differ from the C group, particularly at 12 and 14 months. To verify this, two planned comparisons, B4 versus B1–3 and B4 versus C were tested at each age. Equal variances were assumed because Levene’s adjusted values (see Footnote 2) were not significant. As shown in Table 3, infants with a B4 attachment to their mothers were not significantly different from infants with a B1–3 pattern at any age. On the other hand, infants with a B4 pattern of attachment woke significantly less at 12 and 14 months than infants with a C pattern of attachment.

**DISCUSSION**

The present study had two main goals: (1) to understand how sleep–wake regulation develops for each attachment classification and (2) to assess whether dependency or security was related to sleep regulation. Results of this study suggest that attachment to mothers was related to change in night waking over infancy. Unlike previous longitudinal findings (Beijers et al., 2011), our findings suggest that infants with B, C, and D patterns of attachment did not significantly

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>B4 versus B1–3</th>
<th>B4 versus C</th>
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<tr>
<td></td>
<td>$t(33)$</td>
<td>$p$</td>
</tr>
<tr>
<td>7</td>
<td>−0.939</td>
<td>0.355</td>
</tr>
<tr>
<td>12</td>
<td>1.059</td>
<td>0.297</td>
</tr>
<tr>
<td>14</td>
<td>−0.249</td>
<td>0.805</td>
</tr>
</tbody>
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*Note.* Assuming equal variances. Bold indicates significance, $p < 0.05$. 

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differ on night waking at 7 months. By 12 months, however, infants with a B pattern of attachment woke less frequently than infants with a C pattern of attachment. In other words, infants with a B classification, on average, self-regulated sleep by 12 months better than infants with a C classification, who continued to seek parent regulation beyond 12 months. The present findings also differed from previous studies (Scher, 2001; Scher & Asher, 2004) in that patterns of sleep–wake regulation were more related with security (i.e. all B subgroups) than with dependency (infants with B4 and C patterns of attachment).

Although we acknowledge that this is an exploratory study from which no causal explanations can be drawn, our longitudinal design allowed us to examine change in night waking from 7 to 14 months, which provides insight about changes in sleep behaviour coinciding with the development of the attachment relationship (Bowlby, 1969/1982). The changes in night waking observed in the present study offer support for certain mechanisms of change discussed by Keller (2011). Our findings provide little support for the first contention, that is, early differences in sleep–wake regulation predict differences in attachment. There were no significant differences among the groups at 7 months, which suggests that infants with B and D patterns of attachment are waking as often as infants with a C pattern at 7 months. Rather, differences among attachment groups developed as infants got older.

The present findings, however, provide support for the second contention, which suggests that sleep–wake regulation reflects the attachment relationship. There were no differences in night waking earlier in infancy (7 months), but as the attachment relationship develops (by 12 months), secure attachments appeared to provide sleep benefits, via regulation strategies—infants with a B pattern of attachment rarely woke their parents at night. According to attachment theory, infants with a B pattern of attachment decrease in night waking because bedtime separations become more familiar and they become confident in the availability of their mothers. Infants with a C pattern of attachment, on the other hand, do not seem to develop the same levels of confidence that their mother will be available, even in familiar environments (e.g. bedtime separations). These findings follow previous reports of infants with a C pattern of attachment responding with more distress during maternal separations at home than infants with A or B patterns (Ainsworth et al., 1978).

The patterns of night waking in these data offer support for the third contention as well, which suggests that parenting differences may influence both sleep and attachment. Parenting behaviours (e.g. sensitivity/emotional availability/attunement) are not only related to attachment (e.g. Bretherton, 2000) but also to sleep problems (Priddus, 2009). Research indicates that parents’ emotional availability during nighttime interactions is more predictive of night waking than specific behaviours (e.g. close contact) during nighttime interactions (Teti, Kim, Mayer, & Countermine, 2010). Moreover, there may be differences in how parents encourage their infants to self-regulate. In general, parents are more likely to encourage older infants to self-regulate (e.g. return to sleep on their own) than younger infants (Anders et al., 1992; Goodlin-Jones et al., 2001). Yet, evidence suggests that parents of infants with a C pattern of attachment interfere with infant independent exploration and self-initiated tasks (Ainsworth et al., 1978; Isabella & Belsky, 1991; Miyake et al., 1985). Indeed, mothers who continue to offer high levels of assistance with emotion regulation are less likely to have infants who self-regulate (Silverman & Ragusa, 1990). Taken together, our results suggest that infants with a B pattern of attachment are beginning to self-regulate sleep, whereas infants with a C pattern continue to seek parental
assistance. Future research is necessary to determine whether these differences are caused by differences in parenting quality, parent regulation, attachment security, or multiple pathways as suggested by Sadeh, Tikotzky, and Scher (2010).

Another explanation for the relation between attachment and sleep, suggested by Scher and colleagues (Scher, 2001; Scher & Asher, 2004), is dependency, found in infants with C and B4 patterns of attachment. Scher and colleagues suggested that dependency is more related to sleep–wake regulation than security. This hypothesis was not supported in the present findings. Infants classified as having a B4 pattern of attachment with mothers decreased in the number of night wakes by 12 months of age, whereas infants with a C pattern did not, offering further support of qualitative differences between infants with C and B4 patterns of attachment. These findings offer support for attachment theorists who suggest that the level of dependency does not determine security versus insecurity; rather, it is the effectiveness of the infant’s dependency (i.e. whether the behaviours reduce the stress of the separation and allow the infant to return to exploration) that is the determinant (e.g. Weinfield et al., 1999). In other words, despite the level of distress the infant experiences when separated from the parent, if the infant’s regulatory behaviours with the parent relieve the distress and allow the infant to return to exploration, the infant is considered to be securely attached. Results suggest that infants with a B4 pattern of attachment and infants with B1–3 patterns of attachment develop self-regulation of sleep over time, whereas infants with a C pattern of attachment continued to wake and signal their parents.

Finally, attachment to fathers and change in night waking were assessed in the present study. Supporting previous findings (Goodlin-Jones et al., 2001; Keener et al., 1988), a third or more of fathers responded to their awakened infant. In spite of this, we were unable to detect a relation between attachment to fathers and night waking during infancy, most likely because there were too few infants with a C pattern of attachment with fathers to include in the present sample. Other comparisons, infants with B versus D patterns of attachment, show similar null results for attachment to mothers and attachment to fathers. Attachment to fathers has been shown to predict differences in emotion regulation strategies (Diener, Mangelsdorf, McHale & Frosch, 2002; Volling, McElwain, Notaro, & Herrera, 2002); thus, differences in sleep–wake regulation by attachment to fathers should be investigated further including infants with a C attachment to fathers. Moreover, Diener et al. (2002) found that infants who were securely attached to both parents showed greater consistency in strategy use, suggesting that future research should include samples large enough to investigate infants who have the same versus different attachment classification to mothers and fathers.

**Limitations and Future Directions**

The present study has several limitations. Foremost, the present study has a limited sample size, which prevented us from testing infants with an A pattern of attachment as well as the impact of having a C pattern of attachment to fathers on changes in night waking. We chose to use smaller sample sizes and maintain distinct attachment classifications because previous studies that collapsed across classifications (Higley & Dozier, 2009; Scher, 2001; Scher & Asher, 2004) failed to detect a relation between attachment and sleep–wake regulation. Future research using a larger sample with mothers and fathers could test if a secure attachment...
to one parent could moderate the effect of an insecure attachment to the other parent on change sleep–wake regulation. Additionally, investigating typical nighttime routines longitudinally, for example, emotional availability (Teti et al., 2010), and encouraging self-regulation of sleep along with sleep–wake regulation and attachment might shed some light on how parents’ behaviours are influencing changes in night waking. The present study is an exploratory investigation that cannot conclude why differences in patterns of night waking across attachment groups exist, although these findings offer support for some mechanisms more than others.

CONCLUSIONS

Overall, our findings suggest that the infant–mother attachment relationship relates to the development of infant self-regulation even during the night. Differences in change in night waking suggest that infants with a secure pattern of attachment (all subgroups) increased in their ability to self-soothe (i.e. self-regulate) over time, decreasing the number of times they woke and signalled their parent(s) at night, whereas infants with an insecure-resistant pattern of attachment continued to wake into the second year. These findings offer an important stepping stone in understanding the mechanism(s) underlying the relation between attachment and sleep–wake regulation.

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Notes

1. We were unable to analyze the question pertaining to what, if anything, the parent(s) did when the infant woke at night because when infants did not wake at night, there were no data. Thus, cell sizes for this question by attachment groups were too small to analyze.
2. Because of the design imbalance, Levene’s test of equality of variances was adjusted using Keyes and Levy’s (1997) adjustment suggestions, including using a p-value of <.01 on the adjusted Levene’s test (Milliken & Johnson, 1984).

REFERENCES


