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Brief report

Associations between infant temperament, maternal stress, and infants' sleep across the first year of life

Barbara M. Sorondo*, Bethany C. Reeb-Sutherland

Department of Psychology, Florida International University, 11200 SW 8th Street, DM 256, Miami, FL 33199, United States

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ABSTRACT

Effects of temperament and maternal stress on infant sleep behaviors were explored longitudinally. Negative temperament was associated with sleep problems, and with longer sleep latency and night wakefulness, whereas maternal stress was associated with day sleep duration, suggesting infant and maternal characteristics affect sleep differentially.

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By the end of their first year, infants will have spent well over half their lives sleeping, suggesting sleep is not a trivial factor for their development. Indeed, sleep is associated with various aspects of infant development, particularly cognitive development (see Ednick et al., 2009 for a review), and can significantly impact parental behavior, mental health, and well-being (see Sadeh, Tikotzky, & Scher, 2010 for a review). However, the factors that contribute to sleep behaviors in infancy have not yet been clearly identified, and the relations between these factors remain poorly understood.

Infant sleep patterns develop rapidly over the first year of life, characterized by inconsistency during the first half of the year but stabilizing by the second half (Sadeh, Mindell, Luedtke, & Wiegand, 2009). Night sleep duration increases steadily across this period, from approximately 8.5 h in the first two months to between 10 and 12 h by 12 months, and day sleep duration simultaneously decreases, from nearly 6 h to approximately 2.5 h (Iglowstein, Jenni, Molinari, & Largo, 2003; Sadeh et al., 2009). Night wakings and wakefulness decrease as well during the first year, dropping rapidly from an average of 2 wakings per night and over 1 h of wakefulness in the first two months to approximately 1 waking per night and around or under half an hour of wakefulness in the remaining months of the first year (Galland, Taylor, Elder, & Herbison, 2012; Sadeh et al., 2009). In contrast, sleep latency, or the amount of time it takes an infant to fall asleep, tends to remain steady throughout infancy (Galland et al., 2012).

Although these general patterns of infant sleep have been well characterized, not all infants follow these patterns. Indeed, quite a bit of variability across infants has been observed, suggesting various factors must influence individual differences in sleep patterns. These factors include infant characteristics such as sex and temperament as well as environmental

* Corresponding author. Tel.: +1 305 348 2415.
E-mail addresses: bsorondo@fiu.edu (B.M. Sorondo), besuther@fiu.edu (B.C. Reeb-Sutherland).

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characteristics such as parental stress. Findings of sex differences in infant sleep patterns are mixed with some studies reporting sex differences (Anders, Halpern, & Hua, 1992; Bach, Telliez, Leke, & Libert, 2000; Kaley, Reid, & Flynn, 2012; Richardson, Walker, & Horne, 2010; So, Adamson, & Horne, 2007) but others reporting negligible or no differences (e.g., Tikotzky et al., 2010; Weinraub et al., 2012). Those studies reporting sex differences have found that males sleep less than females (Bach et al., 2000), particularly during the day (So et al., 2007), and have more frequent but shorter night wakings (Kaley et al., 2012; So et al., 2007), longer night wakefulness (Bach et al., 2000), and more sleep problems (Anders et al., 1992), such that overall females sleep more soundly than males (Richardson et al., 2010).

Studies examining temperament and various sleep outcomes during the first year have demonstrated temperament influences night, day, and total sleep duration (Kaley et al., 2012; Spruyt et al., 2008; Weissbluth, 1981), night wakings (Carey, 1974; Schaefer, 1990; Scher & Asher, 2004; Weinraub et al., 2012), and sleep problems (Kelmanson, 2004). Specifically, negative or difficult infant temperament has been associated with shorter sleep duration, particularly at night (Loutzenhiser & Sevigny, 2008; Weissbluth, 1981), and more night wakings (Weinraub et al., 2012) compared to positive or easy infant temperament, which has conversely been associated with greater night and total sleep duration (Kaley et al., 2012; Spruyt et al., 2008). In contrast, some studies report weak or no associations between temperament and sleep (e.g., Anders et al., 1992; DeLeon & Karraker, 2007; Scher, Tirosh, & Lavie, 1998), which may be the result of age-dependent changes in this relation (Spruyt et al., 2008; Weinraub et al., 2012), or temperament's differential relation with active compared to quiet sleep (Parslow et al., 2002). Therefore, though the majority of research suggests a relation between infant temperament and sleep, the exact nature of this relation remains ambiguous.

Previous studies have also found associations between maternal stress and infants' sleep. Increased maternal stress at 4 months has been associated with concurrent infant sleep problems (Sidor, Fischer, Eickhorst, & Cierpka, 2013) and a decrease in the percentage of night sleep (Becker, Chang, Kameshima, & Bloch, 1991), as well as with greater variability in infants' night sleep at 12 months, with infant temperament serving as a possible mediator in this latter relation (Becker et al., 1991). Furthermore, greater maternal stress has been associated with infants' sleep problems and, among mothers on maternity leave, with longer night wakefulness and shorter day sleep duration (Sinai & Tikotzky, 2012). Altogether, the above studies suggest both infant characteristics and maternal characteristics can significantly affect the development of infant sleep patterns.

The present study attempted to unify previous research on the association between infant temperament and maternal stress with infant sleep, by exploring numerous sleep outcomes among the same group of infants across the first year of their lives while taking potential sex differences into consideration. Based on previous research, we hypothesized that infant temperament and maternal stress would each play a partial role in the development of various sleep outcomes.

Participants were part of a larger longitudinal study examining the relation between early associative learning and social behavior development (for details, see Reeb-Sutherland, Levitt, & Fox, 2012). As part of the larger study, infants' temperament and sleep behaviors were assessed via maternal reports using the Infant Behavior Questionnaire (IBQ; Rothbart, 1981) and Brief Infant Sleep Questionnaire (BISQ; Sadeh, 2004), respectively. Maternal stress was also assessed via the Parenting Stress Index-Short Form (PSI-SF; Abidin, 1995). Temperament data have previously been examined in relation to infant behavior in the face-to-face still-face paradigm (Yoo & Reeb-Sutherland, 2013) while the sleep and maternal stress data have not yet been reported.

Initially, 123 infants (63 male, 60 female) were recruited for the larger study. Only data obtained from mothers who completed the IBQ and the PSI-SF when their infants were 5 months, and the BISQ when the infants were 5 ($M = 5.15$, $SD = 0.22$), 9 ($M = 9.19$, $SD = 0.15$), and 12 ($M = 12.24$, $SD = 0.18$) months, were included in the present study ($N = 40$; 21 male, 19 female). The population of infants used in the current study was representative of the greater Washington, DC area with 65% White, 7.5% Black, 5% Asian, 5% Hispanic, and 17.5% mixed/other ethnicity. The infants' mothers were well educated, with 42.5% completing a graduate degree, 37.5% completing a college degree, 10% completing a high school degree, and the remaining 10% reporting an "other" level of education or not reporting their level of education. All infants were born within 2 weeks of their due date and had a mean birth weight of 7.81 pounds ($SD = 1.17$). The infants included in the present study did not significantly differ from the other 83 infants from the larger study on demographic measures except ethnicity, $\chi^2(4, N = 123) = 11.47$, $p = 0.02$ (38.6% White, 30.1% Black, 3.6% Asian, 2.4% Hispanic, and 25.3% mixed/other ethnicity).

The 94-item IBQ asks parents to rate the frequency of several of their infants' behaviors, and categorizes responses into temperamental subscales including activity level, duration of orienting, distress to limitations, fear, soothability, and smiling/laughter. An index of negative reactivity was created by summing the distress to limitations and fear subscales (Rothbart, 1986; Yoo & Reeb-Sutherland, 2013).

The 36-item PSI-SF asks parents to rate various statements on their child's and their own behaviors and attitudes, categorizing responses into parental distress, parent–child dysfunctional interaction, and difficult child scales, and providing a total stress score. This total stress score was used as a maternal stress index. Bivariate Pearson correlation analyses revealed total stress was not significantly correlated with negative reactivity.

The 10-item BISQ asks parents to provide information on several of their infants' sleep behaviors. Six BISQ variables were used: (1) time spent in sleep between 7 in the evening and 7 in the morning (i.e., night sleep duration), (2) time spent in sleep between 7 in the morning and 7 in the evening (i.e., day sleep duration), (3) number of wakings per night (i.e., night wakings), (4) time spent in wakefulness between 10 in the evening and 6 in the morning (i.e., night wakefulness), (5) length of time required to put the infant to sleep in the evening (i.e., sleep latency), and (6) extent of the infant's sleep problems. The BISQ has previously been found (e.g., Sadeh, 2004) to be correlated with other measures typically used in

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