

## *THE ROLE OF INTRINSIC AND EXTRINSIC FACTORS IN INFANT NIGHT WAKING*

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This literature review focuses on factors found to be associated with individual differences in infant night waking. Infant night waking that requires parent intervention to assist the infant to return to sleep is of special concern to parents because of the sleep deprivation and fragmentation that they experience. Both intrinsic and extrinsic factors related to night waking are considered and strategies for reducing night waking are briefly reviewed. An integrative perspective on the causes and effects of night waking, which considers both parent-infant behavioral contingencies and developmental/transactional processes, is proposed.

*Key words:* Sleep, infants, parents, night waking.

Parents of young infants are faced with a number of adjustments and challenges. In particular, during the first few weeks or months following birth, infants require feeding at regular intervals throughout the day and night. Infants signal their need to be fed by crying, and thus the nighttime sleep of parents is frequently disrupted by the cry signal and the need to awaken to feed the infant, change the infant's diaper, and soothe the infant back to sleep. Most parents know to expect these interruptions to their sleep during early infancy, and many mothers and some fathers are able to devote full time to the many demands of caring for a young infant by foregoing employment or taking maternity or paternity leave from their jobs.

By 3-4 months, however, most infants no longer physiologically require night feedings, and most infants have adapted to a daily rhythm in which they sleep more at night than during the day. Although essentially all infants continue to awaken at night at 3 months, about half of them are able to return to sleep without signaling and without parental intervention (Karraker & Cottrell, 2000). The other half signal to their parents when they awaken, and often require feeding, rocking, and other parental assistance to return to sleep. These

signaled night awakenings continue throughout the first year and beyond for a significant proportion of infants, and some infants who begin to "sleep through the night" (meaning that they do not signal to their parents following an awakening) at some point in early infancy return to a pattern of signaled night waking around 9 months.

These signaled night waking behaviors (henceforth referred to simply as "night waking") beyond the first few months of infancy are the focus of the present discussion. They are of concern to parents and practitioners primarily because of their impact on parents. Parents whose sleep is frequently shortened and fragmented experience substantial sleep deprivation, which can cause daytime fatigue, irritability, motor and cognitive deficits, impaired decision making, and lack of motivation (Dement, 1999; Pilcher & Huffcutt, 1996). It has been estimated that parents of infants lose an average of 2 hours of sleep per night from birth to 5 months, and 1 hour of sleep per night from 6 to 24 months (Dement, 1999). Sadeh and Anders (1993) also report that infant sleep difficulties are the most common concern parents report to pediatricians at well-baby visits.

The present paper addresses what is known about infants' night waking, with a focus on the role of environmental causes and correlates of individual differences in this behavior. To provide context, the discussion begins with a review of the normative developmental course of infant night waking, followed by a description of the effects of sleep deprivation on adults. Then, factors associated with individual differences in the frequency of night waking are described. Both intrinsic factors (characteristics of infants) and extrinsic factors (parent behaviors, family environment, etc.) are addressed. Then, the types of interventions commonly used to reduce infant night waking are summarized. Finally, a behavioral and developmental model of the causes and effects of infant night waking is described and illustrated.

### *Normative Developmental Changes in Night Waking During Infancy*

Information about infant sleep behavior is based primarily on maternal reports, video recordings, and actigraph recordings. An actigraph is a wristwatch-like device that is typically attached to the infant's leg and that records movements for later analysis. Hayes (2002) discussed the relative value of these different methods. Although video and actigraph recordings are more objective and detailed than maternal reports, they can be costly, intrusive, and difficult to use. Further, the sole use of actigraph recordings makes it difficult to discriminate signaled and unsignaled night waking events. Although maternal reports are subject to both systematic and nonsystematic bias, they are often the best available method of identifying the rate of infant night waking. Most of the research described here has relied in whole or in part on maternal reports, both real-time diaries and retrospective reports and ratings. Although diaries are reasonably accurate in identifying signaled night awakenings (Sadeh, 1994;

Scher & Asher, 2004), the potential limitations of maternal reporting methods must be acknowledged. In particular, some mothers may be especially prone to inaccurate or biased reporting, leading to inaccurate research results.

According to recent summaries of findings concerning infant consolidated night sleep (Middlemiss, 2004; Sadeh & Anders, 1993; Sadeh, Flint-Ofir, Tirosh, & Tikotzky, 2007; Scher, Zukerman, & Epstein, 2005), approximately 95% of infants regularly signal to parents upon awakening at night during the first month, 50% regularly signal at 6 months, 30-40% regularly signal at 8 months, and 20-30% regularly signal at 12 months, with continued declines after that. Interestingly, several researchers have noted a brief resurgence in signaled night waking, often in infants who previously were reported to have slept through the night, between 6 and 12 months (Anders, 1994; Mindell, 1997; Paret, 1983), possibly due to the onset of separation distress, the acquisition of new motor skills, or pain from teething (Paret).

Several researchers have reported stability in individual patterns of sleep behavior. For example, Bamford et al. (1990) reported stability in the number of daily periods of uninterrupted sleep at 13, 26, and 52 weeks, and Warren, Howe, Simmens, and Dahl (2006) reported statistically significant positive correlations across 6 to 36 months in the number of night awakenings. Further, Zuckerman, Stevenson, and Bailey (1987) found that 41% of the infants in their sample who were identified as having a sleep problem at 8 months also had a sleep problem at 3 years. Goodlin-Jones, Burnham, & Anders (2000) conclude that night waking in infancy appears to be a precursor of sleep problems in toddlerhood and early childhood for a substantial proportion of those children who regularly awaken and signal during infancy.

### *The Effects of Infant Night Waking on Parents*

Infant night waking is a problem for many parents because of its effects on their own ability to receive a sufficient amount of uninterrupted sleep at night. Pilcher and Huffcutt (1996) report the results of a meta-analysis of experimental studies on the effects of sleep deprivation on adults. They concluded that sleep deprivation causes significant decrements in mood, cognition, and motor performance. Partial sleep deprivation (less than 5 hours of sleep in a 24-hour period) had stronger effects on cognitive performance and mood than did long-term (greater than 45 continuous hours) or short-term (less than or equal to 45 continuous hours) sleep deprivation. Bonnett (1989) also reported that fragmented sleep resulted in significant deficits in performance and mood. Many parents of infants who frequently awaken them at night experience both partial sleep deprivation and fragmented sleep. In line with the general findings on the effects of sleep deprivation and fragmentation on adults, parents of frequently waking infants have been found to be more depressed than parents of infrequently waking infants (Karraker & Young, 2007). More frequent infant night waking has also been found to be related to lower parenting satisfaction and parenting self-efficacy (Karraker & Cottrell, 2000), and more negative perceptions of infants (Field, 1995; Foreman & Henshaw, 2002; Karraker & Cottrell, 2000; Nover, Shore, Timberlake, & Greenspan, 1984).

Although little research has examined motor and cognitive functioning specifically in parents of frequently waking infants, research on the effects of sleep deprivation suggests that these parents may be seriously impaired in their thinking, decision-making, and motor performance and may create risks for their own and their children's safety when driving and performing other potentially dangerous tasks. Further, adults often do not

recognize the deleterious effects of sleep deprivation on their functioning and thus do not engage in behaviors to alleviate these effects. Cottrell and Karraker (2002) reported that nap-taking by mothers of young infants was predicted more strongly by the mothers' perception of sleep deprivation than by the actual amount of sleep they received or had lost. Thus, some mothers may experience the negative effects of sleep deprivation without being fully aware of it (Coren, 1996).

### CORRELATES OF INDIVIDUAL DIFFERENCES IN INFANT NIGHT WAKING

A number of factors have been found to be associated with the frequency of infant night waking. These factors can be divided into two general categories: intrinsic factors, or characteristics and behavior patterns of infants themselves, and extrinsic factors, including parent behaviors and characteristics of the infant's environment (see also Sadeh & Anders, 1993). Most research identifying these factors has been correlational in nature and assumptions about whether or not these factors actually serve as *causes* of infant night waking have not often been tested experimentally.

#### *Intrinsic Factors Associated with Infant Night Waking*

Some infants appear to be more inclined than others to develop a pattern of frequent night waking independent of environmental influences. Infant characteristics and behaviors that have been associated with night waking include behavioral dysregulation, difficult temperament, premature birth, separation distress, and the onset of locomotion.

*Behavioral dysregulation.* Behavioral dysregulation (DeGangi, 2000) refers to a constellation of behaviors that includes irritability (frequent fussing and crying),

inconsolability (continued distress behaviors despite adult interventions), eating problems (such as food refusal), demandingness (frequent requests for adult behaviors, such as holding), poor mood regulation (unpredictable changes from one affect state to another and difficulty maintaining a positive mood state), poor attention regulation (frequent attention shifts), high arousal (high activity, distress, or tension), and sleep disturbances (such as night waking or irregular sleep patterns). Infants are identified as behaviorally dysregulated through parent reports of infant behavior or through structured observations. Behaviorally dysregulated infants have an above average risk for later behavioral problems (DeGangi, 2000; DeGangi, Poisson, Sickel, & Wiener, 1995).

DeGangi (2000) suggested that the sleep disturbances observed in behaviorally dysregulated infants result from their high level of arousal, which prevents them from sleeping deeply and continuously through the night. An alternate argument was provided by Weissbluth (1989), who suggested that infant night waking produces daytime fatigue, which leads to irritability and dysregulation during the day. A recent study by DeLeon and Karraker (2007) examined correlations between night waking and daytime crying across adjacent nights and days in a sample of normal infants. Daytime crying did not predict nor was it predicted by night waking in the adjacent night, leaving open the question of whether infants who are constitutionally more dysregulated awaken more at night or whether frequent night waking leads to more dysregulated daytime behavior.

*Difficult temperament.* Difficult temperament was defined in 1977 by Thomas and Chess as the combination of negative mood, low adaptability, high intensity of responses, frequent withdrawal from new experiences, and low rhythmicity. This definition of temperament has many features in common with behavioral dysregulation.

Infant temperament is most commonly assessed using standardized questionnaires that ask parents to report their infants' typical behavioral responses to a variety of common events or situations. Several researchers have found higher rates of sleep problems (primarily night waking) in infants who are rated by their parents as more temperamentally difficult (Minde, Popiel, Leos, & Falkner, 1993; Morrell & Steele, 2003; Weissbluth, David, & Poncher, 1984). Others have found that particular dimensions of temperament relate to poorer nighttime sleep behavior, such as high emotionality (Owens-Stively et al., 1997), low sensory threshold (Carey, 1974), low adaptability (Van Tassel, 1985), and negative mood (Van Tassel, 1985). However, these findings have not always been replicated (e.g., Scher, Tirosh, & Lavie, 1998), raising questions about both the validity of mothers' temperament ratings (Morrell & Steele, 2003; Scher et al.) and the possible influence of maternal fatigue or depression resulting from infant night waking on mothers' perceptions of their infants' temperament (Gelfand, Teti, & Fox, 1992). More objectively assessed measures may provide a better picture of the relation between particular infant behavior patterns reflective of temperament and infant night waking. For example, DeLeon and Karraker (2007) recently reported that diary recordings of infant daytime fussing and crying were more strongly related to night waking than were mothers' more subjective temperament ratings.

*Premature birth and other health problems.* Prematurely born infants show more sleep-wake transitions than full-term newborns when matched for gestational age (Ingersoll & Thoman, 1999). At older ages, more night waking has been reported for prematurely born infants than for full-term infants by Ju, Lester, Garcia-Coll, Oh, & Vohr (1991), but not by Wolke, Meyer, Ohrt, & Riegel (1995). Minor health problems such as colic, teething, and upper respiratory infections also can

cause transitory night waking in infants, but usually do not lead to persistent patterns of increased night waking unless the problems recur frequently or parents respond in a way that reinforces the night waking (Sadeh & Anders, 1993).

*Separation distress.* As noted above, some infants who acquire the ability to self-soothe following night waking in early infancy show a recurrence of waking and signaling in the second half of the first year. Infants' acquisition of certain developmental milestones during this period may be related to this resurgence in night waking. Paret (1983) speculated that the onset of attachment behaviors, including separation distress, around this time leads infants to signal distress when they recognize that their attachment figures are not nearby when they awaken at night. Infants who are more distressed by separation from their parents are expected to be more likely to signal upon awakening. Scher and Asher (2004) found some support for this idea. Less securely attached 12-month-olds in their study had more difficulty returning to sleep than did more securely attached infants. McNamara, Belsky, and Fearon (2003) also found that 15-month-olds with an insecure-resistant attachment pattern showed particularly frequent and long night awakenings. DeLeon and Karraker (2007) also reported that mothers' ratings of their 9-month-old infants' overall intensity of separation distress were significantly correlated with the frequency at which the infants awakened them at night.

*Onset of locomotion.* Another developmental accomplishment that may relate to the observed increase in night waking in the latter half of the first year is the acquisition of locomotor skills. Scher (2005a) found that night waking (measured both by actigraph and maternal report) was more frequent in 8-month-old infants who were able to locomote through creeping or crawling than those who were not yet able to locomote. Scher suggests that many of the maturational

changes and skill acquisitions that occur around this time (including major cognitive skills, increases in communication abilities, changes in attachment relationships, and increased locomotor capacity) disrupt the infant's behavioral organization, thus leading to a temporary increase in night waking.

*Other potential intrinsic factors.* Other intrinsic infant characteristics may be related to individual differences in night waking. These include unidentified genetic factors underlying the need for sleep or the ability to sleep deeply and continuously, various chronic or acute illnesses, and cognitive capacities, such as memory and general intelligence (see Scher, 2005b, for evidence that fragmented sleep is associated with lower mental development). However, little research has addressed these factors.

#### *Extrinsic Factors Associated with Infant Night Waking*

We move now to discussion of extrinsic factors that have been found to relate to infant night waking. The most obvious and most frequently examined extrinsic factor is parent behavior. Parents' choices concerning their infants' sleep environment, feeding routine, and daytime sleep, and the behaviors parents engage in when putting their infants to sleep or when reacting to infant night waking are strongly related to the extent to which infants engage in night waking after the early months. More distal extrinsic factors, including aspects of the personal, social, and physical family context are also related to parents' management of their infants' sleep environments and to parents' abilities to engage in behaviors that facilitate consolidated infant sleep, and thus relate as well to individual differences in night waking.

*Infants' sleep environments.* Parents make a number of choices about the physical sleep environment that they provide for their infant. Although such features of that environment as noise level, temperature, and ambient

lighting may regularly disrupt the sleep of infants with low sensory thresholds, most infants adjust easily to their physical sleep environment. Changes in the sleep environment, however, such as a dog barking at night or a move to a new house, can lead to increased night waking for a time until the infant again adapts to the changed sleep environment.

The infant's sleeping location, in particular whether or not they co-sleep with their parents, is associated with night waking. Infants who co-sleep have been reported to awaken more frequently at night (McKenna et al., 1994; Mindell, 1997) and to reach the milestone of sleeping through the night later than infants who do not co-sleep (Adams, Jones, Esmail, & Mitchell, 2004). However, a parent's decision to co-sleep with an infant is often based on a wide variety of considerations beyond the rate of infant night waking. Middlemiss (2004) provides a useful summary of these issues. She points out that some parents co-sleep because they believe that this practice provides benefits to the infant and parent, including improved ability to monitor the infant's well-being, increased ease of breast feeding, and enhanced parent-infant emotional closeness. In some cultures and subcultures, parents choose to co-sleep because it is the generally accepted practice. Middlemiss also points out that some parents co-sleep with older infants and toddlers as a reaction to their child's difficulties in going to sleep or staying asleep. This reactive co-sleeping appears to be caused by infant night waking whereas co-sleeping from an early age by parent choice may be a cause of higher rates of night waking. Middlemiss also summarizes the risks of co-sleeping, which may motivate some parents to avoid the practice. These risks include a delay in the infant's development of independence, lack of privacy for the parents, and threats to the infant's safety. These latter concerns about safety, which include the danger of the infant

being injured or suffocated, have lead the American Academy of Pediatrics (Cohen, 1999) to recommend against co-sleeping with infants. One additional consideration in parents' decision about co-sleeping, not discussed by Middlemiss, may be the effects of co-sleeping on the parent. Adults who co-sleep with an infant or young child may sleep less well and be awakened more frequently than adults who sleep alone or with another adult.

Another aspect of infants' sleep environment that is under parents' control is the provision of sleep aids. Some studies have found that infants who are provided with sleep aids such as pacifiers, soft toys, or special blankets sleep better than infants who do not have these sleep aids (Anders, Halpern, & Hua, 1992). However, little attention has been paid to the role of infant characteristics in determining the effectiveness of these sleep aids. For example, although most mothers offer a pacifier to their infant at some point, only some infants are soothed by a pacifier and continue using the pacifier for any length of time (Karraker, unpublished data). Another sleep aid that is infrequently used in the United States is the practice of swaddling infants. A recent study (Franco et al., 2005) found that young infants spontaneously awakened less frequently when swaddled than when not swaddled. However, swaddling may not be well tolerated or effective beyond early infancy.

*Feeding practices.* More frequent night waking has been reported for infants who are breast fed rather than formula fed (Burnham et al., 2002; DeLeon & Karraker, 2007; Mindell, 1997). In early infancy, infants consuming breast milk likely awaken more frequently than infants consuming formula because breast milk is easier to digest, leading to a shorter interval before the infant is awakened by hunger. As infants get older, the need for nighttime nutritional intake declines, but breast-fed infants continue to awaken

more frequently than formula-fed infants. Possible reasons for this awakening and signaling include less opportunity for breast-fed infants to learn to sleep for long periods and breast-fed infants associating falling asleep with the act of nursing (Middlemiss, 2004).

*Parent behaviors when putting infants to bed.* Ferber (1985) and others have suggested that infants are likely to have more difficulty self-soothing following a spontaneous awakening when the environment is different during the night than when they initially went to sleep. The infant learns to fall asleep under a particular set of environmental conditions (such as being fed, rocked, and held). When the environmental conditions are different when the infant awakens, the infant reacts with crying, which then initiates the same parent behaviors. The infant thus learns that crying leads to a reinstatement of the previous environmental conditions when awakening at night (Ferber). This analysis suggests that solitary sleeping infants will be less distressed and more able to self-soothe during the night if they fall asleep alone and in their own beds. Numerous studies have confirmed that putting infants to bed asleep, rather than awake, is associated with more night waking (e.g., Burnham, Goodlin-Jones, Gaylor & Anders, 2002; DeLeon & Karraker, 2007; Mindell, 1997; Wolfson, 1998). In addition, parent presence and engagement in comforting behaviors, such as rocking and feeding, when the infant goes to sleep are associated with more frequent signaled night waking (Middlemiss, 2004).

*Parent management of night waking.* How parents respond to infants when awakened by them during the night also relates to the continued frequency of such awakenings. An initial consideration is whether or not the parents are even awakened by the infant's signals. Ju et al. (1991) suggested that parents of premature infants may be particularly vigilant to signs of distress in their infants,

and may encourage night waking by responding even when the infant would otherwise be able to self-soothe following a brief period of fussing. Parents of full-term infants also likely vary in their sensitivity to infant night waking, based on such factors as the proximity of the infant (sleeping in the parents' room vs. in a separate room), the amplitude and persistence of the infant's cries, individual differences in parents' tendencies to sleep deeply and resist awakening, and parents' use of an electronic monitor (which can be set to be so sensitive as to allow the parent to hear the infant breathe). Parent responsiveness to infant night waking may reinforce infants' signaling behavior following awakening and teach them to expect parental interventions. Alternately, a lack of parent responsiveness can eventually (though not necessarily very quickly) extinguish the signaling behaviors.

Simultaneously, infants' responses to parent interventions can serve to reinforce or extinguish the parents' behavior. For example, an infant who quickly and easily goes back to sleep when rocked but not when left in the crib and sung to will reinforce the parent's rocking behavior and extinguish the parent's singing behavior. Because most parents find both infant crying and being awake in the middle of the night to be aversive, they often choose to engage in those behaviors that are most likely to quickly eliminate the crying and allow them to return to sleep. Such behaviors as rocking, feeding, and putting the infant back to bed asleep are reinforcing to parents in the short term because they allow the parent to return to sleep, but in the long term serve to reinforce signaling when infants awaken during the night. Through these patterns of mutual reinforcement and extinction, a vicious circle of infant night waking followed by parent behavior that reinforces the infant's crying upon awakening can be maintained.

*Infants' daytime environments.* Certain aspects of infants' daytime physical and social environments are related to the likelihood that they will awaken at night. Infant napping during the day is of particular concern. Paret (1983) suggested that infants may make up for missed sleep at night by napping more during the day. Alternately, infants who sleep longer during the day may have less need for sleep at night, leading to more frequent and longer periods of wakefulness at night. DeLeon and Karraker (2007) found that infants who awakened more frequently and stayed awake longer at night took more frequent naps than infants who awoke less at night, but did not spend more total time napping. Skuladottir, Thorne, and Ramel (2005) also reported that infants who were awake more at night took frequent short naps during the day. DeLeon and Karraker suggested that infants who have difficulty maintaining sleep at night may also have difficulty maintaining sleep during the day, leading to more frequent naps due to sleepiness, but naps that do not last long enough to fully compensate for nighttime sleep loss. A further consideration related to daytime sleep is that infants in day care, particularly in centers and particularly after the first year, may have nap times dictated by the day care center's routine, which could lead to some infants receiving less daytime sleep than they need and others receiving more daytime sleep than they need. Further research on the relation between daytime and nighttime sleep, especially in infants in group child care settings, would be informative.

Other aspects of infants' daytime environments are also likely to be related to night waking. Sadeh and Anders (1993) discussed the importance of family interaction patterns that can contribute to infant sleep difficulties. For example, in cases when the parents and infant have limited social interaction time during the day due to parent work responsibilities, infant time in day care,

or the presence of siblings, parents and infants may find social interaction during the night to be mutually rewarding. The attachment relationship forged during daytime interactions, including parents' responses to infants' reactions to separation, may reinforce infants' engaging in crying and clinging to prevent further separations and to maintain closeness during the night.

*Family contextual factors.* Parents' choices of behaviors in providing their infants' sleep environment, putting their infants to bed, and reacting to infant night waking, as well as their cognitive and emotional responses to infant night waking, can be modified by family contextual factors, such as parents' personal characteristics and family stressors. For example, mothers who are depressed are generally found to provide less effective parenting than nondepressed mothers (NICHD Early Child Care Research Network, 1999) and therefore may be less likely to respond to night waking in ways that reduce, rather than maintain, the waking. Other family factors that may be associated with parents' behaviors in response to night waking include parents' individual differences in tolerance for sleep deprivation and infant crying, marital stress and conflict, the presence of siblings, maternal attachment and separation concerns (Scher & Blumberg, 1999), work and daycare, parent attitudes about sleep and child care, life stresses, and parent personality. In some families, infant night waking may not even be considered to be a problem. For example, we recently examined correlates of 6-month-old infants' night waking in the NICHD Study of Early Child Care, which included over 1000 families (see also Karraker & Young, 2007). Individual differences in mothers' reactions to their infants' night waking were evident in the finding that 42% of the mothers of chronically waking infants (infants who awakened five or more nights per week and either awakened three or more times per night or stayed awake on average more than 20



minutes) reported that their infants' night waking was not a problem for them. More frequent infant night waking was associated with mothers perceiving their infants as less healthy and themselves as more anxious about separation from the infant, and more frequent night waking and more total time awake were associated with fathers' reports that they were less intimately involved in the care of their infants, probably because mothers were providing much of the nighttime infant care. Morrell (1999) also reported that certain parental attitudes about infant sleep, such as reluctance to set limits or anger in response to infant waking were associated with more infant night waking.

Some families also experience more environmental chaos than do other families, which often is associated with increased night waking in infants. For example, infants may be awakened during the night by noise, family interactions, siblings, etc. Changes in the infant's routine, ranging from major family disruptions such as natural disasters or war to minor disruptions due to moving from one home to another, holidays, or even weekends, also can increase night waking in infants.

Parent behaviors in response to infant night waking (and in putting infants to sleep) also are susceptible to influence by a number of extrinsic factors. For example, interactions with the father can influence mothers' choices of how to respond to infant night waking (and vice-versa), and a variety of external stressors (such as economic strife, working night shifts, and marital discord) may modify parents' abilities to respond consistently and appropriately to infant night waking. Such setting events may influence the effectiveness of parental responses to infant night waking.

#### INTERVENTIONS TO REDUCE INFANT NIGHT WAKING

Reports of successful interventions to reduce infant night waking provide useful

information about possible causes and effects of infant night waking. For example, some interventions that have reduced infant night waking have been found to improve mothers' moods (Armstrong, Van Haeringen, Dadds, & Cash, 1998; Hiscock & Wake, 2001), supporting the argument that infant night waking contributes to maternal depression through the mechanism of sleep deprivation. However, intervention studies are generally conducted with infants who have already developed such disruptive sleep patterns that their parents have requested professional help. Although a particular intervention may reduce the night waking behavior, this information does not necessarily explain how the behavior initially developed over the course of several months or years, and may not always apply to our understanding of this behavior in infants of other ages and with less severe patterns of night waking.

Middlemiss (2004) provides a summary of frequently used intervention strategies. Many interventions rely on behavioral principles such as reinforcement of desired behaviors and extinction of undesirable behaviors (e.g., signaling upon waking). A commonly used approach is systematic ignoring of infant crying during the night, with the intention of extinguishing signaling, though not necessarily waking. This approach has generally been found to be effective when parents are committed to applying and adhering to the intervention. Unfortunately, parents often abandon this approach because of their intolerance for prolonged infant crying. Giving in to the infant's crying after long periods can then strengthen the signaling behavior. A similar approach, with similar challenges, is the graduated withdrawal of attention approach advocated by Ferber (1985). With this strategy, parents respond minimally to infant night-time crying and gradually increase the amount of time between returning to the infant's room to provide reassurance (but without holding, rocking, or

feeding the infant). Again, the procedure can be successful, although it can take a little longer than other systematic ignoring approaches, and many parents find adherence to the intervention guidelines difficult.

Some books for parents recommend preventive strategies to help infants learn to sleep through the night without signaling (e.g., Ezzo & Buckram, 1995; Karp, 2002; Mindell, 1997; Pantley, 2002; Weissbluth, 2003). In general, this set of strategies involves teaching the infant to go to sleep alone from an awake state, thus encouraging the infant to learn to go to sleep in conditions similar to those that recur when waking occurs during the night. Some books also encourage parents to gradually increase the time between nighttime feedings, thus modifying the temporal conditioning that may have occurred during early infancy when regular night feeding was required for adequate nutrition and growth. Another strategy that disrupts temporal conditioning takes a somewhat different approach, by using scheduled awakenings at shorter intervals than those at which the infant spontaneously awakens. Although this strategy is fairly effective, it requires substantial commitment and organization on the part of the parents to awaken themselves and the infant at set intervals (Middlemiss, 2004).

Middlemiss (2004) describes several other intervention approaches. Chronotherapy involves a reorganization of the infant's sleep schedule by reducing nap time (such as by eliminating afternoon naps) and putting the infant to bed earlier with a clear and consistent bedtime routine. In certain circumstances, medication may be used on a short-term basis to reduce the frequency of infant night waking. Although this approach does not teach the infant or parent alternate behaviors, it can provide some short-term benefits to infants and parents. In some cases parents are incapable of adhering to a behavioral treatment plan because of their own cognitive, physical,

and mood deficits that have resulted from persistent sleep deprivation, and medication of the infant can allow them to regain their ability to implement a behavioral treatment plan.

Middlemiss (2004) points out that, in some cases, the only feasible approach to dealing with infant night waking may be to allow the infant to grow out of it. Cottrell and Karraker (2002) have suggested that it may at times be more effective to intervene with parents to help them to cope with sleep deprivation, for example by taking naps, sharing night-time infant care, or rearranging their own sleep schedules, than to try to change the infant's sleep behavior. Many interventionists emphasize the importance of fit between the selected treatment program and the characteristics and capacities of the parents. Although many treatment programs have been shown to be effective when they are properly implemented, treatment adherence is often quite low. The reinforcement value of sleep for parents is a strong influence on their behavior, leading them to engage in behaviors that they know will get their infant back to sleep, so that they too can return to sleep, even though they may also know (or learn) that these behaviors reinforce and thus prolong their child's night waking behavior. The effectiveness of interventions may also be compromised by the secondary gains that some parents may experience from the ongoing infant night waking and resultant parent fatigue. Sadeh and Anders (1993) suggest that some parents may use their infant's night waking as an excuse for their own dysfunctional behavior, as a focus of marital discord, or as a means of avoiding sexual relations with their partner.

#### *An Integrative Perspective on the Causes and Effects of Infant Night Waking*

Several researchers have proposed models of some of the causes and effects of infant night waking (e.g., Goodlin-Jones et al., 2000;

Karraker & Young, 2007; Sadeh & Anders, 1993). As emphasized in the review above, the perspective proposed here integrates behavioral and developmental/transactional principles, and incorporates elements from several other researchers (particularly Goodlin-Jones et al., 2000, and Sadeh & Anders, 1993). The basic premises of this perspective are that: 1) Individual infants and parents possess differential biological or learned tendencies to engage in particular behaviors relevant to infant night waking, 2) Infant and parent behaviors following infant night waking can act to reinforce or extinguish the behavior of the other member of the dyad, 3) Parent-infant behavioral interactions and environmental conditions in place when an infant is put to bed at night influence the likelihood that the infant will signal when awakening at night, 4) Distal extrinsic factors (especially the family context) can directly and indirectly influence both infant night waking behavior and night-time parenting behaviors, and 5) Infant night waking has multiple simultaneous and ongoing causes and consequences that transact across time and development.

The transactional model of development (Sameroff and Chandler, 1975) emphasizes the concept that the individual and the environment continually and reciprocally influence one another. The developmental perspective emphasizes that the nature of these influences changes with development, and that both internal processes (such as cognitions and emotions) and external behaviors can be causes and consequences of behavioral transactions between an individual and the environment. This approach also recognizes that multiple causes and consequences may operate both simultaneously and sequentially. Thus, both intrinsic and extrinsic predictors of infant night waking are likely to vary at different ages, the reinforcement value of particular infant and parent behaviors is likely to change with age,

and the behaviors of infants and parents at any point in time are a complex function of their intrinsic characteristics, the current family context, and their history of interactions.

#### *Illustration: Infant Night Waking and Maternal Depression*

The relation between infant night waking and maternal depression provides an instructive example of the application of this integrative perspective. Although maternal depressive symptoms are frequently found to be positively associated with the frequency of infant night waking (Dennis & Ross, 2005; Goodlin-Jones et al., 1997; Hiscock & Wake, 2001; Zuckerman et al., 1987), there has been considerable debate about the causal direction of the relation between these two variables (e.g., Armstrong, Van Haeringen, Dadds, & Cash, 1998; Warren et al., 2006). Mothers of frequently waking infants experience sleep deprivation, which experimental research has shown to cause an increase in depressive symptoms (Pilcher & Huffcutt, 1996), so infant night waking may cause maternal depression or contribute to postpartum depression. Infants awaken more in early infancy and mothers as a group tend to be more depressed at that time, further suggesting a causal relation between these variables. Alternately, Warren et al. (2006) found evidence that maternal depression affects infant sleep behavior, rather than the reverse, during late infancy. Karraker and Young (2007) suggested that both processes may take place. Chronic infant night waking may cause a contemporaneous increase in depressive symptoms in some mothers through the mechanism of sleep deprivation, and maternal depression, regardless of its source, can lead to increased infant night waking over time because depressed mothers are likely to engage in less effective parenting behaviors (NICHD ECCRN, 1999). Thus, a fatigued and depressed mother of a frequently

waking infant may engage in parenting behaviors that prolong or increase the night waking and therefore their own sleep deprivation, thus leading to increased exhaustion and depression, and so on. Further, multiple factors are known to cause depressive symptoms, and depressive symptoms can lead to other interpersonal difficulties such as marital discord and distorted perceptions of and interactions with the infant. A depressed mother may also be less able to comply with an intervention program if the infant night waking becomes particularly problematic. Overall, the relation between infant night waking and maternal depression changes over time and at different infant ages, and the relation between these variables is influenced by numerous other factors.

### Conclusion

This review has summarized current findings about multiple factors related to infant night waking. Although much about infant night waking can be understood through an analysis of how parent behaviors reinforce or extinguish infants' signaling behavior when they awaken at night, it is important to also recognize that infant behaviors in this setting reinforce or extinguish parent behaviors as well. Often parents engage in behaviors that produce short-term gains (both they and the infant return to sleep), but in the long term maintain or promote signaling following night waking. Understanding infant night waking is also enhanced by a developmental and transactional perspective, as this behavior and its proximal causes are influenced by a variety of other factors, including infant age and family context. Knowledge about these complex causes, effects, developmental changes, and contextual factors can help practitioners in providing advice and interventions to parents whose infants continue to awaken them after the first few months.

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