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Night Waking, Sleep-Wake Organization, and Self-Soothing in the First Year of Life

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Abstract

Few objective data are available regarding infants' night waking behaviors and the development of self-soothing during the first year of life. This cross-sectional study examined 80 infants in one of four age groups (3, 6, 9, or 12 mo) for four nights by using videosomnography to code nighttime awakenings and parent-child interactions. A large degree of variability was observed in parents' putting the infant to bed awake or asleep and in responding to vocalizations after nighttime awakenings. Most infants woke during the night at all ages observed. Younger infants tended to require parental intervention at night to return to sleep, whereas older infants exhibited a greater proportion of self-soothing after nighttime awakenings. However, even in the 12-month-old group, 50% of infants typically required parental intervention to get back to sleep after waking. Results emphasize the individual and contextual factors that effect the development of self-soothing behavior during the first year of life.

The establishment of organized patterns of sleep and waking in human infants is widely recognized as a significant milestone of early development.[1,2] Failure to establish such patterns may lead to sleep problems, the most common of which are problems of going to bed and falling asleep and problems of waking during the night. Both types of difficulty involve the infant's capacity to self-soothe upon transitioning to sleep. Such problems are fairly common, occurring in approximately 20% of infants and preschoolers.[3–6] Moreover, sleep problems often persist from infancy into toddlerhood and later childhood.[7–9] Given the prevalence and persistence of sleep problems, it is important to study the origins of self-soothing behaviors and the potential factors that might facilitate their development.

Consolidation and regulation are two biopsychosocial processes that interact to facilitate the establishment of organized sleep-wake patterns. Consolidation, referred to in the vernacular as sleeping through the night, reflects the gradual development of a diurnal pattern of long sleep periods at night and long waking periods during the day. Self-regulation refers to the process whereby an infant becomes progressively better able to control internal states of arousal and, at night, to fall asleep without help both at the beginning of a sleep period and upon awakening in the middle of the night. This increasing ability to self-regulate during the nighttime hours has been termed "self-soothing."[10] A preliminary study indicated that infants

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who were able to self-soothe at night at 12 months of age were less likely to have a sleep-related problem at 2 years of age.[7]

Progressive lengthening of sleep periods and their shift to the nighttime hours begins during the first 6 months as the infant's sleep-wake cycle moves from being related to hunger and satiety to a circadian cycle entrained by social cues and periods of light and darkness. With increasing age, further consolidation occurs as infants become better able to sustain longer sleep periods.[11] A literal interpretation of sleeping through the night, however, is erroneous. Anders et al[10] and Anders[12] reported that infants younger than 12 months of age typically arouse an average of three times during a night's sleep. These previous reports have indicated that younger infants tend to cry when they awaken and usually require external help to return to sleep, whereas older infants tend to return to sleep on their own. Anders[12] has previously referred to the noncrying awakenings in which the infant returns to sleep without help as self-soothing awakenings to distinguish them from those awakenings in which the infant cries and needs assistance to return to sleep. A slight revision of this distinction is now proposed because we have found that many infants may vocalize but receive no intervention, whereas others do not vocalize but receive an intervention nonetheless. This new distinction is discussed in more detail below.

The shift from externally imposed calming and activating strategies to self-control strategies results, in part, from social interactions with the parent, and, in part, from a variety of other contextual and individual factors.[1,10,13,14] Our laboratory has developed a transactional model to define the potential relationships among context, individual attributes, and parent-child interaction in influencing infant sleep patterns.[14] This model is supported by a number of studies describing the influence of contextual, psychosocial, and individual factors that influence the development of sleep-wake organization in young children. For example, parental psychopathology and poor family psychological functioning are significantly associated with young children's bedtime problems.[15] Other psychosocial factors, such as marital satisfaction, social history, and parenting stress, have also been implicated.[16] In the individual domain, both internalizing and externalizing problems have been associated with sleep difficulties.[16, 17] Infant temperament also has been associated with particular patterns of sleep.[18–21]

Although these reports note significant associations among context, parent, and infant variables and the presence of sleep disturbances at particular ages, these associations have not been examined systematically. Also, few objective data are available about parent-infant nighttime interactions. Although parental reports seem to provide a fairly accurate account of problematic sleep behavior,[22] most data, garnered from parent interviews or structured questionnaires, are unable to objectively quantify the presence of self-soothing behaviors.

This study focuses on the development of sleep-wake organization and self-soothing behavior after nighttime awakenings in the first year of life. Expectable changes and factors influencing sleep in solitary sleeping, normally developing infants are presented. Professional advice about management of infant sleep frequently recommends consistency in interaction; therefore, one factor examined was the emergence of consistent parent-infant interaction styles, especially during the infant's bedtime routine and after middle of the night awakenings. This article provides information for professionals and parents on typical sleep and waking behaviors during the first year of life as they appear in a nonclinical population.

METHODS

Participants

Eighty-eight infants (44 females) were initially enrolled in the study, with approximately 20 infants at each of four ages: 3, 6, 9, or 12 months. These age groups were selected to more

closely study the first year of life, when self-soothing behavior as a developmental milestone often develops. Two families withdrew after initially giving informed consent and were lost to the study. For six infants, the equipment failed or data were insufficient. Thus, data are reported in this study on 80 infants (41 females). Table 1 lists the number of subjects in each age group by gender.

Infants and their mothers were recruited through visits to mothers' support groups and fliers placed in pediatric offices in the surrounding suburbs and towns near the university. Informed consent was obtained from the parents after the presentation of the protocol. Exclusion criteria were any evidence of an abnormal pregnancy or delivery, chronic health problems in the mother or infant, or plans to co-sleep with the infant in a family bed.

All infants lived with both of their biological parents except one, who had been adopted at birth. Ninety-two percent of the families were classified as middle or upper middle socioeconomic status on the Hollingshead scale.[23] Seventy-five percent of the infants were white, and most lived in a single-household dwelling. Sixty-three percent of the mothers worked outside of the home at least part-time (24% worked full-time). Approximately 80% of mothers and fathers were college educated; 50% of these had an advanced graduate or professional degree. Fathers were typically full-time wage earners outside of the home. There were no differences between the different age groups of infants on the basis of ethnicity, family socioeconomic status, or parents' marital status.

Parent Questionnaires

Parents completed a number of questionnaires to assess psychological well-being, including the Beck Depression Inventory (BDI24), the Parenting Events Scale (PES; Halpern and Garcia-Coll, personal communication, 1990), and the Symptom Checklist-90-Revised (SCL-90-R25). The BDI is a brief questionnaire designed to detect symptoms of depression. The PES, adapted from Crnic and Greenberg,[26] is a 20-item instrument that measures typical daily stress experienced when parenting infants. The PES is summarized with two scores: Stress and Hassles. The SCL-90-R is an instrument designed to assess a variety of psychological symptoms; for the purposes of this study, the Anxiety and Global Symptom indices were used. Higher scores on the BDI, PES, and SCL-90-R indicate greater depressive feelings, more hassles and stress, and higher degrees of anxiety and global psychological symptoms, respectively.

Video Recording of Sleep

Sleep-wake behavior was recorded with a portable time-lapse video system consisting of a time-lapse videocassette recorder (AG-6740P; Panasonic, Cupertino, CA), a low-level illumination camera (e.g., VDC-9212; Sanyo, San Diego, CA) on a tripod next to the child's crib, a 12-inch video monitor, and a microphone to record sound.[27] Video and audio signals were recorded by using the 18-hour time-lapse mode so that a full 18 hours could be recorded on one 2-hour standard VHS videotape. A time code generator recorded real clock time on the tape.

By using the in-home video recording system, two consecutive nights of sleep were recorded on each of two occasions, Time 1 (T1) and Time 2 (T2), separated by 2 weeks, for a total of four recorded nights of sleep for each infant. Whenever an infant was ill, the videotaping was postponed until the parent indicated that he or she was again healthy. Telephone contact was maintained with parents after each recording night to establish that the equipment was working properly and to obtain a parental report of the night. Twice weekly, phone contact was maintained during the 2-week interval between T1 and T2.

The method of scoring time-lapse video recordings has been described previously.[27,28] Research assistants were trained to 85% reliability on sleep and waking transitions and on duration of each sleep and waking state. The following indices were derived: the longest sleep period (LSP), percentages of time in active sleep (AS%), quiet sleep (QS%), wakefulness (AW %), and out of crib (OOC%), the number and duration of middle of the night awakenings, and the duration from vocalization to caregiver's interaction. Also scored were the use of sleep aids, the time and duration of the parent's checking on the sleeping infant, and all parent interactions with a wakeful infant during the middle of the night. Disagreements in the scoring of parental interventions and sleep aid use were discussed until consensus was reached.

Each infant awakening lasting two or more minutes that occurred at least 10 minutes after initial sleep onset was considered a nighttime awakening, regardless of the actual clock time. Each awakening was classified on the basis of two dimensions: infant vocalization or no vocalization, and adult intervention or no intervention. Four types of awakenings resulted: infant did not vocalize, parent did not intervene (Type 1); infant vocalized, parent did not intervene (Type 2); infant vocalized, parent intervened (Type 3); and infant did not vocalize, parent intervened (Type 4). During the course of a typical night for any single infant, several types of awakenings were observed. To examine each infant's typical pattern of awakening, the modal awakening style across the four nights of videotaped sleep was computed. The modal, or most common, style for each infant was selected because it was most representative of the behavior exhibited by a particular infant over the four nights. The awakening styles were collapsed further into self-soothing (SS) and non–self-soothing (NSS) categories by combining Styles 1 and 2 and Styles 3 and 4, respectively. In the SS style, the infant consistently did not receive parental assistance to return to sleep after awakening during the night. The NSS style, on the other hand, referred to infants that consistently received parental assistance to return to sleep after a nighttime awakening.

Several sets, or domains, of independent variables likely to affect the development of these nighttime interaction styles were assessed. The variables included in each domain have been discussed in a transactional model of sleep-wake regulation.[14] The infant domain included variables such as age, gender, health status, and birth weight. The parent domain included measures of parental psychological well-being, such as depression, anxiety, and parenting stress and hassles. The sleep-wake organization domain included measures of the LSP, the AW %, AS%, QS%, and OOC%, and the number of nighttime awakenings. Lastly, the sleep context domain included variables such as the number of times the infant was removed from the crib, the behavioral state of the infant when he or she was first placed in the crib, the number of checks a parent made on a sleeping infant, whether potential sleep aids were present, and crib location.

Data Analysis

The sleep-wake organization and sleep context variables were analyzed initially by comparing the first two nights (T1) to the last two nights (T2) of video recordings. No consistent significant differences between T1 and T2 were found. Thus, each variable was collapsed across the four nights for each infant. Parametric statistical tests were used, when appropriate, to examine age group and gender differences. Nonparametric statistical tests were used in the analysis of nominal dependent variables.

RESULTS

The results are grouped into two primary sections. Descriptive results for each domain (i.e., infant, parent, sleep-wake organization, and so on) are presented first. Age and gender differences, when found, are reported for each of these domains. The second part of the section

contains information on the awakening styles. The relationships between these styles and the variables in each domain are presented.

Infant Domain

There were no significant differences among the four age groups in infant birth weight, delivery status, health, or gender. All infants were full-term, and all were in good health after birth and at the time of study. Eighty-four percent of the infants were delivered vaginally with no complications. The mean birth weight for all infants was between 7 and 8 pounds (range, 5 lb 4 oz to 10 lb). The general health of the sample was rated very high. Most 3 month olds (97%), 6 month olds (67%), and 9 month olds (67%) were nursing, with 79.2% of 3 month olds exclusively breast-fed. In the 12-month-old group, in contrast, 12 of 18 (67%) were not nursing at all. The age difference between "some nursing" versus "no nursing" was significant ($\chi_3^2 = 18.2$, $p < .01$). There were no gender differences in nursing status.

Sixty-seven percent of parents reported a stressful event for their child during the day preceding the night of recording on at least one of the four nights. These reports included a range of mild events from pediatric well-baby checks to having a new babysitter. There was a significant association between the presence of a stressful event and gender, with the parents of male infants noting events more often than the parents of female infants ($\chi_1^2 = 4.66$, $p < .05$). There were no age-related differences in reporting of stressful events. In addition, the majority of the nights that were videotaped were rated as typical nights of sleep by the parents, suggesting that the videotaped nights were typical for this sample and that the families were not unduly affected by the presence of the equipment.

Parent Domain

All Beck Depression Inventory (BDI), Parenting Events Scale (PES), and Symptom Checklist-90-Revised (SCL-90-R) scores were within the normal to mild range, confirming the fact that this was not a sample of families with clinical concerns. The overall average BDI score (collapsing across Time 1 and Time 2) was 5.08 (range, 0 to 16). The average Stress scale score was 36.3 (SD = 6.9), and the average Hassle scale score was 34.4 (SD = 9.1). On the SCL-90-R questionnaire, the average Anxiety score was 45.4 SD = 7.9), and the average Global Symptom Index score was 46.9 (SD = 10.1). There were no significant differences in BDI, PES, or SCL-90-R Anxiety and Global Symptom Index scores by infant gender or age group.

Sleep-Wake Organization

Table 2 provides means and SDs for each sleep-wake variable by age. Several significant differences in sleep-wake organization were found from 3 to 12 months of life. The proportionate amounts of quiet and active sleep changed. The percentage of time infants spent in quiet sleep (QS%) increased ($F_{3,79} = 14.87$, $p < .01$), whereas that of active sleep (AS%) decreased from 3 to 12 months of age ($F_{3,79} = 14.86$, $p < .01$). The longest period of uninterrupted sleep during the night (LSP) also increased in duration with age($F_{3,79} = 3.12$, $p = .05$).

Although the overall amount of wakefulness (AW%) and the number of awakenings during the night did not differ significantly among age groups, the amount of time the infant was removed from his/her crib (OOC%) significantly decreased ($F_{3,79} = 3.43$, $p < .05$). Hence, infants continued to awaken as much throughout the first year of life but were not removed from their cribs for as long at older ages. As listed in Table 3, the actual number of awakenings during each of the four nights at each age varied widely. On only a few nights did some infants truly sleep through the night. In general, the mean number of awakenings per night at 3 months of age was equivalent to the mean number at 12 months.

A significant interaction effect was found between gender and age group for QS% ($F_{3,79}$ = 3.67, $p < .05$). Females averaged higher levels of quiet sleep than males at all ages except at 6 months. The age group × gender interaction was less robust for AS% ($F_{3,79} = 2.36$, $p < .08$). The OOC% demonstrated a significant gender effect as well ($F_{1,79} = 6.21$, $p < .02$). Male infants had a higher average OOC% (mean = 4.56%) than female infants (mean = 2.23%). Female infants also had longer LSP durations than male infants ($F_{1,79} = 16.71$, $p < .01$).

An awakening was coded as "vocalized" if the infant cried, cooed, or babbled and was audible on the videotape recording. An age group main effect on the percentage of vocalized awakenings was significant ($F_{3,79} = 3.37$, $p < .05$), with the 6 month olds exhibiting the lowest level (mean = 78.1%) and the 12 month olds showing the highest average level (mean = 90.1%) of vocalization. There was no significant difference between male and female infants on this variable.

Sleep Context

On each of the videotaped nights, the location of the crib was noted. Infants were either sleeping in their own room or in their parents' room. Crib location did not change across the four nights. Crib location did not differ significantly by gender ($\chi_1^2 = .10$; not significant). However, crib location did change with age ($\chi_3^2 = 16.26$, $p < .01$). A majority of 3-month-old infants had cribs located in their parents' room (54.5%), in contrast to 5% to 10% of infants at the older ages.

When the infant was first placed in the crib, his or her behavioral state was coded as awake or asleep. Most infants (63.8% for all age groups) were placed into their cribs awake on some nights and asleep on others. There was a general trend across the age groups for the oldest infants to enter the crib awake and the youngest infants to enter already asleep ($\chi_6^2 = 9.8$, $p = .20$). Restricting the comparison to the 3-month-old and 12-month-old age groups only, a significant difference was found ($\chi_2^2 = 7.2$, $p < .05$). That is, 12 month olds were more likely to enter the crib awake than the 3 month olds. There were no gender differences based on whether infants entered the crib awake or asleep at any age.

Each time a parent checked on the sleeping infant, it was coded as a "sleep intervention." The average number of these interventions differed significantly by the age of the infant, with 3-month-old infants receiving more checks per night than the other age groups (mean = 2.2, SD = 2.7; $F_{3,79} = 3.12$, $p < .05$). There were no gender differences in the number of sleep interventions.

Among those infants who vocalized upon awakening and received a parent intervention, the duration from the vocalization to the onset of the intervention was analyzed. The average duration for the sample as a whole was approximately 4 minutes (mean = 245.55 sec, SD = 244.20, range = 1 to 1076 sec). No significant main effects for, or interaction effects between, age and gender were noted. Typically, it was the mother (59.2%) who interacted with the infant for all awakenings during the four videotaped nights. However, in 38% of the families, both mother and father assisted the infant during the middle of the night. The father exclusively provided assistance for only 2.8% of the families.

Analysis of the percentage of awakenings associated with the use of a sleep aid yielded a significant age group × gender interaction ($F_{3,79} = 2.9l$, $p = .05$). The 3-, 9-, and 12-month-old females (58, 30.6, and 56.3%, respectively) used sleep aids more than the males in those age groups. Gender and age were not significant main effects.

Soothing Styles

As discussed above, each infant's modal awakening pattern was calculated by identifying the most common type across all awakenings during the four nights of recorded sleep. Table 4 lists the percentage of infants in each of the four modal types by age group. The most common awakening pattern across all infants was Type 2, in which the infant vocalized but did not receive a parent intervention (43.8%). The least common pattern was Type 1 (2.5%), in which the infant did not vocalize after an awakening and no one interacted with him or her before he or she returned to sleep. The distribution of types across age groups differed significantly, with more of the older infants categorized as Type 2 and fewer categorized as Type 3 compared with the younger age groups ($\chi_9^2 = 18.5$, $p = .03$).

The infants' modal awakening types were then collapsed into two primary categories, or soothing styles: self-soothing (SS, Type 1 and Type 2) and non–self-soothing (NSS, Type 3 and Type 4). As shown in Table 5, there were 37 infants classified as SS and 43 infants as NSS. To confirm that these styles were truly modal, a mean percentage of SS awakenings was calculated for each infant. The NSS group had a mean of 36% SS responses, whereas the SS group had a mean of 79.3% SS responses across the four nights, confirming that the two groups were clearly different.

A significant association was found between soothing style (SS vs NSS) and age group ($\chi_3^2 = 11.5$, $p < .01$). Partitioning the χ^2 table revealed that proportionately more 3 month olds exhibited the NSS style, whereas more of the 6-, 9-, and 12-month-old infants exhibited the SS style (Table 5). Comparison of soothing style by gender revealed a significant association as well ($\chi_1^2 = 7.34$, $p < .01$). Specifically, more males were categorized into the NSS style (69.2%) compared with females (30.8%), regardless of age.

Factors Affecting Soothing Style

Infants with the two primary soothing styles (NSS and SS) were compared by using independent *t* tests for differences in our previously defined domains. Several of these comparisons were significant. A discussion of each domain follows.

Infant and Parent Domains.—Infant variables, aside from age and gender, included a general health rating by the parent, nursing status, and parental report of stressful events. Overall, there were no significant differences between the two soothing styles on any of these infant variables, with the exception of gender and age, as described previously. It is interesting to note, however, that although more males experienced stressful events as rated by their mothers and more males were categorized in the NSS group, the report of stressful events was not directly related to soothing style. Moreover, there were no significant associations between any of the parental well-being measures and infants' soothing styles.

Sleep-Wake Organization.—More comparisons were significant between the two soothing styles and the sleep-related domains. For instance, LSP differed significantly between the two soothing styles ($t_{78} = 3.93$, $p < .01$). Infants with the SS style had more than 1 hour more of continuous sustained sleep (mean = 367.51 min) than infants with the NSS style (mean = 292.4 min). The total amount of sleep time differed as well, with the SS group exhibiting a significantly longer average total sleep duration per night (mean = 566.35 min) than the NSS group (mean = 521.73 min) ($t_{78} = 3.3l$, $p< .01$). The OOC% differed significantly between styles ($t_{78} = 4.31$, $p < .01$), with the NSS group out of the crib for a greater percentage of time than the SS group (5.3 vs 1.4%, respectively). Further, the percentage of vocalized awakenings differed between the SS and NSS groups, with the NSS group vocalizing more often when awake (mean = 89.1%) than the SS group (mean = 81.1%) ($t_{78} = 2.17$, $p < .05$).

The QS% differed significantly between the two styles ($t_{78} = 2.14$, $p < .05$), with infants in the SS group averaging 46.06% of the night in QS compared with 42.63% of infants in the NSS group. However, the AS% or AW% did not differ significantly between the NSS and SS groups.

Sleep Context Domain.—Comparisons between the primary soothing styles and sleep context variables revealed several significant findings as well. Chi-square was used to compare soothing style with sleep-aid use, crib location, and infants' behavioral state upon entry into the crib. In terms of sleep aid use, there were seven infants who did not use any type of sleep aid, and five of these (71.4%) were categorized as NSS. However, because a large majority of infants (73 of 80) did use some type of sleep aid during the night, the χ^2 statistic was not significant. In terms of crib location, 90.9% of infants with the SS style slept in cribs in their own rooms, compared with 64.1% of infants with the NSS style ($\chi_1^2 = 5.71$, $p = .02$).

Finally, the behavioral state of the infants as they were placed into the crib (asleep all four nights, awake all four nights, or mixed) was compared between the SS and the NSS groups (Table 6). The χ^2 test approached significance ($\chi_2^2 = 5.62$, $p = .06$) and suggested that relatively more NSS infants entered the crib already asleep or sometimes asleep (mixed) compared with the SS group. When the infants with mixed behavior were omitted and only "all asleep" and "all awake" infants were compared, a significant difference was revealed ($\chi_1^2 = 4.07$, $p < .05$). NSS style infants were more likely to be placed into their cribs already asleep.

Relationships Between Domains

Other than the infant variables of gender and age, there were few significant associations across sleep-wake organization, sleep context, or infant and parent domains. A few relatively weak associations between the sleep context, sleep-wake organization, and parent well-being domains were noted. In the sleep context domain, sleep aid use was positively correlated with the proportion of vocalized awakenings ($r = .26$, $p < .05$). Also, the number of out-of-crib transitions during the night correlated negatively with LSP ($r = -.35$, $p < .05$).

In the sleep context and parent domains, the PES Stress score correlated negatively with the percentage of sleep-aid use ($r = -.27$, $p < .05$), whereas the SCL-90-R Anxiety score correlated negatively with the OOC% ($r = -.26$, $p < .05$).

DISCUSSION

A primary purpose of this study was to describe the development of self-regulating behaviors in response to middle of the night awakenings in infants at four ages during the first year of life. Infants' regulatory behaviors were categorized as either non–self-soothing (NSS) when parental assistance was usually provided to assist them in returning to sleep or self-soothing (SS) when the infant usually returned to sleep without parental intervention. Several interesting findings associated with the emergence of the self-soothing style are suggested.

First, it is striking how much night-to-night and week-to-week variability in parent-infant nighttime interaction exists. Both in terms of putting an infant into his or her bed awake or asleep and in responding to vocalizations in the middle of the night parent-infant interactions seem to be more inconsistent than consistent over a 2-week period and four nights of recording. Parents were encouraged to interact with their infants as they would normally, so this large degree of inconsistency seems to be typical of our sample. Professionals recommend that bedtime routines be established early; thus, it might be expected that regular routines would be apparent by the end of the first year. It is not clear whether the large degree of inconsistency found in this sample is characteristic of parent-child nighttime interaction in general, whether it reflects the pressures of current middle-class family life, or whether it is unique to this sample.

The developmental changes in sleep-wake state organization have been reported often. It is important to note that the most noticeable changes in active sleep, quiet sleep (QS), out of crib proportions, and sleep duration (LSP) occur before 6 months of age, highlighting an early period of rapid change followed by a leveling off. Although there seems to be a slight disruption in sleep-wake organization at 9 months, the disruption does not appear in all variables.

The results show that when infants awaken in the middle of the night, they usually vocalize. Surprisingly, the fewest vocalized awakenings occurred at 6 months of age and the most occurred at 12 months. It is possible that crying vocalizations, which are signals for parental assistance, diminish by 6 months of age. After the 9-month disruption, the vocalizations noted at 12 months of age may be of a babbling nature and not requests for parental assistance to return to sleep. Given the limitations of the coding procedure used to score vocalizations, this distinction could not be examined systematically but warrants future study.

The cross-sectional design of this study does not permit causal relations regarding the developmental progression of self-soothing behaviors to be drawn. However, the significant differences between the age groups on modal self-soothing style and other sleep-wake behaviors warrant discussion. For example, the infants' modal self-soothing style seems to change from NSS to SS with age. A higher proportion of 3 month olds exhibited the NSS style compared with the three older age groups. It is not surprising to find a higher proportion of NSS infants in the youngest age group, particularly given that the majority of them were exclusively breastfed. It has been clearly established that infants who receive only breast milk wake more often during the night.[29] However, it is remarkable that between 6 and 12 months of age, a predominant style of self-soothing did not emerge. At the older ages, the SS and NSS styles seemed to be more equally distributed compared with the 3-month-old group.

In an earlier, smaller study, 70% of 12-month-old infants were reported to be "self-soothers" after a middle of the night awakening.[28] In this study, only half of the 12 month olds were in the SS group. This study, however, used a different method of categorizing SS versus NSS and examined infants across four nights compared with only two nights of contiguous recording in the earlier study.

The significant gender differences noted in this study are intriguing. Female infants demonstrated more mature proportions of quiet sleep and longer LSPs. Male and female infants did not differ significantly in the proportion of awake time in the crib or in the number of awakenings during the night. Yet male infants were removed from their cribs for proportionately more time.

Across the four age groups, male infants had an NSS style as their modal pattern more often than female infants did. There were no gender differences in nursing status or in crib location, so the gender difference in soothing style apparently relates to causes other than parental access to the infant. Also, because there was no significant difference in the proportion of vocalized awakenings between male and female infants, the gender difference does not seem to stem from males being more vocal (and thus more likely to receive an intervention) upon awakening. Further, no differences in parent well-being were found by gender of the infant. In other studies, parental reports of temperament and activity level differences between male and female infants have been reported.[30,31] The primary nighttime caregiver in this study was the mother. It may be that mothers perceive their sons to be more difficult or to require more assistance than their daughters.

Several interesting relationships were found between soothing style and the sleep-wake and sleep-context variables. Infants who were classified as SS were found to have longer consolidated sleep periods and a higher percentage of time spent in QS compared with NSS infants. QS% and LSP have been related to increased maturation during infancy.[10]

Interestingly, SS-style infants woke up as often as NSS infants during the middle of the night. Yet, self-soothers were less likely to vocalize after an awakening, thus increasing the chance that mothers were not aware of the awakening at all.

Consistent with previous research,[32] this study found that infants who were consistently put into the crib awake were more likely to be self-soothers than infants who were consistently put into the crib asleep. Infants who required parental assistance to fall asleep at the beginning of each night were more likely to require parental assistance upon awakening in the middle of the night. The use of a sleep aid also seemed to relate to soothing status, as previously suggested.[32] Although there were only seven infants who did not use a sleep aid across any of the four nights, five of these were classified as NSS. Finally, and not surprisingly, infants whose cribs were located in the parents' bedroom were more likely to be categorized as NSS. These infants had more access to the parents, but it is important to note that the relationship between soothing status and crib location was confounded with age: younger infants were more likely to sleep in their parents' rooms than older infants.

Overall, the sleep-wake and sleep context domains were associated with soothing style, whereas the other domains of variables examined in the model did not relate directly. Contrary to expectations, none of the parent well-being or infant variables that we examined were directly related to soothing style. The lack of association may indicate that the particular variables examined were not good indicators. For example, temperament may be a better infant indicator than health status. Also, studying the parental well-being variables within a normal range minimizes the opportunity to observe effects. It is clear that this volunteer sample of middle- to upper-middle class caregivers and infants was a healthy group, and depression, anxiety, stress, and infant health scores fell within the nonclinical, healthy range. Although the gender difference in soothing style shows that different maturational processes may influence the development of self-regulation, there is some indication that soothing style is affected by environmental and interaction variables as well. Even though the overall sample consisted of 80 infants, once the age groups were separated for data analyses there may have been too small of a sample at each age for detection of differences on some variables. It also may be the case that variables measuring parental well-being or infant characteristics may take effect only later, toward the end of infancy, and this study did not include an older age group to examine this possibility. Other authors have noted a significant relationship between parental well-being and sleep problems in toddlers.[15] Future longitudinal studies of both healthy and clinical samples will help to determine the direction and strength of the pathways that lead to self-soothing behavior in young infants and toddlers.

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Table 1

Gender of Subjects by Age Group

Age (mo)	Male (n)	Female (n)	Total (n)
3	10	13	23
6	10	11	21
9	9	9	18
12	10	8	18
Total	39	41	80

Table 2

Means and Standard Deviations Of Sleep-Wake Variables by Age Group

	QS%		AS%		AW%		OOC%		LSP(min)		No. Wakings	
Age (mo)	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
3	38.4	5.6	57.4	5.5	4.6	1.6	5.5	6.0	307.8	70	2.9	1.3
6	43.6	5.6	52.1	6.3	6.3	2.5	2.6	2.3	351.5	112	3.5	1.7
9	47.0	8.3	47.7	8.5	6.8	2.8	3.3	4.0	294.8	89	4.7	3.0
12	49.6	4.3	45.2	5.0	6.9	4.7	2.1	3.6	356.0	88	2.6	1.6

QS% = percentage of quiet sleep; AS% = percentage of active sleep; AW% = percentage of time awake; OOC% = percentage of time out of crib; LSP = longest sleep period in minutes; No. wakings, number of middle of the night wakings.

Table 3

Mean and Standard Deviation of Nighttime Awakenings Across Four Nights by Age Group

	Night 1		Night 2		Night 3		Night 4		Overall	
Age (mo)	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
3	3.61	2.57	3.18	1.76	2.48	1.56	2.39	1.85	2.95	1.32
6	3.67	2.69	3.50	2.82	3.35	1.79	3.38	2.48	3.51	1.66
9	3.47	3.48	3.56	2.89	6.17	4.08	5.12	4.86	4.65	2.97
12	2.61	2.52	2.61	2.15	3.17	2.55	1.94	1.73	2.58	1.56
Overall (mean)	3.37	2.79	3.22	2.41	3.70	2.91	3.14	3.07	3.40	2.04

Table 4

Percentage of Infants in Each of the Four Awakening Types by Age Group

Age Group (mo)	Type 1 (No Voc, No Intervention)	Type 2 (Voc, No Intervention)	Type 3 (Voc, Intervention)	Type 4 (No Voc, Intervention)
3	0.0	17.4	65.2	17.4
6	9.5	52.4	23.8	14.3
9	0.0	61.1	27.8	11.1
12	0.0	50.0	27.8	22.2
Overall age	2.5	43.8	37.5	16.3

Voc, vocalization.

Table 5

Percentage of Infants in the Collapsed Soothing Styles by Age

Age (mo)	Self-Soothing (Type 1 + Type 2)	Non–Self-Soothing (Type 3 + Type 4)
3	17.4	82.6
6	61.9	38.1
9	61.1	38.9
12	50.0	50.0
Total	47.6	52.4

Table 6

Frequency of Infants' Arousal State When First Placed in the Crib by Age Group

Age Group (mo)	Awake (All four nights)	Asleep (All four nights)	Mixed (Across four nights)
3	2	4	17
6	5	1	15
9	6	1	11
12	8	2	8