The relationship between sensory processing patterns and sleep in infants

Elise D. Roth
The University of Toledo

The Relationship between Sensory Processing Patterns and Sleep in Infants

Elise D. Roth

Research Advisor: Alexia E. Metz, Ph.D., OTR/L

Occupational Therapy Doctorate Program

Department of Rehabilitation Sciences

The University of Toledo

May 2012

This scholarly project reflects individualized, original research conducted in partial fulfillment of the requirements for the Occupational Therapy Doctorate Program, The University of Toledo.

Abstract

This study investigated the relationship between sleep problems and sensory processing patterns during the first year of life. Twenty-two parents of healthy infants, ages 1.7 months to 12.9 months, participated in this study. Parents reported on sleep habits, soothing strategies, and sensory processing by completing the Sleep Profile for Children, an assessment created for use in this study using previously published sleep questionnaires, and the Infant/Toddler Sensory Profile by Dunn (2002). The psychometric properties of the Sleep Profile for Children were adequate and suggest potential for further development for clinical application. When assessing the correlation of Sleep Profile for Children scores and Sensory Profile T-scores, there was a sole significant correlation, which occurred in the Sensory Seeking quadrant with a low positive correlation (R=0.534, P=0.0087). As T-scores in the Sensory Seeking quadrant increased (moving from *Typical Performance* to *Less Than Others*), Sleep Profile for Children scores also increased. This suggests that those infants who do not seek sensory input may have increased difficulty sleeping. This may further suggest that by providing sensory seeking infants with the appropriate sensory diet to meet their needs, sleep disturbances may decrease. When comparing the strategies used by parents to soothe their infants to sleep, it was found that parents of infants with sleep dysfunction use the same strategies as the parents of infants without sleep dysfunction. Although the direction of cause and effect could not be determined, this offers no evidence that the parent's behaviors contribute to sleep difficulties. It was also noted that there was no difference among strategies used by parents based upon the child's sensory processing patterns.

The Relationship between Sensory Processing Patterns and Sleep in Infants

Introduction

Infant Sleep

Sleeping through the night depends on a rapid maturational process during the first year of life (Sadeh, 2004; Middlemiss, 2004). However surveys show that as many as 20% to 30% of all infants and toddlers do not succeed in achieving this goal and their sleep continues to be disrupted by multiple and/or prolonged night waking (Sadeh, 2004; Mindell et al., 2009). Sleep problems are one of the most common concerns presented to pediatricians and other child-care professionals by the parents of infants and young children (Owens, 2001). Although longitudinal studies show that sleeping problems tend to decline with age, a significant minority show persistent problems (Morrell, 1999). Studies have shown that sleep disturbances during the first years of life may develop into chronic sleep disorders during childhood (Ward, Rankin, Lee, 2007; Morrell, 1999).

Effects on Parents

Infant sleep patterns not only impact the child, but can also have significant effects on parental sleep patterns as well. As reviewed by Karraker (2008), many parents of infants who frequently awaken them at night experience both partial sleep deprivation (less than five hours of sleep in a 24-hour period) and fragmented sleep. It has been estimated that parents of infants lose an average of two hours of sleep per night from birth to five months and one hour of sleep per night from 6 to 24 months (Dement, 1999). Sleep deprivation and fragmented sleep can cause daytime fatigue, irritability, motor and cognitive deficits, impaired decision making, and lack of motivation. This, in turn, may create safety risks for both parent and child when performing potentially dangerous tasks, such as driving (Karraker, 2008). More frequent infant

night waking has also been related to lower parenting satisfaction and parenting self-efficacy, and more negative perception of infants (Karraker, 2008). There is additional evidence that marital discord, increased stress, anxiety, and depression are prevalent in families of children who have night awakenings (Ward et al., 2007).

Factors Affecting Infant Sleep

Several factors that influence infant sleep have been investigated. Typically these factors can be divided into two general categories: extrinsic factors and intrinsic factors. Extrinsic factors include parent/caregiver behaviors and characteristics of the infant's environment, such as, sleep environment, feeding practices, parent/caregiver behaviors when putting infant to bed, and parent/caregiver management of night waking (Karraker, 2008). Intrinsic factors include characteristics and behavior patterns of infants themselves, such as, infant temperament, attachment status to parents/caregivers, behavioral dysregulation, premature birth, health problems, and sensory processing (Karraker; Middlemiss, 2004; Shani-Adir, Rozenman, Kessel, Engel-Yeger, 2009; Shochat, Tzischinsky, Engel-Yeger, 2009).

The Role of Occupational Therapy in Infant Sleep

According to the American Occupational Therapy Association ([AOTA] 2010), the scope of practice for occupational therapy practitioners working with infants and their families involves promoting function and engagement in everyday occupations, including activities of daily living, rest and sleep, play, education, and social development. AOTA (2008) defines rest and sleep as all activities related to obtaining rest and sleep, including identifying the need for rest and sleep, preparing for sleep, and participating in rest and sleep. Rest and sleep are important areas of occupation, especially as they relate to supporting or hindering engagement in other areas of occupation. Occupational therapists can play a role in infant's rest and sleep in a variety of

ways, such as, helping families to establish a pattern of self-care and relaxation activities in preparation for sleep, advising families how to create pro-sleep nighttime routines for their children, or collaborating with families to help them establish healthy sleep-wake patterns for both parents and infants.

Sensory Processing

As we prepare for and enter a sleeping state, we are constantly surrounded by various sensations, such as, the lighting in the room, the noise heard outside, the feeling of the sheets and so on. As we process the sensations around us, each person has their own unique threshold for noticing, responding to, and becoming irritated with these sensations (Dunn, 2001). Dunn developed a model (Figure 1) including thresholds and responding strategies that represent a continuum of possible sensory processing patterns. The four quadrant portions are named as follows: high thresholds with passive responding strategies are named Low Registration; high thresholds with active responding strategies are named Sensory Seeking; low thresholds with passive responding strategies are named Sensory Sensitivity; and low thresholds with active responding strategies are named Sensory Avoiding. A person's response to sensory processing patterns may fall anywhere on the model. Sensory processing disorder occurs when a person's pattern of responses interferes with his/her everyday life. This can result from extreme or inconsistent patterns.

Dunn (2001) describes behaviors that are consistent with sensory processing disorders in each of the four quadrants. When people have low registration they don't notice everyday sensory stimuli that others notice readily. They may not notice when others come into a room or even something on their face or hands. When people are sensation seekers they enjoy sensory events and look for ways to enhance or extend the stimuli. They like physical movement and

seek additional sensory stimuli for themselves such as making noises or touching objects. Those who are sensory sensitive notice everyday sensory stimuli more than others do. They are easily distracted by things such as movements, sounds and food or fabric textures. People who are sensory avoiders try to limit sensory input. They tend to stay away from distracting settings and often develop rituals to help create only familiar sensory input for themselves.

Some individuals may be more sensitive (have lower thresholds) for some types of sensory input, while being less attentive (have higher thresholds) for other types on sensory input. Dunn (2001) notes that understanding one's sensory processing needs and limits provides important background information for constructing daily life routines and contexts that are respectful of the nervous system's need for some balance of excitation and inhibition. This balance then helps to promote successful performance throughout our daily occupations.

Occupational therapy intervention to address sensory processing concerns can be provided throughout the lifespan. According to AOTA (Bissell, Watling, Summers, Dostal, & Bodison, n.d.), occupational therapists identify sensory related factors and provide interventions to facilitate effective self regulation (wake-sleep cycles, level of alertness, self-quieting), sensory processing, motor development, and adaptive behavior. Occupational therapists can play a role in infant sensory processing in a variety of ways, such as, collaborating with families and other professional to determine a need for specialized evaluation and intervention, identifying and modifying sensory and environmental barriers effecting sleep, and identifying adaptive sensory strategies to facilitate rest and sleep.

Few studies have been conducted to examine if and how sensory processing has an effect on sleep patterns. Shochat, Tzischinsky, and Engel-Yeger, (2009), explored sensory hyperactivity as a contributing factor in the relationship between sleep and behavioral disorders

in normal schoolchildren ages six to ten years by comparing results from questionnaires given to the parents addressing sleep habits, behavior, and sensory processing using the Children's Sleep Habits Questionnaire (CSHQ, Owens, Spirito, & McGuinn, 2000), the Conners' Global Index (CGI, Conners, 1990, 1997), and the Short Sensory Profile, (SSP, Dunn, 1999), respectively. They found that among various sensory modalities, tactile sensitivity was a significant predictor for disrupted sleep in this population. This study suggested that sensory profiles of children with sleep or behavioral problems should be routinely assessed in clinical practice. In a subsequent study, Shani-Adir, Rozenman, Kessel, and Engel-Yeger, (2009), explored the relationship between sensory hypersensitivity and sleep quality of children ages three to ten years with Atopic Dermatitis by comparing assessment results of disease severity (Severity Scoring of Atopic Dermatitis (SCORAD) Score (Hon, Leung, Wong, et al., 2006)), sensory processing pattern (SSP) and sleep characteristics (CSHQ). They found that sensory hypersensitivity was correlated with lower sleep quality for this population. This study suggested that evaluation of children with Atopic Dermatitis should include sensory processing abilities and sleep habits to create intervention programs that will be more focused on the individual needs of the child and family. These current studies both suggest a relationship between sensory processing and sleep problems in young children, however, the relationship may have started as early as infancy.

Assessment of Sleep in Infants

Sleep is a vital component of a growing infant's life. When an infant is receiving inadequate sleep, it can negatively impact his/her occupational performance and overall development. Sleep problems are one of the most common concerns presented to pediatricians and other child-care professionals by the parents of infants and young children (Owens, 2001). Therefore, various assessments of sleep in infants and children have been developed to evaluate

sleep patterns and to determine factors related to sleep disturbances. Current sleep assessments are available for children from birth to school-aged and are used to identify whether sleep problems exist, to detect settling problems, and to determine the strategies used by parents for settling.

Infant Sleep Questionnaire (ISQ). This maternal self-report questionnaire (Morrell, 1999) assesses sleep behavior in children 12 to 18 months. The researchers established reliability and validity with 289 mothers aged 18 to 45 years. The questionnaire contains 10 questions assessing settling, waking, and sleeping in the caregivers' bed. Caregivers are asked if they perceive a sleep problem in the child and if so, to report the duration of the problem. Scores range from 0 to 38, and cut-off scores of 12 or above are indicative of severe sleep problems. Speaking to the validity of the ISQ, the cut score correctly identified 89.5% of children meeting Richman's criteria for sleeping problems (Richman, 1981) which are defined as, "occurring five or more nights per week and of two or more months duration plus one or more of the following: 1) Taking greater that 30 minutes to settle. 2) Waking 3 or more times per night. 3) Waking for greater than 20 minutes during the night. 4) Sleeping in the parental bed because upset and won't sleep 3 or more times per week" (pg. 21). Test-retest reliability was reported at 0.92 at 2 to 4 weeks (Morrell, 1999,).

Brief Infant Sleep Questionnaire (BISQ). This parental questionnaire (Sadeh, 2004) aids in screening for sleep problems in infant and toddlers (0-6 months, 7-12 months, and 12-30 months). The questionnaire has 13 items which ask about duration of sleep, settling, night waking, and sleep arrangements. No score is derived. The author conducted the questionnaire with the parents of 100 children (ages ranged from 5 to 29 months) some with and some without clinically identified sleep problems, to establish psychometric properties. According to the

author of this assessment, sleep problems are defined as having greater than three waking per night, greater than one hour of wakefulness per night, and less than nine hours total sleep during a 24 hour period. The questionnaire correctly classified 90% of the participants as to whether they had a sleep problem. Test-retest reliability was reported to range from 0.82 to 0.95 at 3 weeks (Sadeh, 2004).

Children's Sleep Habits Questionnaire (CSHQ). This parental report of children's sleep (Owens, 2000) screens for behaviors commonly linked to sleep disorders and disturbances among children. The CSHQ was developed for children aged 4 to 10 and demonstrated moderate psychometric properties (internal consistency ranging from 0.68 to 0.78; test-retest reliability ranging from 0.62 to 0.79) in a study of 469 children. Many of the items included in the Sleep Profile for Children which were derived from the ISQ or the BISQ derive the same information as items on the CSHQ. Many of the items of the CSHQ ask information in more specific detail than needed in this study (for example, questions relating to morning appetite and fear of the dark).

Parental Interactive Bedtime Behavior Scale (PIBBS). To describe the strategies utilized by parents to settle their children to sleep, we administered the PIBBS (Morrell & Cortina-Borja, 2002). This self-report questionnaire for parents of children 12 to 19 months identifies methods commonly used to help soothe or settle their child to sleep. Methods used to soothe or settle are categorized into physical, social, oral comforting, distance/proximity, and medication. Parents rate 19 specific methods from various categories on a five point scale ranging from never to very often. In a study of 288 parent-infant pairs the most common strategies reported by parents included feeding, talking softly to the child, cuddling in arms, and stroking the child. A Cornbach's alpha of 0.7 was reported.

Morrell (1999) discusses how sleep dysfunction is likely apparent at the end of the first year; therefore, it is important to have valid and reliable assessment tools available for that time period. The ISQ (Morrell, 1999) was established to assess sleep function in children aged 12-18 months old. In an effort to extend assessment of sleep to younger ages, Sadeh (2004) included infants from birth to 30 months in establishing the psychometric properties of the Brief Infant Sleep Questionnaire (BISQ). The BISQ reliably determines the presence of sleep dysfunction through three criteria; however, it does not provide a score to assess severity of sleep disturbance, measure change in sleep behavior, or allow for correlation studies. Finally, the CSHQ of Owens (2000) includes items that assess the impact of sleep deficits such as difficulty waking and daytime sleepiness.

The Present Study

Dunn (2001) notes that the mechanisms of sensory processing are intertwined with many other brain functions. She suggests that by studying these phenomena in various combinations, the actual contributions and relationships can be revealed and then applied to other scholarly inquires, such as the role of sensory processing in individual differences and various human conditions. The aim of the present study was to examine the relationship between infant sleep problems and infant sensory processing patterns during the first year of life by comparing results of the Sleep Profile for Children and the Infant/Toddler Sensory Profile (Dunn, 2002) completed by caregivers. It was hypothesized that sensory processing difficulties are positively correlated with more sleep problems. A secondary hypothesis tested was that when children have difficulties in both sleep and sensory processing, the strategies that parents use to soothe the children to sleep are not as well matched to their sensory processing pattern as are the strategies used by parents whose children do not have difficulties sleeping.

Methods

Participants

A convenience community sample of 22 parents of healthy infants, ages birth through 12 months, completed the questionnaires. A collaborating graduate student researcher also enrolled 51 parents of healthy toddlers, ages 13 to 36 months. A total of approximately 200 questionnaire packets were distributed; hence, we had an overall return rate of approximately 36.5%. Parents were recruited from local childcare facilities and parent/family organizations in Northwest Ohio to complete questionnaires about their child's sensory and sleep behaviors based on the last month. The qualifying criteria for the study were healthy infants who have not been diagnosed with a major medical condition, as verbally reported by caregivers.

Parental descriptive information was determined using the Four Factor Index of Social Status by A.B. Hollingshead (1975). Using this index, the 22 total participants were categorized by social strata as follows; seven participants (32%) were in the major business and professional social strata, nine participants (41%) were in the medium business, minor professional and technical social strata, one participant (4.5%) was in the skilled craftsman, clerical and sales workers social strata, four participants (18%) were in the machine operators, semiskilled workers social strata, and one participant (4.5%) was in the unskilled laborers and menial service workers social strata.

Research Design

The study is a cross-sectional, questionnaire-based design.

Measures & Instruments

Infant/Toddler Sensory Profile. The purpose of the Infant/Toddler Sensory Profile (Dunn, 2002) is to measure a child's sensory processing abilities and to profile the effect of

sensory processing on the child's daily performance patterns. This assessment was designed to contribute to a comprehensive assessment of a child's performance when combined with other evaluations, observations, and reports, for diagnostic and intervention planning. It provides information about the child's tendencies to respond to stimuli and which sensory systems are likely to be contributing to the child's strengths and challenges. This judgment-based questionnaire about children's responses to various sensory experiences is for parents or caregivers of children birth to 3 years of age. The parent or caregiver who has daily contact with the child completes the questionnaire by reporting the frequency to which certain behaviors occur (Almost Always, Frequently, Occasionally, Seldom, or Almost Never) and responses are scored. For children birth to 6 months, 36 items are scored in four quadrant scores and one combined quadrant score. For children 7 to 36 months, 48 items are scored in five sensory processing section scores, four quadrant scores, and one combined quadrant score. The quadrant scores reflect the child's responsiveness to sensory situations, and are based on Dunn's Model of Sensory Processing, as previously displayed in Figure 1. The alpha coefficient measurement of internal consistency for this questionnaire is reported as 0.56 - 0.79 (birth to 6 months) and 0.70 - 0.86 (7 to 36 months). Authors also report both convergent and discriminate validity, as well as a test-retest reliability of 0.86 for the sensory processing section scores and 0.74 for the quadrant scores.

Because this desired population for this study falls between the two age categories of the Sensory Profile, scores were normalized through conversion to T-scores utilizing the normative data for each group to allow scores of children in both age groups to be entered into collective analyses.

Sleep Profile for Children. The Sleep Profile for Children (see Appendix A) is a questionnaire that was designed to fit the specific needs of this study. Parents or caregivers of children birth to 3 years of age respond to questions about their child's current sleep patterns in the categories of: sleep deficit, sleepiness, bedtime, parent role, night waking, and naps. The sleep deficit and sleepiness scores can be summed for a measure of sleep dysfunction; bedtime, parent role, and naps are summed for a measure of problems settling; and night waking is scored alone. The maximum sum of these scores is 154. This questionnaire was constructed using existing sleep questionnaires in order to cover all aspects of sleep relevant to this study. Questions and ideas for the Sleep Profile for Children were adapted from the Infant Sleep Questionnaire (ISQ, Morrell, 1999), the Brief Infant Sleep Questionnaire (BISQ, Sadeh, 2004), and the Children's Sleep Habits Questionnaire (CSHQ, Owens, 2000). The assessment we have compiled here includes 1) all the items of the ISQ with their original scoring, 2) all the items of the BISQ with new scoring to facilitate combination with the ISQ, and 3) elements of the CSHQ that reflect sleep function and/or impact of sleep deficits (but not those that relate to the underlying causes of sleep dysfunction) with new scoring to facilitate combination with the ISQ. The PIBBS (Morrell & Cortina-Borja, 2002) was included and scored separately from the Sleep Profile for Children. The original assessment included two items that were not included in any of the categories for settling strategies related to the use of sleeping medication and alcohol. These items were not included in this study.

Sleep Profile for Children pilot study. A pilot study of the Sleep Profile for Children was conducted with 13 parents of older children who were asked to recall information about when their child was under the age of 3. Several of the pilot respondents have research training. The purpose of the pilot study was to: 1) ensure that the instructions, questions, and format were

understandable, 2) figure an average time needed to complete the questions, and 3) allow parents to provide any additional comments or suggestions about the questionnaire. This feedback was then used to make necessary clarifications or modifications to the final Sleep Profile for Children being used for this study. Some minor changes included distinguishing between the definitions of the terms "settling" versus "going to sleep", and modifying response categories of total hours of bedtime sleep and naps to include half hour increments versus hours alone.

Procedures

The Infant/Toddler Sensory Profile and Sleep Profile for Children questionnaires were distributed to parents/caregivers who consented to participate following an explanation of the study aims and procedures, through the consent document. Researchers were available in person or via phone or email to answer any questions the participant may have while completing research questionnaire. Research staff did not coach responses in any way. Researchers encouraged participants to complete both questionnaires during identified sessions for data collection in their facilities, and parents were asked to provide contact information for follow-up based on results. To ensure confidentiality, questionnaires and contact information were stored separately, having identification numbers assigned for later follow-up if necessary. Parents of children whose scores indicate problems on either questionnaire were advised to follow up with their child's physician. The original consent asked if parents if to consent to participation in a pilot intervention study in the event that their children showed both sensory processing difficulties and sleep problems; however, no qualifying participants were enrolled in the intervention study.

Data Analysis

Responses to the Sleep Profile for Children are reported using descriptive statistics of mean and standard error or percent of respondents. The correlation of responses to infant age was assessed using Pearson's. To assess the Sleep Profile for Children for concurrent validity, we utilized the criteria of the Infant Sleep Questionnaire (cut score of twelve or higher) and the Brief Infant Sleep Questionnaire (of having less than nine hours of sleep total, greater than three night wakings, and greater than one hour of wakefulness at night) to categorize the participants as having typical or problematic sleep. We then compared the Sleep Profile for Children scores of participants in these two groups using unpaired t-tests expecting that if the Sleep Profile for Children is valid, scores will be significantly higher in children who met the ISQ and BISQ criteria for sleep disturbances. This was used to assess whether the Sleep Profile for Children can reliably discriminate between children with and without a sleep problem. Validity was further assessed through correlation of derived ISQ scores with Sleep Profile for Children scores where high correlation between these scores would indicate that the Sleep Profile for Children is a valid measure of sleep problems. The internal reliability of the Sleep Profile for Children was assessed using Cronbach's alpha for the whole scale and the subscales of sleep, night wakings, and settling. The use of the ISQ and Sleep Profile for Children to describe areas of sleep dysfunction was done through unpaired t-tests of individual items between respondents above and below cut scores. Responses to the PIBBS are reported using frequency distribution and average percent of strategies endorsed.

Raw scores for the Sensory Profile were categorized according to the categories described by the assessment manual of *Less than Others*, *Typical Performance*, and *More than Others* (which included those who fell into the category of *Much More than Others*).

Distributions of scores in these categories were described in percent of infants. For testing of the correlation hypotheses, scores for the Sensory Profile quadrants were converted to T-scores according to the normative data provided in the assessment's manual (Dunn, 1999). T-scores between 40 and 60 are comparable to the diagnostic category of *Typical Performance*. T-scores lower than 40 are comparable to the diagnostic categories of *More than Others* and *Much More than Others*. T-scores higher than 60 are comparable to the diagnostic categories of *Less than Others*. The correlation of Sleep Profile for Children scores and T scores was assessed through Pearson's. The alpha of .05 was adjusted to account for multiplicity of the four quadrants to an alpha of .0125.

Results

Descriptive Statistics

Twenty two parents of infants participated in this study. All of the respondents were the mothers of the infants they reported about. The infants ranged in age from 1.7 months to 12.9 months at the time of participation. The average age was 6.8±0.7 months. Of the infants, 41% were male, the remaining female.

Psychometric Properties of the Sleep Profile for Children

Concurrent validity. The average Sleep Profile for Children score for children with ISQ scores below 11 was 14.2±1.6 (n=18). The average Sleep Profile for Children score for children with ISQ scores of 12 or higher was 25.8±5.8 (n=4). The latter was significantly higher ($p<0.05$, see Figure 2A). There were no cases that met the BISQ criteria for sleep disturbance. ISQ scores and Sleep Profile for Children scores were positively correlated ($R^2=0.699$, $r=0.836$, $p<0.01$, see Figure 2B).

Internal reliability. When including all 15 items of the Sleep Profile for Children in analysis, the Cronbach's alpha was .49. This indicates poor reliability of the scale as a one dimensional measure of sleep behavior in this population. Removal of any of the individual items did not result in higher Cronbach's scores. The subscales sleep, night wakings, and settling also had low Cronbach's alpha scores of -.3, 0.54, and .49, respectively. Interestingly, the Cronbach's alpha of the original 10 items of the ISQ was similarly low in this population (.59).

Sleep dysfunction and maturation. Using a cut off score of 12 on the ISQ, four infants showed sleep dysfunction. In comparing these four infants to the 18 with healthy sleep, scores differed in on the following items (with alpha at 0.003 to account for testing the 15 items of the Sleep Profile for Children): number of nights with problems settling to sleep and number of nights with waking. See Table 1 for these results.

Using a cutoff score of 24 on the Sleep Profile for Children identifies two of four of the infants with a score above 12 on the ISQ (50% false negative rate) and identifies 2 infants with scores below 12 on the ISQ (11% false positive rate). With this cutoff score there were four infants with sleep dysfunction. In comparing them to the 18 infants with Sleep Profile for Children scores lower than 24, the items where responses differed included (at the alpha at 0.003 level): time spent settling the infant, time spent resettling the infant upon night waking, the time spent awake each night, the duration of nighttime sleep, the total amount of sleep, and the sleep deficit. See Table 2 for these results.

Finally, ISQ and Sleep Profile for Children scores were assessed for their correlation with age, see Figure 3. The ISQ score was significantly negatively correlated with age ($R=-.448$, $r^2=.20$, $p<0.05$). Similarly, the Sleep Profile for Children scores were significantly negatively correlated with age ($R=-.646$, $r^2=.42$, $p=0.01$). Taken together suggests that the Sleep Profile for

Children captures sleep immaturity in young infants and reflects the effort parents spend in settling their babies to sleep.

Sleep Profile for Children

The responses to the Sleep Profile for Children offer a picture of sleep behaviors in this population. See Table 3 for the responses to the Sleep Profile for Children. The amount of sleep and sleep consolidation were assessed for correlation with the age of the infants. Total hours of sleep averaged 11.3±0.4 hours and did not vary with age ($R=.301$, $r^2=.09$, $p>0.05$, see Figure 4A). Hours of night time sleep averaged 8.3±0.3 hours and also did not vary with age ($R=.422$, $r^2=.18$, $p>0.05$, see Figure 4B). Responses indicated that infants spent 3.0±0.2 hours napping, and this similarly did not vary with age ($R=-.122$, $r^2=.01$, $p>0.05$, see Figure 4C). The number of nighttime waking was significantly negatively correlated with age ($R=-.612$, $r^2=.37$, $p<0.01$, see Figure 5A). The number of naps per day also was significantly negatively correlated with age ($R=-.529$, $r^2=.23$, $p<0.05$, see Figure 5B).

PIBBS Results

Parents were asked to indicate the frequency with which they use strategies (Morrell & Cortina-Borja, 2002) to settle their infants to sleep. Table 4 reports the results per strategy and category of strategies. The strategy most frequently reported to be used *Very Often,* by 41% of respondents, was giving a bottle, food or nursing. The next three most commonly used strategies were reported to be used *Very Often* by 32% of respondents cuddling; music; and use of a special cloth, blanket, or toy. These strategies are categorized in the Active Physical Strategies category of the PIBBS, and in keeping, respondents endorsed an average of 47±5% of the Active Physical Strategies. The strategy of lying down with the infant was rated as *Never* used by 91% of respondents. The strategies of leaving to cry, standing nearby, and sleeping in the parent's bed

were ranked as *Never* used by 64% of parents. There were no differences in the use of PIBBS strategies between parents of infants with Sleep Profile for Children scores above and below the cutoff of 24 (data not shown).

Sensory Profile

Scores for the Sensory Profile were categorized as *Typical*, *Less than Others*, and *More than Others* according to the normative data provided with the assessment. The number of infants in each category for each of the four quadrants of Dunn's model is reported in Table 5. The distribution reflects the normal distribution associated with the standardization data of the assessment.

Sleep Behaviors and Sensory Processing Patterns

According to our original plan for data analysis, we assessed the correlation of Sleep Profile for Children scores and Sensory Profile T-scores. Table 6 reports these results. The sole significant correlation occurred in the Sensory Seeking quadrant with a low positive correlation. As T-scores in the Sensory Seeking quadrant increased (moving from *Typical Performance* to *Less Than Others*), SPC scores also increased. This suggests that those infants who do not seek sensory input may have increased difficulty sleeping. As a more global assessment of the potential impact of sensory processing on sleep function, we divided the sample population into those who have scores indicative of *Typical Performance* (n =7) and those with Sensory Profile scores indicative of dysfunction in any quadrant (T-scores below 40 or above 60, n=15). Using an unpaired t-test, we compared Sleep Profile for Children scores. There was no difference (13±1.9 for SP typical, 18±2.6 for SP dysfunction, $p>0.05$).

Sensory Profile and PIBBS

In order to assess whether parents' use of strategies vary with sensory processing patterns, we assigned each participant to their strongest sensory processing pattern by using their lowest T-scores. There was one infant without a one T-score lower than the others; therefore, he/she could not be categorized as having a strong sensory processing pattern in one of the four quadrants. Amongst the others, there were the following numbers of infants with their lowest T-score in each quadrant: 6 Low Registration, 7 Sensory Seeking, 2 Sensory Sensitivity, and 6 Sensory Avoiding. A one-way ANOVA was used to assess differences in the use of PIBBS strategies amongst these groups. There were no significant differences, (data not shown).

Discussion

Sleep Profile for Children

The Sleep Profile for Children was designed to fit the specific needs of this study. This questionnaire was constructed using existing sleep questionnaires (the Infant Sleep Questionnaire (ISQ, Morrell, 1999); the Brief Infant Sleep Questionnaire (BISQ, Sadeh, 2004); and the Children's Sleep Habits Questionnaire (CSHQ, Owens, 2000)) in order to cover all aspects of sleep relevant to this study, including sleep deficit, sleepiness, bedtime, parent role, night wakings, and naps.

Utilizing responses from our sample of 22 parents of infants, psychometric properties of the Sleep Profile for Children were figured, and the results suggest that, when compared the Infant Sleep Questionnaire, this expanded questionnaire provides a valid assessment of infant sleep behaviors. When evaluating the internal reliability of the Sleep Profile for Children a low Cronbach's alpha scores of .49 suggests that this may reflect multiple factors that relate to sleep

that do not necessarily correlate with one another. Further factor analysis or Rasch studies may be warranted in identifying the number of elements that influence infant sleep. Further refinement of the Sleep Profile for Children is required to improve its sensitivity as the rate of false negatives was 50% and false positives was 11% when compared to the ISQ. However, the Sleep Profile for Children provided an interesting picture of sleep dysfunction when considering the questionnaire items that were different amongst those infants with scores above 24 (Table 2). These results point to settling to sleep, as opposed to maintaining sleep, as a factor contributing to sleep dysfunction. This provides direction for future studies of the sleep dysfunction in infants as well as an area that can be targeted for intervention.

Sleep in Infants

Sleep problems are one of the most common concerns presented to pediatricians and other child-care professionals by the parents of infants and young children (Owens, 2001). Studies have shown that sleep disturbances during the first years of life may develop into chronic sleep disorders during childhood (Ward, Rankin, Lee, 2007; Morrell, 1999). Of the 22 parents surveyed about their infants sleep, 86% reported that they did not think their child had sleeping problems, and the remaining 14% reported that they thought their child had mild, moderate, or severe sleeping problems.

Among our sample of 22 infants, the average amount of sleep at night was 8.3 ± 0.3 hours, and the average amount of time spent napping during the day was 3.0 ± 0.2 hours per night (with an average of 2.6 ± 0.2 naps per day). Therefore, the average amount of total sleep for infants ages birth to 12 months was approximately 11.3 ± 2.5 hours in a 24-hour period. This is above the BISQ criteria for sleep problems of having less than nine hours of sleep per day (Sadeh, 2004). When considering all of the criteria used to determine sleep dysfunction with the

Sleep Profile for Children, those infants with healthy sleep slept an average of 8.8 $\pm$ 0.1 hours at night, whereas those infants with noted sleep dysfunction only slept an average of 5.9 $\pm$ 1.2 hours at night.

Consolidating sleep is a developmental process that occurs rapidly during the first year of life, however, surveys from previous studies show that as many as 20% to 30% of all infants and toddlers do not succeed in achieving the goal of sleeping through the night and their sleep continues to be disrupted by multiple and/or prolonged night waking (Sadeh, 2004; Mindell et al., 2009). When looking at the sleep patterns of infants at various ages in our study, our results demonstrate that healthy infants become increasingly able to consolidate their sleep into longer periods, as seen in the decrease of night time waking and day time naps while still obtaining the same amount of daily sleep. These results are consistent with those of Sadeh's (2004) results which found that daytime sleep duration and total sleep duration both decreased significantly with age. These results are also consistent with literature reviews about infant sleep (as cited in Middlemiss, 2004) that report that an infant's initially exhibit three to four hour sleep cycles, then consolidate to six hour cycles by three months, and finally consolidate to a more consistent night sleep cycles (including one daytime nap) by one year of age.

Parent Strategies for Settling Infants

In the original report of The Parental Interactive Bedtime Behavior Scale (PIBBS), Morrell and Cortina-Borja (2002) examined the behaviors used by 288 parents to settle their infants of to sleep. Infants in this study ranged from 12 to 19 months, with the average age of 13 months. The most common settling strategies used by parents were feeding, talking softly to the child, cuddling, and stroking (Morrell & Cortina-Borja, 2002). The least common strategies used were swaddling, car rides, and lying down with child in bed (Morrell & Cortina-Borja, 2002). In

our study completed by 22 parents of infants ages 1.7 to 12.9 months (with an average age of 6.8 ± 0.7 months), the most common strategies reported were feeding, cuddling, playing music, and the use of a special toy, cloth or blanket. The least common strategies were leaving to cry, standing nearby, and lying down with child in bed. Strategies from the PIBBS were placed into one of five categories based on similarities. Parents in the study by Morrell and Cortina-Borja (2002) reported using 33% of the active physical strategies, 22% of the encouraging autonomy strategies, none of the movement strategies, 13% of the passive physical comforting strategies, and 25% of the social comforting strategies. Parents in the current study reported using 47% of the active physical strategies, 35% of the encouraging autonomy strategies, 9% of the movement strategies, 10% of the passive physical comforting strategies, and 44% of the social comforting strategies. These differences suggest that parents tend to use fewer settling strategies as their children age.

Infant Sleep and Sensory Processing

The aim of the present study was to examine the relationship between infant sleep problems and infant sensory processing patterns during the first year of life by comparing results of the Sleep Profile for Children and the Infant/Toddler Sensory Profile (Dunn, 2002) completed by caregivers. It was hypothesized that sensory processing difficulties are positively correlated with more sleep problems. This was assessed in each of the four quadrants of Dunn's model of sensory processing. The hypothesis was supported in the quadrant of sensory seeking patterns in which there was a low significant correlation ($R=0.534$, $P=0.0087$), suggesting that decreased sensory seeking behaviors are associated with increased sleep difficulty. This may suggest that by providing sensory stimulation, through an age-appropriate sensory diet, to infants who do not autonomously seek sensory input may be explored as a method to decrease sleep disturbances. A

sensory diet for an infant might include play time or a bath and lotion massage before settling to bed. Occupational therapists can play an important role in helping parents to identify the sensory processing patterns of their children, and also in suggesting sensory diets to assist in meeting each child's specific sensory needs.

A secondary hypothesis tested was that when children have difficulties in both sleep and sensory processing, the strategies that parents use to soothe the children to sleep are not as well matched to their sensory processing pattern as are the strategies used by parents whose children do not have difficulties sleeping. When comparing the results of the PIBBS, it was found that parents of infants with sleep dysfunction use the same strategies as the parents of infants without sleep dysfunction. Although the direction of cause and effect cannot be determined, this offers no evidence that the parent's behaviors contribute to sleep difficulties.

Limitations and Recommendation for Future Research

Although there was one significant result supporting the hypothesis that there is a positive correlation between sensory processing patterns and sleep dysfunction, the correlation between these was low, which is a limitation to the interpretation of the study's results. Generalization of this study's findings is restricted by the use of a convenience sample where limited geographic and socioeconomic diversity were represented. Future research should attempt to include a sample consisting of randomized subjects from a broader range of geographical areas and socioeconomic backgrounds. The small sample size of 22 participants makes this study susceptible to a type II error, and therefore we cannot assume that there is not a link between sensory processing patterns and sleep among infants.

Past studies of children who have conditions affecting sensory processing have indicated that sensory processing disorder can have a negative impact on sleep. Further research is needed

to examine the relationships and correlations between sensory processing patterns and sleep among typically developing infants. Additional research to examine the results of providing parents and caregivers with appropriate strategies to help soothe their infants to sleep based on the infant's sensory processing needs would also be recommended.

Implications for Occupational Therapy

Sleep is an important scope of practice for occupational therapy, especially because of its impact on engagement in other areas of occupation. Occupational therapists can educate parents and caregivers about the suggested amounts of sleep infants should be getting and how sleep can affect activities of daily living, play, and social development. Occupational therapists can collaborate with parents and caregivers to help them establish healthy sleep schedules for the child. Occupational therapists also play an important role in educating parents and caregivers about sensory processing patterns, how these patterns may present in the child, and how they can impact the child's life. Occupational therapists can offer insight into how to incorporate sensory needs into sleeping routines by suggesting strategies for soothing and ways to set up the environment that support the infants current sensory processing patterns in attempts to avoid or decrease sleep difficulties.

Acknowledgements

We would like to express our appreciation to the families of the 73 infants and toddlers that participated in our study, and took the time to complete study questionnaire packets. We would also like to thank: the childcare facilities and individuals who assisted in distributing research materials to families; parents who participated in our pilot study of the Sleep Profile for Children; and Dr. Martin Rice for his statistical guidance and recommendations. We would especially like to thank La Vonia Roane for being a co-investigator and data reviewer throughout this research process.

References

American Occupational Therapy Association. (2008). Occupational therapy practice framework: Domain and process (2nd ed.). *American Journal of Occupational Therapy, 62,* 625-683.

American Occupational Therapy Association. (2010). AOTA practice advisory on occupational therapy in early intervention. *American Journal of Occupational Therapy, 64,* 6(Supplement), S70-S77.

Bissell, J., Watling, R., Summers, C., Dostal, J., & Bodison, S. (n.d.). *Addressing sensory integration across the lifespan through occupational therapy.* Reteieved December 20, 2011 from http://www.aota.org/Practitioners/PracticeAreas/Pediatrics/Fact-Sheets-on-the-Role-of-OT/Fact-Sheet.aspx?FT=.pdf.

Conners, C. K. (1990). Conners' Rating Scales Manual. Toronto, Canada: Multi-Health Systems, Inc.

Conners, C. K. (1997). Conners' Rating Scales - Revised Manual. Toronto, Canada: Multi-Health Systems, Inc.

Dement, W. (1999). The promise of sleep. New York: Delacorte Press.

Dunn, W. (1997). The impact of sensory processing abilities on the daily lives of young children and families: A conceptual model. *Infants and Young Children, 9*(4), 23-25.

Dunn, W. (1999). The Sensory Profile: Examiner's Manual. San Antonio, TX: The Psychological Corporation.

Dunn, W. (2001). The sensations of everyday life: Empirical, theoretical, pragmatic considerations. *The American Journal of Occupational Therapy, 55*(6), 608-619.

Dunn, W. (2002). Infant/Toddler Sensory Profile. San Antonio, TX: Pearson.

Hollingshead, A. B. (1975). *Four factor index of social status.* A. B. Hollingshead. Department of Sociology, Yale University, New Haven, CT.

Hon, K. L., Leung, T. F., & Wong, Y. (2006). Lesson from performing SCORADs in children with atopic dermatitis: subjective symptoms do not correlate with disease extend or intensity. *International Journal of Dermatology, 45,* 728-730.

Karraker, K. (2008). The role of intrinsic and extrinsic factors in infant night waking. *Journal of Early and Intensive Behavior Intervention, 5*(6), 108-121.

Middlemiss, W. (2004). Infant sleep: A review of normative and problematic sleep and interventions. *Early Child Development and Care, 174,* 99-122.

Mindell, J. A., Telofski, L. S., Weigand, B., & Kurtz, E. S. (2009). A Nightly Bedtime Routine: Impact on Sleep in Young Children and Maternal Mood. *SLEEP 32*(5), 599-606.

Morrell, J. M. B. (1999). The Infant Sleep Questionnaire: A new tool to assess infant sleep problems for clinical and research purposes. *Child & Adolescent Mental Health, 4*(1), 20-26.

Morrell, J., & Cortina-Borja, M. (2002). The developmental change in strategies parents employ to settle young children to sleep, and their relationship to infant sleeping problems, as assessed by a new questionnaire: the Parental Interactive Bedtime Behaviour Scale. *Infant & Child Development, 11*, 17-41.

Owens, J. A., Spirito, A., & McGuinn, M. (2000). The Children's Sleep Habits Questionnaire (CSHQ): Psychometric properties of a survey instrument for school-aged children. *SLEEP, 23*(8), 1-9.

Owens, J. A. (2001). The practice of pediatric sleep medicine: Results of a community survey. *Pediatrics. 108,* 554-563.

Richman, N. (1981). A community survey of the characteristics of 1-2 year-olds with sleep disruptions. *Joumal of the American Academy of Child Psychiatry,* 20, 281-

Sadeh, A. (2004). A Brief Screening Questionnaire for Infant Sleep Problems: Validation and findings for an internet sample. *Pediatrics, 113*(6), e570-e577.

Shani-Adir, A., Rozenman, D., Kessel, A., & Engel-Yeger, B. (2009). The relationship between sensory hypersensitivity and sleep quality of children with atopic dermatitis. *Pediatric Dermatology, 26*(2), 143-149.

Shochat, T., Tzischinsky, O., & Engel-Yeger, B. (2009). Sensory hypersensitivity as a contributing factor in the relation between sleep and behavioral disorders in normal schoolchildren. *Behavioral Sleep Medicine, 7*, 53-62.

Ward, T. M., Rankin, S., & Lee, K. A. (2007). Caring for children with sleep problems. *Journal of Pediatric Nursing, 22*(4), 283-296.

Appendix A

Sleep Profile for Children

Child's date of birth:_____
Today's date:_____
Child's gender: [¯] Female [¯] Male
Your gender: [¯] Female [¯] Male
Your relationship to the child:_____

Please base your answers on what you have noticed over the last MONTH

*****Does your child have a regular bedtime? [¯] Yes [¯] No**

	Please check only one box Indicate **how many times per week, on average**							
	0 or N/A	**1**	**2**	**3**	**4**	**5**	**6**	**7**
How many nights a week does your child stay up later than his/her bedtime?	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]
How many nights a week does your child resist going to bed at bedtime?	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]
*, ***How many nights are there problems with getting your child to sleep at bedtime?	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]
*How many nights a week does your child wake up during the night?	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]
*, ***How many nights a week does your child sleep in your bed (all or part of the night) because he/she is upset and won't sleep?	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]
***How many mornings a week does your child need to be woken (by a family member or an alarm clock)?	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]
***How many mornings a week does your child have a hard time waking up/getting out of bed?	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]
***How many days a week does your child seem tired/sleepy during daytime activities?	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]
How many days a week does your child take a	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]	[¯]

nap during the day?								

Please base your answers on what you have noticed over the last MONTH

Does your child have a bedtime routine? [ ] Yes [ ] No

If so, please describe:

		Please check only one box Indicate **how many minutes, on average**						
	N/A	**Less than 10**	**10-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60 or more**
How long is the bedtime routine?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Does your child fall asleep on his/her own? [ ] Yes [ ] No

		Please check only one box Indicate **how many minutes, on average**						
	N/A	**Less than 10**	**10-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60 or more**
*, ***How long does it take your child to fall asleep at bedtime?		[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
How long do you spend with your child settling him/her to sleep at bedtime?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
*If your child wakes up during the night, how long does it take him/her to go back to sleep?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
How long does it take your child to settle/go to sleep at nap time?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Please check only one box Indicate **how many, on average**					
	0	**1**	**2**	**3**	**4**	**5 or more**
*, **, ***How many times does your child wake up each night and need resettling?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
How many naps does your child take during the day?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Please check only one box Indicate **how many hours, on average**										
	Less than 5	**5**	**5.5**	**6**	**6.5**	**7**	**7.5**	**8**	**8.5**	**9**	**More than 9**
****How many hours does your child spend sleeping at night?**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
If less than 5, please specify the number of hours:_____											

	Please check only one box Indicate **how many hours, on average**										
	0 or N/A	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**	**4**	**4.5**	**5 or more**
How many hours does your child spend napping during the day?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
If more than 5, please specify the number of hours:_____											

	Please check only one box Indicate **your answer**			
	No	**Yes, mild**	**Yes, moderate**	**Yes, severe**
*Do you think your child has sleeping problems?	☐	☐	☐	☐

	Please check only one box Indicate **how many months**			
	N/A	**1**	**2**	**3 or more**
*If settling your child to sleep is a problem, how long has the problem been going on?	☐	☐	☐	☐
*If waking up during the night is a problem for your child, how long has the problem been going on?	☐	☐	☐	☐
*If there is a problem of your child sleeping in your bed, how long has the problem been going on?	☐	☐	☐	☐

Do you have any additional comments about your child's sleep behaviors?

Note. *Items on the ISQ; ** Items on the BISQ; The BISQ criteria of more than one hour of nighttime wakefulness was calculated using duration of settling at night multiplied by number of night waking; *** Items modified from the CHSQ.

	Please check only one box Indicate **how often**				
How often do you use the methods below to settle your child to sleep?	**Never (0)**	**Rarely (1)**	**Sometimes (2)**	**Often (3)**	**Very often (4)**
Stroke or pat part of child	[ ]	[ ]	[ ]	[ ]	[ ]
Cuddle or rock child	[ ]	[ ]	[ ]	[ ]	[ ]
Carry child around in your arms	[ ]	[ ]	[ ]	[ ]	[ ]
Push child in stroller	[ ]	[ ]	[ ]	[ ]	[ ]
Take child for a car ride	[ ]	[ ]	[ ]	[ ]	[ ]
Play music or musical toy	[ ]	[ ]	[ ]	[ ]	[ ]
Talk softly to child	[ ]	[ ]	[ ]	[ ]	[ ]
Sing to child	[ ]	[ ]	[ ]	[ ]	[ ]
Read a story to child	[ ]	[ ]	[ ]	[ ]	[ ]
Play with child	[ ]	[ ]	[ ]	[ ]	[ ]
Use of a special toy, cloth, or blanket	[ ]	[ ]	[ ]	[ ]	[ ]
Give bottle/food/drink or nurse	[ ]	[ ]	[ ]	[ ]	[ ]
Leave to cry	[ ]	[ ]	[ ]	[ ]	[ ]
Standing near crib/bed without picking child up	[ ]	[ ]	[ ]	[ ]	[ ]
Settle on sofa/chair with parent	[ ]	[ ]	[ ]	[ ]	[ ]
Lie down with child in his/her bed	[ ]	[ ]	[ ]	[ ]	[ ]
Settle in parent's bed	[ ]	[ ]	[ ]	[ ]	[ ]

Do you have any additional comments about the ways you help your child sleep?

The following information is being asked in order for us to accurately describe the group of people who participated in our study.

Self		Other adult living in the home, such as spouse or committed partner	
A. Level of school completed, select one		A. Level of school completed, select one	
Less than seventh grade		Less than seventh grade	
Junior high school (9th grade)		Junior high school (9th grade)	
Partial high school (10th or 11th grade)		Partial high school (10th or 11th grade)	
High school (private, parochial, trade, or public)		High school (private, parochial, trade, or public)	
Partial college (at least one year) or Specialized training		Partial college (at least one year) or Specialized training	
Standard college or university		Standard college or university	
Graduate professional training		Graduate professional training	
		N/A (i.e. you are single, widowed, divorced)	
B. If employed, please list current job title:		B. If employed, please list current job title:	

Thank You for Your Time!

Table 1 *Significant areas of differences in sleep function using the ISQ cutoff criteria*

Item	Infants with healthy sleep	Infants with sleep dysfunction
How many nights a week does your child stay up later than his/her bedtime?	0.9±0.2 nights per week	2.0±0.7 nights per week
How many nights are there problems with getting your child to sleep at bedtime?	0.3±0.1 nights per week	1.5±0.5 nights per week

Table 2 *Significant areas of difference in sleep function using the Sleep Profile for Children cutoff criteria*

Item	Infants with healthy sleep	Infants with sleep dysfunction
How long do you spend with your child settling him/her to sleep at bedtime?	0.4±0.2 (on a 0-6 scoring scale of increments of 10 minutes from 0 to 60)	1.8±0.5 (on a 0-6 scoring scale of increments of 10 minutes from 0 to 60)
If your child wakes up during the night, how long does it take him/her to go back to sleep?	0.3±0.2 (on a 0-6 scoring scale of increments of 10 minutes from 0 to 60)	1.8±0.8 (on a 0-6 scoring scale of increments of 10 minutes from 0 to 60)
How many hours does your child spend sleeping at night?	8.8±0.1 hours	5.9±1.2 hours

Table 3 *Responses to the Sleep Profile for Children, n=22*

QUESTIONS	ANSWERS
Does your child have a regular bedtime?	Yes, 86%; No, 9%; No response, 5%
How many nights a week does your child stay up later than his/her bedtime?	1.1±0.2 times per week
How many nights a week does your child resist going to bed at bedtime?	0.5±0.2 times per week
How many nights are there problems with getting your child to sleep at bedtime?	0.5±0.2 times per week
How many nights a week does your child wake up during the night?	3.0±0.6 times per week
How many nights a week does your child sleep in your bed (all or part of the night) because he/she is upset and won't sleep?	1.1±0.4 times per week
How many mornings a week does your child need to be woken (by a family member or an alarm clock)?	1.5±0.5 times per week
How many mornings a week does your child have a hard time waking up/getting out of bed?	0.0±0.0 times per week
How many days a week does your child seem tired/sleepy during daytime activities?	1.7±0.5 times per week
How many days a week does your child take a nap during the day?	7.0±0.0 times per week
Does your child have a bedtime routine?	Yes, 73%; No, 27%
How long is the bedtime routine?	2.0±0.4*
How long does it take your child to fall asleep at bedtime?	0.7±0.2*
How long do you spend with your child settling him/her to sleep at bedtime?	0.7±0.2*

Table 3, continued

If your child wakes up during the night, how long does it take him/her to go back to sleep?	0.5±0.2*
How long does it take your child to settle/go to sleep at naptime?	0.8±0.3*
How many naps does your child take during the day?	2.6±0.2 naps per day
How many hours does your child spend sleeping at night?	8.3±0.3 hours per night
How many hours does your child spend napping during the day?	3.0±0.2 hours per day
Do you think your child has sleeping problems?	Yes, 14%; No, 86%
If settling your child to sleep is a problem, how long has it been going on?	0.3±0.1 months
If waking up during the night is a problem for your child, how long has the problem been going on?	0.5±0.2 months
If there is problem of your child sleeping in your bed, how long has the problem been going on?	0.2±0.1 months

**NOTE:* on a 0-6 scoring scale of increments of 10 minutes from 0 to 60

Table 4 *PIBBS results*

	Percent of respondents				
	Never	Rarely	Sometimes	Often	Very Often
Stroke or pat part of child	18	18	18	27	18
Cuddle or rock child	5	0	32	32	32
Carry child around in your arms	14	36	27	18	5
Give bottle/food/drink or nurse	18	14	5	23	41
Settle on sofa/chair with parent	32	27	23	9	9
Settle in parent's bed	64	5	23	5	5
Average percent of active physical comforting strategies endorsed			47.2±3.7		
Play music or musical toy	32	18	9	9	32
Use of a special toy, cloth, or blanket	41	9	9	5	32
Leave to cry	64	14	18	5	0
Average percent of encourage autonomy strategies endorsed			35.2±6.0		
Push child in stroller	73	18	5	5	0
Take child for a car ride	82	14	0	5	0
Average percent of settle by movement strategies endorsed			8.5±3.7		

Table 4, continued

Standing near crib/bed without picking child up	64	14	14	9	0
Lie down with child in his/her bed	91	5	5	0	0
Average percent of passive physical comforting strategies endorsed			10.2±2.8		
Talk softly to child	18	14	27	14	27
Sing to child	18	14	36	18	14
Read a story to child	23	27	25	5	18
Play with child	59	14	5	5	18
Average percent of social comforting strategies endorsed			43.2±5.2		
Average number of all strategies endorsed			34.8±1.8		

Table 5 *Distribution of Sensory Profile scores*

Quadrant	Less Than Others	Typical Performance	More Than Others
		Percent of infants	
Low Registration	23%	64%	13% (includes 4.5% of infants whose scores indicated Much More than Others)
Sensory Seeking	4%	73%	23%
Sensory Sensitivity	4%	82%	14%
Sensory Avoiding	0%	82%	18% (includes 4.5% of infants whose scores indicated Much More than Others)

Table 6 *Correlation of Sleep Profile for Children scores with Sensory Profile T-scores in each quadrant of Dunn's model*

Quadrant	R^2	*R*	P
Sensory Seeking	0.285	0.534	0.0087*
Low Registration	0.076	0.276	0.202
Sensory Sensitivity	0.051	0.225	0.3021
Sensory Avoiding	0.013	0.114	0.6058

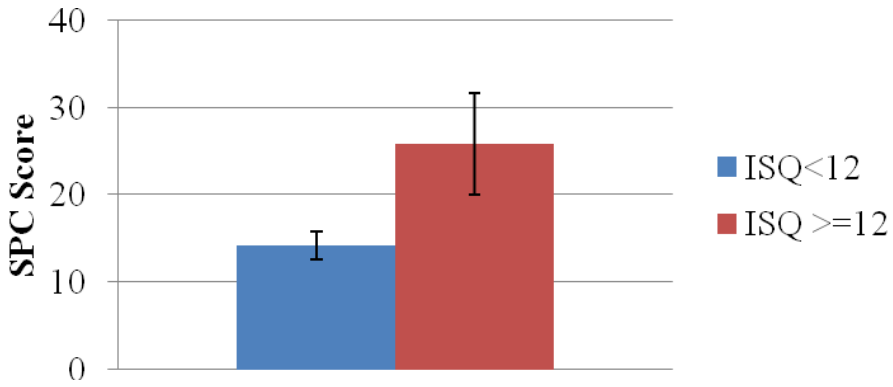
**Note:* $p<0.0125$, $\alpha=0.02$

Figure 1. Dunn's Model of Sensory Processing. From "The Impact of Sensory Processing Abilities on the daily Lives of Young Children and Families: A Conceptual Model" by W. Dunn, 1997, *Infants and Young Children*, 9(4), 23-25.

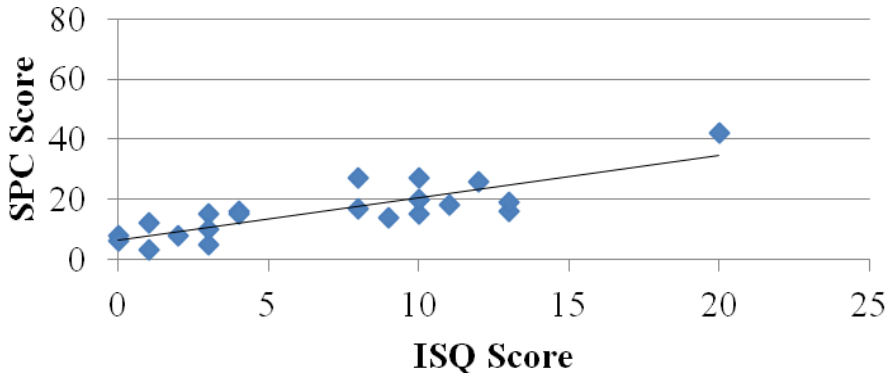
	Responding/ Self-Regulation Strategies	
Threshold/Reactivity	Passive	Active
High	Low Registration	Sensory Seeking
Low	Sensory Sensitivity	Sensory Avoiding

Figure 2. Concurrent Validity of the Sleep Profile for Children with the ISQ

A.

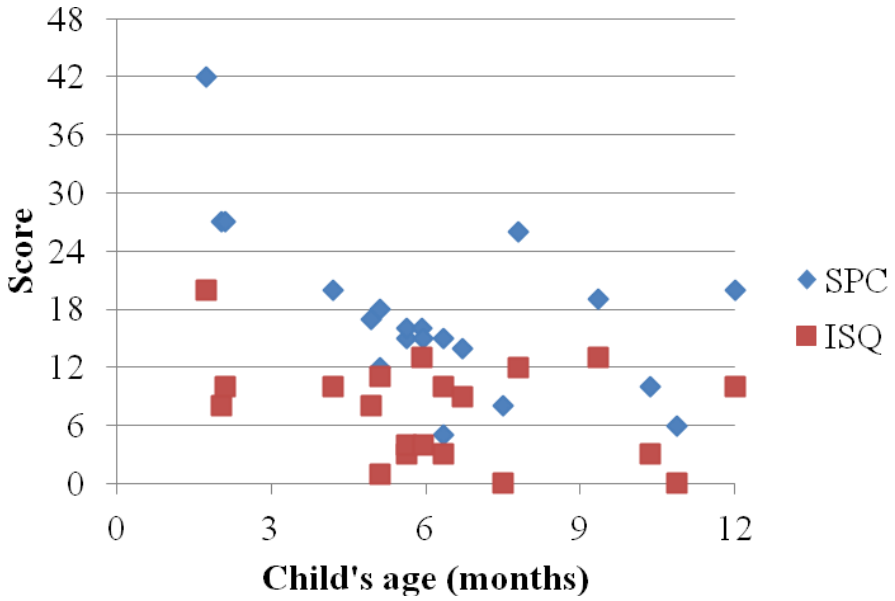


B.



A. The average Sleep Profile for Children score for children with ISQ scores 12 or higher (n=4) was significantly higher than for those with ISQ scores below 11 (n=18, $p<0.05$); B. ISQ scores and Sleep Profile for Children scores were positively correlated ($R^2=0.699$, $r=0.836$, $p<0.01$)

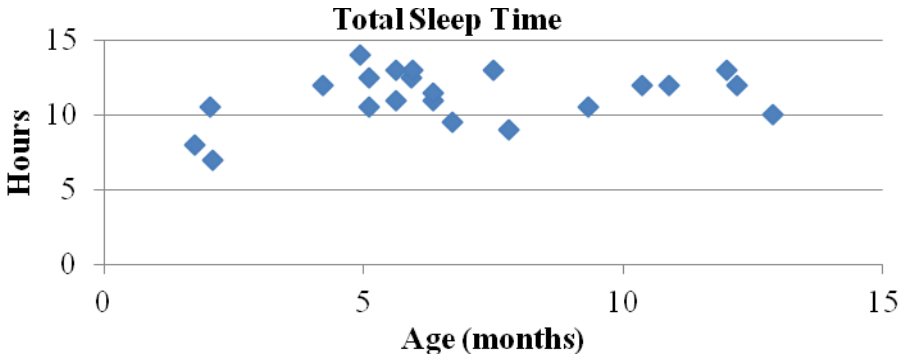
Figure 3. Sleep Assessment Scores with Age.



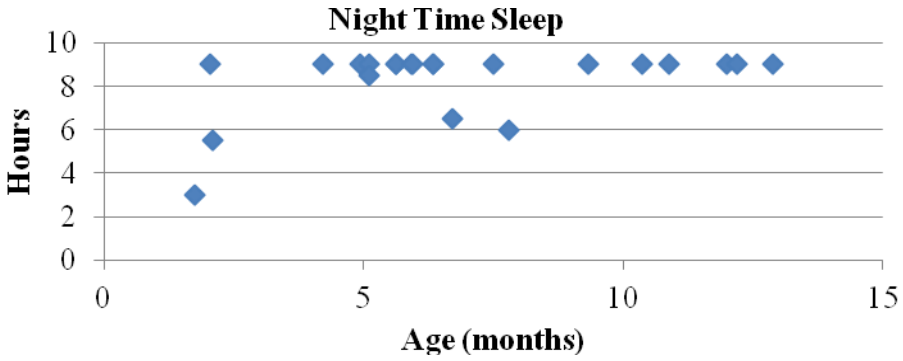
Both scores were significantly negatively correlated with age (ISQ, R=-.448, r^2=.20, p<0.05; Sleep Profile for Children, R=-.646, r^2=.42, p=0.01).

Figure 4. Sleep Time in Infants

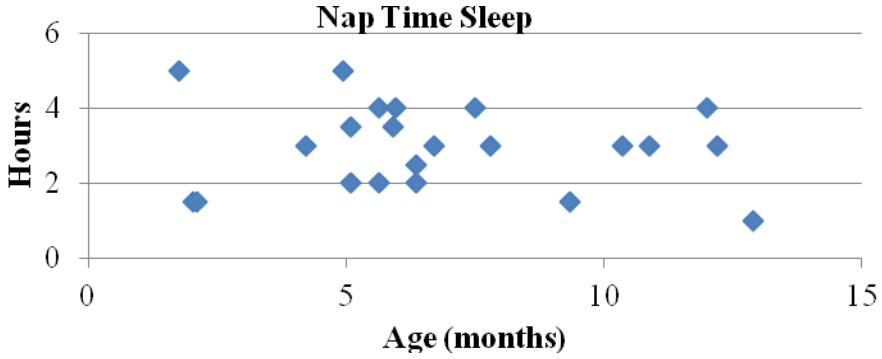
A.



B.



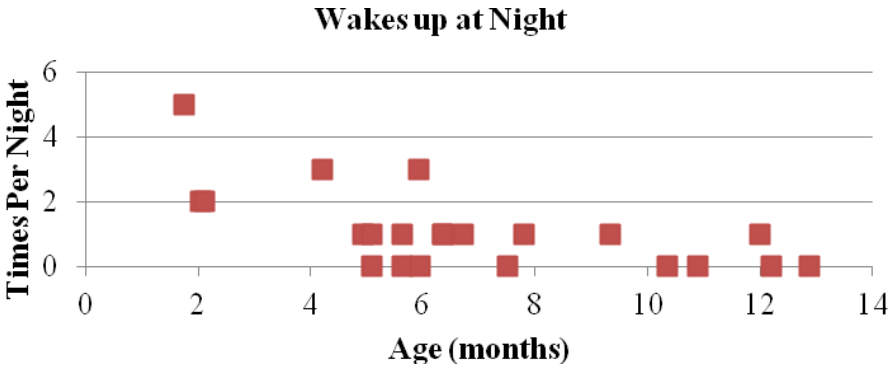
C.



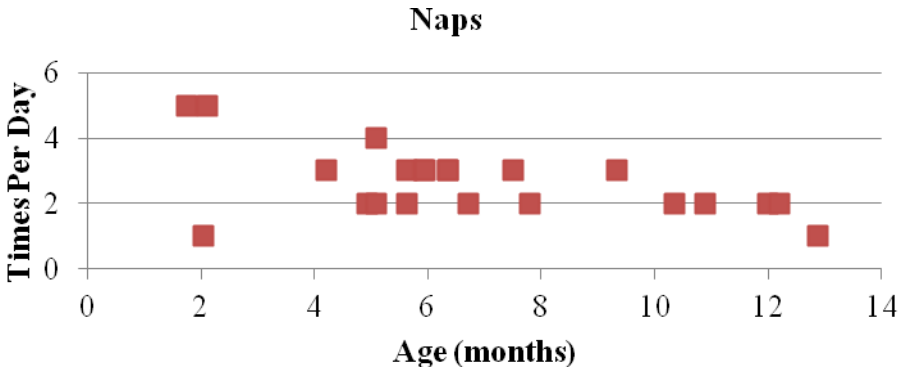
A. Total hours of sleep averaged 11.3±0.4 hours and did not vary with age (R=.301, r^2=.09, p>0.05); B. Hours of night time sleep averaged 8.3±0.3 hours and also did not vary with age (R=.422, r^2=.18, p>0.05); C. Hours spent napping averaged 3.0±0.2 and similarly did not vary with age (R=-.122, r^2=.01, p>0.05).

Figure 5. Sleep Consolidation in Infants

A.



B.



A. The number of nighttime waking was significantly negatively correlated with age ($R=-.612$, $r^2=.37$, $p<0.01$); B. The number of naps per day also was significantly negatively correlated with age ($R=-.529$, $r^2=.23$, $p<0.05$).