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Pediatric Insomnia and Sensory Processing: Exploring the Role of Occupational Therapy Practitoners in Sleep Medicine

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Pediatric Insomnia and Sensory Processing: Exploring the Role of Occupational Therapy Practitioners in Sleep Medicine

by

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Certification

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Abstract

Background. Since the founding of occupational therapy, the occupation of sleep has existed within the scope of practice for practitioners. Sleep disturbances in pediatric clients are estimated to be between 20% and 40% (Galland, Taylor, Elder, & Herbison, 2012; Meltzer, Johnson, Crosette, Ramos, & Mindell, 2010; Mindell, Telofski, Wiegand & Kurtz, 2009; Owens & Mindell, 2011; Sadeh, Mindell, & Owens, 2011). Deficits in sensory processing of pediatric clients play a role in daily functioning and possibly in the ability to settle and transition to sleep (Dunn, 2001; Foitzik & Brown, 2018). **Purpose.** The purpose of this study was to explore the possible relationship between sensory processing and children who do not achieve the recommended sleep duration. **Method.** An exploratory quantitative research design was used to examine trends in sensory presentations in children diagnosed with insomnia. Correlational and statistical regression tests were used to analyze the collected data. **Results.** All four quadrants and five of the six sensory system behaviors were significantly related to the children's sleep behaviors. Predictive relationships were also confirmed between sensory behaviors, both quadrant and sensory systems, and the sleep behaviors of the children. **Significance.** Limited literature regarding the relationship between sensory processing and sleep as an occupation exists. The findings of this study should provide practitioners with additional information to assess and intervene with children with sleep deficits. This study informs occupational therapy's role in the evaluation and treatment of sleep and as a member of a sleep medicine team.

Keywords: Sleep disturbances, behavioral insomnia of childhood, sensory processing

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Chapter 1: Introduction

Sleep is innate to human existence. Adolf Meyer (1922, 1977), an early pioneer in the field of occupational therapy, discussed the importance of a balanced life with the inclusion of work, play, rest, and sleep (Meyer, 1922; O'Brien, Hussey, & Sabonis-Chafee, 2012; Pendleton & Schultz-Krohn, 2013). Between the 1920s and 2000s, sleep was grossly neglected in occupational therapy practice and research (Koketsu, 2017). Green (2008) claimed the neglect of addressing sleep was due to the lack of theorists, researchers, and professional leaders acknowledging sleep as they researched or published about the profession of occupational therapy. Since the late 1990s, there has been a resurgence in the interest in sleep, influencing authors of the second and third editions of the Occupational Therapy Practice Framework (OTPF). In 2008, the American Occupational Therapy Association (AOTA) highlighted sleep and rest and made them primary occupational performance areas rather than activities of daily living (AOTA, 2008; Green, 2008).

The revival of the occupation of sleep is a timely trend as there is a manifestation of sleep disturbances within the pediatric population; in the United States, the incidence of sleep disturbances in children is estimated at 20% to 40% (Galland, Taylor, Elder, & Herbison, 2012; Kothare & Pomeroy, 2008; Meltzer, Johnson, Crosette, Ramos, & Mindell, 2010; Meltzer & Mindell, 2006; Mindell, Telofski, Wiegand, & Kurtz, 2009; Owens, 2005; Owens & Mindell, 2011; Sadeh, Mindell, & Owens, 2011). Sleep deficits result in decreased health and inferior occupational performance of pediatric clients (Institute of Medicine, 2006; Shepard et al., 2005; Wong, Brower, & Zucker, 2009). The National Academy of Medicine, formerly known as the Institute of Medicine (2006), declared sleep deprivation a public health issue. Nationally, a discrepancy between the number of clients with sleep disorders and sleep interventionists exists

(Allen, Howlett, Coulombe, & Corkum, 2016). Green (2008) argued that more research must be completed and disseminated broadly to stakeholders to increase the profession's comfort with the topic of sleep. This dissertation will add to the occupational therapy-based literature regarding sleep.

Researchers in the fields of psychology, public health, pediatric medicine, and neuroscience have published studies regarding both medical and behavioral aspects of sleep (El-Sheikh & Buckhalt, 2015; Moturi & Avis, 2010; Owens & Mindell, 2006). Scant sleep research has been published within the realm of occupational therapy despite occupational therapy practitioners working with many of the professions that have produced a large amount of sleep-based research (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Green, 2008; Reynolds, Lane, & Thacker, 2012; Shochat, Tzischinsky, & Engel-Yeger, 2009; Spira, 2014; Tauman et al., 2017; Vasak, Williamson, Garden, & Zwicker, 2015). Adding an occupational therapy lens to sleep-based literature, especially concerning the impact of sensory processing on children's sleep behavior, may help address the national epidemic of pediatric insomnia. This chapter describes the current identified problem, the research questions, and hypotheses that explored the potential role of children's sensory processing in sleep-based occupational performance.

Background

All humans, at all ages, must participate in sleep (AOTA, 2014; Green, 2008). Sleep effectiveness influences all other wake time occupations' performance, and, in turn, occupations during wake times affect one's sleep (Beebe 2011; Green, 2008; Owens & Adolescent Sleep Working Group, 2014). Sleep is essential for the homeostatic balance necessary for participation and performance in occupations (Picard, 2017). This cyclical relationship between sleep and wake occupations and the two cycles' interdependence is a concern for occupational therapists.

Sleep is the only occupation in the occupational therapy framework that cannot be completed with help from others or by alternate means (Koketsu, 2017). The National Academy of Medicine, formerly known as the Institute of Medicine (2006), and the Centers for Disease Control and Prevention (2015) declared sleep deprivation a public health issue several years ago, and this continues today. Sleep deprivation leads to an increased risk for chronic diseases if not corrected (Léger, Guilleminault, Bader, Lévy, & Paillard, 2002). The U.S. Department of Health and Human Services, in developing Healthy People 2020, wrote four objectives, SH 1-4, about sleep health (U.S. Department of Health and Human Services, 2011a, 2011b). These objectives aim to increase the public's knowledge about the importance of sleep and the evidence-based ramifications regarding the current trend of decreased sleep (U.S. Department of Health and Human Services, 2018). Healthy People 2020 also advocates seeking a sleep professional when a sleep issue is present. Occupational therapy practitioners now have a role in health promotion and are qualified to address good sleep hygiene and sleep performance as part of their evaluation and treatment (AOTA, 2015; Koketsu, 2017).

What Is Sleep?

According to Nordqvist (2013), sleep is a state in which involuntary body movement is minimal but a time when the body is replenishing. Sleep is a reversible absence from sensorimotor interactions with the environment, typically in a state of rest or decreased movement (Rasch & Born, 2013). Sleep also allows persons to recover from emotional and physical interactions from the day and regain bodily energy for the following day (Bathory & Tomopoulos, 2017). In 1966, Ian Oswald conceptualized sleep as a state of restoration.

Oswald (1966, 1969, 1970), a medical physician who developed expertise in sleep medicine, was the first to propose sleep's purpose as a restorative process. Sleep restores the

body's resources to allow for increased repair of bone, muscle, and neurological structures. Physiological effects of sleep include replenishing neurotransmitters, immune system components, and other necessary bodily elements (Benca & Quintans, 1997; O'Leary, Small, Panaite, Bylsma, & Rottenberg, 2017; Van Dongen, Maislin, Mullington, & Dinges, 2003). The restorative function of sleep allows the body to regulate mood, behavior, and metabolism (Knutson et al., 2017). Also, restoration during sleep allows for improved cognitive functioning, including executive function, which has been proven to enhance the overall quality of life (Engel-Yeger & Shochat, 2012; Morgenthaler et al., 2006; Paavonen et al., 2010). The restorative roles of sleep are essential in all clients, but they are especially important in the pediatric population. Sleep duration affects neural development and daily modulation of mood, behavior, cognition, and neurological regulation (Baum et al., 2014; Cardoso et al., 2014; Stein, Mendelsohn, Obermeyer, Amromin, & Benca, 2001). These processes play significant roles in development and can affect learning, a primary occupation of children. Occupational therapy practitioners address body regulation, cognitive development, and quality of life daily in pediatric practice, but may neglect sleep as the foundation of functional deficits in children (Christiansen, 1996; Christiansen, Baum, & Bass, 2011; Christiansen & Matuska, 2006). Addressing sleep could be the missing component to establishing adequate regulation and improving the health and cognitive functioning of the children seen in occupational therapy clinics.

Children's Sleep

Children spend a large portion of their lives participating in the occupation of sleep. Pediatric sleep durations range from 71% of the time for an infant, to 38% in a school-aged

child, to 29% in young adults in a 24-hour day, as shown in Table 1 (Hirshkowitz et al., 2015; National Sleep Foundation, 2014).

Table 1

Recommended Sleep Duration for Pediatric Clients

Age category	Age	Recommended sleep in hours
Newborns	0-3 months	14-17
Infants	4-11 months	12-15
Toddlers	1-2 years	11-14
Preschoolers	3-5 years	10-13
School age	6-13 years	9-11
Teenagers	14-17 years	8-10
Young adults	18-25 years	7-9

Note. Adapted from “National Sleep Foundation’s sleep time duration recommendations: Methodology and results summary” by Hirshkowitz et al. (2015), *Sleep Health*, 1(1), 40-43.

Sleep is the primary occupation of children until the age of 5 and continues to be a principal occupation into adulthood (Matricciani, Blunden, Rigney, Williams, & Olds, 2013). An estimated 20% to 40% of the pediatric population in the United States and Canada demonstrated consistent irregularities in the occupation of sleep, and up to 70% reported at least one sleep issue in their lifetime (Gruber, Constantin, Frappier, Brouillette, & Wise, 2017; Mindell et al., 2009; National Sleep Foundation, 2014; Teng, Bartle, Sadeh, & Mindell, 2012; Vriend & Corkum, 2011). Sleep in America® completed a poll of children 6-17 years of age and reported significantly fewer hours per night than the national recommendations (National Sleep Foundation, 2014). Decreasing a child’s sleep duration by just 1 hour impacts emotional functioning, memory, attention, and cognitive performance (Paavonen et al., 2010; Turnbull, Reid, & Morton, 2013; Vriend et al., 2013).

The importance of sleep in the role of development, executive functioning, and participation in daily activities is established in research; nevertheless, the duration of sleep in children continues to decline (De Ruiter, Olmedo-Requena, Sánchez-Cruz, & Jiménez-Moleón, 2016; Dollman, Ridley, Olds, & Lowe, 2007; Matricciani, Olds, Blunden, Rigney, & Williams, 2012; Matricciani, Olds, & Petkov, 2012). Matricciani et al. (2012) stated that children's sleep duration decreased, on average, 70 minutes in the 20th century. Some researchers point to modernism as a primary reason (Matricciani et al., 2012; Oka, Suzuki, & Inoue, 2008; Williams, 2013). Modernism is a term used to describe increased exposure to technology and external stimulation leading to increased cognitive demands (Matricciani et al., 2012).

The result of this increased complexity of life has led to many children receiving less sleep than recommended. A reduction of sleep in children prompts parents to seek medical care for excessive daytime sleepiness or other symptoms that their children are exhibiting. Routinely, children visit a primary physician for treatment but then receive a referral to physicians with specific sleep medicine training for diagnosis. The field of sleep medicine has grown as a medical specialty and in research since the 1960s (Shepard et al., 2005). This specialization enhances the ability to diagnose pediatric sleep complications and lead to a variety of sleep-specific diagnoses. The prominent diagnoses present in literature are obstructive sleep apnea, sleep-related movement disorders, insomnia of childhood, and parasomnias, or night terrors (Owens & Mindell, 2011). Insomnia of childhood, specifically behavioral insomnia, is the most common type of insomnia in preschool and school-aged children and was the focus of this dissertation (Owens & Mindell, 2011).

Insomnia of Childhood

Literature has varying definitions for the term insomnia (Vriend & Corkum, 2011). Mindel, Emslie, et al. (2006) defined insomnia as "repeated difficulty with sleep initiation, duration, consolidation, or quality that occurs despite age, appropriate time, and opportunity for sleep, which results in some form of daytime functional impairment for the child and family" (p. e1223). Insomnia symptoms can occur at any age, from newborn to adult, and can have two main etiologies: medical and behavioral (Owens & Mindell, 2011). Medical causes of insomnia are often secondary to a medical diagnosis, a prescribed medicine, or secondary to pain. Behavioral causes include lack of routine surrounding bedtime or waking time, use of electronics, need for a particular object to sleep, nighttime fears, or mental health disorders (Van Straten et al., 2018).

Behavioral Insomnia of Childhood

Behavioral insomnia of childhood (BIC) is the inability to fall or stay asleep because of a behavioral aspect, meaning physical causes such as obstructive sleep apnea have been rejected (Vriend & Corkum, 2011). The diagnosis of BIC is the most prevalent sleep diagnosis in children; rates reported are up to 40% in pediatric sleep clinics in the United States (Galland et al., 2012; Kothare & Pomeroy, 2008; Meltzer et al., 2010; Meltzer & Mindell, 2006; Mindell et al., 2009; Owens, 2005; Owens & Mindell, 2011; Sadeh et al., 2011). In 2006, the National Academy of Medicine declared decreased sleep duration a public health crisis, secondary to these troubling statistics. Behavioral insomnia of childhood is the most discussed diagnosis in pediatric sleep literature (Meltzer et al., 2010). Occurrence rates of BIC are higher than all the other pediatric sleep diagnoses added together (Ophoff et al., 2018).

In the third edition of the International Classification of Sleep Disorders (ICSD), the gold standard sleep medicine classification reference, BIC is a single, broad diagnosis category (American Academy of Sleep Medicine [AASM], 2014; Vriend & Corkum, 2011). The ICSD-3 does not separate the behavioral causes of BIC, as previously presented in the ICSD-2. However, the continued division is recommended for clinical application because each BIC category has different symptoms and requires a unique set of clinical skills for treatment (Owens, 2019). A considerable amount of current literature and existing sleep assessment tools use the ICSD-2 divisions as a foundation. The ICSD-2 nosology divides BIC into three categories: BIC sleep-onset association type, BIC limit-setting type, and BIC combined type (AASM, 2005; Bruni, Angriman, et al., 2018; Bruni, Sette, et al., 2018; Honaker & Meltzer, 2016; Ophoff et al., 2018; Owens, 2019). This dissertation used the following nosology from the ICSD-2:

- BIC sleep-onset type: Sleep onset type is an environmental or personal context-based need to settle and fall asleep. The specific requirements are individual to the child, but they often include an intervention from the parent (Owens & Mindell, 2011). Personal context examples may consist of the need for rocking, humming, or the feel of a specific toy or fabric in the bed. Environmental context examples may include the need for a particular temperature, lighting, or specific bedding requirements.
- BIC limit-setting type: A limit-setting type diagnosis represents children who stall, challenge authority, or refuse to go to bed (Vriend & Corkum, 2011). The stalling behaviors, or curtain calls, may include making additions to the nighttime routine, such as asking for a drink or going to the bathroom.

- BIC combined type: The combined type of BIC is a combination of limit-setting and sleep-onset types. A child diagnosed with combined BIC may prolong going to or refuse to go to bed but then also require specific contextual needs for settling (Honaker & Meltzer, 2016).

Behavioral sleep difficulties in children generally are diagnosed before the age of 5 but can last well into the teenage years (Owens & Mindell, 2011). Occupational therapy practitioners have the unique opportunity to address sleep needs of children while working on other developmental skills at home and in school (AOTA, 2015; Brandenburger-Shasby, 2005; Dunn, 1988; Edwards, Millard, Praskac, & Wisniewski, 2003; Individuals with Disabilities Education Improvement Act, 2004). BIC is minimally discussed in occupational therapy literature, which leaves sleep disorders for other professions to address. The exploration of sensory processing's potential connection to BIC through this dissertation could lead to more conversations and research around sleep intervention and the development of therapeutic sleep interventions in occupational therapy.

Sleep in Occupational Therapy

Sleep in occupational therapy has a long history dating back to the 1920s when Adolf Meyer spoke about the importance of sleep in balancing life (Meyer, 1922). Despite sleep having a long history in occupational therapy, dating back to the 1920s, it has been mostly neglected within the profession (Fung, Wiseman-Hakes, Stergiou-Kita, Nguyen, & Colantonio, 2013; Green & Brown, 2015). A resurgence in sleep-based research and publications in occupational therapy literature started in the early 2000s and continues today (Green, 2008; Green & Brown, 2015). Studies with occupational therapy aspects of occupational balance, how sleep affects

daytime occupations, and research regarding sleep's sensory aspects are just a few of the topics recently published (Foitzik & Brown, 2018; Tester & Foss, 2018).

Advancement of sleep to the foreground of occupational therapy practice would be more probable if practitioners address sleep utilizing already established frames of reference or practice models. Finding a relationship between pediatric sleep behaviors and sensory processing could be the pathway to make sleep more prominent in the field of occupational therapy (Vargas & Camilli, 1999; Zimmer et al., 2012). An investigation into the correlation of sensory processing differences and sleep performance was introduced to the occupational therapy profession in 2009 (Shochat et al., 2009). The research thread is still in its infancy but continues to strengthen with additional studies. Additional exploration of the relationship between sensory processing and sleep performance could ultimately lead to sensory processing strategies as an intervention for sleep performance difficulties. This research intended to continue exploring a relationship between sensory processing and sleeping patterns of children, potentially leading to a more influential role of occupational therapy in sleep medicine.

Overview of Sensory Processing

Sensory processing is the neurological process of taking sensory input from the sensory receptors throughout the body and responding to them (Dunn, 2007; Foitzik & Brown, 2018; Miller, Fuller, & Roetenberg, 2014). The actual process is more complex neurologically. The receptors from the eight senses of sight, sound, touch, taste, smell, vestibular, proprioception, and interoception receive input from the environment or body. The eight senses include the five familiar senses and the three hidden senses, vestibular, proprioception, and interoception. Vestibular and proprioception are essential senses to help the body determine the movement and

position of our bodies and the pressure on joints (Miller et al., 2014). Vestibular receptors are located within the inner ear and register the position of the head.

In contrast, proprioception receptors are located in joints and muscles and determine the position of the body. The sense of interoception is the sensory input from the internal organs, which are primarily subconscious (Cameron, 2001). The sense of interoception alerts the individual of internal sensations that may need attention or action. Examples include needing to go to the restroom or if they are experiencing stomach pain. These sensory-based signals are transported to the brainstem then to the cerebral cortex for further processing (Ayres, 1979). Sensory processing "sorts, orders, and eventually puts all of the individual sensory inputs together into a whole-brain function" (Ayres, 1979, p. 28). Ayres described this whole-brain response to the environment as an adaptive response (Ayres, 1979). An adaptive response is purposeful and appropriate for the sensory stimulation experience (Ayres, 1979).

Occupational therapists use observation and parental reports to determine how children respond to sensory input. The Child Sensory Profile-2 (CSP-2) is one measure that helps therapists gather sensory-based information to learn if sensory processing is happening in a typical manner (Dunn, 2014). The ability to process sensory information throughout the day is an essential component in wake occupations (Dunn, 2014). This dissertation explored the child's ability to process sensory information appropriately to settle and participate in quality sleep.

Sensory Processing in Occupational Therapy

The concept of sensory processing was first introduced to the profession of occupational therapy by Dr. A. Jean Ayres in the 1970s. The original terminology of the process by which senses neurologically organized and outward behavior was determined was called sensory integration. This sensory integration theory was first presented to explain difficulties children

demonstrated around academic learning and motor planning (Bundy, Lane, & Murray, 2002). The term sensory integration has evolved to represent the underlying theory and the interventions to treat sensory processing deficits (May-Benson, 2000; Miller, Anzalone, Lane, Cermak, & Osten, 2007).

Sensory processing is a more encompassing term that involves the progression of sensory input from the receptors to the neurological regulation and interpretation centers of the brain as well as the outward response to the stimulus (Critz, Blake, & Nogueira, 2015; Miller et al., 2007; Miller & Lane, 2000). The process allows for proper response to environmental sensations throughout the day with an organized sensory progression. All children, with or without medical conditions, require a functional sensory process for optimal occupational participation (Dunn, Little, Dean, Robertson, & Evans, 2016). Without proper sensory processing, children either over-respond or under-respond to environmental stimuli, resulting in less than ideal participation in functional activities such as sleeping. Occupational therapists, with an understanding of this transactional relationship between the child's responses, the environment, and requirements of the task, could help enhance occupational performance in all areas, including sleep (Dunn, Brown, & McGuigan, 1994; Dunn et al., 2016; Strong et al., 1999).

Ayres' work continues to evolve, grow, and advance due to the researchers within the profession of occupational therapy (Schaaf & Miller, 2005). The evolution of the sensory integration theory fostered models of intervention within occupational therapy. One such model is Dunn's Sensory Processing Framework. Dunn (2001) emphasized how essential sensory input is to individuals' experiences and perceptions of their lives. Dunn (1997) developed Dunn's Sensory Processing Framework, which explained an individual's sensory processing as an interaction between neurological threshold and self-regulation in meeting the environmental

challenges. If the interaction of neurological threshold and self-regulation is disproportionate, and the reaction is over or under what is expected, the person may be experiencing sensory modulation disorder. Dunn's Sensory Processing Framework is a model that gives practitioners the means to identify and describe the alternated pattern of sensory processing. Research to support and validate Dunn's Sensory Processing Framework helps the model gain practitioner support and assists in the development of new assessment tools (Dean, Dunn, & Little, 2016; Dunn, 2014; Ismael, Lawson, & Hartwell, 2018).

The Interdisciplinary Council of Developmental and Learning Disorders (2005) has recognized that children with sensory modulation/processing deficits may have insufficient sleep performance. Appropriate responses to bedtime environmental cues are necessary for a child to complete sleep preparation and sleep hygiene occupations. Processing sensory input adequately and participating in self-calming techniques could significantly affect sleep patterns (Hill, 2011). A child's sensory processing skills could affect self-calming, and, therefore, influence sleep patterns. Occupational therapy practitioners, who have formal training in the evaluation and intervention when a sensory processing difference is noted, could assist with the crisis of decreased sleep duration in children. If this study determines a correlation between sensory processing and insomnia symptoms, occupational therapy's role could advance in pediatric sleep medicine clinics across the United States.

Occupational therapy practitioners analyze occupational performance utilizing sensory processing theory and sensory processing frameworks to evaluate and intervene when deficits of occupation are present. Sleep is a cessation of sensorimotor information and an internalized processing of the day's interactions with the environment; one could deduce that sleep may have a sensory-based component that should be addressed by occupational therapists (Kleitman, 1963;

Rasch & Born, 2013; Rosenzweig, Breedlove, & Watson, 2007). The results of initial studies researching the topic of sensory processing and sleep performance in children discuss varying relationships across all of Dunn's sensory quadrants (Engel-Yeger & Shochat, 2012; Reynolds et al., 2012; Shani-Adir, Rozenman, Kessel, & Engel-Yeger, 2009; Shochat et al., 2009; Vasak et al., 2015; Wengel, Hanlon-Dearman, & Fjeldsted, 2011). The most significant finding is that increased sensory sensitivity affects the ability to sleep. Those children with an over-sensitivity to input experience difficulty calming reactions to external stimuli and settling for sleep (Reynolds et al., 2012). While these findings are significant, the sleep-sensory relationship has not been studied conclusively and with all age groups.

The purpose of this dissertation was to explore the concept of sensory processing as it may affect sleep. Occupational therapy practitioners may use this information to enhance the client's ability to participate in sleep and other daily activities. There is a large amount of research on the effects of sensory processing on multiple occupations in the occupational therapy literature; however, there is a scarcity of studies on the relationship between sensory processing and sleep (Dunn et al., 2016; Green, 2008).

Sleep and Sensory Processing in Occupational Therapy

The research and publications with the occupation of sleep as a focus have increased since the 1990s (Green & Brown, 2015). Publications continue to be limited in sleep as an occupation and more limited in the subtopic of sleep's relation to sensory processing. Seven studies relating to sensory processing and insomnia are present in the current literature. Four were in peer-reviewed, occupational therapy-based journals, two were in sleep-medicine-based journals, and one of the studies was an unpublished dissertation. Six of the studies involved children: two included children up to the age of 3, and four studies included varying ages

between 6 and 12 years of age. One study involved adults between 21 and 60 years of age. Five of the studies used typically developing participants, and two used participants with a diagnosis of behavioral insomnia. Many of the studies showed minimal to moderate correlations between various aspects of sensory processing and insomnia, but the findings were generally preliminary findings for a specific group and could not be generalized at this time (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014; Tauman et al., 2017; Vasak et al., 2015). The actual findings of these studies are discussed further in Chapter 2.

Research exploring behavioral insomnia and the possible link to sensory processing is in its infancy. Research describing groups of children from birth to 3 years and 6 to 12 years of age exists. However, most of the studies state the findings are preliminary, requiring more research to replicate and strengthen research findings. Research on the topic of sleep and sensory behaviors for the ages of 3 to 6 years is absent. This 3- to 6-year-old range involves significant neurological development marked by the construction of neurological pathways vital to sensory processing. Investigating the 3- to 6-year-old age group could provide valuable information to the research of sensory processing and sleep (Brown & Jernigan, 2012). The research should fill the gap by researching participants ages 3 to 6 and replicate research for ages 6 to 10 by exploring a possible correlation between sensory processing and behavioral insomnia of childhood.

Statement of the Problem

As previously stated, up to 40% of all children are reported to have difficulties with sleep (Galland et al., 2012; Kothare & Pomeroy, 2008; Meltzer et al., 2010; Mindell et al., 2009; Owens & Mindell, 2011; Sadeh et al., 2011). With increased knowledge of sensory processing

and the relation to sleep participation, occupational therapy practitioners could help address the incidence of children's sleep issues. Sleep research within occupational therapy is scant, even though the OTPF has defined sleep as a primary occupation in the occupational therapy profession. Previous studies show a potential relationship between insomnia of childhood and sensory processing differences in children. The outcome of this research may provide information regarding the link between sensory processing and insomnia of childhood, which would help strengthen the understanding of occupational therapy's role in sleep medicine.

Relevance

The purpose of this study was to investigate the existence of a relationship between sensory processing skills of children and a diagnosis of BIC. Research exploring sensory-based behavior and insomnia patterns in children will strengthen the abilities and evidence-based practices of occupational therapists in addressing insomnia patterns in children. Understanding the potential connection between sleep and sensory processing may help therapists develop sleep-based sensory protocols or other therapeutic strategies based on Dunn's Sensory Processing Framework. The increased knowledge may also help occupational therapy practitioners develop a role as part of the sleep medicine team. Occupational therapists offer distinct value to help reduce the sleep crisis in the United States.

Theory

Understanding and satisfying one's environmental and bodily needs and desires are fundamental to proper settling for sleep. One aspect of this understanding is sensory processing and its role in self-regulation. Occupational therapists are trained in understanding sensory processing's impact on occupations of client's lives (Schaaf & Miller, 2005). This sensory-based ideation began with the development of the sensory integration theory of Dr. Jean Ayres.

This theory guides researchers and practitioners, such as Dr. Winnifred Dunn, to theoretical approaches to treatment. Dunn and colleagues constructed therapeutic approaches to treatment with their works: Dunn's Sensory Processing Model and the Ecology of Human Performance (EHP). Dunn's Sensory Processing Model and the EHP are presented as the theoretical structure for this study.

Theory of Sensory Processing

One of the signature theories developed within the profession of occupational therapy is the sensory integration theory. Sensory integration theory emphasizes the importance of sensory processing related to a person's motor and social behavior (Bundy & Murray, 2002). Sensory processing encompasses a neurological process that involves the taking in, organization, and response to external stimuli (Bundy & Murray, 2002; Reynolds et al., 2017). Sensory processing is an overarching concept describing the extent to which an individual's response to incoming sensory input from the body or the environment produces an appropriate motor or behavioral response (Ayres & Robins, 2005; Bundy et al., 2009; Dean, Little, Tomchek, & Dunn, 2018; Miller et al., 2007; Schauder & Bennetto, 2016). Dunn's work augments Ayres' work on sensory integration by directly addressing the sensory processing aspect of the sensory integration theory.

Dunn's Sensory Processing Framework

Dunn (1997) developed a sensory processing framework based on the interaction between two constructs: neurological threshold and self-regulation. These two constructs both exist on a continuum, and the axes intersect to result in four quadrants (see Figure 1).

- The neurological threshold is the amount of environmental input necessary to cause a chemical activation within the nervous system (Dunn, 2007). Dunn theorizes an individual's neurological threshold is on a continuum with extremes

being either low or high, represented on the vertical axis. Children with a low neurological threshold require a small amount of environmental input to trigger a neurological response, and a high threshold requires a more substantial amount of input to trigger the neural response (Dunn, 2007).

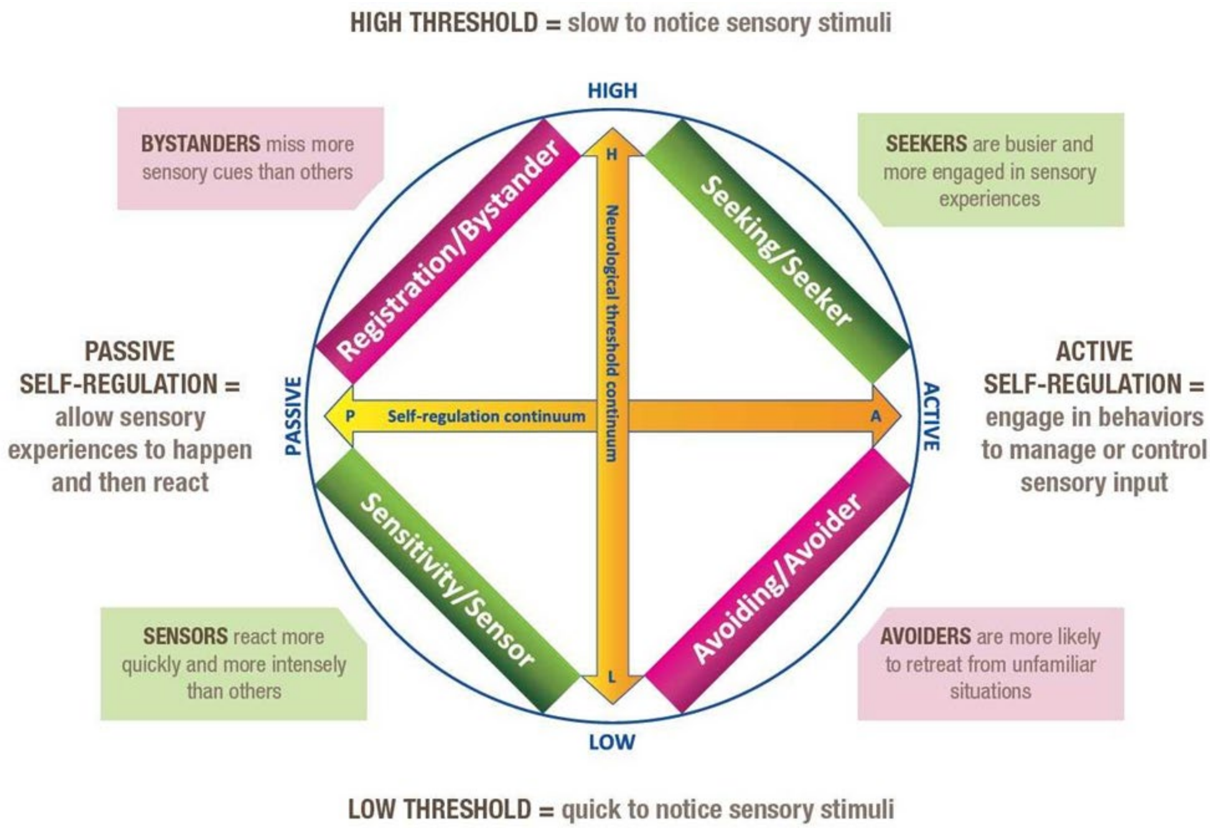

Figure 1. Dunn's sensory processing framework. Dunn's model illustrates the interaction between two constructs: neurological threshold and self-regulation (Dunn, 2014). Usage permission granted from PsychCorp (see Appendix A).

- Self-regulation, represented on the horizontal axis, is the other construct within Dunn's Sensory Processing Framework. Self-regulation is an observable response to the environment (Dunn, 2009). Self-regulation is on a continuum with the extremes existing in two forms, active or passive accommodation. Individuals who present in the active self-regulation range will take an active role in

controlling their environment. Persons in the passive range of the continuum will passively tolerate sensory input from the environment (Dunn, 2009).

It is important to keep in mind both of these constructs are continuums, and the children may fall anywhere between the two extremes. Children may also respond anywhere on the continuum for each respective sensory system (e.g., hearing, touch, or movement). Dunn's research tool, the CSP-2, helps therapists determine where on the continuum the child's behavior is positioned.

Sensory processing is just a small aspect of functioning as an individual interacts with the environment (Dunn, 2001). The environment is a crucial construct within sensory processing and interacting in daily life (Dunn et al., 1994). The close connection and transactional characteristics of a person with the environment led to developing the EHP model within occupational therapy (Dunn et al., 1994). This study used the EHP as theoretical support, as EHP describes the child's interconnectedness and the environment in which they are sleeping or preparing to sleep.

Ecology of Human Performance

The EHP is an occupational therapy model of practice that emphasizes the client's connection to the context surrounding them (Dunn et al., 1994). The assertion of the model states that one must understand the contextual influences upon that person (Dunn et al., 1994). The initial position on context affecting occupation was introduced to occupational therapy by Mosey (1992). Dunn et al. (1994) advanced the concept of contextual effects on occupational performance in developing EHP. The EHP model developed out of the social sciences.

Psychologists Holahan (1986) and Wicker (1979) recognized the critical impact the environment has on an individual's behavior. Bronfenbrenner (1979, 1986) was one of the first developmental psychologists to expand and introduce environmental constructs (including social,

cultural, and physical environment) to childhood development. Building on Bronfenbrenner's work, Dunn et al. (1994) examined the impact of other meaningful contexts such as temporal, cultural, social context, in addition to the physical environment's impact on occupation development and participation. These contextual components significantly describe the person and have been hypothesized to influence personality, demeanor, maturation, development, feeling of competence, and mood (Bruner 1989; Gibson, 1986; Hart, 1979; Lawton, 1982; Murray, 1938). According to the EHP model, the interaction is bidirectional: the person influences the context, and the context influences the person (Dunn et al., 1994). Examining the occupation of childhood sleep disorders through the EHP lens is useful as we can now consider the effects of the natural environment and the child's sensory processing in their sleep preparation and participation

Research Questions

RQ1: Does a correlation exist between sensory behaviors and insomnia behaviors in young children 3 to 10 years of age?

RQ 1.1: If correlations exist, do scores in specific quadrant scores of children predict behaviors of insomnia of childhood?

RQ 1.2: If correlations exist, do scores in the sensory systems (i.e., movement, visual, auditory) have predictive properties in children with insomnia of childhood?

Definition of Terms

For this study, the following terms are defined:

- Behavioral Insomnia of Childhood (BIC):
  - Conceptual definition: BIC is an insufficient sleep duration due to difficulty going to sleep, staying asleep, or waking early from being asleep (AASM, 2014).

This decrease in sleep must result in daily occupation interruption to diagnose insomnia (Meltzer & McLaughlin-Crabtree, 2015). According to the ICSD-3, three classifications of insomnia exist: sleep onset association type, limit setting type, and the combined type (AASM, 2014).

- Sleep onset association type occurs when a child requires a particular item or situation to sleep. Sleep onset difficulties may occur at the beginning of sleep or may include the length or frequency of wakings at night with the inability to settle (Owens & Mindell, 2011). This type is often present in young children below 3-years of age but can exist as children continue to age (Mindell & Meltzer, 2008).
- Limit setting insomnia occurs when the child refuses or pushes back bedtime. Limit setting type typically initiates during toddlerhood and presents with preschool and school-aged children (Mindell & Meltzer, 2008). This type is often exhibited by a strong-willed child or lack of bedtime structure from the parents (Owens & Mindell, 2011).
- Combined type insomnia is a combination of refusing to go to bed and night wakings affecting the daily occupations of children (AASM, 2014). This type of insomnia typically requires some adult intervention to go to or return to sleep.

➢ Operational definition: BIC was measured in this project using the Children's Sleep Habits Questionnaire (CSHQ) developed by Owens, Spirito, and McGuinn in 2000 (see Appendix B). The CSHQ is designed to screen sleep behaviors of children ages 3-10 years to determine if the actions meet the criteria of insomnia.

- Sensory Processing:
    - ➢ Conceptual definition- Sensory processing is the intake of environmental or bodily stimulus through the receptors, transmission of the impulse through the neurological system, and the perception from the brain structures and the behavioral response to the input (Ahn, Miller, Milberger, & McIntosh, 2004; Bundy et al., 2002). Sensory processing is the ability to react or regulate the body's reaction to sensory input in a socially appropriate manner (Mulligan, 2002). When the dysfunction of self-regulation is present, the term is sensory modulation disorder or sensory processing disorder (Interdisciplinary Council on Developmental and Learning Disorders, 2005).
    - ➢ Operational definition- In this dissertation, sensory processing was measured using the CSP-2 developed by Winnie Dunn in 2014. The CSP-2 assesses the sensory processing patterns of children from 3 to 14 years of age, which encompasses the inclusion ages of this study 3 to 10 years (Dunn, 2014). The format for the CSP-2 is an 86-question caregiver report of the child's behaviors in the natural environment. The caregiver rates the behaviors observed from the child on a Likert scale.

Assumptions of the Study

For this study, the following assumptions were made:

- Sensory modulation is an interaction between the environment and the human nervous system.
- Sensory modulation disorders will affect children's performance in daily occupations, including sleep.

- Sleep is a required activity of all humans.
- Sleep is a precipitating action to neurological processes of organizing sensorimotor details of the day.
- Participants in this study would answer the survey truthfully.

Summary

This study aimed to explore the presence of relational trends of sensory processing behaviors of children and a diagnosis of behavioral insomnia of childhood. In 2006, the National Academy of Medicine (formerly known as the Institute of Medicine) declared sleep deficiency to be a public sleep health issue (Institute of Medicine, 2006). Previous research has enhanced the understanding of sleep effects on development and daily occupations (Dahl, 1996; Matricciani et al., 2012; Sadeh & Anders, 1993). Also, other studies have increased the knowledge about the relationship of sensory processing and sleep performance (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014; Tauman et al., 2017; Vasak et al., 2015). This study addressed sleep performance in the age gaps in previous studies (3 to 6 years of age) and added to the current published research. This dissertation, using the theoretical foundations of sensory processing and EHP, was designed to provide additional insight into the problems of children with insomnia symptoms. Expectantly, this research provided evidence for occupational therapy practitioners to support the use of sensory processing strategies when working as a member of a sleep medicine team.

Chapter 2: Literature Review

The following literature review provides information supporting the development and implementation of this dissertation. The EHP and Dunn's Sensory Processing Framework are discussed as guiding theoretical models for this dissertation. Topics of healthy sleep, the history of sleep medicine, and the effects of decreased sleep in children are presented. This review also includes prominent sleep practitioners, etiology of sleep disturbances, and current treatments for insomnia of childhood. Sleep as an occupation and the importance of sleep within the occupational therapy profession are discussed. In conclusion, the current supporting literature exploring the relationship between sensory processing and insomnia of childhood is presented.

Theoretical Underpinnings

The history of sensory integration theory and the theory's connection to Dunn's Sensory Processing Framework and the EHP served as the theoretical underpinning for this dissertation. Sensory integration, the term used originally by Dr. Ayres, often is used interchangeably with sensory processing. However, these terms may be interpreted differently, and this difference will be discussed later in this review. In recent literature, sensory integration refers to the original theory and a form of therapy offered in the field of occupational therapy. Sensory processing is the term used when speaking about sensory input's neurological process rather than the theory (Miller et al., 2007). Throughout this dissertation, the term sensory processing is defined as the ability to react or regulate the body's reaction to sensory input in an appropriate matter (Mulligan, 2002).

Sensory Processing History

Sensory integration is a theory and model of practice within occupational therapy that developed out of the work of Dr. A. Jean Ayres (1972). Ayres' term of sensory integration was

introduced to the occupational therapy world in 1963 during an Eleanor Clarke Slagle Lecture (Ayres, 1963). Ayres, a neuropsychologist and occupational therapist, began her work studying children with learning disorders and published the first sensory integration theory concepts in 1972. Ayres' theory asserts that sensory processing influences the development of skills to meet environmental challenges. Individuals who present with sensory processing deficits may develop deficits of occupational performance (Ayres, 1972; Lane et al., 2019). Sensory integration theory posits that active involvement and interaction with the environment requires the ability to receive sensory input from the environment, organize it, and interact with the environment to produce an appropriate behavior (Bundy & Murray, 2002; Reynolds et al., 2017). The concept of sensory integration, the incorporation of senses from the environment, and a suitable response to this input are intimately involved in establishing readiness for sleep and sleep participation. It is important to consider all the physiological needs required for a healthy bedtime routine. Needs such as hydration (interoception), toileting (interoception), and bed comfort (tactile and proprioceptive) are vital for quality sleep in children. These physiological needs are often not being met and may result in insomnia of childhood (Stepanski & Wyatt, 2003).

Sensory integration encompasses the neurological process continuum for "organization of sensory information for use" within the profession of occupational therapy (Ayres & Robbins, 2005; Bodison, Duker, Cermak, & Blanche, 2019; Miller et al., 2007). Sensory integration has evolved since its inception. Sensory integration theory was initially used to explain children with mild or moderate learning difficulties, particularly those with poor motor coordination or sensory processing disorders (Bundy & Murray, 2002). Within the profession of occupational

therapy, sensory integration has evolved into the terminology used to refer to the sensory integration theory and an approach for clinical practice (Bodison et al., 2019).

Sensory integration and sensory processing are often interpreted differently in the literature (Bodison et al., 2019; Schaaf & Davies, 2010). In contrast to the theoretical-based terminology of sensory integration, sensory processing is the overarching neurological process of taking sensory input from the sensory receptors throughout the body, neurologically processing, and responding to them (Bodison et al., 2019; Foitzik & Brown, 2018; Dunn, 2001, 2007; Miller et al., 2014). Sensory processing is the individual's response to incoming sensory input (Bundy et al., 2002; Miller et al., 2007). These responses may come in many forms, such as attentional regulation or motor, behavioral, or emotional reactions (Miller et al., 2007). For this research, the researcher utilized the concept of sensory processing. Dr. Winnifred Dunn (2007), building on sensory integration's original concepts, proposed Dunn's Sensory Processing Framework. Dunn's framework is one of the first formal models describing the constructs of sensory processing. This model speaks to the relationship between the behavioral responses an individual may exhibit due to their sensitivity levels to the environmental stimuli (Dunn, 1997; Schaaf & Davies, 2010).

Dunn's Sensory Processing Framework

Dunn (1997, 2014) postulated a sensory processing framework that focuses on the interaction between two constructs: neurological threshold and self-regulation, which both exist on a continuum (see Figure 1). The neurological threshold is the amount of environmental input necessary to cause a chemical activation within the nervous system (Dunn, 2007). Dunn theorized individuals may vary between low or high neurological threshold. Only a small amount of input is required to trigger a neurological response for individuals with a low

neurological threshold. In contrast, for individuals with a high neurological threshold, more input is required to trigger the neural response (Dunn, 2007). The other interactive variable within Dunn's Sensory Processing Framework is self-regulation. Self-regulation is the response observed in the environment (Dunn, 2009). Self-regulation can take two forms, active or passive, in accommodating sensory input. Individuals who are in the active self-regulation range take an active role in controlling sensory input. These active individuals will either actively create stimulation or move away from sensory input depending upon their own needs. Persons in the passive range of the continuum will let sensory input from the environment occur and then react reflexively or passively (Dunn, 2009). These individuals will protest sensory input or ignore what is going on around them.

Dunn's Sensory Processing Framework describes four sensory patterns that create a matrix of the interaction between neurological threshold and self-regulation, as depicted in Figure 1. The four presentations are as follows: registration/bystander, sensation seeking, sensory sensitivity, and sensory avoiding. Individuals who fall within sensory seeking and low registration have a high-neurological threshold. Clients with low registration may demonstrate passive behavior toward environmental stimuli or, if actively responding, may seek sensory input in an attempt to satisfy the high-neurological threshold (Dunn, 1997; Engel-Yeger & Shochat, 2012). Individuals with symptoms consistent with sensory sensitivity and sensory avoiding have a low-neurological threshold. A person who is sensory sensitive recognizes the stimuli but responds passively toward non-preferred sensory input. Persons with a sensory avoiding presentation actively move away from non-preferred sensory input (Dunn, 1997; Engel-Yeger & Shochat, 2012).

It is critical to remember each of the constructs of this model (neurological threshold and self-regulation) depict an individual's performance within a continuum. This notion allows a person's behavior to be classified as a degree on the continuum and not only the extremes of high or low and active or passive. Dunn's CSP-2 was used to determine where individuals fall on these intersecting continuums for this dissertation (Dunn, 2014). Scores on the CSP-2-sensory responses are represented on a normal distribution bell curve (Dunn, 2014). Sensory response scores on the CSP-2 are converted to standard deviation scores representing the surveyed population. The normal distribution bell curve depicts scores from the population on the CSP-2. This bell curve is divided into five categories central to the mean. The category capturing the most substantial number of individuals (68% of the population or one standard deviation (SD) from either side of the mean [+/- 1 SD]) is *just like the majority of others*. Those who respond to sensory input more than their peers are either *more than others* (>+1 SD) or *much more than others* (>+2 SD). Individuals who react to sensory input less than their peers are either *less than others* (<-1 SD) or *much less than others* (<-2 SD). It is also imperative to remember the quadrants (Seeking, Avoiding, Sensitivity, and Registration) and individual sensory systems (e.g., auditory, visual, and movement) are measured on a continuum. An individual's quadrants and systems scores are scored independently of each other and could exist at any position on the continuum. However, the quadrant scores represent only the threshold and outward response; the sensory-system scores will help explore the individual's specific sensory experiences.

Dunn's Sensory Processing Framework examines individuals' sensory processing across the continuum from typical performance to atypical performance (Dunn, 2014). Children with atypical performance in sensory processing may have difficulty performing daily activities

because their adaptive skills are different from that of their peers (Bar-Shalita, Vatine, & Parush, 2008; Cohn, Miller, & Tickle-Degnen, 2000; Dunn, 1997; Hiranaka & Parham, 2018; Miller et al., 2014). The clinical terminology for altered sensory processing or ineffective regulation and organization of sensory input is atypical sensory modulation or sensory modulation disorder (Ayres, 1972; Bar-Shalita & Cermak, 2016; McIntosh, Miller, Shyu, & Hagerman, 1999).

McIntosh et al. (1999) were pioneers in validating the distinct clinical difference in behaviors between children with sensory modulation disorder and their typically developing peers. Research continues to authenticate findings of children who have sensory modulation disorder displaying a variety of behaviors and participation and enjoyment of functional activities much differently than their typically developing peers (Ayres, 1972; Bar-Shalita & Cermak, 2016; Bar-Shalita et al., 2008; Dunn, 1997; Schaaf, Miller, Seawell, & O'Keefe, 2003; Schoen, Miller, Brett-Green, & Nielsen, 2009). Altered sensory processing has a significant impact on participation and enjoyment across all life areas, including academics, leisure, and self-care (Bar-Shalita et al., 2008). These functional differences between children with a sensory processing disorder and their typically developing peers can often lead to depression or anxiety (Pfeiffer, Kinnealy, Reed, & Herzberg, 2005). The symptoms and daily actions of persons with a sensory processing disorder, specifically hyperactivity, may overlap with insufficient sleep (Owens, 2005). The fact that an overlap exists potentially indicates a relationship between sensory processing and sleep disorders in children (Owens, 2005). Occupational therapy practitioners have the knowledge to treat both insomnia and altered sensory processing; however, research linking the two variables is negligible. This dissertation will add to the knowledge of the association of sensory-based behaviors and sleep performance.

Dunn's Sensory Processing Framework of neurological threshold and client responses could guide evaluation, development of goals, and sleep disturbances intervention. A sensory-based perspective will help the therapist evaluate the client's habits and routines as they are completed within context, such as sleep environments, to determine supports and barriers for the occupation of sleep. Dunn's Sensory Processing Framework will also guide the occupational therapist to investigate the behaviors, habits, and routines that are noted around bedtime triggering the inability to settle and participate in sleep. This inability to sleep is the basis for a diagnosis of behavioral insomnia and could be related to maladaptive sensory behaviors. Using this sensory processing model will enhance the occupational therapy practitioner's role in developing sensory-based sleep protocols for each client based on their sensory processing behaviors.

Ecology of Human Performance

Dunn and colleagues developed the EHP in 1994. This model's primary focus is ecology, which is defined as the interaction between a person and the situations or contexts around them (Dunn et al., 1994). As shown in Figure 2, the EHP has four constructs that are interacting during a person's occupations: person, tasks, contexts, and the person-task-context transaction (Dunn et al., 1994). The person construct of EHP is composed of skills and capabilities which are unique to that individual. In this research, the person construct is a child who is demonstrating an inability to fall asleep or stay asleep. A child possesses skills and capabilities, including physical constructs (strength, endurance, decreased mobility or pain), cognitive, sensory-motor, or psychosocial (fear and anxiety) components that uniquely influence sleep preparation and sleep performance. The relationship between these unique personal factors and

sleep is difficult to assess (Dutt, Roduta-Roberts, & Brown, 2015). This dissertation focused on the personal construct of sensory processing and its effects on sleep performance.

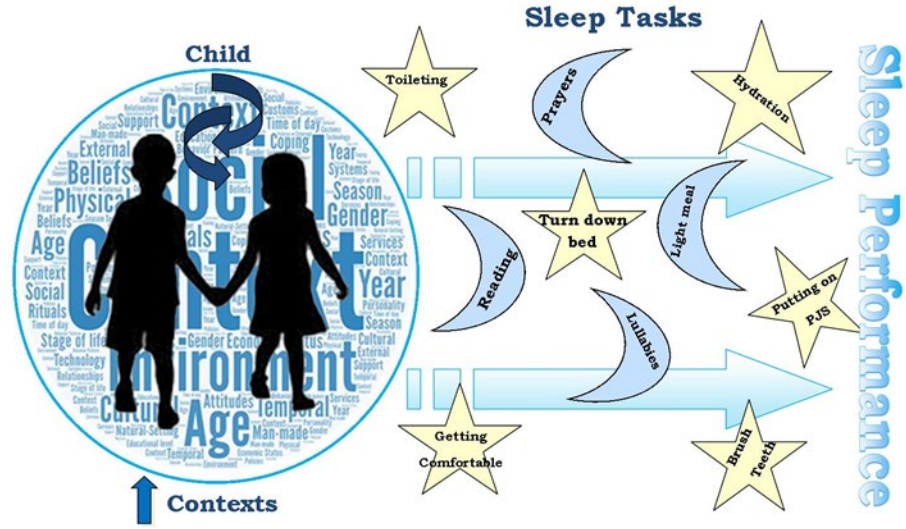

Figure 2. Ecology of human performance. Interaction of child, tasks, contexts, and person-task-context interaction as related to sleep performance. Adapted from Dunn, Brown, & McGuigan, 1994.

The second construct of the EHP model is the task. In this research, the task components are the tasks required to prepare for and participate in the occupation of sleeping. The current fourth edition of the OTPF details a description of the occupation of sleep and the tasks required to participate (AOTA, 2020). The tasks to prepare for and stay asleep vary from person to person but are individual to each person. Examples of common bedtime preparation tasks include grooming, confirming hydration, saying prayers, bedtime stories, or ensuring safety. The occupation of sleep participation is the ability to maintain sleep duration for the recommended time.

Context, the third construct of EHP, is referring to the environment in which a person participates in an occupation. Contexts are further divided to include physical, social, cultural, temporal contexts (Dunn et al., 1994). Physical context refers to the material items around the person. In the context of sleep, physical contexts could refer to the types of bed, alarm, pillow, temperature, and lighting required for sleep. Sleep is a socially and culturally driven occupation (Crabtree et al., 2005). Social and cultural contexts refer to the family's traditions or standards, such as the expectation of specific bedtime, pillow type, or a bedtime preparatory ritual, e.g., lullabies, reading, or prayers. One of the most critical aspects of sleep, developed from the parents and essential for adequate sensory processing, is the ability to self-regulate, self-settle, and calm without parental intervention for sleep (Sadeh & Anders, 1993). Evidence shows cultural aspects such as familial dynamics, structure, and stressors, along with parent's personality, employment, and education, have a substantial effect on sleep patterns and behaviors of children (Blair et al., 2012; Chen et al., 2014; Giannotti & Cortesi, 2009; McDonald, Wardle, Llewellyn, van Jaarsveld, & Fisher, 2014; Owens, 2004). The last context is the temporal context. The temporal context refers to a person's phase of life. Temporal contexts may mean chronological age, a particular phase such as a toddler or school-aged child, or the phase on the disorder or disability continuum.

Within this research project, the temporal aspect of the phase of life was similar for all the participants. The participants belonged to either the preschool age or school-age temporal context and were between the ages of 3 and 10. This age group was selected based upon similar daily schedules, demands, and sleep times. Children typically enrolled in school or preschool will have a similar wake and sleep times. Preschool-aged children generally add a nap time during the day or 1 hour more at night, resulting in between 9 and 13 hours across both age

groups (Hirshkowitz et al., 2015; Weissbluth, 1995). Individuals respond to contextual components and sensory components uniquely. The individual's (child's) response was measured using the CSHQ and the CSP-2.

The person's behaviors and actions are influenced by the interaction between the skills of the person and the environment, or ecology (Dunn et al., 2016). All the components to EHP are inseparable and interdependent (Dunn et al., 1994). The EHP model depicts sleep performance as a collection of tasks, including the occupation of sleep, a person's skills, and the contexts in which they exist. The CSHQ and CSP-2 evaluate components that represent contextual, personal, and task-based factors and help delineate sensory-based needs, within context and the personal skills of a child with insomnia of childhood in this study. The EHP model provides structure to view a pediatric client, their contexts, and their current sleeping concerns.

Importance of Healthy Sleep

Healthy sleep in children is crucial as it has many daily implications. Quality of life, academic success, healthy development, overall health, and safety in children are reliant on healthy sleep (Brand & Kirov, 2011; Chaput et al., 2016, 2017). Healthy sleep is defined as age-appropriate sleep duration, enhanced by a standard sleep schedule, and adequate sleep quality (Belmon, van Stralen, Busch, Hamsen, & Chinapaw, 2019; Buysse, 2014; Harvey, Stinson, Whitaker, Moskovitz, & Virk, 2008; Hirshkowitz et al., 2015; Ohayon et al., 2017). Healthy sleep is imperative for children of all ages, but 20% to 40% of children are not receiving enough healthy sleep as determined by national recommendations (Galland et al., 2012; Meltzer et al., 2010; Mindell et al., 2009; Owens & Mindell, 2011; Sadeh et al., 2011). This reduction of sleep duration may lead to psychosocial symptoms such as depression, anxiety, and inattention

(Amschler & McKenzie, 2005; Brand & Kirov, 2011; Calhoun et al., 2011; Canet, 2010; Willis & Gregory, 2015).

Sleep is a required occupation for all humans to function in daily occupations. Similar to the concept of occupation, sleep is both an intervention and an end goal when discussed in occupational therapy. Assessment and treatment of sleep are the foundational components to increase the occupational performance of a client (Fung et al., 2013). According to the authors of the OTPF-4, sleep preparation, sleep participation, and rest are all divisions of the occupation of sleep (AOTA, 2020). Sleep preparations are the activities involved in getting ready for sleep, including grooming, dressing/undressing, bathing, spiritual rituals, and determining an appropriate schedule. Sleep preparation includes the management of physical and personal contexts to ensure a preferred sleeping environment. This management could include ensuring proper sensory accommodation (e.g., going to the restroom, turning off lights, or using a white noise maker) and safety concerns (e.g., checking for monsters under the bed or locking the entry doors) have been addressed. According to the OTPF-4, rest includes quieting the body and mind to participate in a calming period. An essential component of the occupation of sleep for children is recognizing the need to rest and restore to participate in more wake time occupations.

Sleep Duration

One of the keys to healthy sleep is an appropriate sleep duration. The most significant determinant of sleep duration is age (Green & Brown, 2015). Establishing a healthy sleep duration in children starts with an age-appropriate sleep routine. Caregivers often establish a sleep routine for children, and caregivers need to be aware of each age's recommended sleep durations (Franklin, Smith-Windsor, & Brown, 2008). Establishing a consistent routine with a regular bedtime and wake time is one of the first and most successful sleep recommendations to

address poor sleep patterns in children (Mindell et al., 2009). Determining sleep duration for a child's age is difficult as children transition from sleep duration of up to 17 hours in a 24-hour day for newborns to 13 hours in a 24-hour day when the children are preschool-aged include nap times (Hirshkowitz et al., 2015). Recommended sleep duration continues a downward trend to nine hours of sleep per 24-hour day for adults (Hirshkowitz et al., 2015). For children ages 3 to 10, the current research sample, the recommended sleep duration varies between 9 hours to 13 hours, including naps, with the longer sleep times of 10-13 hours of sleep recommended for preschool-aged children (Hirshkowitz et al., 2015). Table 1, as shown on Page 5, shows a comprehensive chart of recommended sleep periods for birth to age 25, inclusive of naps (Hirshkowitz et al., 2015).

Sleep Quality

Sleep quality is another component of healthy sleep. Being in bed for the recommended duration does not ensure proper sleep quality. Authors who write about sleep quality agree the best predictors of quality sleep are waking refreshed and being alert for the day's activities (Fallone, Owens, & Deane, 2002; Harvey et al., 2008; Moore & Meltzer, 2008). Additional subjective sleep quality descriptors include ease of waking, clear cognition throughout the day, and enhanced mood or attitude (Argyropoulos et al., 2003; Ellis et al., 1981; Webb, Bonnet, & White, 1976). These healthy sleep indicators are valid across the lifespan but have a distinct impact on children who are in the process of development (Chaput et al., 2016; Crabtree & Williams, 2009; Touchette, Petit, Tremblay, & Montplaisir, 2009).

Effects of Decreased Sleep in Children

Sleep deficiency is one of the most reversible and curable public health issues in the pediatric population (Owens & Adolescent Sleep Working Group, 2014). Sleep dominates the

24-hour day as an occupation of children until around the age of 5 and continues to be a crucial occupation into adulthood (Matricciani et al., 2013; Paruthi et al., 2016). A substantial decline in sleep duration of children over the past 40 years is documented in literature across the world; up to .75 minutes less per night per year for the past 100 years (Dollman et al., 2007; Iglowstein, Jenni, Molinari, & Largo, 2003; Matricciani et al., 2012; National Sleep Foundation, 2014; Thorleifsdottir, Björnsson, Benediktsdottir, Gislason, & Kristbjarnarson, 2002). This decline in sleep duration in children has an immediate and lasting effect on children.

Reduced sleep duration has been reported in the literature to have an impact on many mental abilities of children, including emotional functioning, memory, attention, and overall cognitive performance (Paavonen et al., 2010; Sadeh, Gruber, & Raviv, 2002; Steenari et al., 2003; Vriend et al., 2013; Wolfson & Carskadon, 1998). Sadeh et al. (2002) found that children with fragmented sleep struggled more with difficult neurobehavioral tasks. These researchers also found the children with fragmented sleep demonstrated greater behavioral problems based on the parental report (Sadeh et al., 2002). Gruber et al. (2009) correlated mental attention with sleep duration, $F(1, 35) = 4.32$, $p < .05$, finding shorter sleep times increase deficits in attention.

This impaired cognitive functioning could lead to poor school performance, which is linked, within the literature, to poor sleep habits (Touchette et al., 2007; Wolfson & Carskadon, 1998). Wolfson and Carskadon (1998) completed a correlational study relating sleep duration (earlier school start times) with academic performance; students with longer sleep tended to have higher grades, $F(9, 6571) = 8.91$, $p > .001$. Lack of sleep in children may also lead to impaired motor functions, obesity, and weak immune system performance (Chaput & Dutil, 2016; Kuriyama, Stickgold, & Walker, 2004; Sekine, Chandola, Martikainen, Marmot, & Kagamimori, 2006). Inadequate sleep as a child is associated with future implications such as suicidal behavior

and drug and alcohol usage (Liu, 2004; Wong, Brower, Fitzgerald, & Zucker, 2004). An estimated 20% to 40% of the pediatric population in the United States demonstrates deficits in sleep (Gruber et al., 2017; Mindell et al., 2009; Vriend & Corkum, 2011). Sleep professionals, including occupational therapy practitioners, need to address sleep in early childhood to potentially decrease the adverse effects of decreased sleep duration on school-related tasks and daily occupations.

Sleep Medicine History

The phenomenon of sleep has been fascinating for centuries, with writings present in ancient Greece, Egypt, and religious texts (Hobson, 1989; Kirsch, 2011). The formal study of sleep medicine has a history of about 70 years, being boosted with the discovery of rapid eye movement (REM) sleep in 1953 (Aserinsky & Kleitman, 1953; Shepard et al., 2005). Before the 1800s, many theories were proposed around the phenomenon of sleep, but overwhelmingly, the belief was sleep was a passive state between wakefulness and death (MacNish, 1834). In the late 1800s and early 1900s, scientists began discovering the brain's electrical activity in animals and humans (Berger, 1930, 1969; Carskadon & Dement, 2005). These discoveries challenged the concept of sleep as a passive process (see Figure 3).

The discovery of non-rapid eye movement (NREM) in 1973 and the existing knowledge of REM from 1953 solidified the idea of sleep being active (Dement & Kleitman, 1957). This discovery offered an active perspective of sleep and lead Dement and Kleitman (1957) to propose a five-stage sleep cycle, which continues to be used in sleep medicine today. Since the 1950s, the literature in the field has increased, which propelled sleep medicine into today's formal medical specialization (Shepard et al., 2005). Research evidence has indicated that sleep disorders are common in today's society (Shepard et al., 2005). The increased prevalence and

need for the more scientific study of the disorders led to the development of specific sleep centers. The first sleep center was established at Stanford University in 1964, and today more than 1200 accredited sleep centers exist (Bailey & Attasanio, 2012; Ievers-Landis & Kuhn, 2012; Shepard et al., 2005). Soon after the AASM's 1978 founding, accreditation of sleep centers and sleep medicine practitioners occurred, followed by the founding of peer-reviewed journals dedicated explicitly to sleep (Shepard et al., 2005).

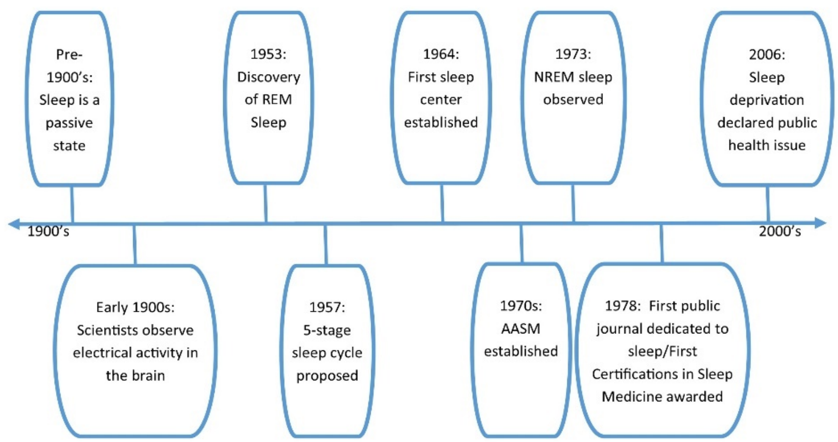

Figure 3. Brief timeline of sleep medicine. This figure illustrates a brief timeline of significant events in sleep medicine history.

The formalization of sleep medicine drew interest from various medical professionals seeking sleep professional status (American Board of Sleep Medicine, 2019). Prominent medical professionals with specialization in dental, psychiatry, neurology, pulmonology, pediatrics, and research were interested in becoming specialized (Shepard et al., 2005). Psychology was later to the scene but has made a recent and significant effect in the field of sleep medicine (Meltzer, Phillips, & Mindell, 2009). The development of the American Board of Sleep Medicine (2019)

and the Board of Behavioral Sleep Medicine (2019) were instrumental in the certification of sleep professionals.

Sleep medicine is one of the most inter-professional disciplines of all the medical professions, but occupational therapy is missing from any literature on certification (Green, 2008; Smith, 2014). Although occupational therapy has a history involving sleep and rest since its founding in 1917, occupational therapy currently has a minimal presence in the area of sleep medicine practice.

Insomnia of Childhood

Insomnia is one of the most limited topics researched in the neurosciences despite the prevalence of up to 40% of children with sleep deficits (Dement, 1986; Doghramji, 2006). Authors in medical and psychological journals lack the consistency of an operational definition for the term insomnia, which makes it difficult to assess the rigor of study findings (Doghramji, 2006; Drake, Roehrs, & Roth, 2003; Morin, LeBlanc, Daley, Gregoire, & Merette, 2006; Roth, 2007; Vriend & Corkum, 2011). Three different entities in the medical and psychological world have created formal definitions for insomnia: the Diagnostic and Statistical Manual of Mental Disorders, the ICSD, and the International Statistical Classification of Diseases and Related Health Problems developed by the World Health Organization (AASM, 2014; American Psychiatric Association, 2013; Drake et al., 2003; World Health Organization, 1992). The definitions vary slightly but have an underlying theme of lack of sleep duration as the primary reason for the diagnosis, regardless of the etiology. The ICSD, in its newest publication, decided to combine the former sub-types of insomnia (limit setting, sleep onset, and combined types) under one global diagnosis of insomnia of childhood. This decision of the ICSD-3 to identify insomnia globally rather than divided based on etiology has been met with hesitancy from sleep

clinicians due to the differences in treatment for each type (Meltzer, 2010). For this dissertation, insomnia will be defined as insufficient sleep duration due to difficulty going to sleep, staying asleep, or waking early from being asleep (AASM, 2014).

Reasons for Lack of Diagnosis

Children with insomnia or other sleep disorders are often underdiagnosed (Blunden et al., 2004). This lack of a diagnosis may be the lack of sleep education of the physician leading to decreased attention, evaluation, and documentation of sleep concerns; additionally, parental knowledge of sleep may be a factor. A sleep disruption must be recognized by the parent and reported to a medical professional to receive treatment. The parents may not have the education to know the difference between healthy sleep and a sleep deficit, so the onus is often placed upon the physician to ask pertinent questions (Blunden et al., 2004; Honaker & Meltzer, 2016; Robinson & Richdale, 2004; Smedje, Broman, & Hetta, 1999; Stein et al., 2001). Most parents only view children's sleep as disturbed if it is different from their sleep, which is problematic as children have different needs in total sleep time based on age (Strocker & Shapiro, 2007). Although the prevalence of insomnia symptoms of children is well documented in the literature, many pediatric sleep-based questions are not present or minimal on well-health screenings given by pediatricians (Blunden et al., 2004; Chervin, Archbold, Panahi, & Pituch, 2001; Meltzer et al., 2010; Owens, 2001; Smedje et al., 1999). The importance of sleep on development and daily occupations may not be fully understood by the parent and puts the onus of responsibility on the physician (Meltzer et al., 2010; Owens, 2001).

Physicians are grossly unaware of documented health-related consequences that occur due to lack of sleep, as evidenced by dismissal of or lack of documentation of parental reported concerns of sleep disruption by the physician (Honaker & Meltzer, 2016; Meissner et al., 1998;

Owens, 2001). Chervin et al. (2001) found less than 15% of children with a parental sleep complaint were addressed in the medical record. This dismissal of the importance of sleep may or may not be intended. Authors have reported that sleep medicine training offerings are minimal in the general medical curriculum unless seeking secondary certification (Blunden et al., 2004; Davis, Parker, & Montgomery, 2004; Owens, 2001). On average, pediatricians get only 4.8 hours of training in sleep (Mindell, Moline, Zendel, Brown, & Fry, 1994). Medical students in psychiatry programs receive about 3 hours of total teaching time about sleep (Mindell et al., 1994). A physician may only receive sleep certification after they complete primary medical education in another area. According to the Accreditation Council for Graduate Medical Education (2012), only those with primary medical training in family medicine, internal medicine, neurology, otolaryngology, pediatrics, psychiatry, and pulmonology may apply for a sleep fellowship. Education across multiple disciplines benefits the client, but unfortunately, the multidisciplinary providers are not generally in the same clinic.

Wiggs (2003) spoke about the need for a multi-disciplinary approach to pediatric sleep disorders to match the standard in other chronic diseases. The current medicine trend is to encourage a multidisciplinary approach pulling from a spectrum of expertise to address chronic illness (Choi & Pak, 2006; Shelgikar et al., 2014). Sleep disorders could benefit from a multidisciplinary approach as the causes of sleep disorders can stem from multiple sources as neurological, psychological, or physical aspects (Owens, 2019). Sleep is included in the OTPF, and occupational therapy practitioners would be a valued member of a multi-disciplinary sleep team (Green, 2008).

Etiology and Models of Treatment for Insomnia

Etiology. The causes of insomnia are abundant and highly debated in the literature (Roth, 2007; Saddichha, 2010). The primary reason for this fluidity reflects the inconsistent definition of insomnia used during the research (Arroll et al., 2012; Drake et al., 2003). One of the primary debates among authors is the importance of determining if insomnia is a primary or secondary complaint: primary meaning the immediate reason for the client reporting to a professional or secondary meaning the insomnia is the result of another medical condition (Drake et al., 2003; Monti, 2004). The stimulus control model, 3-Factor Model, and neurocognitive model are primary theories when addressing insomnia, regardless of being considered primary or secondary.

The stimulus control model. The stimulus control model is a psychological model discussing the importance of keeping the bedroom strictly for sleep (Bootzin & Nicassio, 1978). According to the stimulus control model, children with insomnia spend a significant amount of time in bed doing things other than sleep causing the brain to associate the bed with non-sleep occupations rather than sleep (Perlis, Gehrman, & Ellis, 2011). The daytime occupations enjoyed in bed are often reading, homework, playing, or on electronics. The brain becomes confused about what is taking place in the bedroom setting and releases neurotransmitters to keep one awake (Bootzin & Nicassio, 1978). The stimulus model was used until the 1990s as a primary avenue to treat insomnia by removing all non-sleep activities from the bed/bedroom (Morin, Culbert, & Schwartz, 1994).

3-factor model. The 3-factor model, also known as the 3P model, Spielman Model, or behavioral model of insomnia, was one of the first widely accepted models of insomnia (Perlis, Shaw, Cano, & Espie, 2011; Spielman, Caruso, & Glovinsky, 1987). The underlying theory

behind the 3P model was first developed by Rechtschaffen (1968) and stated many individuals with insomnia are light sleepers and become aroused quickly with external stimuli. This 3P model expanded upon Rechtschaffen's theory to consist of three factors causing insomnia: predisposing, precipitating, and perpetuating (Perlis, Shaw, et al., 2011). Predisposing factors are related to the person's biological traits, e.g., characteristics attributed to features of hyperarousal, a tendency to worry, or poor sleep schedules (Perlis, Shaw, et al., 2011). Precipitating factors are internal instigators causing a sleep disturbance such as anything causing stress to the person and medical or psychological disorders (Perlis, Shaw, et al., 2011). Perpetuating factors are behaviorally adopted by the person (Perlis, Shaw, et al., 2011). These factors typically center on actions such as trying to make up sleep by going to bed early, napping, or waking later. The practice of making up sleep causes dysregulation of the body's ability to regulate the sleep-wake cycle (Perlis, Shaw, et al., 2011). The 3P model led to the clinical treatment of sleep restriction, which attempts to eliminate prolonged nightly awakenings. Sleep restriction is discussed in the treatment section of this chapter.

Neurocognitive model. The neurocognitive model, developed in 1997, is an extension of the 3P or Speilman model (Bootzin & Nicassio, 1978; Perlis, Giles, Mendelson, Bootzin, & Wyatt, 1997; Perlis, Shaw, et al., 2011; Speilman et al., 1987). This model proposes that increased cortical arousal is the primary cause of insomnia: there is an increased amount of sensory information processing at sleep onset or during NREM sleep (Perlis, Shaw, et al., 2011). This increased processing may cause a startle or orienting response of the individual.

The neurocognitive model aligns with the findings of several of the sensory-based studies involving sensory behavior and symptoms of insomnia. The neurocognitive model's premise is that arousal occurs secondary to increased sensory information processing while trying to fall

asleep or during the light sleep of NREM sleep. Several studies validate the neurocognitive theory by comparing the cortical arousal level of those with insomnia versus good sleepers. Those studies point to increased cortical arousal, indicating increased sensory processing in those with insomnia around sleep onset and NREM sleep compared to typical sleepers (Lamarche & Ogilvie, 1997; Perlis, Smith, Andrews, Orff, & Giles, 2001). Also, occupational therapy-based studies looking at sensory arousal and accommodation levels of children and adults found sensory sensitivity in areas of movement, vision, auditory and tactile correlate with insomnia symptoms (Engel-Yeger & Shochat, 2012; Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014). Even though research has found correlations between sensory processing and insomnia, sleep medicine professionals may not assess these variables. Exploring these correlations between sensory arousal and insomnia symptoms will help occupational therapy practitioners' engagement with sleep medicine practitioners using mutual terminology.

Expansion of neurocognitive models. New researcher groups have further developed and expanded upon the neurocognitive models (Espie, Broomfield, MacMahon, Macphee, & Taylor, 2006; Harvey, 2002). These models developed out of research on anxiety disorders. Harvey's (2002) model suggests individuals with insomnia have higher levels of worry or anxiety around their sleep as well as daytime consequences due to lack of sleep (Perlis, Shaw, et al., 2011). Espie et al. (2006) developed another cognitive model (attention-intention-effort pathway), which differs from the Harvey model. In this model, there is a failure to inhibit wakefulness, which leads to hypersensitive behaviors, e.g., increased attention and perception preventing the person from falling asleep (Perlis, Shaw, et al., 2011). It appears that the neurocognitive theories and Dunn's Framework similarly discuss the same phenomenon of hypersensitivity in discussing sleep, but the two professions have been investigating in a parallel

manner. This study may bring the two scientific discussions together to develop mutual conversations and common practice strategies.

Current Treatments

Several treatment options are available for insomnia, including medications, behavioral approaches, and alternative therapies (Morin et al., 2006). Over-the-counter and prescription medications were conventional treatments used by pediatricians and general practitioners for children with insomnia, followed by psychological or behavioral treatments (Owens, 2001; Owens, Rosen, & Mindell, 2003). Studies have shown behavioral approaches are the least invasive, and often effects are longer lasting than medications (Mitchell, Gehrman, Perlis, & Umscheid, 2012). A comprehensive approach considering the least invasive to most invasive methods should be considered in treating childhood insomnia (Felt & Chervin, 2014; Owens et al., 2005). Non-invasive occupational therapy treatment using sensory-based models focusing on the person and their contexts related to sleep will enhance sleep performance in children.

Pharmacological treatment. Pharmacological treatment involves medications prescribed by a physician or over the counter. In 2015, there were no U.S. Food and Drug Administration-approved medications to address sleep concerns in children (Bruni & Angriman, 2015). At the time of this research, there is no evidence any medications have been approved for pediatric clients. However, one study found 80% of children presented to physicians with sleep difficulties were prescribed medications (Stojanovski, Rasu, Balkrishnan, & Nahata, 2007). Typically prescribed pharmacological treatment for insomnia involves two branches of hypnotic drugs: benzodiazepine hypnotics or non-benzodiazepine hypnotics. These drugs have been used to treat insomnia since the 1960s (Drake et al., 2003). Both drug classes cause significant side effects such as cognitive or functional impairment the following day (Petit, Azad, Byszewski,

Sarazan, & Power, 2003). Furthermore, in general, the effectiveness of benzodiazepine receptor drugs lacks substantial evidence over a long period (Holbrook, Crowther, Lotter, Cheng, & King, 2000; National Institutes of Health, 2005; Petit et al., 2003).

Another classification of drugs prescribed for insomnia is antihistamines. This class of drugs cause drowsiness and are recommended for brief treatments for children (Younus & Labellarte, 2002). Many short-term and long-term consequences have been found with antihistamine therapy. The most common side effect is impaired consciousness, and lesser found side effects include anxiety, dry mouth, constipation, and mild confusion (Bruni, Angriman, et al., 2018). Another effect of antihistamines is tolerance can be developed very quickly, slowing the effects and requiring more intervention (Gringras, 2008). These drugs are not indicated or approved by the U.S. Food and Drug Administration for children unless other sleep interventions have been attempted prior (Mindell, Emslie, et al., 2006; Owens, 2019).

Behavioral/behavioral cognitive treatments. Cognitive-behavioral treatment for insomnia (CBT-I) is the number one suggested and most researched topic in treating insomnia in children (Owens et al., 2003; Petit et al., 2003). These types of treatment were introduced in the 1970s and are increasingly becoming one of the first lines of defense in behavioral insomnia (Drake et al., 2003; Vriend & Corkum, 2011). CBT-I consists of several different psychological and educational strategies to develop positive associations with sleep, appropriate sleep routines, and introduce relaxation skills (Reid, Huntley, & Lewin, 2009). In a systematic review of just over 50 studies, 94% of the studies stated CBT-I produced effective and reliable results with bedtime refusals and night wakings in young children (Mindell, Kuhn, et al., 2006; Owens, 2019). The positive benefits of CBT-I are that none of the studies reported adverse effects to CBT-I and that behavioral intervention increases secondary outcomes such as the daily

functioning of the child (Mindell, Kuhn, et al., 2006; Morgenthaler et al., 2006). Specific techniques within cognitive behavioral therapy for insomnia include the following:

- *Stimulus control therapy*- This therapy is used to establish a conditioned response to the bed and bedroom environment for sleep based on the stimulus control theory of insomnia. This method is used if the person has established an association between wake time activities (TV, reading, homework, play) and the bed or bedroom. This control therapy method would ask the client only to do sleep and sleep hygiene activities on or near the bed (Bootzin & Nicassio, 1978). This method establishes a response that the bed is used for sleep and only sleep (Morin et al., 1994; Murtagh & Greenwood, 1995). Researchers in one study found that 54% of participants achieved a reduction in insomnia symptoms using stimulus control (Morin et al., 2006).
- *Sleep restriction therapy*- Sleep restriction therapy involves restricting or consolidating the time in bed both during the day and at night (Glovinsky & Spielman, 1991; Miller et al., 2014; Spielman & Glovinsky, 2010). The purpose is to make the time spent in bed more beneficial and decrease the middle-of-the-night awakening. This therapy begins with the person in bed the current amount of time they sleep while keeping a consistent wake time, spending a minimum of five hours in bed. Matching the time asleep to the time in bed is a cognitive strategy to associate the bed with sleep, while the consistent wake time encourages the body to stay asleep for a typical time. Then, sleep restriction therapy involves slowly (weekly) lengthening the time in bed until an age-appropriate recommended sleep duration is achieved while keeping night wakings

at a minimum (Miller et al., 2014). Miller et al. (2014) reported on the efficacy of sleep restriction therapy and found that it could be used as a single component treatment as well as a multicomponent treatment (Miller et al., 2014)

- *Sleep hygiene*- Sleep hygiene therapy is essential to establish for almost all children of any age and include environmental and routine based strategies. Sleep hygiene is the ability to create an environment that promotes sleep and using healthy sleep habits. The sleep environment aspect speaks to the physical environment. The bedroom should be dark, cool, quiet, and void of electronics (Galland et al., 2012; Owens et al., 1999; Vriend & Corkum, 2011). The room should not be used for anything but sleep. Punishment should never occur in the bedroom because this action could associate a negative feeling with the bedroom (Davis et al., 2004). The second component of sleep hygiene is developing a routine. Routines involve the time leading up to bed. For children, it often includes bathing, dressing, oral hygiene, reading, praying, or journaling. This routine could start earlier in the day with fluid restriction, caffeine restriction, or eliminating electronic devices some time before bed (Corkum & Vriend, 2011; Davis et al., 2004).
- *Faded bedtimes*- Similar to extinction, faded bedtime moves the bedtime to a time when the child will fall asleep within 15-20 minutes, but the wake time remains the same (Moore, Meltzer, & Mindell, 2007). The bedtime is then moved slowly earlier to an appropriate bedtime, increasing sleep duration while maintaining the same wake time. This method was useful in establishing a proper bedtime and reducing tantrums in preschool children (Cooney, Short, & Gradisar, 2018). A

reduction of parental reports of insomnia symptoms from 100% pretreatment to 62% posttreatment. Also, sleep onset latency decreased from 23.2 minutes before treatment to 13 minutes after treatment. This form of CBT-I is mostly used with the pediatric population.

- *Extinction*-This form of therapy involves the parents helping the child find a way to self-soothe rather than require parental intervention (Tikotzky & Sadeh, 2010). Extinction has been proved efficacious for younger children (Reid, Walter, & O'Leary, 1999; Rickert & Johnson, 1988). This method is sometimes difficult for parents as it requires the parents to ignore the child's attempts to receive attention (Kuhn & Elliott, 2003; Reid et al., 1999). This method of CBT-I is also used mostly with the pediatric population.
- *Other areas of CBT-I include treatment for nighttime fears or anxiety.* This therapy could involve more alternative therapies such as relaxation, guided breathing, guided imagery, or desensitization (Gordon, King, Gullone, Muris, & Ollendick, 2007). A meta-analysis reviewing 29 studies concluded that alternative methods were promising in reducing insomnia symptoms when dealing with childhood fears (Gordon et al., 2007).

Sleep in Occupational Therapy

Sleep is an occupation in which all humans, at all ages, must participate (AOTA, 2014; Green, 2008). Sleep influences all other wake time occupations' performance, and in turn, occupations during wake times affect one's sleep (Green, 2008). According to Picard (2017), sleep is essential for the homeostatic balance necessary for participation and occupational performance. This cyclical relationship between sleep and wake occupations and how each

affects the other makes sleep a significant concern for occupational therapists. Although children and parents can help with sleep preparation, sleep is the only occupation in the occupational therapy framework that cannot be completed with help from others or by alternate means (Koketsu, 2017). The National Academy of Medicine, formerly known as the Institute of Medicine (2006), declared sleep deprivation a public health issue for all ages leading to an increased risk for chronic diseases if not corrected. Altevogt and Colten (2006) reported billions of dollars a year are expended on medical costs related to sleep disorders. This statement does not account for all the secondary costs that contributed to the lack of sleep. Occupational therapists, working toward a balanced life, need to recognize the importance of sleep as an occupation.

Regarding the history of sleep in occupational therapy, Corlateanu, Covantev, Botnaru, Sircu, and Nenna (2017) stated, “Sleep is that golden chain that ties health and our bodies together” (p. 137). Ann Wilcock (2007) stated that occupational therapy practitioners work toward a foundation of health, as it is tied to occupation; therefore, sleep should be a foundational concern for occupational therapy practice. Occupational therapy is a vast and encompassing profession focusing on the human need to participate in life (Meyer, 1922). As a daily necessity, sleep is integral to occupational performance, and deficits in either sleep or occupation could alternatively disrupt the other (Green, 2008). The study of sleep is now on occupational therapy researchers’ radar with preliminary and exploratory studies published in professional journals.

Adolf Meyer (1922, 1977), an early pioneer in the field of occupational therapy, discussed the importance of a balanced life with the inclusion of work, play, rest, and sleep (Meyer, 1922; O’Brien et al., 2012; Pendleton & Schultz-Krohn, 2013). For most of the years

between the 1920s and 2000s, sleep was neglected from practice and research in occupational therapy (Koketsu, 2017), as shown in Figure 4. Green (2008) reported that the critical lack of discussion about sleep as an occupation in the occupational science and occupational therapy disciplines may have come from merely a lack of interest or focus for theorists, researchers, and professional leaders. Another reason for the lack of focus may have been the debate as to whether sleep was considered an occupation. Gray (1997) and Yerxa (2000) defined occupation as a meaningful and intentional pattern of actions. When compared to this definition, sleep may not qualify as an occupation as the act of sleeping is void of physical action. Because of this contradiction, occupational therapy practitioners, researchers, and theorists within the occupational therapy profession have debated the inclusion of sleep as an occupation over time. This passive definition of sleep varies differently from the active sleep definition growing within sleep medicine specialization.

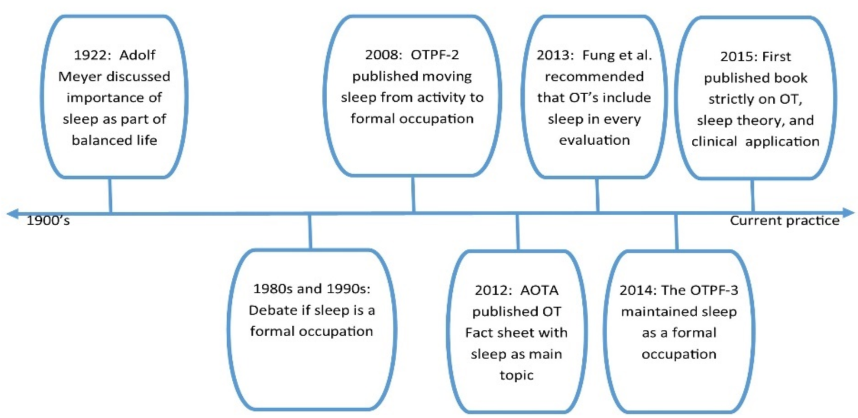

Figure 4. Brief timeline of sleep in occupational therapy. Timeline of the sleep discussion with the field of occupational therapy.

Howell and Pierce (2000) proposed the central reason sleep is neglected in the current occupational therapy professional research is the overall societal outlook in which time spent sleeping is viewed as non-productive. These authors further explained the neglect of sleep as a cultural phenomenon as western societies adopted a Protestant work ethic viewing idle time, including sleep, as wasted. Today's research has shown sleep to be a very active and productive state. The idea of sleep involving an active neurological process in the disciplines of medicine and psychology occurred in the 1950s with the discovery of REM (Kumar, 2010). Unfortunately, occupational therapy researchers were debating the nature of sleep as an occupation in the 1990s.

Sleep is part of occupational therapy's history, but sleep faded into the background with daytime occupations taking the forefront due to changes in the profession. The AOTA's (2008) OTPF classified sleep as an occupation rather than an activity of daily living. This move increased acceptance of sleep into mainstream occupational therapy practice (Koketsu, 2017). The status of sleep as an occupation was upheld in the AOTA's third edition of the OTPF. The AOTA (2015) published an Occupational Therapy Fact Sheet with Occupational Therapist's Role in Sleep as the main topic; this fact sheet was updated again in 2017 (Picard, 2017). Since 2008, a resurgence of research, evaluation, and treatment of sleep has occurred in occupational therapy across all age groups. Currently, sleep is seen as a vital occupation because of its impact on all other occupations (Green, 2008). Exploring the history, contexts, and recent sleep research is only the first step toward holistic treatment in the profession of occupational therapy.

Andrew Green, an occupational therapist, is a pioneer in the revival of occupational therapy sleep intervention and has co-edited a book for multiple disciplines on their roles in sleep (Steger, Green, & Westcombe, 2012). This book covers sleep-related theory and clinical

applications for occupational therapists, the first of its kind (Green & Brown, 2015). Before 2015, sleep had limited focus in the occupational therapy texts. This groundbreaking publication was a crucial step in the movement of sleep to an increased emphasis of sleep within the profession. This increased focus has led professionals and researchers in occupational therapy to publish more research on sleep in professional journals.

Sleep Research in Occupational Therapy

In addition to AOTA's embrace of sleep, occupational therapy researchers from around the world are investigating the occupation of sleep. Fung et al. (2013) published a keystone piece recommending the inclusion of sleep in every occupational therapy evaluation. Multiple authors, occupational therapy practitioners, and other professions are discussing specific diagnoses including apnea, insomnia, physical disabilities, sensory processing disorders, autism spectrum disorders, and Alzheimer's as they relate to sleep performance (Devnani & Hegde, 2015; Leland, Marcione, Niemiec, Kelkar, & Fogelberg, 2014; Peter-Derex, Yammine, Bastuji, & Croisile, 2015; Reynolds & Malow, 2011; Wright, Tancredi, Yundt, & Larin, 2006). Another trend in sleep research is studying contextual influences on sleep, such as sleep in the military, long-term care facilities, or societal changes or expectations effects on sleep (Carskadon, 2004; Martin & Ancoli-Israel, 2008; Miller, Matsangas, & Kenney, 2012; Mitler, Dement, & Dinges, 2000; Peterson, Goodie, Satterfield, & Brim, 2008; Troxel et al., 2015). The societal studies emphasize the impact of shift work, longer work expectations, the abundant usage of electronics, diet changes, and other lifestyle changes (Carskadon, 2004; Luckhaupt, Tak, & Calvert, 2010). As Green (2008) pointed out in his article, most research at the time related to sleep was related to a particular diagnosis, such as autism spectrum, apnea, or shift workers, but was not generalizable to anyone with insomnia as a primary diagnosis. This is important because insomnia was still not

being addressed directly as an occupation but as a co-morbidity to other medical diagnoses. For this reason, this dissertation explored typical developing children with parental reports of sleeping difficulty.

Occupational Therapy Research in Sleep and Sensory Processing

A literature search was conducted to determine the current evidence published combining the terms of sensory processing, sensory modulation topics, and pediatric insomnia. Predominately, the literature that was found discussed results relating behavioral insomnia to a specific diagnosis (e.g., Attention Deficit Hyperactivity Disorder, autism spectrum disorders, fetal alcohol syndrome, and mood disorders) rather than discussing behavioral insomnia as a primary diagnosis (Cortesi, Giannoti, Ivanenko, & Johnson, 2010; Fjeldsted & Hanlon-Dearman, 2009; Goodlin-Jones, Waters, & Anders, 2009; Ivanenko, Crabtree, & Gozal, 2004; Meltzer & Mindell, 2006, 2008; Owens, Spirito, McGuinn, & Nobile, 2000). This search validated Green's (2008) statement alluding to literature being more about insomnia as a secondary diagnosis rather than a primary. There is a need for research exploring insomnia of childhood as a primary diagnosis because a majority of the literature has discussed insomnia as a secondary diagnosis. This dissertation will close a literature gap with sleep performance being a primary complaint about children ages 3 to 10.

Research studies exploring a relationship between sleep performance and sensory modulation differences, without other diagnoses, began appearing in the literature around 2009 (Spira, 2014). After an exhaustive search, nine studies related to sensory processing and insomnia were found. Six of the articles found were published; four in occupational therapy-based journals, and two were in sleep-medicine-based journals. Three of the studies were unpublished dissertations at the time of this manuscript. Seven of the studies involved children,

encompassing ages birth to 3 and 6 to 12 years of age, while only one of the study's participants were adults ages 21-60 years. Seven of the studies used typically developing subjects, and two used participants with a diagnosis of behavioral insomnia. The studies focusing on sleep and sensory processing will be presented chronologically, starting with the adult populations, and then followed by the studies on the pediatric populations.

Adult Populations

Engel-Yeger and Shochat (2012) studied the effects of sensory patterns effects on sleep in healthy adults. The measures used in this study were the Adult and Adolescent Sensory Profile and the Pittsburgh Sleep Quality Index. The results of the study found that there were low to moderate correlations in the low-neurological threshold quadrants and sleep quality, sensory avoiding, active self-regulation, $p = .009$, and sensory sensitivity, passive self-regulation, $p = .02$ (Engel-Yeger & Shochat, 2012). More people with sleep disturbances demonstrated sensory sensitivity. Specifically, sensitivities in the visual and auditory systems most impacted the participants, while auditory avoidance behaviors were also most noted.

Furthermore, sensory seeking behaviors were significantly negatively correlated with sleep disturbances, $r = -.28$, $p = .02$. This negative correlation could be interpreted to mean participants with sensory-seeking behaviors have fewer sleep disturbances (Engel-Yeger & Shochat, 2012). This study was the first and only, to the researcher's knowledge, to discuss adult sleep from a sensory perspective. These findings are congruent with the 3-Factor model of insomnia, which states individuals with sleep disturbances tend to become easily aroused or are sensitive to sensory input (Engel-Yeger & Shochat, 2012; Rechtschaffen, 1968). Transposing these findings into Dunn's Framework, the findings state individuals with auditory sensitivity, low neurological threshold, who actively move away from auditory stimuli, will have difficulty

with sleep (Engel-Yeger & Shochat, 2012). Those participants with a sensory-seeking inclination have better sleep quality. This finding may be interpreted as the sensory seeking participants may be more active during the day, and daily activity is recommended for improved sleep (Naylor et al., 2000).

Pediatric Populations

The studies presenting sensory aspects of sleep in the pediatric populations will be presented chronologically based on publication date; unpublished will follow. Shochat et al. (2009) explored the relationship between sensory processing abilities, sleep, and children's daytime behavior. Parents of typically developing school children (age range 6-12) were asked to complete the Short Sensory Profile (McIntosh, Miller, Shyu, & Dunn, 1999), the CHSQ (Owens et al., 2000) and the Conners Global Index (Conners, 1997). This study indicated a moderate negative linear correlation between sleep habits global score and global sensory scores, $r = -0.45$, $p < .001$. Specific subcategories of the Short Sensory Profile, specifically sensory sensitivity, could be correlated with the global CHSQ total to find sensory sensitivity correlated stronger, $r = -.50$, to sleep issues than other subcategories. The other sensory-based categories ranged from $r = -.45$ to -.23. Taste-smell sensitivity had a weak positive correlation, $r = .21$. Linear regression was calculated between the CHSQ and all the subtests of the Short Sensory Profile. The results indicated that tactile sensitivity predicted sleep patterns 25% of the time, $F(1, 49)$, = 16.30, $p < .001$ (Shochat et al., 2009). Overall, the findings indicated a relationship was present between sleep habits, sensory processing, and daytime behavior, supporting previous studies with similar constructs, but all constructs need further investigation (Bar-Shalita et al., 2008; Dunn, 1997).

Reynolds et al. (2012) studied participants with and without an autism spectrum disorder diagnosis. The two research groups included those with autism spectrum disorder ($n = 27$) and control ($n = 28$). The Sensory Profile-1 (3-10 age form), Child Behavioral Checklist, and a Salivary Cortisol collection were used as research data collection tools. The Child Behavioral Checklist was used as a sleep screening tool in this study. This study used a comparable-aged sample (6-12 years old) as Shochat et al. (2009) and similarly examined the sensory and behavioral perspectives of typically developing participants. In the typically developing group, Spearman's correlation statistics found moderate relationships in all quadrant areas when compared to the total sleep index scores: low registration, $r = .528$, $p = .008$; sensory seeking, $r = .552$, $p = .005$; sensory sensitivity, $r = .486$, $p = .016$; and sensation avoiding, $r = .537$, $p = .007$ (Reynolds et al., 2012). Children in the autism spectrum disorder group were significant only in the sensation avoiding quadrant, $r = .502$, $p = .011$. No other quadrants were found to have a statistically significant correlation. Linear regressions were conducted with the scores of the various tools in this study, and none of the variables were statistically significant to predict poor sleep behaviors (Reynolds et al., 2012). Reynolds et al. then combined both groups (with autism spectrum disorder and without autism spectrum disorder) to analyze as a single sample. The sleep index scores moderately to significantly correlated to all four quadrants of the Sensory Profile-1 in a whole-group comparison: low registration, $r =.466$, $p = .001$; sensory seeking, $r = .547$, $p < .001$; sensory sensitivity, $r =.504$, $p < .001$; and sensory avoiding, $r = .573$, $p < .001$. The results point to children with autism spectrum disorder demonstrating a higher probability to exhibit sleep disturbances. The participants in the autism spectrum disorder group who were demonstrating sensory avoidance behaviors correlated higher with sleep disturbances. The typically developing sample's correlations were high in all four quadrants of the Sensory Profile-

1. These findings could be interpreted to mean that typically developing children showed various sensory modulating behaviors, and neither behavioral characteristic (passive or active) could be related specifically to sleep performance. The authors recommended further exploration of sensory modulation behaviors and sleep performance in the typically developing population. They feel their findings, whether statistically significant or not, differentiate between good and poor sleepers.

Vasak et al. (2015) were the first to conduct a sensory processing and sleep study on typically developing infants. This study included 177 typically developing infants and toddlers, ages 0-36 months, to explore a relationship between sensory processing patterns and sleep difficulties. Data were collected for 3 years in an occupational therapy practice specializing in sleep. The Infant/Toddler Sensory Profile and a Brief Infant Sleep Questionnaire were the tools used in this study (n = 177). The results for the Infant/Toddler Sensory Profile indicated that 55.4% of the children in the study demonstrated *more than others* in one or more quadrants on the Infant/Toddler Sensory Profile; 40.7% of children showed *more than others* in only one quadrant (Vasak et al., 2015). All quadrants of sensory processing were represented in the sample. These findings are congruent with the statement that all children have different sensory processing skills, and a higher score does not indicate a disability (Dunn, 2007). This study's overall finding was the most significant percentage of children with increased sensitivity (36.2%), and avoiding patterns (21.5%) were the infants being referred due to sleep difficulties. Spearman correlations were conducted between the variables of sleep and sensory processing. The results indicate children with increased seeking behavior demonstrated less time asleep during the day, $r = -.24$, $p = .002$, and children with increased sensitivity took more time to settle, $r = .27$, $p < .001$. The findings of children with low neurological thresholds (avoiding and

sensitivities) validate the results of the Shochat et al. (2009) and Reynolds et al. (2012) studies, which explored different ages.

Tauman et al. (2017) also studied infants and toddlers. The researchers explored children with sleep and feeding difficulties who were under 3 years of age. A total of 85 infants and toddlers between the ages of 7 and 36 months of age were recruited for this study. Only the behavioral insomnia group (n = 25) is discussed as part of this review. The parents completed the Brief Infant Sleep Questionnaire, Behavioral Pediatrics Feeding Assessment scale, and the Infant/Toddler Sensory Profile. The Tauman et al. findings reported children with a diagnosis of BIC presented with statistically significant more sensory avoiding behaviors, p = .037, than those within the control group. The Tauman et al. findings are unique as they expose an active self-regulation quadrant to be the most significant concerning sleep issues. In contrast, other studies found significant relationships between passive self-regulatory quadrants and poor sleeping behaviors (Engel-Yeger & Shochat, 2012; Shochat et al., 2009; Vasak et al., 2015). This study also concluded that children seeking help for behavioral insomnia had distinctly more sensory differences than the control group (Tauman et al., 2017).

Foitzik and Brown (2018) recently conducted a study examining sensory processing and sleep performance. The study included 45 typically developing participants between the age of 8 and 12. The assessment tools used in this study were the Sensory Processing Measure-Home Form, CSHQ, Children's Report of Sleep Patterns, and Children's Sleep Hygiene scale. This study was unique because it is the first research to use a sleep hygiene measure (i.e., Children's Sleep Hygiene scale) and the first to use a child report tool (i.e., Children's Report of Sleep Patterns). The participants were asked to rate their sleep behaviors rather than obtaining information strictly from the parents. However, the researchers did include a parental rating

(Children's Sleep Hygiene scale), which allowed them to monitor and analyze variances of the responses for each participant. The Sensory Processing Measure-Home Form, the sensory processing measurement utilized in this study, is not in the product line of Sensory Profile Assessments, which use Dunn's Sensory Processing Model. The Sensory Processing Measure-Home Form is designed to measure sensory processing across sensory domains of vision, hearing, touch, taste, smell, praxis, and social participation (Foitzik & Brown, 2018). The Sensory Processing Measure-Home Form measures similar constructs to the Sensory Profile-2 but are not reported on a quadrant scale.

Foitzik and Brown (2018) found significant correlations between the subtests of the Sensory Processing Measure-Home Form and subscales on the CHSQ. These findings included correlations between sleep duration and touch, $r = .33$, $p < .05$; taste/smell, $r = .33$, $p < .05$; and planning and ideas, $r = -.33$, $p < .05$. The study suggested sleep duration was minimally related to heightened touch and taste/smell behaviors and negatively correlated to the planning and ideas behaviors. Daytime sleepiness also had significant correlation with the subscales of touch, $r = .36$, $p < .05$, and taste/smell, $r = .36$, $p < .05$. These results point to the sensory aspects of touch and taste/smell sensory systems as having a possible effect on sleep duration and daytime sleepiness. The researchers used the Children's Sleep Hygiene scale to address environmental factors that influence sleep hygiene. Social participation on the Sensory Processing Measure-Home Form was correlated with sleep hygiene scores to find a significant effect, $\rho = .34$, $p = .05$. This finding suggests that children with increased social participation are more likely to have better sleep hygiene routines (Foitzik & Brown, 2018). Again, this study supports findings from other studies that find sensitivities of specific sensory systems such as touch and taste are related to sleeping difficulties (Shochat et al., 2008; Vasak et al., 2015). The Foitzik and Brown study

did find significant correlations between children's sensory processing skills and sleep patterns but lacked reporting of regression analysis between the CHSQ and the Sensory Processing Measure-Home Form. Also, small sample size was a limitation to the strength of the findings of this study.

Spira (2014) is an unpublished dissertation correlating sensory-based behavior with sleep in children ages 6-11 years. The tools used in this study were the Short Sensory Profile and the CSHQ. The findings correlating overall sensory behavior and sleep difficulties were not significant. However, once the children were divided into symptom-based groups, statistical significance increased (Spira, 2014). Excessive daytime sleepiness had a low correlation with tactile and taste-smell sensitivities, $r = .28$, $p < .05$. Night waking also minimally correlated with movement sensitivity, $r = .28$, $p < .05$. These symptoms are important in the diagnosis of insomnia of childhood. This study found minimal correlations once insomnia symptom-based difficulties were taken into consideration, which is the first-time correlations between insomnia symptom categories and sensory processing skills were conducted.

The studies presented exploring a relationship between sensory processing abilities and sleep performance are limited in number and varied in the measures used. At this time, seven articles have reported on a relationship between sensory processing and sleep performance. The reviewed studies included a variety of ages and measurement tools. The age group, 3 to 6 years of age, is missing from current literature. The existing studies have recommended continued exploration to draw more reliable conclusions about the relationship between sensory processing and sleep behaviors. With an estimated 20% to 40% of the pediatric population having behavioral insomnia as a medical diagnosis, the occupational therapy profession needs to explore potential causes of sleep disruptions (Galland et al., 2012; Meltzer et al., 2010; Mindell et al.,

2009; Owens & Mindell, 2011; Sadeh et al., 2011). The current research dissertation results will strengthen occupational therapy practitioners' ability to evaluate and intervene, using a sensory perspective, with children demonstrating deficits in sleep performance.

Summary

Up to 70 million Americans, including up to 40% of the pediatric population, is not receiving enough sleep per night (Galland et al., 2012; Institute of Medicine, 2006; Meltzer et al., 2010; Mindell et al., 2009; Owens & Mindell, 2011; Sadeh et al., 2011). The impact of sleep deprivation on children is substantial, affecting educational performance, daytime behaviors, and may lead to a weakened immune system (Sadeh et al., 2002; Sekine et al., 2006; Touchette et al., 2007; Wolfson & Carskadon, 1998). Sleep medicine has evolved drastically over the past 30 years, and occupational therapy practitioners need to become more involved (Shepard et al., 2005). Assessing and treating sleep through a sensory processing lens and the Ecology of Human Performance constructs of person, contexts, and tasks may enhance the opportunities for occupational therapy practitioners in the field of sleep medicine. Current studies have established preliminary associations between aspects of sensory processing and sleep behaviors of children. Some research has established predictive abilities between sensory processing skills and insomnia in children. This study will close the age gap in the literature (ages 3-6 years) of typically developing children with insomnia and will add to the current literature strengthening the role of occupational therapy in sleep medicine.

Chapter 3: Research Design and Methodology

Introduction

Sleep is a significant component of children's daily functioning and is now included in the OTPF. This research further explored the relationship between sensory processing behaviors and sleep patterns in children. This study's results may assist occupational therapy practitioners in enhancing their treatment in the areas of sleep medicine. This study participants were parents of children 3 to 10 years of age who completed questionnaires about their child's current sleep patterns and observed sensory-based behavior. This research focused on determining if sensory responses of the child impact the child's ability to participate in the occupation of sleep. If a relationship existed, the research would explore potential predictive relationships between sleeping behavior variables and sensory processing behavior in the children. This research's findings should empower occupational therapy practitioners to be more effective in treating children with behavioral sleep disorders from a sensory-based perspective.

Method of Inquiry

This study was an exploratory correlational design. Correlational and regression methods were used to explore if children's insomnia behaviors were related to the sensory-based behaviors of the participants' children. Based on previous literature, it was hypothesized an association was present (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014; Tauman et al., 2017; Vasak et al., 2015). Specifically, individuals who fell into the sensory sensitivity quadrant from Dunn's Sensory Processing Framework demonstrated an increased difficulty in settling and transitioning to sleep and staying asleep (Dunn, 1997; Engel-Yeger & Shochat, 2012; Spira, 2014; Vasak et al., 2015). This study

continues the exploration of a potential relationship between children, ages 3 to 10, with difficulties sleeping and current sensory processing behaviors.

Research Design and Rationale

This exploratory research study used a correlational analysis to answer the research questions. Exploratory research designs investigate two or more variables systematically (Portney & Watkins, 2015). In this study, the two variables were pediatric insomnia behaviors measured by the CHSQ and sensory-based behaviors measured by the CSP-2. A correlational analysis was utilized to analyze data from these two measures and to determine the degree of association between the variables in question, in this case, pediatric insomnia symptoms and sensory processing skills (Portney & Watkins, 2015). This statistical method was previously used and found effective in research in exploring the relationship between poor sleep habits and sensory-based behaviors (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014; Tauman et al., 2017).

The analysis of the data gleaned from this study determined the existence of a relationship between the variables, so regression statistics were used to explore the predictive nature of the two variables. Regression is the statistical analysis to observe the predictive ability of two or more variables on each other (Portney & Watkins, 2015). The first variable in this study was sleep behavior, measured with the CHSQ. The second variable was the sensory-based behaviors component, measured with the CSP-2. The CSP-2 determined the behaviors noted in the children of participants and ranked their behaviors into four quadrants: low-registration, sensation seeking, sensory sensitivity, and sensory avoiding (Dunn, 2007, 2014). Each quadrant represented a degree of neurological threshold and the child’s ability to self-regulate and provide a reaction to the environmental stimuli (Dunn, 2007). The CSP-2 allows therapists to determine

which sensory systems (auditory, visual, touch, movement, body position, and oral) of the body are most reactive to the environment (Dunn, 2014). In this dissertation, a regression analysis was conducted to determine if either the quadrant or sensory system-based behavior predicted insomnia symptoms. A predictive quality was verified through the statistical outcomes of this study. The predictive nature found could guide occupational therapy clinical reasoning behind treatment options in clients with childhood behavioral insomnia.

Strengths and Weaknesses of Exploratory Design

Exploratory research designs are the first step in a research thread. The chosen non-experimental, quantitative, exploratory research design was appropriate as no variables were manipulated but only observed at a specific moment in time (Portney & Watkins, 2015). Exploratory research designs are a reliable method when the research question is requiring a depiction of a situation or phenomenon (Christensen, Johnson, & Turner, 2015). The literature exploring a correlation between sensory behaviors of children and insomnia symptoms is relatively new in the existing research (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014; Tauman et al., 2017; Vasak et al., 2015). The current published literature exploring children's sensory behaviors and sleep difficulties represents children's age groups birth to 3 and ages 6 to 10. There is no existing research on children ages 3 to 5 investigating insomnia symptoms and sensory-based behaviors. This dissertation's exploratory research design addressed the gap of missing information for the 3 to 5 age group.

In addition to the exploratory design, this dissertation used a correlational design. Correlational designs go beyond a description level and add a predictive component to the analysis (Christensen et al., 2015). A strength of this design is the data are collected in a natural

environment with no manipulation of variables (Portney & Watkins, 2015; Thompson, Diamond, McWilliam, Snyder, & Snyder, 2005). The predictive aspect of a correlational design allows a researcher to understand the variables as they relate to each other. One of the weaknesses of correlational research is the assumption of causation, which cannot be implicit in correlational research (Christensen et al., 2015). Consideration over extraneous variable and confounding variables must be considered to establish a relationship. A correlational design in research measures variables in their natural setting and extraneous variables are assumed, not eliminated.

Threats

The goal of this research was to explore the possible relationship between sensory-based and insomnia behaviors in children. Threats to research decrease the dependability of the findings. Threats to this dissertation may include internal validity, construct validity, external validity, and statistical validity (Portney & Watkins, 2015). Internal validity speaks to the study's design and measures and the ability to answer the research question. Although this study was not determining cause and effect, the research was exploring a relationship. This relationship was investigated in the natural setting, and extraneous variables were not controlled in this design, such as unknown, prescribed, or over-the-counter medications causing differences in sleep. Variables such as parental shift work or the impact of a recent change in the child's life were not accounted for in this study (Dunifon, Kalil, Crosby, & Su, 2013). The fact that confounding variables were present could threaten the findings' internal validity (Portney & Watkins, 2015). Another threat to the internal validity of this study involved temporal effects, specifically the fact that children between the ages of 3 and 10 developmentally demonstrate variability in sleep durations (Moturi & Avis, 2010). These changes could minimally impact the overall sleep duration but may cause parents to report differences in going to sleep later or

sleeping later in the morning. The selection of the participants using strict inclusion and exclusion criteria allowed for a more homogeneous group addressing some of the concerns of confounding variables.

Construct validity is the degree to which the variables are measured in the study (Portney & Watkins, 2015). In this study, construct validity was controlled by operational definitions based on previous literature and how they relate to the current study. Both assessments used in this study were validated to measure the constructs intended. The CSP-2 reports internal consistency to be .60-.90, test-retest reliability to be .87-.97, and interrater reliability to be .49-.89 (PsychCorp, 2014). The CSHQ scores internal consistency at .68 and .78 (Owens et al., 2000). Scores on these measures accurately reflect the nature of the variable construct.

External validity is the ability of the findings of this study to be generalizable to the general population of children with sleep difficulties (Portney & Watkins, 2015). One of the threats to the external validity of this study is the limited sample. To enhance external validity, different data collection sites across the United States are participating. The multiple site collection and larger sample size made the results more generalizable (Portney & Watkins, 2015). However, the generalizability was limited to child populations ages 3 to 10.

Context of the Study

Ethical Consideration

Ethical standards, based upon state and local regulations, were reviewed at multiple levels to establish the participants' ethical treatment and the participant's information throughout the study (Portney &Watkins, 2015). The first level of review for this dissertation was the dissertation committee review. The Nova Southeastern University (NSU) Occupational Therapy Department requires each doctoral candidate to be under the supervision of a three-person

dissertation committee (NSU Health Sciences Division, 2019). This committee's role was to guide the candidate through an ethically and methodically sound dissertation leading to a terminal degree. This study, entitled *Pediatric Insomnia and Sensory Processing: Strengthening the Role of Occupational Therapy Practitioners in Sleep Medicine*, was vetted through the research committee before any other reviews.

In addition to the dissertation committee, this study was considered by the Institutional Review Board (IRB) at NSU. The NSU IRB approved the study before any recruitment, data collection, or any other study procedures began. The recruitment sites, at the time of this manuscript, agreed to accept NSU IRB approval. The sites provided site approval letters to allow the recruitment of participants from each site (see Appendix C). No medical information or facility resources were used during this research study. None of the sites required any further IRB approval during the research process.

The study employed a caregiver self-selection process in this research study. The caregivers volunteered by contacting the principal investigator by way of information on the flyer in respective sleep centers and online recruitment posts. All participants were given informed consent before participating in the study (see Appendix D). All electronic data received from this study were stored on the Pearson Clinical's secured data-based, Q-global®, and NSU's secure questionnaire data-based Research Electronic Data Capture (REDCap™). At the end of the data collection timeline, all electronic data were merged into a single data file and stored on a Radford University password-protected network drive. The primary investigator was the only person with access to this password. A statistician was consulted for statistical analysis with deidentified data. All data would be saved for 36 months after the completion of this study

and would be destroyed in 2023. Participants of this study were under minimal risk. The information gathered was deidentified before analysis and was reported in aggregate.

Study Setting

Data collection took place in a virtual environment. After self-selection to participate and vetting for inclusion by the researcher, participants completed the questionnaires online via the internet. The participant chose Internet-accessible locations to complete online evaluations. The data were analyzed in a private office at Radford University Carilion.

Funding

This research was funded, in part, by a grant of $3,570 from Jefferson College of Health Sciences. The funding was used for the following purposes: purchase of assessment materials, recruitment materials, and remuneration for participants. The funds were utilized to obtain all the CSP-2 testing material and the Q-global® electronic scoring software. The funding was used to obtain ten-dollar gift cards for each participant. This use of funding may entice participants to complete the surveys promptly. The requested materials met funding guidelines and were purchased before June 30, 2019, before the merge between Jefferson College of Health Sciences and Radford University.

Participants

The researcher used a purposeful and convenience sampling method to recruit caregivers of children between the ages of 3 to 10 years with a caregiver-reported sleep difficulty. The participants were able to read English at the fifth-grade level and had access to an email. This dissertation's sampling method took place in one sleep clinic in the United States and from Internet-based forums with interests in parenting, pediatrics, and pediatric insomnia. These recruitment procedures were similar to those studies completed previously on the topic of

sensory processing and insomnia of childhood (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Reynolds et al., 2012; Shochat et al., 2009; Tauman et al., 2017; Vasak et al., 2015).

Power

The number of participants needed for this exploratory study was analyzed by a statistician using a two-sided alternative correlation coefficient continuous outcome test. The level of desired power (80%) and p = .05 were used to calculate the power for this dissertation using the statistic software program nQuery© (Elashoff, 2000). The data used to conduct the power analysis were gleaned from Vasak et al. (2015). An estimated 135 participants were needed to meet the statistical power of 80% in this dissertation. The participant numbers reached 135 approximately 3 months after the launch of data collection.

Inclusion Criteria

Caregivers of children ages 3 to 10 years old were recruited for this research. The recruiting took place in a hospital for children and via Internet pediatric sleep interest groups. Inclusion criteria included a caregiver report of pediatric insomnia symptoms, including symptoms of being unable or unwilling to go to sleep, staying asleep, awaken early, or reducing overall sleep duration viewed as interrupting daily activities. The child, under the care of the caregiver, was not receiving any sensory-based therapy. The caregivers completed the CHSQ and the CSP-2 in an English format; therefore, the caregivers understood conversational English. The overall Flesch Reading Score of both tests required a fifth-grade reading level (CSHQ 1.2 and CSP-5.3). The caregivers had access to the Internet and an Internet-accessible device to complete the surveys.

Exclusion Criteria

Exclusion criteria include caregivers (a) with children who were below the age of 3 or over the age of 10 years, (b) who were unable to read and respond in English at a fifth-grade level, (c) with children who were currently receiving occupational or any other therapy for sensory processing issues, (d) with children who had received any medical treatment or prescribed medicine for insomnia, and (e) who were unable to access the Internet and electronic mail. Exclusion criteria were based upon the specific demands of the participants to answer the research question and address the internal validity of the dissertation. The age requirements of 3 to 10 years were based upon the age groups which have validity, as reported in the published literature on the CHSQ (Owens et al., 2000; Goodlin-Jones, Sitnick, Tang, Liu, & Anders, 2008). The choice of the age range of 3 to 10 years was based upon the paucity of information about this population in literature. This dissertation closed the gap in the literature for 3 to 5 years of age and added to the limited published data on children 6 to 10 years old (Foitzik & Brown, 2018; Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014).

Several other exclusion criteria must be employed to give the most accurate information regarding the correlation of sensory processing and insomnia of childhood, including language barriers, treatment for insomnia, and those who may be seeking sensory-based therapy. The CHSQ is currently only validated in English; therefore, the researcher excluded anyone unable to read and understand English. The children being discussed in this study demonstrated at least one deficit in sleep performance (unable to go to sleep, stay asleep, or awakes early, resulting in reduced sleep duration) but had not received any prior medical treatment for insomnia symptoms. These insomnia symptoms included being unable or unwilling to sleep, staying asleep, awakening early, or reducing overall sleep duration viewed as interrupting daily

activities. This study explored the connection between insomnia of childhood and sensory-based behavior; for this reason, the researcher excluded children who have been receiving therapy for sensory processing disorder. Having received therapy in sensory-based performance could affect the internal validity of the study. Lastly, the participants had access to and could navigate the internet on a computer or internet-based device and had access to an active email account to receive the questionnaires.

Recruiting Procedures

Three recruiting sites were approached in preparation for this dissertation. In addition to physical sites, Internet forums served as recruitment sites. All chosen facilities and online forums had access to pediatric clients' caregivers with sleep disturbances, including limit-setting, sleep on-set association, and combination types. Each specific physical site had a primary contact for the recruitment of the participants. The online forums were the responsibility of the principal investigator of this research.

Physical recruitment sites.

- The physical recruitment sites agreed to accept the NSU IRB approval. The physical sites submitted site approval agreements agreeing for the recruitment of participants from each facility.
- A Virginia-Based Clinic's Sleep and Pulmonary Department
    - Posters stating the name and contact information of the primary investigator, inclusion criteria, time requirement, compensation, and research objectives were distributed to the medical practitioners and office staff for display in the waiting rooms and the examination rooms.

    - Personal flyers were distributed to caregivers who the medical staff believe meets the inclusion criteria. The flyers included the name and contact information of the primary investigator, inclusion criteria, time requirement, compensation, and research objectives

- Behavioral Sleep Medicine Department of Pediatric Pulmonology, Allergy, and Sleep Medicine at a Midwest Children's Hospital.
    - Posters stating the name and contact information of the primary investigator, inclusion criteria, time requirement, compensation, and research objectives were distributed to the medical practitioners, office staff, and displayed in the waiting rooms and the examination rooms.
    - Personal flyers were distributed to caregivers who the medical staff believe meets the inclusion criteria. The flyers included the name and contact information of the primary investigator, inclusion criteria, time requirement, compensation, and research objectives
- A Mid-Atlantic Children's Hospital
    - Posters stating the name and contact information of the primary investigator, inclusion criteria, time requirement, compensation, and research objectives were distributed to the medical practitioners and office staff the Mid-Atlantic Children's Hospital Specialty Care Center to display in the waiting rooms and the examination rooms.

- Personal flyers were distributed to caregivers who the medical staff believe meets the inclusion criteria. The flyers included the name and contact information of the primary investigator, inclusion criteria, time requirement, compensation, and research objectives.

Internet recruitment sites.

- Online forums, communities, and message boards with interest in pediatrics, parenting, and pediatric insomnia were utilized in this research. The primary investigator inquired for permission from each selected site before posting. Once approval was granted, the primary investigator posted the invitation to participate in the research. This post included name and contact information of the primary investigator, inclusion criteria, time requirement, compensation, and research objectives. The members of the forums were encouraged to share the post to anyone they felt met the criteria. Follow-ups, with permission to online recruitment, were completed weekly to maintain prominence.

- Upon Dissertation Committee Approval, IRB applications and forms were submitted to Nova Southeastern University.
- Sites approval letters were submitted to IRB for approval to recruit participants from each physical recruitment site.
- Once IRB approval was granted, the actual data collection procedures began.
- The researcher followed up with the main contacts at each center to distribute the recruitment materials. At this follow-up, a presentation of inclusion and exclusion criteria and specific procedures were reiterated to practitioners and medical staff.

- The pediatric sleep departments previously mentioned were asked to post and distribute recruitment posters and flyers to participants meeting inclusion criteria. The flyers included the name and contact information (email and phone) of the primary investigator, inclusion criteria, time requirement, compensation, and research objectives.

Data Collection

Data Collection Procedures

- The qualifying caregivers chose to participate and directly contacted the researcher via email or phone.
- The researcher confirmed the inclusion criteria with each participant, either verbally or in an email, before obtaining any information.
- The researcher made all attempts to keep the identity of the caregiver anonymous by creating a crosswalk document. The researcher assigned the participant a number and tied that number to a valid email address for the distribution of the surveys and the incentive. This information was kept for two purposes: for follow-up if the surveys were not completed and allocation of a $10 electronic gift card to participants after survey completion. The log with the participant’s email and participant number was kept separate from the research data on a Radford University Carilion computer’s secure drive. The crosswalk document was destroyed once the data collection had ceased and all participants had received their compensation.
- A survey link was emailed to the participants. The link launched an introductory video from the primary investigator.
    - The video included an introduction, thank you message from the investigator, along with the purpose of the study, time commitment

statements, and incentives. It also included the contact information to allow the participants to contact the investigator during the process if they had questions.

  - After watching the video, the participants were presented with the written, informed consent information. The participant had the opportunity to read the informed consent. At that time, if they have questions, they called the primary investigator, whose contact information was provided. The participant electronically signed that they have read the informed consent and agree to the terms. The questionnaire did not continue unless their signature was present.

- Once the participants verified the informed consent, the caregivers were introduced to the first survey.
  - The first survey presented was the CSHQ. The instructions for completing this survey was in written form at the top. The participants were asked to complete the survey. At the bottom of the first electronic survey, another link took the participants to the CSP-2.
- The participants saw new instructions, in written form, to complete the CSP-2. The caregivers were asked to complete the CSP-2 based on observed behaviors of a child under their care.
- Upon obtaining the threshold of 135 participants, the data collection ceased.
- The data collected from the demographic and CSHQ was housed in REDCap™ (Research Electronic Data Capture) through NSU. REDCap™ is a secure, web-based application that builds and manages surveys and databases for research (Harris et al.,

2009). The team at REDCap™ assisted, with input from the researcher, in designing and deploying the questionnaire links and building the database used by the researcher. The database was designed to import data explicitly as it was analyzed to answer the research questions. All the data were stored in the REDCap™ databases until extraction by the researcher. The data were extracted from REDCap™ to the Statistical Package for the Social Sciences (SPSS®) for the final analysis.

- The data collected from each participant filling out the CSP-2 was housed in the secure, password-protected Pearson Clinical databases and accessible to the researcher at any time. These data were extracted to SPSS® for analysis.
- Once the researcher verified the complete status of both surveys by checking the status via the participant number, a completion incentive of a $10 electronic gift card was emailed to the study participant.
- After completion of data collection and participant receipt of the electronic gift card, the participant's confidential information was destroyed. With this procedure, the data were deidentified and analysis began.
- The raw data from the surveys from REDCap™ and Q-Global® were extracted, combined, and uploaded into SPSS for analysis. The data raw on REDCap™ and Q-Global® would be kept for up to 2 years and then would be deleted.

Measurement Tools

The two measures used to gather data in this dissertation were the CSP-2 and the CSHQ. Both measures are respected and used within the respective practices and research. A majority of the previous studies comparing the topic of sensory processing and insomnia employed the

CSHQ or the Sensory Profile suite of measures (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014; Tauman et al., 2017).

The children's sleep habits questionnaire (CSHQ). The CSHQ was used to determine sleep disruption variations in each child aged 3 to 10 years. The CSHQ is a retrospective questionnaire completed by the parent to determine sleep behaviors and deficits in children (Owens et al., 2000). The CSHQ is designed with the International Classification of Sleep Disorders diagnoses as a guide (Owens et al., 2000). The CHSQ consists of 33 three-point Likert style scale items, as shown in Figure 5 (Owens et al., 2000).

Children's Sleep Habits Questionnaire			
Times per week observing each behavior	Usually (5-7 per week)	Sometimes (2-4 per week)	Rarely (0- 1 per week)
Choose one	☐	☐	☐

Figure 5. Children's sleep habits questionnaire Likert-like scale. Caregivers will choose between usually, sometimes, and rarely. Adapted from Owens et al. (2000).

The CHSQ has eight subcategories to help explain types of BIC:

- *Bedtime resistance*- refusing or battling the caregiver a bedtime.
- *Sleep onset delay*- demonstrating difficulty falling asleep once they are in bed.
- *Sleep duration*- is the length of time asleep.
- *Sleep anxiety*- is the presence of nervousness or concern around bedtime. Often related to a need for a parent or being afraid of the dark.
- *Night wakings*-frequency of waking during the night typically noted with difficulty returning to sleep.

- *Parasomnias*-unwanted and abnormal behaviors during sleep or partial arousal (Bollu, Goyal, Thakkar, & Sahota, 2018). *(i.e., sleepwalking, bed wetting, sleep terrors.)*
- *Sleep disordered breathing*-Physical obstruction of the airway either due to a physical abnormality or collapsing of airway structure (Meltzer & McLaughlin-Crabtree, 2015). Typically, not considered a behavioral sleep disorder but is included in the CHSQ as a subscale.
- *Daytime sleepiness*-Excessive sleepiness during the day affecting social and occupational performance throughout the day. May see an increase in napping or negative behavioral episodes (Liu et al., 2019).

The completion of the survey took 10-20 minutes. The participants rated statements aimed toward age-appropriate sleep complaints, including "bedtime behavior and sleep onset; sleep duration; anxiety around sleep; behavior occurring during sleep and night waking; sleep-disordered breathing; parasomnias; and morning waking/daytime sleepiness" (Owens et al., 2000, p. 1043). The children's caregivers were asked to score their most recent week in which typical sleeping behavior was noted. Each response was recorded on a 3-point Likert-style scale. The response categories are *usually*, meaning five to seven times per week, *sometimes*, two to four times per week and *rarely*, occurring zero to one time per week.

A cut-off score of 41 or above on the CHSQ identifies 80% of children with a sleep difficulty with a calculated sensitivity score of 0.80 and specificity at 0.72 (Owens et al., 2000). The psychometric properties of this 35-question measure were reported by Owens et al. (2000) and met acceptable standards within the population of 3 to 10 years of age. Reliability and validity were determined in two groups: a community sample (n = 1,099) and a clinical sample

(n = 154), resulting in the following: internal consistency at .68 and .78, test-retest reliability at .62 and .79, and sensitivity at .72 and .80, respectively (Owens et al., 2000).

Goodlin-Jones et al. (2008) described the utility and validity of the CSHQ in children ages 2 to 5.5 years old. These researchers determined the children with a parentally reported sleep difficulty displayed a significantly higher score on the CSHQ than the typically developing group, $F = 10.65(9,168)$, $p = .000$. When analysis of variance (ANOVA) methods were applied to the data, all subscales and the total scores of the CSHQ between the sleep difficulty group and the typically developing group were found to be significant, $p = .000$ to $p = 007$. This research supports the use of the CHSQ as a sleep difficulty screening tool for children ages 24-66 months. With the findings from Goodlin-Jones et al. and the previous findings from Owens et al. (2000), the CHSQ is supported to determine sleep difficulties in ages 22 months to 10 years of age. The CSHQ is freely available from the original author on Boston Children's Hospital's web page (Boston Children's Hospital, 2019). In this study, the CHSQ was delivered in an electronic format to the participants.

The child sensory profile-2 (CSP-2). The CSP-2 is used to assess children's sensory processing patterns from 3 to 14 years of age, which encompasses the inclusion ages of this study of 3 to 10 years (Dunn, 2014). The CSP-2 is a standardized, parent response questionnaire. The CSP-2 has an electronic version distributed by the publisher, Pearson Clinical, which will be used in this research project. The CSP-2 is proprietary, and payment was supplied before usage in the study.

The CSP-2 is an 86-item caregiver questionnaire is divided into six sections, including auditory, visual, touch, movement, body position, and oral sensory processing (Dunn, 2014). Three additional sections of the questionnaire involve conduct, social, emotional responses, and

attentional responses. The frequencies of the behaviors in these six sensory sections and three behavioral sections are rated on a 5-point Likert type scale. These scores are then calculated to categorize the behaviors in one of four presentations: low-registration, sensation seeking, sensory sensitivity, and sensory avoiding (Dunn, 1997). The scores of the sensory sections and behavioral sections are also scored on a normal curve. PsychCorp (2014) reports an atypical score on the CSP-2 quadrant scores, and sensory section scores are those greater than +/- 1 standard deviation from the population scores. The psychometric properties for the CSP-2 are as follows: internal consistency at .60-.90, test-retest reliability at .87-.97, and interrater reliability at .49-.89 (PsychCorp, 2014). These findings are considered within standards for research and were published by the PsychCorp.

Data Analysis

Data Analysis Procedures

The researcher, with guidance from a statistical consultant, conducted the analysis phase of the study. The data held in the REDCap™ and Pearson Clinical databases were merged into a master database in SPSS®. The information was cleaned and verified complete by the primary investigator. All data were analyzed using the proper reporting and statistical tests to answer the research questions (RQ) using SPSS®.

- First, the frequency, mean, range, and standard deviations of the demographic data on the survey (see Appendix E) were computed.
- To answer **RQ1** (Does a correlation exist between sensory behaviors and insomnia behaviors in young children 3 to 10 years of age?), a correlational statistical test was employed. The data gleaned from the CSP-2 and CSHQ are considered continuous data; therefore, Pearson product-moment coefficient of correlation (Pearson's) procedures or

Spearman's Rank Order Correlation (Spearman's) calculations are appropriate to establish correlations between the participants' data. The deciding factor in which measure is chosen to answer RQ1 was the parametric or non-parametric properties of the data. The data were considered parametric so, a Pearson's calculation was used. These correlational calculations determined the degree of association between the scores on the CSP-2 and the CSHQ. The scores ranged between 1 and -1, with scores closer to 1 or -1, indicating a stronger correlation.

- The normality of the data needs was resolved to proceed with the most powerful statistical tests. A Shapiro-Wilk normality test was employed to determine the normality of the continuous data collected (Meyers, Gamst, & Guarino, 2016).
- The correlational tests were performed to determine if a statistical relationship exists between the sample's sensory behaviors and insomnia symptoms. Raw scores were used for the quadrant and sensory section CSP-2 data. A total score will be used for the CSHQ. In all correlational calculations, a Pearson's Product Moment correlation calculation will be employed, because of the linear properties of the data.
- To answer the quadrant portion of **RQ1,** the CSP-2 quadrant scores were correlated with the insomnia scores (CSHQ). The CSP-2 quadrant data included scores that placed participants' children in the categories of sensory seeking, low registration, sensory avoiding, and sensory sensitivity.
- To answer the sensory system portion of **RQ1**, the CSP-2 sensory section scores (auditory, visual, touch, movement, body position and oral) were used to calculate

a correlation between the individual sensory system scores and insomnia behaviors.

  - In a further step, the sample as a whole was analyzed to determine what percentage of the sample scores +1 or -1 standard deviation (SD) and the percentage of the sample scores +2 or -2 SD from the mean on both quadrant and sensory systems scores are statistically different from the typical behaviors. This procedure offers statistics to see if the +/- 1 SD or +/- 2 SD group differed from those who fall within the typical range.

- To answer **RQ 1.1** (If correlations exist, do scores in specific quadrant scores of children predict behaviors of insomnia of childhood?) and **RQ 1.2** (If correlations exist, do scores in the sensory systems (i.e., movement, visual, auditory) have prediction properties in children with insomnia of childhood behaviors?) a statistical linear regression was conducted.
  - The concept of a linear regression measures the predictive abilities of one or more independent variables (sensory processing quadrants or sensory sections) on a dependent variable of insomnia of childhood (Meyers et al., 2016).
  - Linear regression measures were conducted on scores of the quadrant scores of the CSP-2 and an overall score of the CSHQ to answer **RQ 1.1**.
  - To answer **RQ 1.2**, the independent variables were the sensory system categories of the CSP-2 (auditory, visual, touch, movement, body position, and oral), and the overall score of the CSHQ was the dependent variable. Linear regression calculations were conducted to determine if predictive qualities exist between the variables.

- In further investigation, linear regressions were conducted to see if the sensory systems predicted any subcategories of the CSHQ (bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep-disordered breathing, and daytime sleepiness).

Together, correlational tests and linear regression tests answered the research questions to determine if a relationship exists between children's sensory behaviors and pediatric insomnia symptoms and if any of the sensory quadrants or specific sensory system behaviors predict poor pediatric sleep habits. The data were calculated with overall scores and specifically to any sleep disturbances measured on the CSHQ to sensory system sections on the CSP-2.

Format for Presenting Results

This study's results are presented in a narrative format with graphs and figures to enhance the understanding of the data by the reader. The results were presented in an oral defense and at local, state, national, and international conferences by invitation. The results of this study will also be developed into a manuscript and submitted for publication in the future.

Limitations and Delimitations

This study has potential limitations that include the following: measurement tools rely on parental reports, insomnia, and insomnia of childhood are consistently poorly defined in the literature, the research tools are only presented in English, and the potential to exclude participants because of the electronic nature of the study. First, this study relies on two parental report measurement tools. The parental report may or may not represent the exact behaviors experienced by the child. The tools are designed to be based on observation and may be influenced by the parents' awareness and personal feelings. Second, terminology within sleep medicine regarding insomnia is difficult to ascertain. Three major medical organizations, the

World Health Organization, the AASM, and the American Psychiatric Association, have varying operational definitions of insomnia. This study used an operational definition from the AASM. Lastly, because of the exclusion criteria, it is not known if caregivers who are fluent in languages other than English or are unable or uncomfortable navigating the internet may similarly answer the questions.

Summary

A quantitative, correlational exploratory design was chosen for this research to discover if any relationships exist between sensory-based behaviors and insomnia symptoms in children. The data were collected electronically from participants who care for children ages 3 to 10 who have experienced sleep difficulty. The recruitment took place in three sleep clinics across the United States and on electronic forums with interests in parenting, pediatrics, and pediatric insomnia. The quantitative data were analyzed using correlation procedures to determine if a relationship exists between the variables of sensory-based behavior and insomnia symptoms. If a correlation relationship existed, the data were further analyzed to calculate predictive characteristics between the variables. Having the answers to these vital research questions helps inform occupational therapy practitioners' care in pediatric sleep domains.

Chapter 4: Results

Introduction

This study explored the relationship between sensory processing behaviors and sleeping patterns in children. This chapter details the data collection procedures, demographics, and analysis of the sample. The results for the following questions are included:

- Does a correlation exist between sensory behaviors and insomnia behaviors in young children 3 to 10 years of age?
- If correlations exist, do scores in specific quadrant scores of children predict behaviors of insomnia of childhood?
- If correlations exist, do scores in the sensory systems (i.e., movement, visual, auditory) have predictive properties in children with insomnia of childhood behaviors?

Data Collection

After approval from two IRBs in early January 2020, data collection began at one physical site and in online forums. IRB applications were submitted and approved by both NSU (November 2019) and Radford Universities (January 2019). Recruitment for the study began January 2020. The researcher initially discussed participation with three pediatric recruiting centers early in 2019 and the online forums in early January 2020. Two of the recruiting centers declined participation. The midwest Children's Hospital was the only physical site to participate in recruitment for this study. The researcher approached forum administrators hosting forums covering topics such as parenting, pediatrics, children, and pediatric insomnia for approval to post participant recruitment materials. Upon forum administration approval, the researcher posted the recruitment poster on individual forums initially and every 2 weeks afterward until

reaching the recruitment numbers for statistical power. The participants of these forums were encouraged to share the recruitment post to achieve a snowball sampling. The participant sample size for statistical power for the study was reached.

Initial participant demographics include 156 potential participants who made contact with the researcher via email or phone and met inclusion criteria to receive the surveys. A total of 140 participants completed at least one survey, and 139 completed both surveys and the demographic portions of surveys. The researcher completed the data analysis from the 140 complete or partially completed surveys, where applicable. All the participants were kept in the analysis because all individual surveys were completed; only one participant was not represented in the CSP-2 data. REDCap™ and Pearson's Q-Global® databases housed the data. The researcher then uploaded the data into SPSS® for statistical analysis.

Dissertation Data

Items 2-8 on the REDCap© survey collected demographic information. A total sample of 140 completed the surveys (see Appendix E). Most of the children were age 3 (n = 37, 26%) at the time of the survey, with the average being 5.69 years of age. Of the participants' children, most were male (n= 87, 62%), and 53 were female (38%). Race of the children covered four of the six major race choices, with White being an overwhelming majority (n = 117, 83.6%). All the other race choices collectively represented approximately 10% of the sample and 7% choosing the other option. The location of the participants represented 21 of 50 states in the United States. Most of the participants were from Virginia (n = 56, 40%), followed by West Virginia (n = 23, 16.4%) and Florida (n = 16, 11.4%). Participants of the study reported household incomes in all ranges offered on the survey. The majority of participants reported a household income of \$100,000 to \$149,000 (n = 38, 27.1%). The income categories of \$50,000-

$74,999 ($n$=25, 17.9%) and $75,000 to $99,999 ($n$ = 25, 17.9%) were tied for second most frequent. A majority of the participants reported having an education level at the bachelor's degree (n = 45, 32.1%), but all educational levels were represented.

Question 6 on the REDCap© survey asked the caregivers to voluntarily report any medical diagnosis given to the child with the sleep disturbance. A variety of diagnoses were reported from 43 (30.7%) participants. These reported diagnoses were divided into the categories of neurological, developmental, or other medical diagnoses for illustration purposes. Developmental diagnoses affect children's predictive developmental categories, including physical, cognitive, and language (Zablotsky et al., 2019). Neurological diagnoses affect the children's neurological development (Thapar, Cooper, & Rutter, 2017). Other medical diagnoses include all other diagnoses issued by a medical professional that do not fit the two previous categories. The categorized diagnoses are represented in Figure 6. A vast majority (n = 97, 69.3%) reported having no known diagnosis.

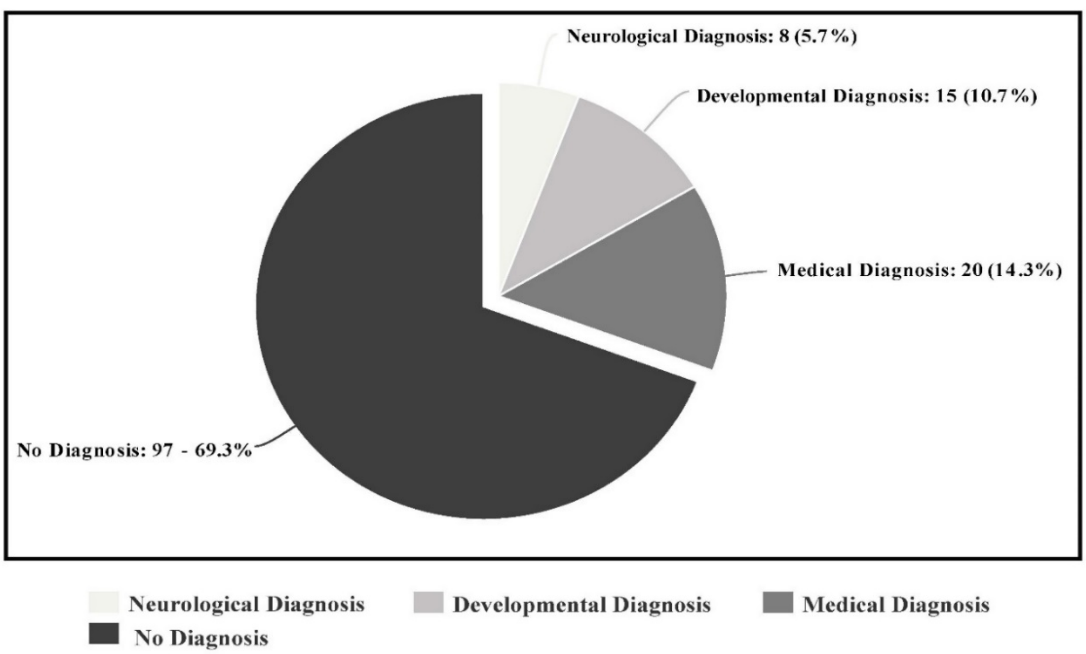

Figure 6. Categorized responses to survey question about diagnoses.

Children's Sleep Habits Questionnaire Data

The sample size for the CSHQ data was 140. The CSHQ was completed by 140 of the participants. The cutoff score of 41 on the CSHQ determines the likelihood of a clinical sleep disturbance (Owens et al., 2000). One-hundred percent of the sample in this study scored 41 or above on the CHSQ. Thus, it can be inferred that the likelihood of being clinically diagnosed with insomnia is high among this study's sample.

Child Sensory Profile-2 Data

The sample size for the CSP-2 data was 139 due to one participant not completing this portion of the study. The CSP-2 divides the sample into those who demonstrate typical responses to sensory input and those responding more or less than most others. Typical behavior is up to one standard deviation (SD) above and below the mean. Each additional SD (+/- 1 or +/- 2) indicates the severity of sensory, behavioral responses, both over and under responsiveness, as they deviate from typical sensory responses. The data on typical and atypical sensory behavior categories for quadrant behaviors are in Figure 7. The data for typical and more or less responsive sensory behavior categories for sensory system behaviors are in Figure 8. Figures 7 and 8 show participants' numbers in each category to the nearest tenth: 90 and 100, respectively.

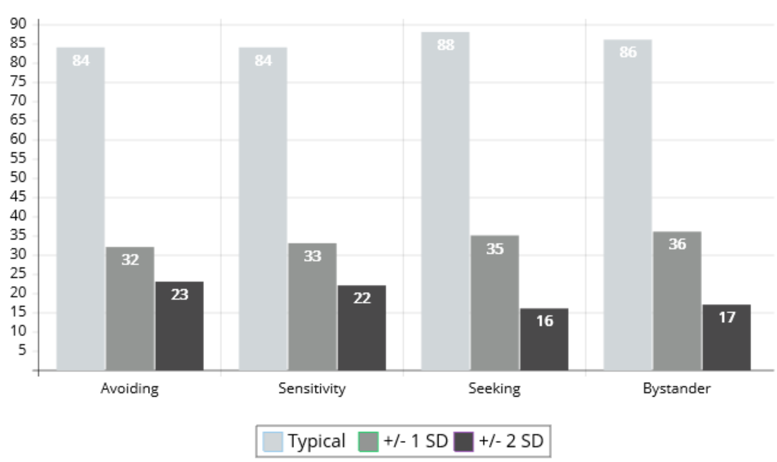

Figure 7. Distribution of sample from the mean on the CSP-2 for quadrant behaviors.

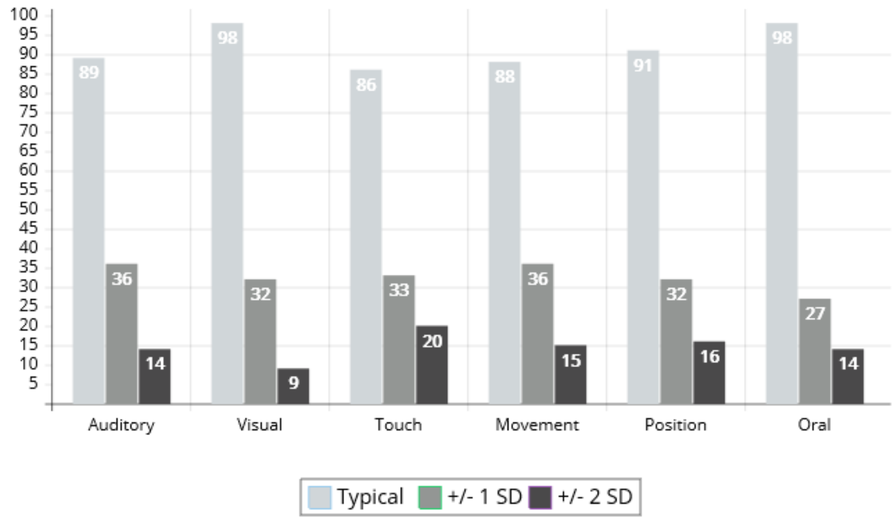

Figure 8. Distribution of sample from the mean on the CSP-2 for sensory systems.

Results for ANOVA

An ANOVA was conducted to determine if the means of the scores on the CSHQ of groups determined by the scores of the CSP-2 were statistically different. This comparison started by dividing participants by their scores on the CSP-2 into those who scored typically, +/- 1 standard deviation (SD), and +/2 SD from the mean for each quadrant and each sensory system. Once divided, an ANOVA was used to compare the sleep behavior scores on the CSHQ between each of these CSP-2 scoring groups. As seen in Table 2, the participants' CSHQ scores increased within all the CSP-2 quadrants as the scores moved in either direction from the mean on the CSP-2. The sensory system categories showed a different trend. In the sensory systems of auditory and visual, the trend was scores increase on the CSHQ as the scores of the CSP-2 move away from the mean. The difference occurs with the systems of touch, movement, position, and oral. The participants' sensory system scores on the CSHQ went down for those in the first SD from the mean and then increased with those in the second SD from the mean. Details of these statistical trends can be found in Table 2.

Table 2

Descriptive Statistics of CSHQ Scores Catgorized by CSP-2 Scores

Quadrant	CSP-2 Breakdown	No.	Mean	SD
Avoiding	Typical	84	57.1	7.7
	+/-1 SD	32	60.4	5.7
	+/-2 SD	23	61.5	8.0
Seeking	Typical	88	57.9	7.8
	+/-1 SD	35	59.1	6.5
	+/-2 SD	16	61.8	7.2
Sensitivity	Typical	84	57.4	7.5
	+/-1 SD	33	59.4	7.7
	+/-2 SD	22	62.3	6.0
Bystander	Typical	86	57.6	7.8
	+/-1 SD	36	59.7	7.1
	+/-2 SD	17	61.3	5.8
Sensory system				
Auditory	Typical	89	57.1	7.1
	+/-1 SD	36	60.0	7.2
	+/-2 SD	14	64.8	7.4
Visual	Typical	98	58.2	7.3
	+/-1 SD	32	58.7	7.5
	+/-2 SD	9	62.7	8.6
Touch	Typical	86	58.1	7.4
	+/-1 SD	33	56.7	6.6
	+/-2 SD	20	64.1	7.0
Movement	Typical	88	58.4	8.0
	+/-1 SD	36	58.2	6.4
	+/-2 SD	15	61.0	7.1
Position	Typical	91	58.7	8.0
	+/-1 SD	32	57.9	6.4
	+/-2 SD	16	59.7	6.4
Oral	Typical	98	58.5	8.0
	+/-1 SD	27	57.9	6.0
	+/-2 SD	14	61	5.4

The ANOVA was also used to determine if the means of the CSHQ scores were statistically different among participants who scored in the typical, +/-1 SD, or +/-2 SD ranges on the CSP-2. Two of the quadrant scores, avoiding and sensitivity, showed statistically significant differences between means of the scores of the participant groups. The scores of the other two quadrants, seeking and bystander, were not statistically significantly different at the *p*

= .05 level. The ANOVA of the sensory systems scores indicated two of the sensory systems, auditory, and touch, showed statistically significant differences between the participants' scoring category on the CSP-2. The other four sensory systems were not statistically significant at the $p = .05$ level. The specifics of the ANOVAs comparing CSHQ scores with divisions based on CSP-2 scores can be found in Table 3.

Table 3

ANOVA Results of CSHQ Scores Compared with CSP-2 Scoring Categories

Quadrants	*SS*	*df*	*F*	η	*p*
Avoiding	248.6	2	4.5	.25	.013*
Seeking	215.6	2	2.0	.17	.146
Sensitivity	448.8	2	4.2	.24	.017*
Bystander	248.0	2	2.3	.18	.109
Sensory systems					
Auditory	800.3	2	7.8	.32	.001*
Visual	163.0	2	1.5	.15	.24
Touch	743.8	2	7.2	.31	.001*
Movement	90.3	2	.80	.12	.45
Position	35.0	2	.31	.07	.74
Oral	105.8	2	.94	.12	.39

Note. η = eta.
*$p < .05$.

Results for *t* Test

Another way to analyze the sample was to divide the sample into two groups: those who have children with identified medical diagnoses and those who have children with non-identified medical diagnoses. The results could indicate a difference between those with a medical diagnosis and those without a known diagnosis of having sleep issues. An independent samples *t* test was conducted to explore the means between the two groups' scores on the CSHQ (see Table 4). The results of the *t* test indicated that the scores of the two groups were not statistically significantly different, $M = -1.42$, 95% CI(-4.13, 1.30), $t(138) = -1.03$, $p = .30$. This finding indicates that having a medical diagnosis did not significantly affect the scores on the CSHQ.

Table 4

Means, Standard Deviations, and T-Test Results of CSHQ of Those with and without Diagnosis

Group	No.	*M*	*SD*	*t*	*p*
Diagnosis	43	57.6	7.6	-1.03	.30
No Dx	97	59.0	7.4	-1.02	.31

Note. Equal variances assumed. Dx = Diagnosis.

An independent-samples *t* test was conducted to explore the means between the two groups, those with a diagnosis and those without a diagnosis, with each quadrant score and the sensory systems scores on the CSP-2 (see Table 5). This test's findings determined if a difference existed in the scores of the CSP-2 between those with and without a medical diagnosis. The mean scores of all the CSP-2 quadrants were significantly different at the p =. 05 level between the Dx group and those not declaring a Dx.

Table 5

Means, Standard Deviations, and T-Test Results of Subscales of CSP-2 of Those with and without a Diagnosis

Item	Group	No.	*M*	*SD*	*t*	*p*
Seeking	Dx	43	45.4	18.4	3.2	.002*
	No Dx	96	36.1	14.4	2.9	
Avoiding	Dx	43	47.1	15.6	2.6	.010*
	No Dx	96	39.8	15.3	2.5	
Sensitivity	Dx	43	43.8	14.1	3.7	.000*
	No Dx	96	35.0	13.0	3.5	
Bystander	Dx	43	42.0	16.4	2.8	.007*
	No Dx	96	34.5	13.9	2.6	
Auditory	Dx	43	22.1	7.00	1.7	.100
	No Dx	96	19.8	7.48	1.7	
Visual	Dx	43	14.7	4.80	2.2	.028*
	No Dx	96	12.9	4.49	2.2	
Touch	Dx	43	20.8	8.82	2.9	.004*
	No Dx	96	16.3	8.08	2.8	
Movement	Dx	43	17.0	7.11	2.8	.005*
	No Dx	96	13.5	6.34	2.8	
Position	Dx	43	13.5	6.74	2.3	.025*
	No Dx	96	11.0	5.63	2.1	
Oral	Dx	43	21.8	9.81	3.5	.001*
	No Dx	96	16.1	8.63	3.3	

Note. Equal variances assumed. Dx = Diagnosis.
*p < .05 (2-tailed).

The difference between means of the CSP-2 sensory systems between the two groups were also all statistically significant, except for the auditory scale. The findings shown in Table 5 indicated that the scores on the CSP-2 were statistically different between those with and without a medical diagnosis in all sensory quadrant behaviors and most of the sensory systems.

Analysis for Research Question 1

Research Question 1 asked the following: Does a correlation exist between sensory behaviors and insomnia behaviors in young children 3 to 10 years of age? A Pearson product correlational method was chosen to assess the strength and direction of the relationship between the scores of the CSHQ and the CSP-2. Certain assumptions must be met to assure the correctness of this correlational method.

Verifying Assumptions for Pearson Product-Moment Correlation

Evaluation of five assumptions establishes the appropriate correlational test. The research verified the first two assumptions involving the continuous variables, and each participant has a value for both variables. Based on visual inspection of an SPSS® scatterplot, the data appeared to have a linear relationship and no significant outliers. The fifth and final assumption establishes the bivariate normality of the data. The test of normality used to verify this assumption is the Shapiro-Wilk test. The Shapiro-Wilk's test, $p > .05$, verified the CSHQ, $p = .41$, variables were normally distributed. The four sensory quadrants' scores were determined not normally distributed, or nonparametric, by the Shapiro-Wilk's test, $p > .05$. Because this data set has more than 50 data points, data that are normal may be misrepresented by the Shapiro-Wilk's test (Laerd Statistics, 2018). Therefore, a graphical method of the quadrant data was employed to evaluate normality. Histograms of each quadrant (seeking, avoiding, bystander, and sensitivity) revealed the data were distributed normally. Therefore, to summarize,

the data were analyzed for normality using the Shapiro-Wilk's test and graphical depictions of the data. The results indicated the Pearson's product-moment correlation (*r*) was the appropriate correlational test for this data.

Correlation Analysis Data Findings

Pearson's product-moment correlations were conducted to determine the association between sensory processing measures and sleep behaviors. The sensory processing quadrants (seeking, avoiding, sensitivity and bystander) and the sensory processing sensory system (auditory, visual, touch, movement, position, and oral) were examined to determine a series of Pearson correlations on the 139 participants. Table 6 presents the Pearson product-moment correlation coefficients and their significance. In this study, $r = 0.1$ to 0.29 were considered to be small or modest relationships, $r = .30$ to .49 were considered to be moderate relationships, and $r > .50$ were robust relationships (Cohen, 2013; Portney & Watkins, 2015).

Table 6

Pearson Correlation Coefficients between CSP-2 Results and CSHQ Scores

Item	Seeking	Avoiding	Sensitivity	Bystander		
CSHQ	.26**	.30**	.26**	.23**		
	Auditory	Visual	Touch	Movement	Position	Oral
CSHQ	.36**	.19*	.30**	.22**	.17*	.12

Note. $r > .1$ modest, $r > .3$ moderate, $r > .5$ robust correlation.
**Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level.

The correlational analysis indicated specific sensory behaviors correlate positively with insomnia behaviors. There is a range of correlation between the CSP-2 quadrant scores and CSHQ scores. The correlations for seeking, $r = .26$, $p < .001$, sensitivity, $r = .26$, $p < .001$, and bystander, $r = .23$, $p < .001$, were positive and small, but statistically significant in relation to the CSHQ scores. This result indicates a slight relationship between the CSHQ scores and the quadrant scores of the CSP-2. The sensory avoidance behaviors had a statistically significant,

moderate positive correlation with insomnia behaviors, $r = .30$, $p < .001$. This finding means the presence of sensory avoidance behaviors is moderately related to insomnia behaviors in the children of this sample.

The specific sensory systems were analyzed using a Pearson product-moment correlation, and five of the systems, auditory, visual, touch, movement, and position, were statistically significant. The oral sensory system did not statistically correlate, $r = .119$, $p = .164$, with sleep behaviors. Moderate associations between the sensory systems of auditory, $r = .36$, $p < .001$, and touch, $r = .30$, $p < .001$, were shown with insomnia behaviors. These results suggest statistically significant positive correlations at various levels among insomnia behaviors and all sensory quadrants, as well as most specific sensory systems.

Analysis for Research Question 1.1

Research Question 1.1 asked the following: If correlations exist, do scores in specific quadrant scores of children predict behaviors of insomnia of childhood? To answer Research Question 1.1 and address the predictability between the two variables of the children's insomnia and sensory processing behaviors, multiple linear regression models were conducted.

Verifying Assumptions for Multiple Regression

Establishing the appropriateness of using multiple regression requires meeting eight assumptions (Laerd Statistics, 2018). First, the independent and dependent variables used for the regression are continuous. Linearity was confirmed using a series of scatter plots of the dependent variable, each of the independent variables individually, and also a scatter plot depicting the dependent and independent variables collectively. There were homoscedasticity and normality of the residuals in these data. One outlier was discovered in the data. The outlier was not removed due to the leverage and influential points being within the normal range. In

summary, all eight assumptions were met, and multiple linear regression was used to analyze this data.

Quadrant Regression Analysis Data Findings

Multiple linear regression was conducted with the dependent variable of the CSHQ scores and independent variables of the four quadrant scores from the CSP-2. The total sample was N=139 due to the exclusion of one participant who only completed one survey. The coefficient of determination (R^2) for the overall model was 10.4%, with a (ΔR^2) of 7.8%, a small effect, according to Cohen (1988, 2013). The overall model, including all four quadrants of the CSP-2, predicted statistically significant scores of the CSHQ, ($F(4, 134) = 3.909$, p =.005). The correlation coefficients for the individual quadrants are represented in Table 7; however, the findings were not statistically significant at the p = .05 level.

Table 7

Regression Coefficients in Predicting Change in the CHSQ with CSP-2 Quadrant Scores

Predictor	*B*	*β*	*SE*	*t*	*p*
Seeking	.080	.174	.057	1.408	.161
Avoiding	.120	.252	.065	1.856	.066
Sensitivity	.016	.030	.093	.175	.862
Bystander	-.053	-.106	.077	-.681	.497

Note. B = Unstandardized regression coefficient; *β* = Standardized coefficient.

Analysis for Research Question 1.2

Research Question 1.2 asked the following: If correlations exist, do scores in the sensory systems (i.e., movement, visual, auditory) have predictive properties in children with insomnia of childhood? To answer Research Question 1.2 and address the predictability between the two

variables of the children's insomnia and sensory processing behaviors, multiple linear regression models were conducted.

Verifying Assumptions for Multiple Regression

Multiple linear regression was chosen to predict CSHQ sleep behaviors from the sensory systems from the CSP-2 (i.e., auditory, movement, position). Linearity and homoscedasticity were confirmed visual inspection of plot graphs of residuals and predicted values. Independence of residuals was confirmed with a Durban-Watson statistic. No evidence of multicollinearity or outliers were present in the data. The assumption of normality was met by visually assessing a Q-Q plot. All assumptions were met, and multiple linear regression was employed to determine if the sensory system scores on the CSP-2 had predictive qualities in the CSHQ scores.

Sensory System Regression Analysis Data Findings

Multiple linear regressions was conducted with a dependent variable of the CSHQ total scores and independent variables of the six sensory system scores from the CSP-2. The total sample was $N = 139$; the exclusion of one participant occurred due to an incomplete survey. The coefficient of determination (R^2) for the overall model was 14.4%, with an adjusted R^2 of 10.6%, a small effect, according to Cohen (1988, 2013). The six systems, together, added statistically significantly to the prediction of insomnia behaviors, $F(6, 132) = 3.714$, $p = .002$, accounting for about 14% of the variability of the CSHQ.

As seen in Table 8, the auditory sensory system was the only statistically significant system to have predictive qualities on the results of the CSHQ. The unstandardized coefficient (*B*) represents the change in the slope of the dependent variable. For each unit of the sensory system scores (independent variables), the CSHQ (dependent variable) will move in the direction

and amount of unstandardized coefficient (*B*). For example, in this study, for the increase of one unit on the CSP-2 in the auditory score, the CSHQ will move in a positive direction by .32 units.

Table 8

Regression Coefficients in Predicting Change in the CHSQ with CSP-2 Sensory System Scores

Predictor	*B*	*β*	*SE*	*t*
Auditory	.321*	.32	.114	2.811
Visual	-.057	-.04	.162	-.353
Touch	.158	.18	.112	1.412
Movement	-.009	-.01	.123	-.076
Position	-.082	-.07	.137	-.600
Oral	-.018	-.02	.077	-.232

Note. B = unstandardized regression coefficient; *β* = standardized coefficient.
*$p < .05$.

Linear Regression Models of Subscales of the CSHQ

The second part of this research question was to investigate the six sensory systems and the prediction quality of the subscales of the CSHQ. The six sensory areas include auditory, visual, touch, movement, position, and oral. The eight CSHQ subscales include bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep-disordered breathing, and daytime sleepiness.

Verifying Assumptions for Multiple Regression for Subscales

A series of eight multiple regression models were run to predict the CHSQ subcategories' outcomes from the CSP-2 sensory systems. Assumptions of the models were met, and the variables were all continuous. Linearity was confirmed by visual inspection of partial regression and residuals plots against the predicted values. Durban-Watson statistics were within an appropriate range to verify the independence of residuals. Homeoscedasticity and lack of multicollinearity were assessed and confirmed. No outliers were found in the majority of the models. Disordered breathing had three outliers, but the linear model was still assessed due to

leverage and influential points being within a normal range. Normal distributions were confirmed with a visual inspection of the Q-Q Plot. With all the assumptions met, multiple linear regression models were conducted and analyzed.

Regression Model Data Analysis for Each Subscale of the CSHQ

All six sensory system variables, together, significantly contributed to the prediction of two CSHQ subscales of bedtime resistance, $F(6, 132) = 2.382$, $p = .032$, and daytime sleepiness, $F(6, 132) = 5.357$, $p < .001$; no others subscales met significance. All the multiple linear models were analyzed, and two models demonstrated significant predictive variance. The two CSHQ subscales with the highest coefficients of determination (R^2) were bedtime resistance ($R^2 = .098$) and daytime sleepiness ($R^2 = .196$). This finding means the sensory system variables, as a whole, predicted 19.6% of the variance of daytime sleepiness and < 10% for all the other CSHQ subscales, as seen in Table 9. All of the coefficient findings in this model indicate small effects (Cohen, 1988, 2013).

Table 9

Regresssion Coefficient Models for Predicting CSHQ Subscales with Sensory Systems

Subscale	R^2	ΔR^2
Bedtime resistance	.098*	.057
Sleep onset	.074	.032
Sleep duration	.077	.035
Sleep anxiety	.071	.029
Night wakings	.067	.025
Parasomnias	.089	.048
Disordered breathing	.048	.005
Daytime sleepiness	.196*	.159

Note. R^2 = Coefficient of determination. ΔR^2 = Adjusted R^2.
*$p < .05$.

The individual sensory system score coefficients with each CSHQ subscale were analyzed to examine which sensory systems significantly influenced the subscale scores. The

subscale of bedtime resistance had three sensory systems (auditory, visual, and positioning), that significantly contributed to the scores' variance. The auditory system accounted for the most positive variation in the bedtime resistance score with the influence of an unstandardized coefficient (*B*) of .11. The sensory system of auditory had the most influence on the subscale of sleep anxiety. Night wakings appeared to be influenced most by the vision system; the parasomnia subscale was influenced by the movement system, and daytime sleepiness the auditory system. Sensory system scores did not significantly influence the three remaining CSHQ subscales of sleep onset, sleep duration, and disordered breathing. In summary, these findings suggest that auditory processing scores have a statistically significant influence on three CSHQ subscales. Statistically significant relationships are represented in Table 10.

Table 10

Multiple Regresssion Results for CSHQ Significant Subscales Predicted by CSP-2 Sensory System Scores

CHSQ subscale	CSP-2 sensory system	*B*	*SE*	*t*	*β*
Bedtime resistance	Auditory	.11*	.05	2.10	.24
	Visual	-.16*	.07	-2.20	-.22
	Position	-.14*	.06	-2.20	-.25
Sleep anxiety	Auditory	.08*	.03	2.40	.28
Night wakings	Visual	-.09*	-.04	-2.30	-.24
Parasomnias	Movement	.08*	.04	2.10	.24
Daytime sleepiness	Auditory	.12*	.04	2.73	.30

Note. *B* = Unstandardized regression coefficient. *β* = standardized coefficient.
$^{*}p < .05$.

Summary

Chapter 4 (results) section of this dissertation presented the data collection procedures, demographics of the sample, and analysis of the data that answered the three research questions. The results of this quantitative, exploratory study demonstrated the existence of small but statistically significant relationships between sensory-based behaviors and insomnia symptoms

of children. The regression analysis of the CSP-2 quadrant scores and the CSHQ total summative scores showed a statistically significant prediction of 10.4% of variance but, individually, the quadrants relationships were not significant. The regression analysis of the sensory systems, as a whole, with the CSHQ summative score, was similar to a statistically significant prediction of 14.4%. In the examination of the regression prediction between the subscales and the sensory systems, only bedtime resistance (R^2 = 9.7%) and daytime sleepiness (R^2 = 19.6%) subscales were significantly predicted by the sensory systems. The auditory sensory system appeared to have the most influence on the subscales, but vision, movement, and positioning all had some degree of prediction of the subscale scores. This information could lead to new methods of evaluating the client's sleep participation and sleep preparation. It may also lead to treatment link considerations between sensory processing intervention and sleep performance. Overall, the relationships and predictive behaviors explored in this study between sleep behaviors and sensory behaviors could inform the occupational therapy practitioner's care of pediatric clients who have trouble sleeping.

Chapter 5: Discussion

Introduction

The treatment of sleep disorders in children should be a priority in today's healthcare system because up to 40% of children are having sleeping difficulties (Galland et al., 2012; Kothare & Pomeroy, 2008; Meltzer et al., 2010; Meltzer & Mindell, 2006; Mindell et al., 2009; Owens, 2005; Owens & Mindell, 2011; Sadeh et al., 2011). This study's purpose was to explore the relationship between sensory processing and sleep performance skills in children. The study examined if sensory behaviors, quadrant or sensory systems, predicted specific sleep behaviors in children. Current literature on pediatric sleep and the relationship of sleep and sensory behavior is scarce and provides minimal consensus. This study has provided additional data related to the relationship between sensory and sleep behaviors in children and points to the possible role of occupational therapy in sleep medicine. This chapter discusses the present study results as related to previous studies on a similar topic, ideas for further research, and recommendations to the practice of occupational therapy.

Theoretical Background of the Study

The EHP occupational therapy model provided a foundation for this study and serves as a framework for the discussion of the results, limitations, and implications of this study. The EHP is an occupational therapy-based practice model that highlights a person as existing in a transactional interaction with external constructs called contexts (Dunn et al., 1994). Often in research and therapeutic intervention, the person is primarily viewed according to their deficits in performance or one singular personal aspect rather than their performance as it relates to the transactional relationship with other people, objects, time, and culture. The EHP model

emphasizes this transactional relationship between the person and contexts to advance toward desired or required occupational performance.

As stated, the central constructs within the EHP model are the person, contexts, and occupational performance. The person construct is the individual's experiences, skills, and abilities (Dunn et al., 1994). A context influences the environment on the person, including the physical, temporal, social, and cultural aspects of one's environments (Dunn et al., 1994). The EHP model states that a person's actions or occupations are heavily influenced by the contexts surrounding the person. This study explored behavioral reactions to sensory input (person) as related to the children's sleep behaviors (occupation) from the caregiver's perspective.

Person

The current study design explored aspects of the sensory processing skills of the person. The design of the CSP-2 is to evaluate the daily sensory processing patterns of children (Dunn, 2014). Specifically, the findings of the CSP-2 helps determine how the children's sensory processing skills augment or impede occupational performance. The CSP-2, when completed by a close caregiver, can give excellent data on the child's sensory behaviors as they participate in daily occupations. Having sensory performance information helps occupational therapy professionals develop treatment plans to enhance occupational performance. However, the daily interactions assessed by the CSP-2 do not involve sleep occupations. This study employed the CSHQ to assess the sleep behaviors of the participants' children.

The CSHQ assesses children's sleep habits and potential sleep disturbances (Owens et al., 2000). These sleep behaviors, patterns, and disturbances are unique aspects of the person. Some of the personal aspects assessed by the CSHQ include the fear of sleep or darkness and anxiety around sleeping alone. Whether related to sleep or sensory processing, these personal attributes

are essential and must be assessed when exploring reasons children are not sleeping. Higher scores on both assessments indicate a negative effect on the child's daily performance of occupations and sleep.

Occupational Performance

Another EHP construct explored within this research study was the occupation and tasks of sleep. This research study assessed the occupation of sleep participation globally with the CSHQ (Owens et al., 2000). The CHSQ captures aspects of bedtime and sleep performance, such as nightly routine, how long it takes to go to sleep, night wakings, and the ease of waking in the morning. These sleep aspects are essential to the overall quality of sleep performance, but this study did not analyze specific aspects of sleep performance.

The profession of occupational therapy breaks sleep into three areas, rest, sleep preparation, and sleep participation (AOTA, 2020). This study focused on sleep participation. In the fourth edition of the OTPF, sleep participation is defined as the ability to conclude the activities of the day, quieting the mind, and maintaining a restful night's sleep (AOTA, 2020). The inclusion criteria required parental-reported sleep participation difficulty. The current data determined all of the participants' children scored above the cut-off scores on the CSHQ, indicating the participants' children had a strong chance of having a clinical sleep difficulty (Owens et al., 2000).

Contexts

Contexts encompass the environment aspects in which an occupation takes place. Specifically, contexts include the physical, social, cultural, and temporal domains surrounding the person (Dunn et al., 1994). Contextual influences strongly affect the occupation of sleep. Research has shown familial aspects such as cultural background, employment, education,

dynamics, and stressors have a substantial impact on sleep patterns (Blair et al., 2012; Chen et al., 2014; Crabtree et al., 2005; Giannotti & Cortesi, 2009; McDonald et al., 2014). Those aspects affect the family globally, but specific contextual aspects affect each family member individually, including children. These individualized contextual influences may include sleep expectations, location, duration, or sleep hygiene routine. Contexts are accounted for in this study with the implicit understanding that occupational performance cannot be performed outside of context, an assumption of EHP (Dunn et al., 1994). Both the CSP-2 and CSHQ inquire about daily behaviors as they occur within the context of the natural environment. However, the collection of specific details of the contexts did not occur within this study.

Another essential aspect of EHP is the transactional influence context has on the child (Dunn et al., 1994), as shown in Figure 2. This influence means the contextual components affect the child and occupation, and the child and occupation, in turn, affect the contexts. Children will change their sleep routines, location, or duration when a sleep disruption occurs to correct poor sleeping behaviors. Children and their parents may attempt to address the contextual aspects surrounding sleep, such as sleep hygiene routine, bedding, or the choice of room before visiting a physician for the sleep disturbance (Green & Brown, 2015). Parents recognize sleep issues in their children and attempt to remediate before visiting a medical professional. Because a delay in seeking professional medical assistance occurs, a parent-reported sleep issue was the minimal standard for inclusion in this study.

Discussion of Measures within Studies

A challenge in interpreting and comparing results of prior studies exists secondary to the variety of instruments used and their operational definitions of the constructs. Studies within this line of research use various tools measuring the sensory processing and sleep behaviors of

children. Each of the tools measures the same construct but may use different terminology or measure different aspects of the overarching construct. These differences in the tools may have an impact on how the construct is measured or reported. In turn, this can affect the results and the ability to compare and contrast the studies.

Within the occupational therapy, there are different theoretical applications to the sensory processing construct. This dissertation used the CSP-2 for the measurement of sensory processing behaviors of the children. It is vital to remind the reader that the CSP-2 is one of a family of assessments based on Dunn's sensory processing theory. Several published studies used other versions of the Sensory Profile, based upon the same theory as the CSP-2. In contrast, the Foitzik and Brown (2018) and Spira (2014) studies measured sensory constructs on the Sensory Processing Measure, which uses a different theoretical approach to sensory processing (Parham & Ecker, 2007). Therefore, the Sensory Processing Measure may report sensory-based performance using different language and refer to other sensory categories (i.e., planning and ideas) not mentioned in the Sensory Profile assessments. Both tools are well established in the profession of occupational therapy and have established validity and reliability (Miller-Kuhaneck, Henry, Glennon, & Mu, 2007; PsychCorp, 2014). Both assessment tools are appropriate for determining their recommended age groups' sensory processing behaviors but utilize different terminology.

The current sensory assessments in the profession of occupational therapy do not address sleep behaviors. For some children with sensory processing issues, sleep may be the only occupation affected. Accommodation of this gap in addressing sleep behaviors and sensory processing occurred with the addition of the CSHQ. A majority of similar studies also used the CSHQ to capture the occupational deficits of sleep, but some used other sleep assessments. The

results appeared to indicate a consensus on terminology and measured comparable aspects of sleep regardless of assessment used.

Discussion and Interpretation of Results

This study consisted of one research question with two subquestions that explored relationships between sensory processing and sleep performance and predictive abilities of sensory processing aspects of the person on the occupation of sleep. The data of this study indicated a positive relationship between sensory processing and the occupation of sleep. The data also suggested predictive qualities exist between the sensory processing of children and their ability to sleep. A discussion of the details of the findings follows.

Demographic Comparisons

Age. This study's sample consisted of 140 parents of children 3-10 years of age with a parent-reported sleep issue. This dissertation was the first to study sensory processing and sleep with children 3-6 years of age and added information to the four existing studies for children ages 3-10 years (Foitzik & Brown, 2018; Reynolds et al., 2012; Spira, 2014; Shochat et al., 2009). A skewing of the ages represented in this study occurred with a majority of the sample (65%) being 3-6 years of age, the age range missing from the current literature. Three years of age was the most reported (26.4%). The previous studies, with similar age ranges, varied in the participant number, but all included under 60 participants. This dissertation doubled the number of participants and data of the previous studies, increasing the power behind the findings.

Race. The previous studies rarely reported race in the findings. One reason may be that race is a social construct and is viewed as less significant in clinical research (Grandner, Williams, Knutson, Roberts, & Jean-Louis, 2016). However, in this study, the sample included 83.6% White children, and African American/Black, Hispanic, and American Indian represented

9.3% of the sample; 7.1% reported other in the race category. The participants in this study all reported living in the United States. It is important to note many of the currently reported sensory processing and sleep studies occurred outside the United States; three took place in Israel and one each in Canada and Australia. The other pediatric study and the lone adult study did not report locales for their participants.

Reporting research location and participant race is essential to the research because culture heavily influences sleep preparation and participation (Owens, 2004). Culture dictates familial habits and routines around sleep, including sleep hygiene routine, bedding choices, sleep location, napping rituals, and sleep duration (Johnson, Jackson, Williams, & Alcántara, 2019). Cultural habits and routines of daytime activities also influence sleeping patterns (Bar-Shalita et al., 2008). Reporting race and physical locations of research is critical for external validity consideration.

Income, education, and socioeconomic status. Information on socioeconomic status and caregiver education is omitted from the published studies on sleep in general and specifically sleep and sensory processing articles. Socioeconomic status has been shown to affect with whom, how, and where people sleep (Williams, 2013). Caregiver education is an essential contextual component of sleep, and correlations have been drawn between education level, income, and socioeconomic status (Wolla & Sullivan, 2017). Although the construct of socioeconomics is essential, only two of the previous studies reported the caregivers' education or socioeconomic status in their study (Shochat et al., 2009; Tauman et al., 2017). Neither of those provided discussion on the impact value of income, education level, or socioeconomic status on their findings.

Demographic information for the current study included socioeconomic status and education of the caregivers. Overwhelmingly, this study's participants had at least some college (8.6 %) or received a college degree (72.8%). It may be inferred that because education, socioeconomic status, and income are positively correlated, income may also be in the higher range (Wolla & Sullivan, 2017). However, this is only partially true for the current sample; 55% had an income of over $75,000, while 42.9% were below $74,999. These results do not reflect the educational level of all caregivers in the family unit, but only the one who answered the survey. The education levels of the participants in other studies were mostly omitted. The one that did report the education demographic was similar, stating that college graduates comprised the majority of the sample.

Reported diagnoses. As part of the inclusion criteria, all the participants' children exhibited a parent-reported sleep difficulty. According to the results of their CSHQ, all study participants' children exhibited characteristics of a clinical diagnosis of insomnia of childhood, with each child's scores being above 41 (Owens et al., 2000). However, none of the participants reported a behavioral sleep diagnosis from a medical professional. This finding was surprising as one of the collection sites was a behavioral sleep clinic. It is not known whether the recruits came from the internet forums or the behavioral sleep medicine clinic because the surveys were submitted anonymously.

Approximately 31% of the participants reported their child had other medical conditions. The diagnoses were categorized into developmental, neurological, and other medical diagnoses. The method for the division was described and visually depicted in Chapter 4. The inclusion criteria of this study required a sleep performance difficulty but did not control for particular

diagnoses. Numerous diagnoses were reported in this study: those with and without documented relationships to sleep disturbances.

Sixty-nine percent of this research sample reported having no medical professional's diagnosis but did have a parent-reported sleep issue. This finding is concerning, as all the children in the sample displayed poor sleep symptoms and scored above the cut-off score on the CSHQ, indicating a higher probability of insomnia of childhood. This under-identification is similar to that of the general population, as many physicians are not asking questions regarding sleep and are underdiagnosing sleep issues in children (Blunden et al., 2004). Also, many caregivers are not aware of typical sleep patterns in children and often do not report the sleeping issue to medical professionals (Blunden et al., 2004; Honaker & Meltzer, 2016; Robinson & Richdale, 2004; Smedje et al., 1999; Stein et al., 2001). This study's finding indicates an underdiagnosis or lack of awareness of sleep concerns of the pediatric population.

Previous studies have researched the sensory and sleep qualities of diverse groups of children. Three of the six previous studies studying sleep in children studied typically developing children, with no known sleep issue (Foitzik & Brown, 2018; Shochat et al., 2009). Two other studies researched children with diagnoses of autism or sensory modulation disorder (Reynolds et al., 2012; Spira, 2014). One study involved children who had a behavioral sleep diagnosis and were currently in treatment at a sleep clinic (Tauman et al., 2017). The current study aimed to find children who had been identified as having a sleep disturbance but were not receiving therapy for sensory processing concerns. The results of this dissertation add to the information on typically developing children.

Subgrouping Comparisons

CSHQ score comparisons. Those with and without a diagnosis were analyzed to determine if a difference existed between poor sleep behaviors. In this study, the findings revealed no significant difference between the scores on the CSHQ between those with and without a diagnosis. Currently, there is not a consensus among researchers. Of the two published articles studying sensory and sleep behaviors with those with and without a diagnosis, only Reynolds et al. (2012) reported a comparison of sleep behaviors. Reynolds et al. found a significant difference between sleep scores of those with a diagnosis of autism spectrum disorder and typically developing children. Reynolds et al. agreed that other studies supported the link between sleep disturbances among the autism spectrum disorder population. Tauman et al. (2017) did not report on the comparison between the sleep behaviors between those in their experimental and control groups. Researchers are not in agreement regarding these findings.

CSP-2 score comparisons. The sensory processing scores of the two groups, diagnosis and without a diagnosis, were also analyzed. The current study found the two groups' sensory processing scores on the CSP-2 were significantly different in all four sensory quadrants and most sensory systems, except for the auditory scale. The current results indicated that individuals with a medical professional issued diagnosis had a higher probability of having sensory processing differences.

Before comparing to other studies, it is essential to state that the current study did not isolate specific diagnoses before analysis. Reynolds et al. (2012) obtained a similar conclusion in finding children with autism spectrum disorder had a significantly higher degree of difference across all four sensory quadrants than their typical peers. Still, there was no information reported related to comparisons at the sensory system level (Reynolds et al., 2012). In contrast to the

current study, Tauman et al. (2017) reported finding a significant difference between the behavioral insomnia group and their control group in one sensory quadrant, sensation avoiding. This finding is unique; it only identified one sensory quadrant. The other two studies and the current study found differences between the two group scores on all four quadrants. When analyzing the sensory systems, Tauman et al. found oral processing, and the current study found auditory processing to be significantly different between those with and without a reported diagnosis. Continued research is recommended to discover a possible consensus.

Some reasons could explain the varied findings. One reason for the results may be that sensory processing differences could influence children's development, therefore contribute to parents seeking medical guidance. This medical guidance could lead to a formal diagnosis; therefore, a potential for all four sensory processing quadrant scores could differ from those with and without a diagnosis (Botergerg & Warreyn, 2016; Dunn, 2001; Tauman et al., 2011). Another reason may be that, in some families, the child's sensory processing dramatically differs from the caregivers' sensory processing. This discrepancy may cause difficulties during occupational participation and co-occupations resulting in the parent seeking medical advice. These possible explanations could lead to a higher rate of visiting a medical professional, which may ultimately lead to a developmental or neurodevelopmental diagnosis. These explanations are just speculation, as a specific reason is unclear from the current data. The auditory processing results not being significantly different between those with and without a diagnosis is harder to explain. Understanding this finding is not achievable within this study's context due to the lack of a full understanding of the children's diagnoses.

Further analysis of CSP-2. The current analysis divided the sample into groups of children whose sensory processing was like the majority of others and children whose sensory processing deviated over one standard deviation (SD) away from the mean, both above and below. Descriptions of the analysis of the divided data are below.

Quadrant analysis. An ANOVA found the mean CHSQ scores of the children significantly increased across all four of Dunn's sensory processing model quadrant scores as the participant's scores moved away from the mean, in either direction. This analysis found evidence that those with sensory processing difficulties are more likely to have insomnia symptoms as measured by the CSHQ. This result aligns with previous studies that found that children with autism spectrum disorder scored higher in the sensory profile quadrant scores and demonstrated increased sleep difficulties than the control group (Reynolds et al., 2012). This occurrence of the increase in disruptive sleep behavior scores as the sensory scores moved away from typical behavior supports this study's hypothesis that sensory processing appears to impact overall sleep behavior.

Further analysis using an ANOVA also confirmed that statistically significant differences among the two groups occurred in the low neurological threshold quadrants, avoiding, and sensitivity. Overall these findings agree with the results reported by Engel-Yeger and Shochat (2012) when looking at adults and for children, as reported by Spira (2014), Reynolds et al. (2012), Shochat et al. (2009), Vasak et al. (2015), and Tauman et al. (2017). There is significant support in the literature which confirms the correlation that children exhibiting behaviors within the avoiding and sensitivity quadrants, low threshold quadrants, are more likely to exhibit insomnia symptoms (Reynolds et al., 2012; Shochat et al., 2009; Spira, 2014; Tauman et al., 2017; Vasak et al., 2015).

According to Dunn's sensory processing model, this phenomenon could be explained by the increased sensitivity to sensory input that occurs in children who have a low neurological threshold. Children with sensory sensitivity react with a passive reaction, meaning they may not react or speak about it. Still, they may be very aware of any sensory input which comes in through their sensitive systems. Children with avoidance reactivity react with active behaviors; they will verbally state annoyance and move to avoid the incoming sensory input. Both of these subtypes would stay awake or awaken to sensory input because their bodies interpret input as dangerous or alerting.

Sensory system analysis. The sensory system data were similar to that of the quadrants for the auditory and visual systems. The further away from the mean the sensory system scores of auditory and vision were on the CSP-2, the higher the CSHQ scores. This phenomenon could be explained by the close connection between the calming of the visual and auditory systems are to the occupation of sleep (Velluti, 1997). One of the necessary sensory behaviors which must occur before sleep are the eyes closing; this occludes the vision system and prepares the body for a lower arousal level for rest (Velluti, 1997). Auditory, the other system significantly related to insomnia scores, is often calmed by the child or an adult before sleep (Velluti, 1997). This modulation could occur by reading a story, singing a lullaby, or saying a prayer. If this calming or decreased arousal level doesn't occur, the arousal level could remain heightened at bedtime and interfere with the sleep process.

Other researchers have found relationships between all the sensory systems and sleep behaviors with oral, smell, vision, and tactile reported as the most prominent systems found in a majority of the studies (Engel-Yeger & Shochat, 2012; Foitzik & Brown, 2018; Reynolds et al.,

2012; Spira, 2014; Tauman et al., 2017, Velluti, 1997). Discussions about the strength and direction of these relationships are in the next section.

Correlations between the CSP-2 and CSHQ

Quadrant findings. The investigation of the first research question regarding relationships between sensory behaviors and insomnia behaviors in young children 3 to 10 years of age yielded significant relationships. The results indicated small but statistically significant positive correlations between CSHQ scores and the sensory processing quadrant scores of seeking, $r = .26$, sensitivity, $r = .26$, and bystander, $r = .23$. There was a slightly higher, moderate correlation for the avoidance quadrant behaviors, $r = .30$, and insomnia scores. This finding suggests a higher probability of having sleep issues if a child has sensory avoidant behaviors. These results support the previous studies, as reported below.

Reynolds et al. (2012) found similar findings to the current study with moderate correlations across all four the sensory quadrants. Engel-Yeger and Shochat (2012) found significant low to moderate positive relationships between those in the low neurological threshold quadrants, sensitivity, and avoiding. Shochat et al. (2009) report finding modest but positive correlations between sensory sensitivity and seeking quadrants and sleep behaviors. These historical and present findings support the neurological sleep literature and theories, stating that poor sleepers tend to have a higher state of arousal or sensory sensitivity (Engel-Yeger & Shochat, 2012; Perlis, Shaw, et al., 2011; Rechtschaffen, 1968). In contrast, Vasak et al. (2015) and Engel-Yeger and Shochat (2012) did not find any relationship between sleep behaviors and the registration quadrant. One hypothesis behind this finding is that people who fall into the low registration quadrant of sensory processing have difficulty registering stimuli that would wake them during sleep (Vasak et al., 2015).

Previous studies also revealed some negative correlations. Foitzik and Brown (2018) discovered statistically significant but negative low to moderate relationships between sensory behaviors and the CSHQ scores. The Engel-Yeger and Shochat (2012) and Foitzik and Brown studies of typical adults and children found seeking behaviors were negatively correlated with sleep performance, indicating those who present with sensory seeking behaviors may have less trouble sleeping. With a high sensory threshold, sensory seekers often spend the day seeking input from their environment, which may explain the sensory seeking quadrant finding. Seekers are also very active in their pursuit of sensory input (Dunn, 1997, 2014). Higher daytime activity reduces the amount of time it takes to go to sleep and increases the time children are in deep sleep (Physical Activities Guidelines Advisory Committee, 2008; Singh, Kogan, Siahpush, & Van Dyck, 2008). This finding is in the inverse of the current research result, which found a positive correlation, $r = .26$, for seeking and higher CHSQ scores, indicating sensory seeking could be contributing to insomnia. Because a consensus has not been found, further studies in sleep and sensory processing quadrants could help build other theories and clinical practices around sleep medicine.

Sensory system findings. As demonstrated by the results of the current study and previous studies researching the sleeping patterns of children with and without sensory processing issues, children have various sleeping and sensory processing patterns (Dunn, 1997, 2014). It is essential to state that both wake and sleep behaviors are affected by sensory processing abilities (Dunn, 2007; Vasak et al., 2015).

The sensory system analysis using the individual sensory systems as variables impacting sleeping behaviors demonstrated statistically significant relationships. Positive moderate relationships were discovered between auditory and touch sensory systems and sleeping

behaviors. Also, visual, movement, and position systems were all modestly correlated with sleep scores. The only system which did not have a significant correlation was the oral system in the present study. Dunn's sensory processing model details sensory processing's effect on an individual and the brain activity during sleep discovered by Dement and Kleitman (1957). All the sensory systems impact the person's occupations throughout the day, and it could be hypothesized that sensory processing also impacts sleep behavior.

This study indicates that the oral system does not have a statistically significant relationship with sleep behaviors measured on the CHSQ. The oral system's sensory processing definition includes responses to touch and taste within the mouth (Dunn, 2014). The overall reduction of oral input during sleep may explain this finding, but we know children are different pragmatically. Often children suck their thumb to calm during sleep routines, or they may mouth breathe, leaving the mouth cavity open to the environment. The percentage of children who mouth breathe is unknown and often underdiagnosed (Junqueira et al., 2010). Having a wet or dry mouth may cause a difference in sleep performance as it may awaken the child to retrieve a drink or cause them to dry their face. Even accounting for mouth breathing and thumb sucking, oral stimulation is often decreased while sleeping and may have led to this finding. Additional research is recommended to investigate the relationship between the sensory system's impact on sleep performance.

Previous studies found all the sensory systems were related to sleep performance at various degrees. The sensitivity of touch, auditory, and movement was found to be the most frequently associated (Foitzik & Brown, 2018; Shochat et al., 2009). Engel-Yeger and Shochat (2012) found statistically significant relationships between sleep quality and sensitivity of vision and touch, along with avoidance of auditory in adults. Spira (2014) found all the systems were

statistically significantly associated with one or more of the sleep difficulty categories. Specifically, Spira found that taste/smell sensitivity and visual/auditory sensitivity had more significant relationships with sleep issues. Superficially, Spira's finding could contrast the current findings, but the tool used in her study, the Sensory Processing Measure, groups taste with smell into one category. The CSP-2, used in this study, does not measure smell at all and groups taste with other oral processing components. Additionally, Reynolds et al. (2012) reported the auditory reactions were the most distinctive in predicting good versus poor sleepers. Current research has recognized the critical relationship of sensitivity to touch, vision, and hearing to sleep disturbances across studies of all ages. These findings are based upon only six studies with children and one with adults looking at the relationships between sleep and sensory behaviors.

In contrast, Foitzik and Brown (2018) found significant negative correlations between the sensory system behaviors of touch, taste/smell, and planning and ideas, as measured by the Sensory Profile Measure and sleep duration, a subscale of the CSHQ, meaning that atypical behaviors in touch, taste/smell, and planning and ideas lead to more extended sleeping patterns. Their study was the first to find negative correlations between sleep behaviors and sensory system behaviors across pediatric or adult studies. The results of all the studies discussed in this section are not conclusive, and further research on the relationship between sensory processing, specifically sensory system effects and sleep behaviors, is indicated.

Several legitimate questions need to be addressed through further research regarding the relationship between sensory processing and sleep behaviors in children. There is no valid, reliable occupational therapy assessment that examines participation in sleep across the lifespan. It is recommended that occupational therapy researchers develop a new tool or revise a current

tool to examine this essential occupation. Second, it would be important to delineate uniform use of sensory assessments so that findings can be used to determine evidence of consensus. Lastly, the results of this study point to some beginning evidence for occupational therapy intervention for sleep disorders. Further research of those treatments could benefit all children and possibly lessen the effects of the public health issue of sleep deprivation (Institute of Medicine, 2006).

Predicting Sleep Behavior with the Sensory Behaviors

The current study used linear regression models to examine the extent to which sensory systems and sensory quadrants predict sleeping difficulties. The effect sizes of 10-29% (small), 30-49% (medium), and ≥ 50% (large) were used in this interpretation (Cohen, 1988, 2013). The summary model indicated all the sensory quadrants, together, predicted 10.4% of the variation of the scores of the CSHQ. It is important to note that, while there is a small effect size, the statistical effect could be influenced by the sensitivity of the measures used, the assessment's ability to discern those with and without atypical sleep or sensory behaviors. For example, the CSP-2 has clear cut-off scores between the separate categories (i.e., more than others, less than others, or like the majority) on the continuum, based on one substantial national normative research sample. However, the individual test items were designed to identify behaviors that are further away from typical behavior (Dunn, 2014). Dunn's sensory processing model describes an individual's typical sensory processing as a continuum that ranges from -1 SD to +1 SD (Dunn, 2014). The individual's range of responses could vary and might affect linear regression statistics.

Individually, the quadrants were not statistically significant predictors of the sleep behaviors measured by the CSHQ. To further interpret the data, linear regressions were

conducted to observe the variance on CSHQ subscales by the sensory systems (bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, and parasomnias). As a group, the sensory systems accounted for almost 10% of the variance in bedtime resistance. Further analysis found that the subscale of bedtime resistance was significantly affected by three sensory systems: positively by the auditory system scores and negatively by the visual and positioning system scores. These findings mean that bedtime resistance increases when a person demonstrates more sensitivity to auditory input, but not with visual and positioning input. This negative coefficient finding is a new finding in this line of research.

The current findings are interesting from a sensory-based perspective. The results found that sensory systems together had a very small effect, statistically, on bedtime resistance. Occupational therapy practitioners may disagree, as many bedtime resistance behaviors are hypothesized to be based on sensory needs. Examples such as needing food or a drink to settle or adding one more story all have a potential sensory-based need as an underlying cause. The statistics do not agree with the pragmatic reasoning. The positive influence the auditory system had on bedtime resistance was understandable from a sensory-based perspective. When sensitivity in the auditory system occurs, it keeps the body in an alert state. This alert state would keep the child awake, therefore, increasing a tendency for bedtime resistance.

The vision and positioning's negative effect on bedtime resistance is more thought provoking. The findings indicate that having more or much more than others in the reactivity of vision and positioning would decrease the overall score on bedtime resistance. Dunn's sensory processing model states that people who report more or much more than others often demonstrate difficulty managing their behaviors to incoming input. Those individuals may or may not be able to modify their environment to their sensory needs. However, they may actively

avoid difficult sensory situations. For instance, a child with difficulty managing visual input may actively occlude their vision by closing their eyes or covering their eyes with bedding. The removal of the visual input could facilitate the body's overall calming and settling to sleep faster. A therapist may encourage the caregivers to remove visual clutter, paint the bedroom a calming color, or use ambient lighting to encourage calmness.

According to Dunn's sensory processing model, body position is the position of the body, the pull on the individual muscles of the body, or muscle tension (Dunn, 2014). Children who score more than or much more than others in body positions react to the constant need to move. Children who have difficulty reacting to various body positioning require external support, visually appear weak, or have a need to cling to objects in their environment (Dunn, 2014). Pragmatically, lying in bed, is relaxing and provides full-body support to the child. This external support provides the accommodation needed and allows the child to relax and drift off to sleep easier. Knowing that the bed and sleeping position provides the support needed would increase the willingness to go to bed and reduce resistance.

The highest variance when analyzing CSP-2 sensory systems, all together, with the CSHQ subscales, was 19.6%, a small effect in the variance in daytime sleepiness. Further analysis found that daytime sleepiness was the most affected by auditory processing. Auditory processing reactions could impede sleep in children. A child with increased auditory reactivity reacts to noises that are not noticed by others. These children could have difficulty settling to sleep due to sounds from the environment, such as television, street noise, or self-made noises, which could lead to shortened sleep times due to the inability to settle or frequently awaking at night due to reactions to external noise. Short sleep duration or frequent waking could lead to improper rest and cause daytime sleepiness.

Some of this study's findings are unique in this line of research, and other data confirm other researchers' findings. Similarly to the current study, Reynolds et al. (2012) found that none of the quadrant scores were statistically significant in predicting quality sleep. Sensory sensitivity and sensory avoidance again are common behavioral elements in predicting different sleep aspects of children and adults. According to Dunn's sensory processing model, both quadrants involve having a low sensory threshold. Individuals who have lower sensory thresholds tend to respond very quickly to incoming input, which awakens the person or causes them not to settle into sleep (Dunn, 1997, 2014).

Two studies using Dunn's sensory processing model as a theoretical background to their studies found contrasting findings. Shochat et al. (2009) found sensitivity, specifically tactile sensitivity, predicted 25% of the variance of their sleep questionnaire. Engel-Yeger and Shochat (2012) found tactile sensitivity predicted 5.4%, and auditory avoidance predicted 4.5% of poor sleep quality in adults. It is also important to note when comparing adult and children's sleep, sleep changes over time. Adults have different sleep durations than children, and sleep efficiency decreases with age (Hirshkowitz et al., 2015; Ohayon, Carskadon, Guilleminault, & Vitiello, 2004). The findings of this research both agreed and disagreed with previous research as detailed in this section. Using this information can guide occupational therapy practitioners in evidence-based practice and help formulate treatments to address sleep behaviors in individuals with sleep deficits.

Limitations and Delimitations

Some limitations and delimitations of this study exist throughout the entire research process. These include the selection of methodology and sample, the collection of data, and the tools' sensitivity.

Delimitations

One delimitation of this study is the study's scope. The study scope was limited due to the convenience of the sample, English language limitation, and all participant's children had a caregiver reported sleep issue. The recruitment for the convenience sample took place in one physical location and online forums. The recruitment of online participants took place in focused arenas with topics related to parenting, pediatric, children, and pediatric insomnia. This online recruiting procedure and the surveys' virtual nature limited the participants to only those who had access to computers or electronic devices and could respond using the device. The study was offered only in English, so those who only spoke other languages could not answer the surveys. The study had an operational definition of insomnia but did not establish an operational definition of a caregiver-reported sleep issue. This lack of operational definition may have led caregivers to include chronic sleep issues and the occasional sleep issues in the children.

Limitations

Some limitations occurred during the process of data collection. The study's data collection from survey-based data comes with inherent assumptions, including that those taking the surveys are who they said they are, that participants followed the directions to each survey and that they also reported the data with careful consideration and accuracy. Recall bias is another limitation of this study. Both surveys asked the caregiver to recount the past two weeks' activity for sensory behaviors and one week for sleep behaviors. Recall bias could be present as the caregivers often recollect what was important or the most memorable to the caregiver rather than what happens. The survey tools are designed based on observation and may be influenced by the caregivers' subjective awareness and personal feelings.

This study's limitations include that other medical diagnoses or survey tool sensitivity may have influenced the output of the data. In the study design, caregivers of children with sleep disturbances were recruited to participate in this study. Although no other medical diagnosis was a part of the inclusion criteria, 30.7% of the sample had a medical diagnosis, which could be an extraneous variable with sleep performance.

Another limitation of this study is the lack of an occupational profile (AOTA, 2020). Obtaining an occupational profile from each participant would strengthen the study, as it would provide a complete picture of the participant's occupational participation. An occupational profile could offer insight into cultural implications such as whether the child co-sleeps or sleeps alone, bedtime routines, family dynamics around sleep preparation and participation, or the environmental conditions needed for sleep. The CHSQ survey asks questions regarding whether the child sleeps alone or prefer a specific item to go to sleep. However, those questions were not individually analyzed within this exploratory study. An occupational profile of the child's daily or nightly occupational preferences, habits, and routines would help develop a complete picture (Dunn, 2014). Using both the occupational profile to gather contextual information and the standardized questionnaires would allow a therapist to make a meaningful, client-centered plan should an occupational deficit, such as sleep, be present.

Implications for Practice

Occupational therapy practitioners have discussed sleep as an occupation since the early days of the profession. However, limited sleep research can be found in occupational therapy literature, possibly due to a lack of researchers in this area (Green, 2008; Koketsu, 2017). This study was conducted to add to the existing research on the topic of sleep concerning sensory processing and potential causes of sleep disturbances. Sleep disorders affect up to 40% of

children (Galland et al., 2012; Kothare & Pomeroy, 2008; Meltzer et al., 2010; Meltzer & Mindell, 2006; Meyer, 1922; Mindell et al., 2009; Owens, 2005; Owens & Mindell, 2011; Sadeh et al., 2011). Lack of sleep significantly impacts all daily occupations, including school performance (Sadeh et al., 2002; Sekine et al., 2006; Touchette et al., 2007; Wolfson & Carskadon, 1998). A recent study found that a majority of pediatric practitioners feel unprepared to assess, intervene, or address sleep with their clients (Piller et al., 2020). Occupational therapy practitioner's new awareness of the relationships between sensory processing and sleep patterns or disorders could inform the efficacy of occupational therapy intervention of sleep. It also seems evident from research, both physicians and parents could benefit from education on sensory processing and its influence on proper sleep recommendations (Chervin et al., 2001; Honaker & Meltzer, 2016; Meissner, 1998; Owens, 2001). The current research study provides a basis for considering sensory processing as influencing sleep. This study could provide a conduit for therapists comfortable in addressing sensory processing and addressing sleep concerns in children.

Implications of this research can be applied to the information in practice, education, and further research into potential relationships between sensory processing and sleep performance. This study and previous research provide preliminary evidence that sensory processing is associated with poor sleep. The findings can now be used to encourage occupational therapists' to, first, assess sleep as an occupation of their clients and then subsequently intervene. This study found additional sensory processing quadrant profiles and sensory systems have a relationship with sleep performance. Occupational therapy practitioners, armed with the knowledge of this research and the application of EHP and Dunn's Sensory Processing Framework, are equipped to analyze the children's sensory profiles with sleep disturbances and

make therapeutic recommendations (Dunn, 1997; Dunn et al., 1994). With this new evidence base, occupational therapy practitioners can increase sensory processing awareness within sleep teams and become a vital member in treating children with sleep disturbances. As a member of a sleep team, the occupational therapy practitioners can assess sensory processing skills, educate the family on how to address daily sensory needs, and make an activity or environmental modifications to help assist the children off to sleep (Engel-Yeger & Shochat, 2012; Vasak et al., 2015).

Comprehensive sleep assessments need to be developed within the profession of occupational therapy. The current sleep assessments evolved out of the fields of behavioral sleep medicine and psychology. Existing sensory assessments do not include any questions about sleep preparation and sleep participation. This absence encourages therapists to focus on only active, daytime occupations. Lastly, the profession's occupational profiles need to include questions regarding sleep performance and the contextual considerations around the occupation of sleep. These additions to the assessment process may lead to a higher comfort level of practitioners with the occupation of sleep.

Implications for Further Research

The evolving research regarding sensory processing and sleep as variables is still in its early stages. This dissertation contributes to the current research regarding sensory processing and sleep. This study confirmed and established new relationships between varying sensory processing skills and sleep performance of children ages 3-10. This dissertation provided initial findings for children 3-6 years of age and added to the findings for children ages 6-10. Working to answer questions about sensory behavior's effects on sleep performance is a critical aspect of children's occupations' holistic treatment.

Future research should continue to investigate the relationship between sleep and sensory processing across all age groups and those in early childhood and adolescence in which research data is sparse. These age groups are in a critical stage of neurological development, and sleep plays a large part in neurological development (Baum et al., 2014; Cardoso et al., 2014). Research needs to focus on those developing typically and those with varying diagnoses, including with and without sleep disruptions, to achieve a holistic understanding. Researchers would also benefit from getting the child's input rather than second-hand information addressed in only one study to date (Foitzik & Brown, 2018). Future studies should use a mixed-method approach to capture a more holistic view of the problem. A mixed-method approach could include an occupational profile or a contextual assessment component to develop a clearer picture of the occupation and the individual's desires. And finally, current research has used two popular clinical assessments to assess sensory behaviors; neither assessment addresses sleep behaviors. Continued research using either or both would help interpret if either assessment measured sensory processing related to sleep more accurately.

Exploratory studies are continually needed to fill gaps in research regarding sensory processing and sleep; however, treatment research is slowly emerging. The effectiveness of sensory-based treatments was introduced in Spira's (2014) study but has not been replicated. Ideally, more studies are needed to investigate the efficacy of sensory-based sleep protocols. The subjects of sleep and sensory performance are new in research; many topics in this research line need continued work.

Summary

The discussion section of this dissertation interpreted the data using the ecology of human performance and sensory processing theory related to sensory processing and sleep

performance in children. This research was exploratory by design to document relationships and prediction abilities between sensory processing and sleep behaviors of children 3-10 years of age. A quantitative methodology was used to collect and analyze data regarding sleep and sensory processing from caregivers of children with a caregiver-reported sleep issue. The results support the idea that Dunn's low neurological threshold quadrants, avoiding, and sensory sensitivity, were the most positively correlated with sleep performance. Specifically, auditory and tactile sensory systems yielded the most relationship to sleep performance. These findings were linked to a psychological model of insomnia, stating individuals who demonstrate poor sleep awaken easier due to hypersensitivity (Perlis, Shaw, et al., 2011). A discussion of the predictive aspects of sensory processing skills on sleep occurred. While this study found less than 15% of the variability in sleep performance scores came from quadrant or sensory systems, other studies found more predictive results in their studies.

The integration of this dissertation's findings leads to a more robust interpretation of the connection between sensory and sleep performance to the medical field and the occupational therapy profession. This study's data and discussion should encourage occupational therapy practitioners to ask more questions, do more research, and apply the findings to their current practice. This study provided further information on the relationship between sensory processing aspects of children and their sleeping performance, but additional substantive research is suggested to inform practice further.

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Appendix A: PsychCorp Permission

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Jason Browning
Southeastern University
28 February 2019

Email: jtbrowning@ichs.edu

Pearson Reference # **PC247**

Re: Sensory Profile™ 2

Thank you for your request for permission to use: **Sensory Profile™ 2** (Figure 2.1 from the User's Manual) to be used in your dissertation write-up, (the "Use").

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Appendix B: Children's Sleep Habits Questionnaire

Children's Sleep Habit Questionnaire
(Preschool and School-Aged)

The following statements are about your child's sleep habits and possible difficulties with sleep. Think about the past week in your child's life when answering the questions. If last week was unusual for a specific reason (such as your child had an ear infection and did not sleep well or the TV set was broken), choose the most recent typical week. Answer USUALLY if something occurs **5 or more times** in a week; answer SOMETIMES if it occurs **2-4 times** in a week; answer RARELY if something occurs **never or 1 time** during a week. Also, please indicate whether or not the sleep habit is a problem by circling "Yes," "No," or "Not applicable (N/A).

Bedtime

Write in child's bedtime: ____________________

	3 Usually (5-7)	2 Sometimes (2-4)	1 Rarely (0-1)	Problem?
Child goes to bed at the same time at night **(R) (1)**	☐	☐	☐	Yes No N/A
Child falls asleep within 20 minutes after going to bed **(R) (2)**	☐	☐	☐	Yes No N/A
Child falls asleep alone in own bed **(R) (3)**	☐	☐	☐	Yes No N/A
Child falls asleep in parent's or sibling's bed **(4)**	☐	☐	☐	Yes No N/A
Child falls asleep with rocking or rhythmic movements	☐	☐	☐	Yes No N/A
Child needs special object to fall asleep (doll, special blanket, etc.)	☐	☐	☐	Yes No N/A
Child needs parent in the room to fall asleep **(5)**				Yes No N/A
Child is ready to go to bed at bedtime	☐	☐	☐	Yes No N/A
Child resists going to bed at bedtime	☐	☐	☐	Yes No N/A
Child struggles at bedtime (cries, refuses to stay in bed, etc.) **(6)**	☐	☐	☐	Yes No N/A
Child is afraid of sleeping in the dark **(7)**	☐	☐	☐	Yes No N/A
Child is afraid of sleep alone **(8)**	☐	☐	☐	Yes No N/A

Sleep Behavior

Child's usual amount of sleep each day:_____________hours and_____________minutes
(combining nighttime sleep and naps)

	3 Usually (5-7)	2 Sometimes (2-4)	1 Rarely (0-1)	Problem?
Child sleeps too little **(9)**	☐	☐	☐	Yes No N/A
Child sleeps too much	☐	☐	☐	Yes No N/A
Child sleeps the right amount **(R) (10)**	☐	☐	☐	Yes No N/A
Child sleeps about the same amount each day **(R) (11)**	☐	☐	☐	Yes No N/A
Child wets the bed at night **(12)**	☐	☐	☐	Yes No N/A
Child talks during sleep **(13)**	☐	☐	☐	Yes No N/A
Child is restless and moves a lot during sleep **(14)**				Yes No N/A
Child sleepwalks during the night **(15)**	☐	☐	☐	Yes No N/A
Child moves to someone else's bed during the night (parent, brother, sister, etc.) **(16)**	☐	☐	☐	Yes No N/A
	☐	☐	☐	

Sleep Behavior (continued)

	3 Usually (5-7)	2 Sometimes (2-4)	1 Rarely (0-1)	Problem?
Child reports body pains during sleep. If so, where? ______________________	☐	☐	☐	Yes No N/A
Child grinds teeth during sleep (your dentist may have told you this) **(17)**	☐	☐	☐	Yes No N/A
Child snores loudly **(18)**	☐	☐	☐	Yes No N/A
Child seems to stop breathing during sleep **(19)**	☐	☐	☐	Yes No N/A
Child snorts and/or gasps during sleep **(20)**	☐	☐	☐	Yes No N/A
Child has trouble sleeping away from home (visiting relatives, vacation) **(21)**	☐	☐	☐	Yes No N/A
Child complains about problems sleeping	☐	☐	☐	Yes No N/A
Child awakens during night screaming, sweating, and inconsolable **(22)**	☐	☐	☐	Yes No N/A
Child awakens alarmed by a frightening dream **(23)**	☐	☐	☐	Yes No N/A

Waking During the Night

	3 Usually (5-7)	2 Sometimes (2-4)	1 Rarely (0-1)	Problem?
Child awakes once during the night **(24)**	☐	☐	☐	Yes No N/A
Child awakes more than once during the night **(25)**	☐	☐	☐	Yes No N/A
Child returns to sleep without help after waking	☐	☐	☐	Yes No N/A

Write the number of minutes a night waking usually lasts: ________________

Morning Waking

Write in the time of day child usually wakes in the morning: _______________

	3 Usually (5-7)	2 Sometimes (2-4)	1 Rarely (0-1)	Problem?
Child wakes up by him/herself **(26) (R)**	☐	☐	☐	Yes No N/A
Child wakes up with alarm clock	☐	☐	☐	Yes No N/A
Child wakes up in negative mood **(27)**	☐	☐	☐	Yes No N/A
Adults or siblings wake up child **(28)**	☐	☐	☐	Yes No N/A
Child has difficulty getting out of bed in the morning **(29)**	☐	☐	☐	Yes No N/A
Child takes a long time to become alert in the morning **(30)**	☐	☐	☐	Yes No N/A
Child wakes up very early in the morning	☐	☐	☐	Yes No N/A
Child has a good appetite in the morning	☐	☐	☐	Yes No N/A

Daytime Sleepiness

	3 Usually (5-7)	2 Sometimes (2-4)	1 Rarely (0-1)	Problem?
Child naps during the day	☐	☐	☐	Yes No N/A
Child suddenly falls asleep in the middle of active behavior	☐	☐	☐	Yes No N/A
Child seems tired **(31)**	☐	☐	☐	Yes No N/A

During the past week, your child has appeared very sleepy or fallen asleep during the following (check all that apply):

	1 Not Sleepy	2 Very Sleepy	3 Falls Asleep
Play alone	☐	☐	☐
Watching TV **(32)**	☐	☐	☐
Riding in car **(33)**	☐	☐	☐
Eating meals	☐	☐	☐

Subscale Items
Children's Sleep Habits Questionnaire (CSHQ)

Numbers in parentheses refer to CSHQ item number

1. **Bedtime Resistance** (6 items)[A]
Goes to bed at same time **(1) (R)**
Falls asleep in own bed **(3) (R)**
Falls asleep in other's bed **(4)**
Needs parent in room to sleep **(5)**
Struggles at bedtime **(6)**
Afraid of sleeping alone **(8)**

2. **Sleep Onset Delay** (1 item)
Falls asleep in 20 minutes **(2) (R)**

3. **Sleep Duration** (3 items)
Sleeps too little **(9)**
Sleeps the right amount **(10) (R)**
Sleeps same amount each day **(11) (R)**

4. **Sleep Anxiety** (4 items)
Needs parent in room to sleep **(5)**
Afraid of sleeping in the dark **(7)**
Afraid of sleeping alone **(8)**
Trouble sleeping away **(21)**

5. **Night Wakings** (3 items)
Moves to other's bed in night **(16)**
Awakes once during night **(24)**
Awakes more than once **(25)**

6. **Parasomnias** (7 items)
Wets the bed at night **(12)**
Talks during sleep **(13)**
Restless and moves a lot **(14)**
Sleepwalks **(15)**
Grinds teeth during sleep **(17)**
Awakens screaming, sweating **(22)**
Alarmed by scary dream **(23)**

7. **Sleep Disordered Breathing** (3 items)
Snores loudly **(18)**
Stops breathing **(19)**
Snorts and gasps **(20)**

8. **Daytime Sleepiness** (8 items)
Wakes by himself **(26) (R)**
Wakes up in negative mood **(27)**
Others wake child **(28)**
Hard time getting out of bed **(29)**
Takes long time to be alert **(30)**
Seems tired **(31)**
Watching TV **(32)**
Riding in car **(33)**

Total Sleep Disturbance Score (33 items)[B]

Scoring: **Usually = 3** **Sometimes = 2** **Never/Rarely = 1**

[A] Note: Some items (*R*) should be reversed in scoring, so that a higher score reflects more disturbed sleep behavior.

[B] Note: The Total Sleep Disturbance Score: Consists of all 33 subscale items instead of 35 (although items 5 and 8 are on both the Bedtime Resistance and Sleep Anxiety scales, they should be included only once in the total score)

Appendix C: Site Approval Letters

From:
To: jtbrowning@jchs.edu
Subject: IRB approval letter

Date: August 23, 2019

Nova Southeastern University 3301
College Avenue
Fort Lauderdale, FL 33314-7796

Subject: Site Approval Letter To

whom it may concern:

This letter acknowledges that I have received and reviewed a request by Jason Browning, OTR/L to conduct a research project entitled "Insomnia of Childhood and sensory processing: exploring the role of occupational therapy practitioners in sleep medicine." at Sleep Center Carilion Clinic- Roanoke and I approve of this research to be conducted at our facility.

When the researcher receives approval for his/her research project from the Nova Southeastern University's Institutional Review Board/NSU IRB, I agree to provide access for the approved research project. If we have any concerns or need additional information, we will contact the Nova Southeastern University's IRB at (954) 262-5369 or irb@nova.edu.

Sincerely,

Frank H. Biscardi, MD, FCCP, FAASM Director
Carilion Sleep Center

OFFICE OF
RESEARCH COMPLIANCE
INDIANA UNIVERSITY

August 9, 2019

To Whom it May Concern:

The involvement of Indiana University and/or IU Health personnel in recruitment of subjects for the study titled "Insomnia of Childhood and Sensory Processing: Exploring the Role of Occupational Therapy Practitioners in Sleep Medicine" does not require review and approval by the Indiana University IRB. Because IU/IUH involvement will be limited to providing recruitment materials to subjects, neither Indiana University nor IU Health are engaged in human subjects research per IU Human Research Protection Program Policies and OHRP's Guidance on Engagement of Institutions in Human Subjects Research. Therefore, local IRB approval is not required.

Please feel free to contact me if you have further questions. I can be reached at (317) 278-7831 or bwinnie@iu.edu.

Sincerely,

Bethany L. Johnson, CIP
University Director, Human Research Protection Program
Office of Research Compliance
Indiana University

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Lockefield Village, 3rd Floor 980 Indiana Avenue Indianapolis, IN 46202
2218 North Dunn Street Bloomington, IN 47408 https://research.iu.edu/compliance/

Appendix D: Informed Consent Form

Nova Southeastern University
Informed Consent
For: Research Study Entitled:
Pediatric Insomnia and Sensory Processing: Exploring the Role of Occupational Therapy Practitioners in Sleep Medicine

Who is doing this research study?

College: Dr. Pallavi Patel College of Health Care Sciences, Occupational Therapy Department
Principal Investigator: Jason Browning, OTR/L, MOT, OTR/L
Faculty Advisor/Dissertation Chair: Elise Bloch, EdD, OT/L
Site Information:

Children's Hospital #1

Children's Hospital #2

Children's Hospital #3

Online Forums- Facebook, Blogs, Special Interest Groups, etc.
Internet-based parental groups with subjects pertaining to parenting, pediatrics, and pediatric insomnia.

Funding: This study is partially funded by Jefferson College of Health Sciences, Roanoke, Virginia: Internal Resource Grant

What is this study about?

Jason Browning is a doctoral student at Nova Southeastern University engaged in research to satisfy a requirement for a Doctor of Philosophy degree. The primary purpose of this study is to explore the relationship between behavioral insomnia of childhood and differences in sensory processing in children 3-10 years of age. If a correlation does exist, the research will also be calculating prediction abilities between the insomnia symptoms and the sensory processing differences.

Why are you asking me to be in this research study?

Participants are caregivers with children with sleeping difficulties. Your child, per your report, has been identified as having sleeping difficulty. The results of this research will better inform the profession of occupational therapy on treating children with sleep difficulties.

It is anticipated that there will be 130 participants from 3 separate sleep clinic locations. A portion of the participants will be recruited from online forums related to parenting, pediatrics, pediatric insomnia.

What will I be doing if I agree to be in this research study?

While you are taking part in this research study, you will complete two questionnaires regarding your child and their sensory responses and sleep habits. It will take between 15-45 minutes to complete both questionnaires.
Research Study Procedures - as a participant, this is what you will be doing:

- If you choose to participate, you will directly contact the researcher via e-mail or phone found on the research flyer or posters from the recruiting locations or online.
- The researcher will then discuss/review the inclusion, exclusion criteria, purpose of the study, basic procedures, and time commitment with the caregiver.

- Once you agree verbally, you will be asked for an e-mail address. The e-mail address will be used to send the survey and incentive.
- By email a survey link will be sent to you. The link will launch an introduction video from the primary investigator and have instructions for the questionnaires.
- Once you sign the informed consent for this research, you will be introduced to the first survey on sleep behaviors of your child.
- At the bottom of the first survey, a link will be provided to take you to the second survey. You will then be asked to complete the second survey based on currently observed sensory behaviors of your child under your care.
- Once you have completed both surveys, an incentive will be e-mailed to you for their participation.

Are there possible risks and discomforts to me?

This research study involves minimal risk to you or your child. To the best of our knowledge, the things you will be doing have no more risk of harm than you would have in everyday life.
The primary concern will be confidentiality through the data collection, storage, and analysis stages of the study. Every step possible to ensure confidentiality will be taken by the researcher.

What happens if I do not want to be in this research study?

You have the right to leave this research study at any time, or not be included. If you do decide to leave or you decide not to be in the study anymore, there will be no penalty or lack of services. If you choose to stop being in the study, any information collected about you **before** the date you leave the study will be kept in the research records for 36 months from the end of the study but you may request that it not be used.

What if there is new information learned during the study that may affect my decision to remain in the study?

If significant new information relating to the study becomes available, which may relate to whether you want to remain in this study, this information will be given to you by the investigators. You may be asked to sign a new Informed Consent Form, if the information is given to you after you have joined the study.

Are there any benefits for taking part in this research study?

There are no direct benefits from being in this research study. We hope the information learned from this study will enhance the role of occupational therapy in the profession of sleep medicine.

Will I be paid or be given compensation for being in the study?

Those participants completing both surveys will be eligible to claim a ten-dollar gift card to Amazon.com for their participation. If you remove yourself from the study, you will not receive a gift card.

Will it cost me anything?

There are no costs to you for being in this research study.

How will you keep my information private?

Information we learn about you in this research study will be handled in a confidential manner, within the limits of the law and will be limited to people who have a need to review this information. The entire the study, including the informed consent, will be electronic. Your contact will deidentified from the survey data, so your information cannot be linked to you. The surveys will only contain a participant number. All electronic files, including consent forms, will be stored on the researcher's password-protected computer only accessible on a password

protected network. This data will be available to the researcher, the Institutional Review Board and other representatives of this institution, and any regulatory and granting agencies (if applicable). If we publish the results of the study in a scientific journal or book, we will not identify you. All data will be kept for 36 months from the end of the study and destroyed after that time by deleting all electronic files involved in this study.

Whom can I contact if I have questions, concerns, comments, or complaints?
If you have questions now, you may contact the researchers or the IRB office. If you have more questions about the research, your research rights, or have a research-related injury, please contact:

Primary contact:
Jason Browning, MOT, OTR/L may be reached at XXX-XXX-XXXX.

If primary is not available, contact:
Elise Bloch, EdD, OT/L may be reached at XXX-XXX-XXXX.

Research Participants Rights
For questions/concerns regarding your research rights, please contact:

Institutional Review Board
Nova Southeastern University
(954) 262-5369 / Toll Free: 1-866-499-0790
IRB@nova.edu

You may also visit the NSU IRB website at www.nova.edu/irb/information-for-research-participants for further information regarding your rights as a research participant.

Research Consent & Authorization Signature Section
Voluntary Participation - You are not required to participate in this study. In the event you do participate, you may leave this research study at any time. If you leave this research study before it is completed, there will be no penalty to you, and you will not lose any benefits to which you are entitled.

If you agree to participate in this research study, sign this section. You will be given a signed copy of this form to keep. You do not waive any of your legal rights by signing this form.

SIGN THIS FORM ONLY IF THE STATEMENTS LISTED BELOW ARE TRUE:

- You have read the above information.
- Your questions have been answered to your satisfaction about the research.

Adult Signature Section

I have voluntarily decided to take part in this research study.

____________________	____________________	__________
Printed Name of Participant	Signature of Participant	Date

Appendix E: Demographic Survey Information

Indicate the sex of the child which has sleep disturbances:

- Male
- Female
- Other

Please enter the birthdate your child with the sleep disturbance. Enter in MM/DD/YYYY format.

Which state do you currently reside?

- State choices from REDCap™- All 50 states
- Outside the U.S.

What race is the child which has sleep disturbances?

- White
- Black/African American
- Hispanic or Latino
- American Indian or Alaskan Native
- Asian (Chinese, Filipino, Asian Indian, Vietnamese, Korean, & Japanese)
- Native Hawaiian
- Pacific Islander
- Other
- Prefer not to answer

Please list any medical diagnoses in which your child with sleep disturbances has been given. If no, diagnosis has been identified, type none.

What is the educational level of caregiver?

- No schooling completed
- Nursery school to 8th grade
- Some high school, no diploma
- High school graduate, diploma or the equivalent
- Some college credit, no degree
- Trade/technical/vocational training
- Associate degree
- Bachelor's degree
- Master's degree
- Professional degree
- Doctorate degree

What is the yearly income of the household?

- Less than $5,000
- $5,000 through $11,999
- $12,000 through $15,999
- $16,000 through $24,999
- $25,000 through $34,999
- $35,000 through $49,999
- $50,000 through $74,999
- $75,000 through $99,999
- $100,000 and greater
- Don’t know
- No response

PARTICIPANT DEMOGRAPHIC INFORMATION

Demographics; N=140	Category	Frequency	Percentage
Sex of child	Male	87	62.1
	Female	53	37.9
Location	Colorado	1	.7
	Connecticut	2	1.4
	Florida	16	11.4
	Georgia	2	1.4
	Illinois	2	1.4
	Indiana	2	1.4
	Kansas	2	1.4
	Kentucky	3	2.1
	Maryland	1	.7
	Missouri	1	.7
	New Jersey	3	2.1
	New York	3	2.1
	North Carolina	3	2.1
	Ohio	4	2.9
	Oklahoma	3	2.1
	Pennsylvania	6	4.3
	South Carolina	2	1.4
	Tennessee	4	2.9
	Virginia	56	40.0
	Washington	1	.7
	West Virginia	23	16.4
Age of child with sleep disturbance	3	37	26.4
	4	19	13.6
	5	14	10.0
	6	21	15.0
	7	12	8.6
	8	15	10.7
	9	11	7.9
	10	11	7.9
Race of child	White	117	83.6
	Black or African American	7	5.0
	Hispanic or Latino	5	3.6
	American Indian/Alaska Native	1	.7
	Other	10	7.1
Participant Education Level	Below high school education	12	8.5
	High school graduate or equivalent	8	5.7

	Some college credit, no degree	12	8.6
	Trade/technical/vocational training	6	4.3
	Associates Degree	17	12.1
	Bachelor's degree, Master's degree, or Doctorate Degree	85	60.7
Income	Less than 24,999	8	5.7
	25,000 to 34, 999	11	7.9
	35,000 to 49,999	16	11.4
	50,000 to 74,999	25	17.9
	75,000 to 99,999	25	17.9
	100,000 to 149,999	38	27.1
	150,000 or more	14	10.0
	Prefer not to answer	3	2.1