Sensory intervention to improve sleep behaviors and social participation of children in Israel with Sensory Modulation Disorder

Geela Spira
Nova Southeastern University

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A SENSORY INTERVENTION TO IMPROVE SLEEP BEHAVIORS AND
SOCIAL PARTICIPATION OF CHILDREN IN ISRAEL WITH
SENSORY MODULATION DISORDER

by

Geela Spira

Submitted in partial fulfillment of the requirements for the degree of
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Occupational Therapy Department
College of Health Care Sciences
Nova Southeastern University
Fort Lauderdale, Florida 33328

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This dissertation, written by Geela Spira under the direction of her Dissertation Committee, and approved by all of its members, has been presented and accepted in partial fulfillment of requirements for the degree of

DOCTOR OF PHILOSOPHY

DISSERTATION COMMITTEE

Max A. Ito, PhD, OTR/L
Chairperson of Dissertation Committee

Cathy Peirce, PhD, OTR/L
Dissertation Committee Member

Deborah Marr ScD, OTR/L
Dissertation Committee Member
Certification

We hereby certify that this dissertation, submitted by Geela Spira, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirement for the Doctor of Philosophy degree.

Approved:

__________________________  ______________
Kristin Winston, Ph.D., OTR/L  Date
Ph.D. In OT Program Director

__________________________  ______________
Wendy Stav, Ph.D., OTR/L, FAOTA  Date
Chair, Occupational Therapy Department

__________________________  ______________
Stanley Wilson, PT, Ed.D., CEAS  Date
Dean College of Health Care Sciences
Abstract

The aim of this study was to investigate a sensory intervention of moderate pressure touch on children with sensory modulation disorder on the outcomes of sleep behaviors and social participation. 50 children, aged 6-11 years, with both sensory modulation disorder and sleep difficulties were randomly divided into an experimental group and a control group. The experimental group participants received three weeks of nightly massage by their parents. The parents filled out questionnaires reporting on sleep behaviors, sensory modulation, and social participation, as well as recording a sleep log, and determining goal attainment scaling goals. The questionnaires used were the Short Sensory Profile, the Child Sleep Habits Questionnaire, the Child Behavior Checklist (CBCL), and the Sensory Processing Measure social sub-section. Significant improvement was found between the total and sub-group scores of sleep and social participation measures. While obstructive sleep disorders remained unchanged, behavioral sleep difficulties of sleep onset, sleep anxiety, parasomnias, sleep duration, and daytime sleepiness, as well as the total sleep scores ($F(1,48)=24.71$, $p<.001$) improved. All social measures on the CBCL, with the exception of withdrawal, improved, with the internal scores ($F(1,48)=15.74$, $p<.001$) improving more than the external scores ($F(1,48)=14.03$, $p<.01$). Hierarchical regression, $R^2$, showed that the sensory related measures accounted for 13.8% of the change in social participation, $p<.001$. The results of this study suggest that moderate pressure touch can be used in clinical practice to improve both sleep and social participation in children with sensory modulation disorder.

**Keywords:** moderate pressure touch, sensory, sleep behaviors, social participation
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A Sensory Intervention to Improve Sleep Behaviors and Social Participation of Children in Israel With Sensory Modulation Disorder

Chapter 1: Introduction

Background to the Problem

Sensory Modulation Disorder

According to the Interdisciplinary Council on Developmental and Learning Disorders (ICDL, 2005), sensory modulation disorder (SMD) is defined as a subtype of a pediatric sensory processing disorder in which children have an inability to grade the degree or intensity of responses to sensation. Initial estimates of prevalence of SMD in the United States is 13.7%, or 5.3% using a more stringent procedure of accounting for non-returned questionnaires (Ahn, Miller, Milberger, & McIntosh, 2004). More recent estimates of the prevalence of SMD in typically developing children have reached 16.5% (Ben-Sasson, Carter, & Briggs-Gowan, 2009). Similar estimates of 11.6%-15.6% were noted in a second prevalence study (Gouze, Hopkins, Lebailly, & Lavigne, 2009).

Although no known prevalence studies of SMD in children in Israel have been undertaken to date, the Israeli Central Bureau of Statistics (ICBS, 2008) reports the total population in Israel at 7.2 million residents. Children comprise 35% of the population, or 2.6 million individuals. In modern Western countries, the percentage of children typically stands at 20-25%. The percentage of children in Israel is 31%, greater than the average of 20-25% in Western countries (ICBS, 2008). Assuming that Israel has a similar prevalence rate of SMD as the United States, between 35,000 to 137,800 children would be
estimated to have a SMD. Additionally, 33,000 children are enrolled in special education classes in Israel including those with diagnoses of mental retardation and autism spectrum disorders (ICBS, 2008). Special needs children tend to have higher rates of SMD, so the prevalence rates may be slightly higher than the rates for typically developing children (Miller, 2006).

The basis of SMD is unknown. One possible etiology is a physiological imbalance between the sympathetic and parasympathetic branches of the central autonomic nervous system (Schaaf, Miller, Seawell, & O'Keafe, 2003; Shani-Adir, Rozenman, Kessel, & Engel-Yeger, 2009). Over stimulation of the sympathetic nervous system can cause heightened arousal and difficulty in calming which can make sleep difficult (Kandel, Schwartz, & Jessel, 2006).

SMDs are expressed by a wide range of difficulties. Recently, SMD has been linked to sleep difficulties including sleep onset delay, bedtime resistance, sleep anxiety, parasomnias and night terrors, and daytime sleepiness (Shochat, Tzischinsky, & Engel-Yeger, 2009). Children with SMD and atopic dermatitis were also found to have poor sleep behaviors (Shani-Adir et al., 2009). Children with SMD and autism spectrum disorders have been documented to have sensitivity to auditory filtering which affects sleep (Reynolds, Lane, & Thacker, 2012). Another expression of SMD is social impairment (Hilton, Harper, Kueker, Lang, & Abbacchi et al., 2010; Silva, Schalock, Ayres, Bunse, & Budden, 2009). The effects of SMD on sleep behaviors and social problems will be investigated in this dissertation study.
Sleep Disorders

Sleep difficulties are rising in the United States, with 31.2% reports of inadequate sleep in 2003, and increasing to 41.9% in 2012 for adults (Singh & Kenney, 2013). Sleep disorders affect between 11-37% of typically developing school aged children, causing a myriad of problems including daytime fatigue and decreased gross motor abilities (Moran, Carvalho, Prado, & Prado, 2005; Owens, Spirito, McGuinn, & Nobile, 2000). Reduced cognitive performance is noted as well (Paavonen et al., 2010). Children with special needs diagnoses such as autism have an even greater reported prevalence of sleep difficulties which range from 40%- 80% (Cortesi, Giannoti, Ivanenko, & Johnson, 2010; Krakowiak, Goodlin-Jones, Hertz-Picciotto, Croen, & Hansen, 2008; Richdale & Schrek, 2009).

The ICDL Diagnostic Manual for Pediatric Disorders notes that one of the characteristics of SMD is sleep dysfunction (ICDL, 2005). Sleep difficulties in children are divided into two major categories: physical breathing disorders, and sleep behaviors. Physical breathing disorders include apnea and difficulty breathing. Quality of sleep behaviors include sleep latency (difficulty falling asleep), wake time after sleep onset, total sleep time, and night terrors (Chokroverty, 2010; Sleepnet.com, 2011). Two articles documenting behavioral sleep difficulties with hypersensitive children were found in the literature. Neither article studied children with SMD exclusive of co-morbid conditions. However, both articles found correlations between a type of SMD and sleep (Shani-Adir et al., 2009; Shochat et al., 2009). Additional studies of sleep disorders in autism appear in the literature (Cortesi et al., 2010; Polimeni, Richdale, & Francis, 2007; Wiggs & Stores, 2004). However, no studies have established a clear correlation between sleep
difficulty and SMD independent of confounding co-morbid diagnoses, creating a need for the current study.

Social Difficulty

Poor sensory modulation can cause a delay in the acquisition of social skills (Watson et al., 2011). Children with SMD have more social problems than their typically developing peers. Their circle of friends is more restricted and their patterns of play are different than their peers of the same age, showing a preference for open-ended play without rules or expectations of succeeding (Cosbey, Johnston, & Dunn, 2010). Links between sensory deficits and behavior problems have been noted in pre-school through school-aged children (Gunn et al., 2009).

Massage as Intervention

Massage has been used as an effective intervention for a variety of problems with children (Diego, Field, & Hernandez-Reif, 2005; Field & Hernandez-Reif, 2001; Silva, Schalock, Garberg, & Smith, 2012). While light touch pressure has been found to alleviate stress and improve quality of life, only moderate touch pressure produces a physiological response of neurotransmitter release (Field, Diego, & Hernandez-Reif, 2010). The use of moderate pressure touch for children with SMD has been noted in the literature (Mollow, Schaaf, & Benevides, 2008; Silva et al., 2009). Therefore, moderate pressure touch massage will be utilized in this study as a way to improve sleep behaviors and social participation.

Statement of the Problem

The American Occupational Therapy Association (AOTA, 2008) Occupational Therapy Practice Framework supports establishing patterns of behavior that are
"observable, regular, and repetitive" because they "provide structure for daily life" (p. 643). Due to fluctuating responsivity to life events, children with SMD are unable to interpret their experiences in a consistent and understandable framework. As a consequence, they are often unable to engage coherently in tasks, activities, or roles that form the doing of occupations.

Specifically, children with SMD may be at risk for reduced engagement and participation in the domains of sleep and social participation (Ahn et al., 2004; AOTA, 2008; Miller, 2006). In the domain of sleep, children with SMD are at risk for reduced engagement with their surroundings due to fatigue and disorientation. Suggestions to improve sleep in children with SMD were found in occupational therapy literature but were largely limited to environmental conditions and contexts such as dimming ambient lighting, providing snug bedding, and adhering to predictable bedtime routines (Kramer & Hinojosa, 2010).

Limitations in function have also been described in the domain of social participation, particularly participation in family occupations and diminished social support (Bagby, Dickie, & Baranek, 2012; Cosbey et al., 2010). However, the mechanism responsible for social difficulties in children with SMD was unclear. Without a clear vision of the mechanism that caused the difficulties in social participation, occupational therapists were likely to have difficulty choosing a targeted focused intervention. The person-environment-occupational performance (PEOP) model was used in this study to promote understanding of how to halt disruption of the process of forming occupations by targeting the specific personal intrinsic factor of SMD and the processes that affect SMD (Christiansen & Baum, 1997).
Purpose of the Study

The purpose of the study was to determine the effect of a sensory intervention on sleep behaviors in children with SMD, on their social participation, and to determine if there is a relationship between sleep and social participation in those children. Parent massage was the sensory intervention that was used. Sleep habits of the children were viewed by use of a sleep log (see Appendix A) and a parent report on the parent intake form (see Appendix B). Social participation was determined by the parent report as well. By better understanding how changing the arousal level of children with SMD affects outcomes of sleep behaviors and social participation, and using the evidence-based research outcomes of this study, occupational therapists will be able to expand and update their therapeutic approach to select effective interventions for practice.

Research Questions

- What is the effect of the sensory input of moderate pressure touch on the quality of sleep in children with SMD who have sensory and sleep disturbances as compared to similar children who do not receive this input?
- What is the effect of the sensory input of moderate pressure touch on social participation in children with SMD who have sensory and sleep disturbances as compared to similar children who do not receive this input?
- Is the effect of moderate pressure input on social participation in children with SMD due to the sensory or sleep behaviors?

Definition of Terms

For the purposes of this study, the following terms are as defined:
- **Sensory modulation disorder**
  - Conceptual definition: SMD is defined as "the inability to grade the degree, intensity, and nature of responses to sensory input" (ICDL, 2005, p. 81). The level of the child's arousal does not match the demands of the environment. SMD includes three sub-types. In sensory over-responsivity children respond to sensation faster, with more intensity, or for a longer duration than others with associated behavioral reactions of avoidance, difficulty with change, anxiety and fears, and tantrums (Miller, Coll, & Schoen, 2007). In sensory seeking, children seek intense sensations seemingly without satiation. Sensory under-responsivity is noted by slow or apathetic response to stimuli (Davies & Gavin, 2007; ICDL, 2005).
  - Operational definition: The classification of SMD was applied to children who scored abnormally on the Short Sensory Profile (SSP) (McIntosh, Miller, Shyu, & Dunn, 1999). A previous study of SMD defined an abnormal score on the SSP as a total z score of ≥ 3 standard deviations (SD) below the mean, > -2.5 SD on two or more subtests, or > -4 SD on one subtest (Miller, Coll, et al., 2007). This study used the same parameters.

- **Behavioral sleep difficulty**
  - Conceptual definition: The regulation of sleep-wake rhythms is modulated by two opposing factors. The homeostatic drive for sleep and the circadian day-night rhythm promote sleep and arousal. Sleep
architecture describes the stages of the sleep-wake cycle via rapid eye movement (REM) sleep with corresponding physiologic changes such as blood pressure and heart rate. Interruptions in this cycle affect continuous restful sleep (Chokroverty, 2010). Behavioral sleep difficulties consist primarily of daytime sleepiness which is an inability to sleep when desired and non-continuous, non-restful sleep. The criteria for behavioral sleep difficulties include an elevated arousal threshold, sleepiness, and a reversible unconscious state (Meltzer & Mindell, 2006).

- Operational definition: A cut off score of over 41 points in the Child Sleep Habits Questionnaire (CSHQ) (see Appendix C) defined sleep difficulty (Owens et al., 2000). Eight sub-categories of behavioral sleep difficulties listed in the CSHQ were used to define the specific areas of sleep difficulty. There categories were:
  - *Bedtime resistance* when children do not want to go to bed.
  - *Sleep onset delay* where children who are in bed experience difficulty falling asleep.
  - *Sleep duration* where the length of sleep is measured.
  - *Sleep anxiety* where the child does not want to sleep alone, in the dark, or in a bed other than the child's own.
  - *Night wakings* where the frequency and quality of waking is noted, along with difficulty returning to a state of sleep.
- **Parasomnias** which are partially aroused states of sleep between wakefulness and sleep where emotions and perceptions are disassociated. Behaviors include nightmares, sleepwalking, and inconsolable confused crying (Malow et al., 2006).

- **Daytime sleepiness** where the child is tired during the day at a level that affects daytime function of maintaining arousal and the ability to concentrate and learn (Chokroverty, 2010).

- **Sleep disordered breathing** is also included as an indicator of physical sleep difficulties such as polyps or adenoids that obstruct breathing. Although not a behavioral sleep disorder, it is included as a sub-category in the CSHQ questionnaire for referral to medical intervention (Owens et al., 2000).

* Sensory input
  - Conceptual definition: Sensory inputs are the application of "direct sensory stimulation with the purpose of eliciting a generalized behavioral response" (Bundy, Lane, & Murray, 2002, p. 480). Any of the sensory systems may be used for input in this definition.
  - Operational definition: The sensory input chosen for this study was moderate pressure touch and was operationally defined as parent massage. The parent massage instruction was written in both a written form for consistency and unified execution by parents. Parent massage instruction was described in Appendix D. The principal investigator
(PI) confirmed that the parents understood the instructions by requesting that the parents demonstrate the technique.

- **Social participation**
  - Conceptual definition: "Active engagement in the typical activities available to and expected of peers in the same context" (Coster, 1998, p. 341).
  - Operational definition: Social participation was operationally defined by the outcome measures. The outcome measures for social participation included the socialization subtest of the Sensory Processing Measure (SPM) (Parham, Ecker, Kuhaneck, Henry, & Glennon, 2007) (see Appendix E). Also used was the Child Behavior Checklist ([CBCL], Achenbach, 1991) as provided in Appendix F. A third social participation measure used was goal attainment scaling ([GAS], Kirusek, Smith, & Cardillo, 1994) as shown in Appendix G.

- **Bedtime story**
  - Conceptual definition: A bedtime story was used as the control group application. In the experimental group, the bedtime story was used together with the application of moderate pressure touch input. The bedtime story was the equivalent of a neutral application of an input, while providing the same duration and frequency of time, similar parental attention, and same use of physical space as the experimental procedure.
Operational definition: A story read at bedtime to the child by the child's parent for 20 minutes. Parents were instructed that the story content be neutral and should not contain frightening, scary, spooky, or highly exciting content. The parents used any appropriate story of their choice that fit these guidelines.

Need for the Study

Stringent prevalence estimates of 5.3% suggest that approximately 35,000 children in Israel suffer from a SMD (Ahn et al., 2004; ICBS, 2008). Lack of continuous sleep, lack of sufficient sleep, or impaired quality of sleep may impair occupational performance during the day for children with SMD. Children with SMD are also at risk for impaired social participation due to disproportional responses to environmental cues (Ahn et al., 2004; Miller, 2006). Present intervention choices for SMD are not well founded on theory or evidence-based literature. Current occupational therapy intervention programs have a disorganized treatment approach due to lack of scientific knowledge about the prevalence and efficacy of intervention programs for children with both SMD and behavioral sleep difficulties. Understanding and treating sleep disturbances and social difficulties in children with SMD will contribute to advancing knowledge of the transactional nature of these problems with SMD and will contribute to the betterment of occupational therapy practice.

Theoretical Perspectives and Rationale for the Study

PEOP Model

The PEOP model was used in this dissertation as a framework in which to understand the responses of children with SMD to moderate pressure touch (Christiansen...
The model focuses on factors that limit and support occupational performance (Walker & Ludwig, 2004). Authors of the PEOP model state that optimal occupational performance provides the foundation necessary for participation in a meaningful life (Baum & Christiansen, 2004).

**Person.** The authors of the PEOP model view intrinsic personal factors which enable performance as experiential. In other words, what we do defines who we are. The balanced use of capacities and consistent response to actions performed determines the quality of one’s occupational performance, and provides motivation to persevere and actively engage in one’s world (Wilcock, 1993).

According to the PEOP model, five supporting factors and mechanisms which are person related enable performance. They are physiological, cognitive, spiritual, neurobehavioral, and psychological factors which reside within the person (Christiansen & Baum, 2005). This dissertation thesis will focus on the intrinsic physiological personal factors which contribute to performance of children with SMD.

A physiological factor particularly common in children with SMD is the ability to modulate arousal to a calm, focused state. Over-reactivity, under-reactivity, and seeking out sensory stimuli are hallmarks of SMD (ICDL, 2005). Physiological changes in the sympathetic nervous system due to stress and subsequent misinterpretation of typical sensory inputs are noted by changes in blood pressure, emotional stability, and in one's sense of well-being (Antonovsky, 1979). The inability to accurately grade sensory input, to consistently regulate unanticipated stimuli, or to maintain a balanced state of arousal may cause difficulty in interpreting one's experiences and cause the formation of maladaptive coping strategies (Kramer & Hinojosa, 2010). As a consequence of these
physiological inconsistencies and subsequent misinterpretations, children with SMD may have difficulty engaging in occupations in a purposeful and goal directed manner that would enable the child to positively engage in occupations (Bundy et al., 2002).

The mechanism of poor occupational performance is explained by the PEOP model. The authors propose that individuals set goals and regulate behavior in correspondence with their feelings of being effective and competent. When an individual feels competent in an activity they are more likely to attribute a poor outcome to a need for greater effort, rather than attributing the failure to a lack of ability. The individual will continue to strive to attain the goal. However, individuals who perceive that they are not able to effect change are more likely to interpret poor performance as beyond their control; thus, they are more likely to disengage from the activity (Stone, 2005).

The process of making occupational choices depends on a sense of self in the present, but also requires an ability to accurately represent one’s possible self, or belief that one can achieve what it takes to become the person one wants to be (Kofa & Weary, 1998). Children with SMD may not only have a consistent sense of self in the present due to inconsistent modulation of one’s state of arousal, but due to long-term physiological over- or under-reactivity. In addition, they may not have developed an accurate representation of their future self. As a result, rather than an explore activities and engage in experiences, the child with SMD may develop a pattern of avoidance of engagement, resulting in limited occupational performance (Dunn, 1997).

**Environment.** A tenet of the PEOP model is that participation is influenced by the context of the environment in which it occurs (Christiansen & Baum, 2005). Not only does the environment allow for physical participation, the characteristics of the
environment also influence the individual’s internal perception of possibilities, which in turn influence occupational choices and activities (Gibson, 1979). Possible environments in the PEOP model include the built physical environment such as access, the natural environment such as sunlight or darkness, the cultural environment of socially transmitted behavior patterns and expectations, economic systems that determine a child’s access to therapy and health care, and social interaction with family and peers.

In some occupational models, the person factor and the environment factor are viewed as dualistic, wherein each factor interacts with the other and emphasis is placed on one of the factors rather than focusing on the relationship between the two factors as the central concept. For children with SMD, viewing the interaction of personal factors with environmental factors as transactional, in which human beings function as “organisms in environment as a whole” will more accurately reflect the complex totality of the child’s experience (Dickie, Cutchin, & Humphry, 2006, p. 83).

In sleep and sleep preparation, transitioning from daytime to nighttime activities often involve family routines and rituals (AOTA, 2014). Children with SMD are greatly influenced by the sensations in their environments, affecting their performance of activities, tasks, and roles. For example, a child with sensory over-responsivity may have an over-reactive sympathetic nervous system, causing anxiety and stress as the family endeavors to prepare for a quiet, smooth bedtime routine (Cacioppo, Tassinary, & Berntson, 2007). Similarly, a child who is seeking sensation might resist the bedtime routine and interfere with bedtime rituals in order to continue seeking sensation. Such actions can disrupt and conflict with family expectations, thereby constricting the shared family occupation of bedtime preparation (Bagby et al., 2012).
This dissertation study will focus on the social milieu as the environmental factor of the PEOP model, both at bedtime and in the child’s life. Children with SMD who are overwhelmed by sensory stimuli may be overwhelmed, interact inappropriately with tired siblings, or engage in behaviors that are in contrast to their family norm at bedtime, limiting their social participation and acceptance in the family unit (Cohn, Miller, & Tickle-Degnan, 2000; Hilton, Graver, & LaVesser, 2007). Participatory behaviors may become reduced and social participation may become highly limited (Porges, 1995). In the PEOP model and in this dissertation study, social interaction was considered as both part of the context or extrinsic environment, as well as the expression of occupational performance and participation, depending on the intent of process or outcome.

**Paradigms.** Two paradigms were used to conceptualize the transactional relationship between person and environment which influence the central outcome construct of occupational performance and participation. In the first paradigm, sleep was the measure of occupational performance. In the second paradigm, social participation was the measure of occupational performance. In both paradigms, a focus was placed on the intrinsic person factor of physiology, as noted by arousal levels. The context of the bedtime or social environments will be considered the extrinsic factors and will be thought to contribute equally with the person factor to produce a transactional interaction which influences the outcome of occupational performance and participation.

**The occupation of sleep.** In the first paradigm, sleep will be considered the measure of occupational performance and participation. Sleep and rest are one of eight primary domains of function which "define the focus of occupational therapy" (AOTA, 2008, p. 355). Sleep patterns, habits, and routines are a basic component for the
establishment of a daily routine. Meyer (1922) stated that establishment of a routine is a stage in the establishment of a given behavior into an occupation.

Occupations commonly have a temporal dimension to their performance. For example, a night time routine is a recurring daily occupation with predictable tasks and which add structure to our existence (Christiansen & Baum, 2005). For the child with SMD, orderly rhythms of the sleep-wake cycle, consistency of an established bedtime routine, and the ability to regulate the level of alertness to a lower state of arousal so as to permit falling asleep, are negatively affected.

In the PEOP model, the transition from task performance to occupation occurs when performance of the tasks become a stream of goal-directed behavior (Csikszentmihalyi, 1993). In children with SMD, the transition at bedtime from wakefulness to sleep may be interrupted and therefore may not develop into an occupation with robust occupational performance (Miller, 2006).

The occupation of social participation. In the second paradigm, person and environment factors combine to produce social participation. The PEOP model emphasizes that occupation occurs within the context of our relationships with others (Christiansen, 1999). Just as multiple expressions of one’s self exist through daily interactions, pieces of ourselves are distributed throughout the social environment. One significant piece of the self occurs only through social interaction with others (Baum & Christiansen, 2004).

Social participation begins as actions that are meaningful to the individual as one works, plays, and participates in home and community life environments. As the child becomes more proficient, a flow of goal-directed socializing occurs, crystallizing into the
occupation of social participation (Csikszentmihalyi, 1993). Children with SMD often do not experience flow in their socializing due to inconsistent modulation of their arousal state. With decreased social participation comes a reduction in social proficiency, due to reduced practice socializing and limited feedback due to less frequent outcomes.

**Assumptions of the Study**

- Sensory modulation is a physiological system regulated through the autonomic nervous system.
- Activating the autonomic nervous system will affect sleep behaviors since sleep is an arousal system of physiological response.
- Sensory modulation disorders interfere with a sense of coherence due to inconsistent response to sensory stimuli. The sense of coherence is necessary for consistency, though which daily occupations and relationships with others are constructed, and which provide meaning and a sense of well-being in the child's life.
- Moderate pressure touch activates the autonomic nervous system via nerve receptors and via activation of neuro-regulatory neurotransmitters, and provides an intervention based on under- or over-responsivity to this physiological stimulus.

**Limitations of the Study**

A limitation of this study is that of selection bias. The selection of participants was limited to English-speaking participants; geographical sampling was limited to one site. Examiner bias was a possible threat to validity because there was one examiner in this study, including the scoring of GAS goals. Bias of parents may be reflected in parent
reports via the questionnaires used in the study. Additionally, the design of the study used convenience sampling, with random assignment to groups which could limit the ability of the study to generalize findings to the greater population. Furthermore, variations in application of the moderate pressure touch by the parents may have varied between participants which may have influenced the magnitude of the effect. Finally, confounding of effects was a concern due to additional diagnoses other than SMD, and would make causality difficult to establish. The inclusion criteria were greatly controlled to account for this problem.
Chapter 2: Literature Review

This chapter is a review of the relevant literature for children with sensory modulation disorder (SMD) who experience sleep difficulties and who may have impaired social participation. First, the occupational therapy person-environment-occupational performance (PEOP) model and the ecological model of sensory modulation dysfunction will be reviewed. Then, the current knowledge regarding SMD will be explored. Behavioral sleep difficulty in children with SMD in the literature will be documented. The chapter will then review social participation of children with SMD.

PEOP Model

The PEOP model is a client centered occupation-based model. The model focuses on occupational performance as the creation of meaning and participating in occupations for a meaningful life. The PEOP model proposes that one “makes meaning” through the experience of “doing” (Jonsson & Josephsson, 2005, p. 118). Christiansen (1999) postulates that meaning in life is reduced when one is not able to engage effectively in occupations. The acquisition of an occupation requires practice. Through doing, the child develops skill efficacy, mastery, and meaningful relationships with others (Wilcock 1993). Occupational choices and preferences are clarified. Through repetition, activities become fluid and the child develops patterns of occupation (Coster, 1998). Without such practice, occupational performance is limited because the child has not developed the necessary knowledge or skill to effectively engage in occupations (Christiansen & Baum, 2005).

Children with SMD avoid experiences perceived as negative, even when the experiences are, in reality, not extraordinary (Miller, 2006; Smith-Roley, Blanche, &
Schaaf, 2001). According to Cohn et al. (2000), the ability of the child with SMD to regulate and modulate arousal levels is a major concern reported by parents. This inability to grade sensory input, to regulate unanticipated stimuli, or maintain a balanced state of arousal can cause the child to avoid engaging in his or her environment, because the environment is perceived as threatening and non-supportive (Smith-Roley et al., 2001). As a result, children with SMD have reduced social participation.

Cohn (2000) further reports that a second significant area of concern of parents was expressed in their child’s inability to socialize with peers. An important facet of participation in life is defined and shaped through social encounters with others (Baum & Christiansen, 2005). Social difficulties in children with SMD have been noted in the literature, in areas such as play, social networking, and in initiation of social contacts (Cosbey et al., 2010; Dickie, Baranek, Schultz, Watson, & McComish, 2009; Hilton et al., 2007). Social difficulties in children with SMD will be reviewed later in this chapter.

**A Base for Occupation: The Person Factor of Physiology**

According to the PEOP model, the intrinsic personal factor of physiology is the study of mechanisms and how things work. According to Christiansen and Baum (2005), physiological competence is attained when the body achieves and sustains a state of homeostasis. Disturbance to a physiological system can change body structure or body function, and thus affect an individual’s activities (AOTA, 2014). According to the World Health Organization (WHO, 2001), physiological body functions include sensory functions. Sensory modulation is the ability to regulate responses with appropriate arousal to the situation (Bundy et al., 2002). Authors of the PEOP model assert that “arousal has physiological characteristics related to one’s level of alertness” (Christiansen
When a child achieves a focused and regulated level of alertness, he or she is able to perform activities in a consistent and repetitive manner (Hinojosa & Kramer, 2009; Roley-Smith et al., 2001).

**Beginning a Hierarchy of Occupation-Related Behaviors: From Actions to Tasks**

The PEOP model defined how an action becomes an occupation. Three levels are required to progress to achieve the status of occupation, as seen in Figure 1. At the simplest level are actions such as lifting or walking. At the next level, actions become tasks when part of a goal-oriented activity such as folding a towel, or lifting a basket. Tasks are supported by skills or proficiencies to perform the task. When a number of related tasks are performed over time in recognizable goal-directed behavior, they become an occupation. Task performance morphs into engagement in occupation when the tasks become part of a stream of goal-directed behavior (Christiansen & Baum, 2005). Authors of the *Occupational Therapy Practice Framework* (OTPF) further add that occupations are life engagements that are constructed of multiple activities (AOTA, 2014). Routines are occupations with established sequences and routines involve sequences of occupations (Christiansen & Baum, 2005).

The OTPF was updated in 2014 to reflect both domain and process in the performance of occupations (AOTA, 2014). The addition of process to the OTPF is significant for children with SMD. Children with SMD do not necessarily exhibit skill deficiencies in task performance, rather they exhibit difficulty in the process of performing occupations. Identifying the mechanism that prevents the stream and flow of
activities can be used for intervention to enable children with SMD to achieve occupational performance and thus engage in purposeful occupations.

![Hierarchy of occupation-related behaviors](image)

**Figure 1.** A Hierarchy of occupation-related behaviors. Adapted from Christiansen & Baum, 2005, p. 252.

**Consistency.** Children with SMD do not consistently perform actions in a repetitive manner that develop into tasks, and do not sequence tasks in a sequential manner that develop into routines or habits. They do not experience success consistently, and so develop patterns of avoidance of engagement. For example, avoidance patterns of engagement match sensory patterns of avoidance noted in the literature (Dunn, 1999; Dunn, 2003).

**The Continuation of Occupation Building: From Tasks to Occupation**

In years past, Yerxa (1966) asserted that in order to attain self-actualization, one must discover both one’s limitations and one’s possibilities. In order to discover limitations and possibilities one must first *do* something. In the second transition of occupation building, the transformation of tasks into the more complex occupations occurs when the task becomes a stream of goal-directed behaviors with multiple tasks (Christiansen & Baum, 2005).
Flawed interpretation. Patterns of avoidance in children with SMD are often based on flawed interpretation of sensory events (Bundy et al., 2002; Dunn, 1997). The children do not perceive that they can succeed in socialization, and are not motivated to make the effort required, rather they abstain from socializing. For example, sensory seeking patterns of engagement have been linked to social dysfunction of aggression and delinquent behaviors (Mangeot et al., 2001). A lack of positive and successful experience hinders development of strategies needed to succeed in this occupation (Cosbey et al., 2010).

Sensory Modulation Disorder

Historical Development of Sensory Modulation Disorder

The use of the term sensory modulation disorder (SMD) is a relatively recent diagnostic classification. SMD evolved from the field of sensory integration (SI) in pediatric occupational therapy as proposed by Dr. Jean Ayres in 1964. SI is a brain-behavior theory which explains how a child processes and organizes the flow of sensory input in an organized way that elicits an adaptive response (Ayres, 1972; Fisher, Murray, & Bundy, 1991).

Ayres wrote that SI included tactile disorders such as sensitivity to touch, the precursor to the broader concept of sensory over-responsivity. Shortly before her death, Ayres reclassified the diagnosis of SI. Besides including categories of somatodyspraxia and bilateral integration disorder based on vestibular dysfunction, sensitivity to touch was changed to tactile defensiveness (Ayres, 1989). The original concept was that a hyperactive sense of the tactile system in children caused abnormal responses (Ayres, 1979). In 1990, a broader term named sensory defensiveness began to appear in the
literature (Cool, 1990; Oliver, 1990; Wilbarger & Wilbarger, 1991). The concept of over-sensitivity was expanded to include all the sensory systems rather than defining disorders solely in the tactile system (Wilbarger & Wilbarger, 1991).

In 1999, four literature reviews and two meta-analysis studies from the years 1982-1999 researched the effectiveness of SI intervention. None of the studies found conclusive treatment effects of SI as more effective than other methods of treatment (Arendt, MacLean, & Baumeister, 1988; Hoehn & Baumeister, 1994; Ottenbacher, 1982; Polatajko, Kaplan, & Wilson, 1992; Schaffer, 1984; Vargas & Camilli, 1999). As a result of those findings, health care agencies began to refuse SI therapy reimbursement and the National Association of School Psychologists argued that there was no evidence as to the efficacy of SI therapy (Blue Cross and Blue Shield Association, 2000; Shaw, 2002).

The future development of SI was jeopardized. Reorganization was needed. At the same period in time, advances in the medical field began to include use of evidence-based practice (EBP). EBP is a practice of integrating clinical judgment with the best current research studies and evidence for optimal and efficient individual client care (Sackett, Rosenberg, Muir-Gray, Haynes, & Richardson, 1996).

During this period of change in the general medical field in the mid 1990s, occupational therapists began to promote novel but unsubstantiated theories of SI using the term sensory processing based on new neuroscience literature (Hanschu, 2000; Wilbarger & Wilbarger, 1991). Sensory processing disorders (SPD) were defined as the "ability to take in and make sense of many different kinds of sensations which come into
the brain along different sensory channels at the same time, and which allows the child to make an adaptive response" (Hanschu, 2000, p. 6).

**Terminology and Classification of Sensory Processing Disorders**

The field which began historically as SI had expanded into a larger concept of sensory processing. A variety of terms were in use in the literature which confused dialog within the profession and when communicating with other professions. An effort was made to reach a consensus of unified terminology (Lane, Miller, & Hanft, 2000). The term sensory processing was used to describe the process of "reception, modulation, integration, and organization of sensory stimuli, including the behavioral responses to sensory input" (Miller & Lane, 2000, p. 2). The term *sensory processing disorder* was to be used for a diagnosis of sensory dysfunction.

Use of the term SI was considered to be a specific scientific neurological construct and was removed from the lexicon of treatment in occupational therapy. However, recognizing the historical contribution of Ayres to the field of sensory processing, the term *sensory integration theory* was proposed for use when discussing theory, and sensory intervention was to be termed *OT-SI* (May-Benson, 2000; Miller, Anzalone, Lane, Cermak, & Osten, 2007). Further, a distinction in terminology was made between neuro-physiological processes and behavioral processes by using the term *reactivity* to refer to neurological and physiological processes, while the term *responsivity* would refer to observable behaviors in children (Miller, Anzalone, et al., 2007). As knowledge and common terminology of sensory processing advanced, a nosology of three SPD subtypes was proposed in 2005 by the Interdisciplinary Council of Developmental and Learning Disorders (ICDL) as shown in Figure 2.
The first subtype of SPD was termed sensory discrimination disorder (SDD). Sensory discrimination disorders are typically the result of poor sensation. The child has difficulty discriminating similarities or differences between temporal and spatial characteristics of sensory stimuli (ICDL, 2005; Lane et al., 2000; Miller, 2006). The second subtype was termed SMD and was characterized by an "inability to grade the degree, intensity, and nature of response to sensory input" (ICDL, 2005, p. 81). Stated more simply, poor sensory modulation was noted when the level of the child's alertness level did not match the demands of the environment.

The third subtype of SPD was termed sensory-based motor disorder (SBMD). SBMD is further divided into disorders of dyspraxia and of postural disorders (ICDL, 2005). SBMD was formerly considered as SI dysfunction (Ayres, 1989). Occupational therapists associated with Ayres had returned to the data, reviewed the factor analyses, and concluded that earlier diagnostic categories of SI dysfunction were not supported. This led to the current classification of only two subtypes of SBMD (ICDL, 2005; Lane et al., 2000; Mulligan, 1998; Mulligan, 2000).

In SMD, a child with the subtype sensory over-responsivity is typically overwhelmed with sensory input and undergoes a flight or fight reaction. A child with the subtype sensory under-responsivity is under-responsive to sensory input and may appear lethargic. A child with sensory seeking behaviors craves sensory input and will actively seek sensation, often in maladaptive and excessive ways (Miller, 2006). Children in all three categories of SMD have difficulty matching their level of arousal, or alertness, to the demands of the environment. This study will focus on the subtype of SMD.
An Ecological Model of Sensory Modulation

The ecological model of sensory modulation provides a lens with which to view SMD and the behaviors associated with SMD. The model may be used as a theoretical base for intervention planning. The model is composed of three internal dimensions that affect modulation abilities. The three internal dimensions are attention, emotion, and sensation. Attention is defined as the ability to sustain performance for tasks and relationships, and includes activity level. Emotion is defined as the ability to regulate one's affect and behavioral responses. Sensation is described as the ability to take in and organize sensory information in a regulated state of alertness and level of focus to the task at hand (Smith-Roley et al., 2001).

The model is also comprised of four external dimensions that support the internal dimensions. The four dimensions are culture, environment, relationships, and task. Culture
includes societal expectations and environment is the physical milieu of the child. Relationships include the child's interactions with other people and task includes the occupations and activities of the child. According to the model, childhood occupations include "activities of daily living, play, school, sleep and social relating" (Smith-Roley et al., 2001, p. 60).

Each child has a unique sensory profile of interaction between the three internal dimensions and the four external dimensions. The expression and extent of influence of each dimension varies between each individual. The authors of the model consider that an imbalance between the adaptive capacities of the internal dimensions and the demands of the external dimensions would cause maladaptive behaviors and limited occupational performance (ICDL, 2005; Smith-Roley et al., 2001). For example, a child who is over-sensitive to noise may react by shutting down, both physiologically and behaviorally. Or, a child who seeks sensation may over touch his or her peers causing irritated responses to the intended gesture of friendship. Such responses could reduce the child's attending to a school lesson or diminish social participation with friends (Kramer & Hinojosa, 2010).

Children with SMD can react in atypical ways to typical sensory stimuli. Responses range from under- to over-responsive reactions to physiological shutdown responses including changes in respiration, cardiac function, and decreased consciousness (Kimball, 1993). Children with the sub-type SOR tend to have greater responsivity to irrelevant stimuli, creating a higher state of arousal. Therefore, achieving continuous quality sleep is more difficult than for typically developing children when entering a sustained and relaxed sleep state (Reynolds et al., 2012). Children with the sub-type of sensory seeking have a greater need for continued sensory stimulation, and may not cease the sensory seeking at the designated bedtime. For the child with SMD, an overly high state of arousal would require greater effort to enter and maintain a state of
low enough arousal sufficient for sustained and restful sleep (Davies & Gavin, 2007; Milner, Cuthbert, Kertesz, & Cote, 2009).

Studies support the existence of SMD as a unique disorder, distinct from other childhood neurological or affective disorders such as attention deficit hyperactivity disorder (ADHD) or autism (Dunn & Bennett, 2002; Tomchek & Dunn, 2007; Yochman, Parush, & Ornoy, 2004). One example of support for the existence and quality of external dimensions of the model is a study which considered how interactions of families that include a child with SMD changed the organization of the family's routines (Bagby et al., 2012).

Theories of sensory processing and sensory modulation are few and have minimal research to support theoretical claims. One such theory is the conceptual model of sensory modulation (Dunn, 1997). Dunn's conceptual model of sensory modulation makes a theoretical link between neurological thresholds to behavioral responses (Dunn, 1997). No further research was found in the literature that supported or expanded the theory beyond the original concept paper. Similarly, no direct research was found in the literature to substantiate the ecological model of sensory modulation. However, the concept of SMD was incorporated into the diagnostic manual of the ICDL for Infancy and Early Childhood in which theoretical concepts underlying SMD were referenced as a framework "classifying classic patterns and subtypes of sensory processing problems" (ICDL, 2005, p. 74). The ICDL framework is referenced in studies and concept papers regarding SMD (Ben-Sasson, Cermak, et al., 2007; Mangeot et al., 2001; Miller, Coll, et al., 2007; Schoen, Miller, & Green, 2008; Spira & Kupietsky, 2005). While support of the totality of the ecological model of sensory modulation has not been researched, studies have focused on substantiating the dimensions of SMD.
The dimensions of the model researched include studies of the occupational performance of children with SMD, social contexts and participation in school and home, and specific performance components such as sensory sensitivities and self-stimulating behaviors, as noted in this chapter (Bagby et al., 2012; Cohn et al., 2000; Cosbey et al., 2010; Fertel-Daly, Bedell, & Hinojosa, 2001; Parham & Mailloux, 2010; Smith, Press, Koenig, & Kinnealey, 2005).

While a need to substantiate basic claims of the uniqueness of SMD remains imperative, it is worthwhile for the occupational therapy profession to conduct research on the theoretical basis of SMD as well. The theory informs the research and the data collected refines the theory, creating a positive spiral loop of expanding knowledge (Kielhofner, 2006; Mosey, 1981).

**Research in SMD**

**SMD as a distinct diagnosis based on physiological response.** Children with SMD often overreact or underreact to typical situations. Their attempts to effectively adjust and regulate their arousal levels or meet sensory needs often appear to be unusual behaviors (Cohn et al., 2000). Atypical physiological responses of children with SMD must be addressed in order to provide opportunities to engage in occupation according to their physiological profiles. Additionally, classification of SMD as a distinct disorder reinforces the construct of a personal intrinsic factor of physiology noted in the PEOP model. Correspondingly, initial research into SMD focused on peripheral measures of physiological reactivity.

In 1999, the first research articles in the field of sensory processing disorders were published in peer-reviewed medical journals. Two related studies suggested that a clinically distinct group of children with sensory processing disorders existed (McIntosh, Miller, Shyu, & Hagerman, 1999; Miller et al., 1999). The two studies investigated the use of eccrine sweat gland
activity during sympathetic nervous system innervation to distinguish between typically developing children and children who were over-reactive to sensory input. Results were significant and provided initial support for a group of children who reacted differently when presented with sensory stimuli than typically developing children. Two significant differences found in the studies were that children with SPD reacted with greater magnitude to sensory stimuli and habituated to the stimuli more slowly than typically developing peers (McIntosh, Miller, Shyu, & Hagerman, 1999).

After establishing initial support for the existence of sensory processing disorders in typically developing children, studies began to focus on the expression of SPD in children with special needs. Dunn, Myles, and Orr (2002) found that children with Asperger syndrome had more difficulty with auditory processing and in regulating responses to sensory stimuli according to a parent questionnaire. Dunn and Bennett (2002) also found different sensory processing patterns in children diagnosed with ADHD. Research then began to focus specifically on SMD.

A breakthrough study investigated peripheral physiological reactivity via electrodermal skin response (McIntosh, Miller, Shyu, & Hagerman, 1999). This peripheral measure of electrical skin conduction noted sympathetic nervous system arousal in response to sensory stimuli. Subjects with SMD were found to have greater sympathetic nervous system arousal than typically developing subjects (Miller et al., 1999).

In 2007, a central measure of sensory processing via brain imaging was introduced (Davies & Gavin, 2007). The authors noted the use of this new technique to study sensory responsivity stating “Electroencephalography (EEG) and event-related potentials (ERPs), functional neuro-imaging methods, are ideal techniques that may offer occupational therapists new strategies for studying SPD” (Davies & Gavin, 2007, p. 177). The electroencephalography
(EEG) technology provided an ability to measure real-time brain activation during the processing of sensory stimuli. Event-related potentials are graphic displays of time locked segments of the EEG, typically occurring in the study at 50 milliseconds (ms) post stimulus (P50), 100 ms (N100), and 200ms (P200) post-stimulus. An event-related potential waveform which measures amplitude and latency was produced. The study was significant because it showed that children who were hypo-responsive to sensation reacted with less amplitude to sensation and children who were hyper-responsive to sensation reacted with greater amplitude to sensation than typically developing peers. These results support the hypothesis that children with SMD have different neural processing mechanisms than their typically developing peers. A recent study confirmed results from the earlier study that brain wave activity was able to correctly distinguish children with SMD with 77% accuracy (Gavin et al., 2011).

Two additional physiological measures studied were the function of the vagal nerve in the parasympathetic nervous system of children with SMD and secretion of the stress hormone cortisol. The parasympathetic nervous system is an important regulator of arousal levels in children (Schaaf et al., 2010). High parasympathetic activity has been associated with the ability to cope and adapt. Low parasympathetic activity is associated with a narrow range of behavioral coping and is a predictor for stress (Degangi, Dipietro, Greenspan, & Porges, 1991; Porges, 2007).

The vagus nerve is a cranial nerve that originates in the brain and goes through the entire body, past the heart to the viscera. The vagal nerve is the primary regulator of parasympathetic activity in the body (Kandel et al., 2006). The term vagal tone refers to the amount of vagal nerve reactivity to physiological changes in the body. Greater vagal reactivity to body states has been linked to greater social participation and behavioral regulation (Porges, 1995). Field et al.
(2010) suggest that moderate pressure massage elicits a parasympathetic nervous system response which in turn affects neuro-endocrine function, growth and development, and psychological outcomes.

Three studies within the occupational therapy literature address vagal control in children with SMD. One study found that infants with regulatory disorders were less able to consistently regulate vagal control as compared to the control group (Degangi et al., 1991). A second study found lower vagal control on both baseline levels and in reaction to sensory stimuli than typically developing children. Children who had difficulty regulating their arousal states and behavioral responses had lower vagal control; therefore, they had physiologically increased sympathetic nervous system activity. The authors noted that when the ability to maintain a calm and focused state was disrupted by lower vagal control, participation in activities was negatively affected (Schaaf et al., 2003).

A third study found that patterns of physiological responses to sensory stimuli differed between typical children and children with severe SMD. The authors were able to predict which children scored as having SMD on sensory questionnaires based on the children’s’ vagal control in response to stimuli (Schaaf et al., 2010). Additionally, a study of cortisol levels in children with sensory sensitivity found both low levels and high levels of cortisol, suggesting two types of responses to stress, responders and non-responders (Corbett, Schupp, Levine, & Mendoza, 2009). The findings of these studies suggest a physiological link to the difficulties encountered in SMDs and have implications for intervention strategies (Schaaf et al., 2003). The studies support studying sleep disturbances in children with SMD, as sleep is also a physiological process.

In summary, basic physiological studies of children with SMD have been of good quality and have used rigorous procedures including random allocation and large sample sizes. Methods
that have been successful in investigating physiological dysfunction in children with SMD include studies of peripheral electrodermal skin response, central measures of evoked response potential brain waveforms, a parasympathetic nervous system control mechanism of vagal tone, and levels of the stress hormone cortisol (Gavin et al., 2011; Miller, Schoen, James, & Schaaf, 2007).

**Efficacy research in SMD.** Efficacy studies have been limited by use of a backwards chaining approach to research instead of using forward chaining. The research is data driven and therefore focused and logical (Wagman, 2003). A continuous flow is established from the theoretical mechanism of change through to the intervention and the noted outcomes. The explanation of the phenomenon is natural and not facilitated (Rogers, 1999). In backwards chaining, the study begins with a goal and regresses the goal back through actions that achieve at least one of the sub-goals. This approach can be wasteful as there are many possible ways of trying to prove something and almost all of the approaches must be tried before finding the one that works. The explanation of the mechanism of change is not natural but rather is facilitated with attempts to explain the outcomes (Rogers, 1999).

One such study used three children with different diagnoses from each other (Kimball et al., 2007). In this study, one subject’s results showed an increase in salivary cortisol post-intervention instead of a reduction in the stress hormone. In the discussion, the authors changed the original hypothesis to account for the unexpected and contradictory results by stating that the child in question must have had decreased arousal rather than increased arousal in the pretest phase. Yet, no determination of decreased arousal was documented in the pretest phase of the study.
Most commonly, studies of SMD have used lower levels of evidence in the hierarchy of evidence-based practice (EBP), such as the use of questionnaires (Ashburner, Ziviani, & Rodger, 2008; Ben-Sasson et al., 2007; Case-Smith, Butcher, & Reed, 1998; Dunn, 1997; Dunn et al., 2002; Kientz & Dunn, 1997; Kinnealey & Fuick, 1999; Pfeiffer, Kinnealey, Reed, & Herzberg, 2005; Tomchek & Dunn, 2007). Many of these studies used caregiver-based questionnaires such as the Sensory Profile which are subject to bias (Dunn, 1999). Other lower levels of evidence in the hierarchy of EBP include studies based on observations (Baranek et al., 2002; Franklin, Deitz, Jirikowic, & Astley, 2008). Some studies have been descriptive with only one to three single case studies (Kinnealey, 1998; Kinnealey, Oliver, & Wilbarger, 1995). Other single subject studies were conducted with small sample sizes (Dunbar, 1999; Fertel-Daly et al., 2001; Kimball et al., 2007; Mollo et al., 2008; Reisman & Gross, 1992; Schaaf & Nightlinger, 2007; Schilling, Washington, Billingsley, & Deitz, 2003; Stagnitti, Raison, & Ryan, 1999).

More rigorous levels of quantitative studies in the EBP hierarchy have lacked control groups (Silva, Ayres, & Schalock, 2008; Smith et al., 2005; Vandenberg, 2001). Other studies used assignment without randomization or made use of convenience sampling (Bundy, Shia, Qi, & Miller, 2007; Hall & Case-Smith, 2007; Pfeiffer & Kinnealey, 2003; Pfeiffer, Koenig, Kinnealey, Sheppard, & Henderson, 2011).

Four studies have contributed substantial knowledge regarding the efficacy of sensory interventions for SMD. The Miller, Schoen, et al. (2007) random controlled trial study in 2007 used behavioral outcome measures including goal attainment scaling (GAS), behavioral questionnaires, and a physiological measure of electrodermal response in order to determine the efficacy of occupational therapy sensory interventions. Results were significant and showed greater and larger responses of children with SMD to sensory stimuli than typically developing
children. A second random controlled trial study showed that sensory interventions improved behavioral outcomes and reduced stereotypic behaviors in the classroom (Pfeiffer et al., 2005). In 2008, Pfeiffer, Henry, Miller, and Witherell studied school children with attention difficulties by using a behavioral measure to study outcomes following a sensory intervention of a disc O sit cushion. Results were significant for increased attention to task and decreases in behavioral difficulties. However, none of the studies specified which types of sensory inputs contributed to the significant results. A later study by Silva, Schalock, and Gabrielsen (201) found that moderate touch of a specific Chinese massage protocol for children with autism showed significant results post-treatment. Children with autism who completed the massage touch protocol showed significant improvement in behavioral and social participation and were calmer.

**Qualitative research in SMD.** Qualitative studies provide further information about issues of meaning to parents of children with SMD. This type of study began to appear in the literature well after the establishment of prevalence rates, physiological characteristics in SMD, and intervention studies. Occupational therapists began to understand what SMD was, what it looked like, and had begun to develop competent treatment approaches. At this point, questions were raised about quality of life and occupational performance of children with SMD. Hilton et al. (2007) examined social competence. The authors reported that 77.8% of children with autism had significant sensory sensitivities, and the same percentage of children in the study had significant social responsiveness. The authors theorized that children with autism who had SMD either used sensory avoiding patterns of interaction due to being overwhelmed by the unpredictable nature of stimuli involved when playing with other children, or did not notice social cues due to low arousal levels and missed opportunities for social participation (Hilton et
al., 2007). In 2010, Hilton et al. (2010) again found a moderate to strong correlation between sensory over-responsivity and social impairment.

Cosbey et al. (2010) investigated social participation patterns of children with SMD as compared to typically developing children. Although both groups of children exhibited socialization, children with SMD had a less diverse social network, and had more challenging and less appropriate social behaviors than their peers.

Bagby et al. (2012) surveyed the effect of raising a child with SMD on families and family occupation. The authors reported emergence of three main themes. Families chose to participate or avoid participating in meaningful family activities based on the child’s sensory responses. Families of children with SMD required increased preparation to participate in family event and activities. Finally, shared family experiences, meanings, and feelings were affected by the needs and experiences of the child with SMD. Thus, family occupations were affected by the presence of SMD.

Emerging literature on the experience of adults with SMD has begun to appear in the literature. One study of adults found a correlation between sensory over-responsivity and poor social supports as well as a high correlation with anxiety and a lower quality of life. The social support was perceived as a mitigating factor which could either improve or decrease one’s quality of life (Kinnealey, Koenig, & Smith, 2011).

**Critique of the research in SMD.** Uniform terminology is not used in a standard manner in the literature. Research articles use different terms at times than the terms defined in this study, although efforts to unify terms have begun (Miller, Anzalone, et al., 2007). Additionally, the current approach when choosing SMD intervention is to use a variety of techniques in a scattered approach and then evaluate the effectiveness. If results are significant, an underlying
theoretical mechanism is then posited. At present, research has clearly shown that children with SMD have a distinct definable set of symptoms which can be predicted by peripheral and central brain measures (Davies & Gavin, 2007; Gavin et al., 2011). However, the core theories of SMD remain unsubstantiated. As a result, research studies and interventions for SMD remain without a clear direction.

An example of choosing an intervention approach without a model for SMDs is a study of Kripalu yoga in order to decrease sensory over-responsivity (Mollo et al., 2008). Significant results were explained by a connection of proprioceptive input that would modulate sensory over-responsivity. However, research has not yet linked the two variables. The authors note that "activities rich in proprioception are thought to improve self-regulation and decrease SOR. The neurological mechanisms responsible are not known" (Mollo et al., 2008, p. 1). The authors attempted to explain why yoga calmed children with sensory over-responsivity. The first suggestion was that decreasing SNS over-arousal was the mechanism of change. Then, the authors raised the idea that parasympathetic nervous system activity might be the mechanism by which proprioception influences regulation of sensory over-responsivity: "Perhaps heavy work activities improve the parasympathetic nervous system response, a hypothesis that requires further testing" (Mollo et al., 2008, p. 3). An additional suggestion was made by the authors that deep breathing might be the cause of the increased calming, stating "It is also possible that differences in vagal tone were due to enhancements in breathing rather than enhanced proprioception" (Mollo et al., 2008, p. 3). Ultimately, the physiological mechanisms underlying the calming responses of the children remained unclear. Thus, even with significant results, the authors were no closer to being able to choose an intervention strategy based upon understanding
the physiological correlates. The study supported a successful intervention without understanding why it was effective.

Another issue to be considered is that much of the research in SMD has been conducted with co-morbid diagnoses, such as SMD in children on the autism spectrum. Use of co-morbid diagnoses confounds results and whether the dysfunctions are due to the secondary diagnosis or due to independent difficulties of SMD. For example, children with additional diagnoses such as Fragile X, ADHD, and autism spectrum disorders (ASD) show atypical reactions to sensory stimuli (Dunn et al., 2002; Dunn & Bennett, 2002; Miller et al., 1999). In intervention, it is possible that noted improvement may be due to characteristics inherent to autism spectrum disorder rather than characteristics inherent in SMD.

Limitations in efficacy research were noted by issues found in the general approach to occupational therapy research and were not specific to the study of SMD. The main issues found were a lack of experimental procedures and small sample sizes. It is recommended that the field of occupational therapy organize and promote quality research with rigorous standards.

**Research in moderate pressure touch as an intervention technique.** Two primary intervention principles are theorized for modulating SMD, pressure touch and proprioceptive activities (Wilbarger & Wilbarger, 1991). The application of pressure touch and proprioceptive input to modulate sensation is found in the literature (Smith-Roley et al., 2001). Difficulty with emotional regulation in children with decreased proprioception has been noted as well (Blanche, Reinoso, Chang, & Bodison, 2012). One occupational therapy textbook states that "deep pressure and proprioception continue to be important therapeutic tools in intervention to decrease sensory defensiveness" (Bundy et al., 2002, p. 265). However even proponents of the use of pressure touch and proprioception to modulate SMD caution that our understanding of mechanisms that
underlie sensory modulation deficits remain primarily hypothetical (Bundy et al., 2002). Since
the occupational therapy literature has not significantly corroborated the efficacy of using
pressure touch input, the literature review will turn to literature found in other health care fields.

A study of 23 infants who had difficulty falling asleep found that their sleep difficulties
improved following massage (Field & Hernandez-Reif, 2001). Children were divided into a
control group who were read a bedtime story, and into an experimental group who received a 15-
minute massage prior to bedtime. Outcome measures used were a sleep diary and two
observations, one at the beginning of the intervention and again at the conclusion of the
intervention. Conclusions were limited by the weakness of the outcome measures and the small
number of subjects in each group. However, the results of the study found that the infants who
were massaged went to sleep with greater ease and showed fewer disruptive bedtime behaviors.

**Moderate pressure touch vs. light touch or relaxation techniques.** Studies comparing
the use of light versus moderate pressure touch found that only moderate pressure touch elicited
parasympathetic nervous system responses and increases in vagal activity (Diego & Field, 2009).
Both responses indicated an influence on regulation of body state. Use of either light touch
stimulation or cognitive relaxation techniques reduced anxiety but did not calm body physiology.
Only moderate pressure input via stimulation of the skin mechanoreceptors released calming
neurotransmitters and increased vagal activity in subjects (Diego, Field, Sanders, & Hernandez-
Reif, 2004; Field et al., 2010). A study which found that optimal infant development was
obtained from moderate massage versus light pressure massage corroborated the preference of
moderate touch interventions over light touch interventions (Field, Hernandez-Reif, Diego, Feijo,
Vera, & Gil, 2004).
**Moderate pressure touch elicits body responses.** Multiple reports of moderate pressure touch in the literature used a 20-30 minute touch application twice weekly (Diego, Field, Hernandez-Reif, Shaw, Friedman, & Ironson, 2001; Field, Hernandez-Reif, Diego, Schanberg, & Kuhn, 2005; Moraska, Pollini, Bounanger, Brooks, & Teitlebaum, 2010). Outcome measures in these studies were levels of dopamine and serotonin neurotransmitters which regulated arousal and modulation, and cortisol which was a hormone that indicated a state of stress (Kandel et al., 2006). After a 20-30 minute moderate pressure massage, physiological responses were noted by increases in dopamine and serotonin, and reduction in cortisol. After receiving massage for a six week period of time, infant serotonin levels increased by 34% (Field, Grizzle, et al., 1996). Adolescents with bulimia had an increase of 30% in dopamine levels following massage (Field et al., 1998).

Cortisol is commonly measured because it crosses the blood brain barrier and enters the bloodstream, making data collection relatively simple (Cacioppo et al., 2000). Decreases in cortisol indicate a reduction in stress. Hospitalized children who were depressed were found to have lower levels of cortisol after five days of a back massage for 30 minutes when compared to a control group (Field et al., 1992). Lower cortisol levels were also noted in children with posttraumatic stress disorder who received massage when compared to children who watched a video for the same amount of time (Field, Seligman, Scafidi, & Schanberg, 1996).

Vagal tone was found to increase following massage. As noted, vagal tone is a measure of reactivity in the body and indicates behavioral coping abilities (Cacioppo et al., 2000; Porges, 1995). Higher vagal tone indicates a physiological state of calm and reduction of physiological stress due to higher parasympathetic control (Cacioppo et al., 2000). Preterm neonates who received massage showed increased vagal tone and gained weight (Diego et al., 2005). Infants
who were exposed to cocaine reported that massage increased vagal tone as well (Field, 2002). The results of these studies support the use of moderate pressure touch as a calming technique for children with SMD.

**Effects of moderate pressure touch via massage on social participation.** Touch input has been found to improve social development in infants (Cigales, Field, Lundy, Cuadra, & Hart, 1997). Several studies have measured the effect of massage on children with autism who have sensory modulation difficulties (Silva et al., 2009; Silva et al., 2011). Improvement was noted in level of sensory dysfunction and in adaptive behavior following five months of Qigong style massage by the children's parents (Silva et al., 2009). In another study, children who were massaged showed fewer autistic behaviors and improved on social scales when compared to children who were only held on the examiner's lap (Field et al., 1997). Massage has been successful in reducing anxiety and improving social communication in children with ASD (Edelson, Edelson, Kerr, & Grandin, 1999).

**Critique of the research in moderate pressure touch.** Intervention of moderate pressure touch massage can provide a calming influence to the autonomic nervous system through release of modulating neurotransmitters such as dopamine and serotonin, by modulating vagal tone, and by decreasing levels of the stress hormone cortisol (Diego et al., 2004; Field et al., 1992; Field et al., 1998). Behavioral effects such as calming, anxiety reduction, and increased social participation are also documented in the literature (Cigales et al., 1997; Silva et al., 2009; Silva et al., 2011). However, only studies of physiological calming were found in the literature, to the exclusion of the effect on sensory seeking or on under-arousal.

Studies of the effects of moderate pressure touch on children include a multitude of diagnoses including eating disorders, prematurity, and juvenile arthritis. However, no studies
were found that studied the effect of massage on children with SMD independent of additional diagnoses. This dissertation study will examine the effect of moderate pressure touch massage on children with SMD alone to determine if the effects on sleep and social participation are applicable to children with SMDs.

**Sleep**

The effect of the parasympathetic nervous system on both sensory modulation and on sleep is a central tenet of this study. Sleep is a physiological process that affects the autonomic nervous system and is therefore a component of arousal. Restricted or disrupted sleep blunts parasympathetic reactivity to stress and increases sympathetic nervous system activity (Sgoifo et al., 2006; Meerlo, Sgoifo, & Suchecki, 2008).

A typical child needs 9-11 hours of sleep for optimal growth and development. Lack of sufficient sleep has a myriad of negative consequences for a typical child, such as clumsiness and impaired attention to task (Sadeh et al., 2002). Chronically disrupted sleep can lead to problems in cognitive functioning including memory, attention, and abstract complex tasks (Owens, 2004). Significant behavior, mood, and performance impairments have also been documented (Kopasz et al., 2010; Moturi & Avis, 2010). Approximately 25% of all children experience behavioral sleep difficulties such as bedtime resistance, night awakenings, or daytime sleepiness (Meltzer & Mindell, 2006).

As previously noted, occupational therapy is concerned with rest and sleep as one of eight domains of function which "define the focus of occupational therapy" (AOTA, 2008, p. 355). The domain of rest and sleep encompasses the areas of rest and relaxation to restore energy and calm, the establishment of sleep patterns that support growth and health, sleep preparation including preparation and routines as well as preparation of the physical environment, cessation
of activities to insure onset of sleep, the sustaining of a sleep state without disruption, night time care of toileting and hydration needs, and interaction with those sharing the sleeping space (AOTA, 2014; Kramer & Hinojosa, 2010). It is theorized that the heightened arousal noted in children with SMD impairs the ability to fall asleep in a timely manner, to stay asleep without waking, and to experience a calm restful sleep (Schwartz & Carney, 2012).

**Physiology of Sleep as a Base for Sensory Intervention**

According to the PEOP model, the natural cycle of the human is influenced by internal biological clocks, a phenomenon known as chronobiology. This physiological factor changes levels of arousal and influences activity levels (Christiansen & Baum, 2005). The similarities to sleep are striking. Sleep is a natural cycle influenced by internal biological clocks (American Academy of Sleep Medicine, 2001). Stress and anxiety negatively affect sleep (Lavie, 2001). Similarly, heightened arousal noted in children with SMD may impair the ability to fall asleep in a timely manner, to stay asleep without waking, and to experience a calm, restful sleep (Schwartz & Carney, 2012). Daytime sleepiness has also been found to affect social participation (Sadeh, Gruber, & Raviv, 2002). A search of the literature did not yield studies regarding the influence of sensory seeking on sleep behaviors.

**Review of Sleep Disorders in Children**

The majority of the literature for behavioral sleep difficulty in children was found in related special needs diagnoses and not within the field of SMD itself. Three diagnostic groupings that were especially noted to have persistent sleep problems were ADHD, mood and affect disorders, and autism spectrum disorders (Ivanenko, Crabtree, & Gozal, 2004).

**Sleep problems in children with ADHD and fetal alcohol syndrome.** Children with ADHD had significantly higher scores of sleep disturbances than typically developing children,
up to five times greater reported problems (Goodlin-Jones, Waters, & Anders, 2009; Owens et al., 2000). Children diagnosed with ADHD had greater difficulty initiating and maintaining sleep when compared to typically developing children (Weibe, Carrier, Frenette, & Gruber, 2013). When treated with melatonin, symptoms of sleep difficulties such as sleep onset latency lessened, and sleep duration increased in children with ADHD (Spruyt & Gozal, 2011). The same effect of medication was found with mood and affect disorders including depression.

The literature also supports a relationship between physical sleep problems such as obstructive sleep apnea or snoring, and ADHD, concluding that 20%-30% of children with ADHD had obstructive sleep apneas (OSA). Conversely, 95% of children with OSA had attention difficulties (Youssef, Ege, Angly, Strauss, & Marx, 2011). When physical sleep problems were treated, the incidence of ADHD was reduced (Perfect, Archbold, Goodwin, Levine-Dornerstein, & Quan, 2013). The relationship between sleep disordered breathing in children with ADHD is important to note when distinguishing between children with ADHD and children with SMD. Children with SMD do not typically have obstructive sleep problems such as sleep apnea. However, few studies address sleep in children with SMD, and none were found that addressed OSA.

An additional group of children with sensory disturbances are children with fetal alcohol syndrome. A study found that the sensory disturbances were associated with multiple sleep problems and recommended sensory based therapy to improve sleep regulation and sleep consolidation (Wengle, Hanlon-Dearman, & Fjeldsted, 2011).

**Sleep problems in children with autism spectrum disorder.** In children with ASD, sleep difficulties range from 40%-80% (Cortesi et al., 2010; Meltzer & Mindell, 2006). Multiple studies provide evidence that children with ASD have different sleep patterns than typically
developing children. Nap time was of reduced frequency and of reduced duration (Schwichtenberg, Isoif, Goodlin-Jones, Tang, & Anders, 2011). Reduced total sleep time was a predictor for increased stereotypic behaviors and for social skills deficits (Cortesi et al., 2010; Schreck, Mulick, & Smith, 2004).

Researchers of sleep disorders have begun to consider the role of sensory modulation in children with ASD who have difficulty sleeping. In 2004, Schreck et al. (2004) questioned whether regulatory neurotransmitters such as serotonin would be a useful addition to cognitive behavioral therapies. Cortesi et al. (2010) queried if the use of melatonin would better modulate synaptic transmission. Behavioral interventions alone were found to have limited success resolving sleep disturbances in children with ASD (Ivanenko et al., 2004). The low rate of success for using only cognitive behavioral interventions prompted child psychiatrists to list children with ASD as the highest priority for pharmacologic intervention in order to decrease their over-arousal (Mindell et al., 2006).

**Sleep problems in children with SMD.** Initial studies regarding sleep difficulty in children with SMD began to appear in the literature in 2009. Of the few studies found, only one related to SMD independent of a co-morbid diagnosis. That study found that tactile sensitivity, one symptom of SMD, was a significant predictor for sleep disturbances in normal school children, accounting for 25% of the variance (Shochat et al., 2009). A second study with a co-morbid diagnosis of atopic dermatitis found that sensory over-responsivity was correlated with lower quality of sleep than for typically developing children (Shani-Adir et al., 2009). A third study concluded that children with autism had a higher prevalence of atypical sensory responses and sleep disturbances than typically developing children, but a causal relationship was not reported (Reynolds & Lane, 2011). A link has been proposed between difficulty filtering
extraneous stimuli and difficulty lowering arousal levels sufficient for healthy sleep (Reynolds et al., 2012). Additionally, a study of adults with SMD found similar results of decreased sleep quality for subjects with hyper-sensitivity, particularly to tactile, visual, and auditory stimuli (Engel-Yeger & Shochat, 2012).

**Impact on occupational performance in children with SMD and sleep problems.** Research in SMD has typically focused on sensory difficulties but until recently, research has been minimal regarding the link between sensory dysfunctions and occupational performance limitations. One study reported on the ability of families to adopt sensory strategies that would increase the child’s occupational performance in the home and in the child's daily routines (Bagby et al., 2012). In 2010, a systematic review of the literature was undertaken by the American Occupational Therapy Association as part of an evidence-based literature review project. The project focused on limitations in functional performance with children who had difficulty processing and integrating sensory information. Included in the project was a review of the domain of rest and sleep in children with SMD, where the authors found difficulty in functional performance (Koenig & Rudney, 2010).

**Summary of the research on sleep and SMD.** Due to the inclusion of other co-morbid diagnoses in addition to SMD in the majority of studies found in the literature, a lack of clarity exists which makes it difficult to determine if SMD is directly related to sleep difficulties. Only one study was found that compared sleep difficulty to SMD with no other confounding diagnoses such as ASD or ADHD (Shochat et al., 2009). The Shochat et al. (2009) study, found that tactile sensitivity was a significant predictor for behavioral sleep problems, accounting for 25% of the variance. Given the paucity of information about the relationship between SMD and sleep in children, conclusions must be drawn with reservations. Initial research supports the claim that
children with SMD have a higher prevalence of sleep disturbances than typically developing children, including a wide spectrum of difficulties (Ben-Sasson et al., 2009; Shani-Adir et al., 2009). As opposed to other diagnostic conditions such as ADHD where solving the sleep problems seem to alleviate the daytime symptoms of the ADHD diagnosis, SMD appears to be the cause of the sleep difficulties (Perfect et al., 2013; Shochat et al., 2009). Since SMD is a modulation disorder, researchers have begun to investigate the use of modulation interventions to improve sleep difficulties (Bagby et al., 2012). Suggestions have been raised that providing environmental contexts such as the establishment of routines may be conducive to sleep and rest. Influencing internal dimensions within the child through the use of sensory calming inputs such as massage or warm blankets have also been considered in the literature (Kramer & Hinojosa, 2010). However, the lack of studies researching SMD exclusive to other major diagnoses reduces the ability to link sleep difficulties specifically to children with SMD or to plan targeted effective interventions.

**Bedtime Stories**

Use of a similar yet non-reactive input for comparison to a sensory intervention is found in the occupational therapy literature. In a random controlled trial study of the effectiveness of sensory interventions for children with SMD, an active placebo of tabletop games was used. Adults who were not occupational therapists played games and did arts and crafts activities with children for the same duration and frequency as the sensory interventions experimental group. The room size and the attention that the children in the placebo group received from the adult at bedtime were similar to the intervention conditions (Miller, Coll, et al., 2007). Similar use of tabletop activities as a control group intervention is found in a study to decrease self-stimulation and self-injurious behaviors in children with sensory disorders. A 30- minute control session
using table top activities took place in the same room as the intervention, and for the same amount of time (Smith et al., 2005).

Use of bedtime stories as an active placebo control measure was found in a study of massage therapy for infants who had sleep difficulty. In this study, the control children were read bedtime stories for 15 minutes for a month, instead of being massaged as the experimental group had been (Field & Hernandez-Reif, 2001). The Field and Hernandez-Reif (2001) study is similar to the use of the bedtime story in this study, where the control children had a bedtime story read to them for 20 minutes for three weeks, instead of the massage that was administered to the experimental group.

Social Participation

In the PEOP model social development occurs through interaction of the individual with one's social environment. This development is reliant on individual and social contexts (Edwards & Christiansen, 2005). Children with difficulty regulating arousal to a level commensurate with successful social participation in activities have a limited ability to learn and develop competent performance of occupations (Dickie et al., 2009). A contributing factor to poor social participation in children with SMD is flawed interpretation and subsequent development of avoidance strategies.

The choices an individual makes to participate in an activity is based on perceived impact of the outcome. This perception of the possibility of success is a reason why individuals participate in or avoid activities, and is called the possible self (Lunenberg, 2011). Children observe themselves in an activity, observe their choices, and develop strategies to overcome difficulty. The selection and use of strategies enables one to sustain and direct occupational performance. Sustained consistent repetitive doing becomes crucial to formation of motivation to
perform. The experience of flow and joy when performing activities, in turn, creates positive feedback and the feeling of success, further motivating the child to continue to be motivated to participate. The experience of doing creates a self-schema in which the child perceives his or her abilities, and acts in accordance with what seems possible to them (Christiansen & Baum, 2005). Such self-perception is built on accurate interpretation of the environment and one’s abilities.

**Disruption of Social Participation in Children with SMD**

Poor self-modulation of sensation can affect behavior. Children with SMD often overrespond to moderately graded sensory stimuli with a subsequent misinterpretation of the experience (Smith-Roley et al., 2001). A child with a book bag passing by in the classroom can be interpreted as an intentional aggressive strike, so the child with SMD responds in kind. Cognitive misinterpretation of physiological stimuli frequently results in maladaptive responses in children with SMD (Miller, 2006). With repetition of negative experiences, children with SMD learn that their perception of reality produces detrimental results and develop patterns of avoidance (Dunn, 2001).

In a qualitative study of parental concerns for children with SMD, parents described a desire for their child to realize the consequences of out of control behavior due to sensory overload stating "I would like her to be able to stop and change her behavior. There are times she is totally out of control and not cognizant of what she is doing" (Cohn et al., 2000, p. 39).

**Research in Social Participation in SMD**

Studies that investigate the relationship between SMD in children and social participation have begun to appear in the literature. Significant correlations were found between patterns of sensory modulation and increased difficulty in social participation. Social skills and adaptive behaviors decline as symptoms of SMDs increase (Pfeiffer et al., 2005).
One study found that children with sensory over-responsivity tended to avoid interacting with peers because they were overwhelmed by sensory stimuli whereas children with under-responsivity did not initiate social interactions and missed environmental cues (Hilton et al., 2007). A later study correlated oversensitivity to touch and oral sensitivity as the sensory systems most related to the decrease in social skills (Hilton et al., 2010). Children with high functioning autism who had sensory over-responsivity scored higher in social impairment as the degree of over-responsivity increased (Hilton et al., 2007). A later similar study noted an inverse relationship between increases in sensory over-responsivity and social impairment (Hilton et al., 2010).

One study supported a causal connection between sensory processing dysfunction and maladaptive behaviors, with findings that sensory difficulties accounted for 50% of the variance in maladaptive behaviors (Lane, Young, Baker, & Angley, 2009). Koenig et al. (2010) disagree, stating that the relationship of SMD to social participation is correlated but beyond anecdotal reports, it remains unclear if SMD causes the decrease in social participation. A need exists for further study and clarification of this relationship.

A qualitative study reported on parental hopes for children with SMD. Parent-stated goals tied SMD to occupational performance outcomes. Emergent themes were hopes that their children would better regulate their sensory issues, have increased self-esteem and perceived confidence, and significantly, improve their social participation. Parental reports on difficulties with SMD in their children were embedded in concerns about functional behaviors and social interactions such as noise interfering with the child's ability to attend a sporting event with friends (Cohn et al., 2000).
Social participation of children with SMD has been found to be different than that of typical children. The social network of children with SMD was less diverse and the social base was compromised of a narrower circle of family and friends (Cosbey et al., 2010). Families of children with SMD reported that family occupations changed due to the sensory challenges. SMD affected what families chose to do or not to do, and how families shared experiences and meanings. For example, families with a child with sensory over-responsivity avoided noisy locations (Bagby et al., 2012). Furthermore, children with SMD mature to become adults with SMD. In adults, sensory over-responsivity continued to interfere with social participation, and was specifically related to poorer social functioning and reduced social supports (Kinnealey, Koenig, & Smith, 2011). No intervention studies were found in the literature regarding improvement of social skills in children with SMD.

A study of socialization in toddlers with and without SMD with social behaviors in the Child Behavior Checklist (CBCL) found a higher severity of externalizing problems in children with SMD (Robles, Ballabriga, Dieguez, & daSilva, 2012). The difference between findings of primary social externalizing problems in toddlers and this study's finding of primary social internalizing problems in children can be viewed within an understanding that toddlers are less engaged in internal thoughts than children as they mature. Therefore, moving from task to occupation in younger children would involve less strategy development and would rely on external social behaviors.

**Social Participation Measures in the SMD Literature**

Behavioral measures that have been used to study change in the SMD population include goal attainment scaling (GAS), the Vineland adaptive behavior scale, and the CBCL
(Achenbach, 1991; Kiresuk et al., 1994; Stinnett, Harvey, & Oehler-Stinnett, 1994). Repeated use of similar measures over varied studies has added validity to the results.

The use of GAS offers the ability to document individualized goals in a quantifiable manner (Doig, Fleming, Kuipers, & Cornwell, 2010). GAS reflects functional and meaningful aspects of a child's progress as identified by the child and the child's family. When using GAS, a five point scale is used, from -2 to +2. Zero is the expected level of performance. The scores are standardized by spacing the outcomes the same distance or level of difficulty apart (Mailloux et al., 2007). GAS has been shown to be more responsive to change than standardized outcome measures (Miller, Schoen, et al., 2007; Rockwood et al., 2003).

According to Pfeiffer et al. (2011), use of GAS for occupational therapy intervention is supported because GAS captures the individual meaningful and relevant changes in occupational performance that have hitherto been difficult to measure. GAS has been used in pediatric settings such as rehabilitation, schools, and SI therapy (Dreiling & Bundy, 2003; Lannin, 2003; Miller, Coll, et al., 2007). Occupational therapy studies that used GAS found significant improvement in desired goals. A study by Dreiling and Bundy in 2003 found that GAS goals met subject expectations 56% of the time for one treatment condition and 50% of the time for a second treatment condition. Another study found that children in the intervention group made significantly greater gains than children in the control groups as measured by GAS (Miller, Coll, et al., 2007).

A review of the literature shows a reasonable use of the CBCL to investigate social participation goals with statistically significant gains noted. The CBCL is a 113-item checklist that measures three competence scales of activities, school performance, and social participation
(Achenbach, 1991). Use of the CBCL is noted in prevalence studies of sensory modulation in school children. Children with elevated SMD scores also had higher scores in the CBCL social subsection (Ben-Sasson et al., 2009). Miller, Schoen, et al. (2007) found statistically non-significant but great gains on the socialization sections of the CBCL for children with SMD when compared to typically developing children. Mangeot and colleagues (2001) found a correlation between the degrees of dysfunction in SMD with aggressive behavior scores on the CBCL. One study found significant correlations between the infant/toddler version of the Sensory Profile with behavioral and social problems in an infant/toddler version of the CBCL (ages one and one half-five years) including low sensory registration with externalizing behaviors and scoring two or more affected sensory areas, in contrast to the group with mental health diagnoses, who had less than two affected sensory areas (Robles et al., 2012). The CBCL was also used in research studying the relationship of SMD to sleep disorders in children with autism. A higher frequency of problem sleep behaviors was noted in children on the autism spectrum than in typically developing children (Reynolds & Lane, 2011).

Use of the Sensory Processing Measure (SPM) is less commonly found in the research literature due to a later publication date of the questionnaire. The social participation scale of the SPM measures the child's general interactions with friends and parents in the home and in the community (Parham et al., 2007). Studies that used the SPM in non-English speaking populations have recently been noted in the literature (Lai, Chung, Chan, & Li-Tsang, 2011). One study that used the SPM to measure outcomes did not report significant effects (Pfeiffer et al., 2011).
Summary

A review of the literature relating to SMD, sleep, and social participation has shown that all three areas have been discussed and researched in pediatric conditions. Evidence that SMD is a distinct disorder, independent of disorders such as autism has been supported in the literature. The role of physiological arousal and calming in both SMD and behavioral sleep difficulties has been documented. Both SMD and sleep difficulties have been shown to affect the daily life occupations of children, particularly that of social participation. Providing initial evidence towards a relationship between SMD and sleep is in initial stages, and only recently have studies about this relationship appeared in the literature. Use of moderate pressure touch massage to decrease physiological over-arousal, improve sleep behaviors, and increase social participation has been studied in children with special needs, but has not yet been studied exclusively in children with SMD. Intervention techniques for improving social participation in children with SMD are not noted in the literature.
Chapter 3: Research Design and Methodology

The study was comprised of children with Sensory Processing Measure (SPM) between the ages of 6-11 years old who had concurrent behavioral sleep difficulties. The children in the experimental groups received moderate pressure touch massage from their parents and had a bedtime story read to them. A control group had a bedtime story read to them nightly by their parents for the same amount of time that the experimental procedure was conducted. The study used a randomly assigned convenience sample in a pretest-posttest non-blinded experimental design (Polit & Beck, 2008). The intent of this research study was to show the effect of the sensory input of moderate pressure touch on behavioral sleep parameters and on social participation in children with sensory modulation disorder (SMD).

Research Design and Rationale

Children with SMD are at risk for impaired social participation due to behavioral and physiological misinterpretations and disproportional reactions to environmental cues (Ahn et al., 2004; Miller, 2006). The American Occupational Therapy Association (AOTA, 2008) stated that rest and sleep are one of eight primary domains of function which define the focus of the profession. Sleep deprivation impairs the ability of the child with SMD to regulate alertness levels. Regulation of alertness levels is one of three major concerns reported by parents of children with SMD (Cohn et al., 2000). Thus, the study of children with both SMD and behavioral sleep difficulties is relevant to the social participation of children.
The main purpose of the study was to investigate the effect of moderate pressure touch on sleep behaviors of children with SMD, on social participation of children with SMD, and to clarify if improved social participation in children with SMD was due primarily to sensory or sleep parameters. The efficacy of current interventions to improve sensory modulation in children is limited by a lack of research. Studies have focused on finding significant outcomes of sensory intervention rather than specifying and comparing the types of interventions used (Miller, Coll, et al., 2007; Smith et al., 2005).

This study aimed to examine a specific input used in occupational therapy intervention to measure the effect on sleep behaviors and social participation of children with SMD. Knowledge of an effective sensory intervention can then ultimately be used to improve engagement in occupation for children with SMD.

A pretest-posttest design was used to note improvement after treatment with the experimental condition. Randomization was addressed by a random assignment procedure to the control or experimental group. The design is prospective in that the intervention is introduced and the effect is then determined. This study used a prospective design to ensure a higher quality of evidence than other time-based designs, such as a retrospective design (Polit & Beck, 2008).

**Procedures**

1. Initial registration. In the first stage of the selection process, participants were recruited from the waiting list at a developmental center. At the time of initial registration, all English-speaking parents of children with referrals for sensory problems were informed by the registering secretary that they were being screened for participation...
in a study by the occupational therapist. Parents who decided to participate in the study were scheduled for an intake meeting.

2. Intake meeting. In the second stage of the selection process, the purpose and procedures of the study were explained to parents by the principal investigator (PI) of the study. After determining that the parents had time to consider, had their concerns met, and had their questions answered, parents who agreed to participate in the study with their child were given an intake form (see Appendix B) and an informed consent form (see Appendix H) as approved by the Nova Southeastern (NSU) Institutional Review Board (IRB) to read and sign. Parents then filled out intake questionnaires of the Short Sensory Profile (SSP) and the Child Sleep Habits Questionnaire ([CSHQ], see Appendix C), and a parent intake form (see Appendix B). The PI then scored the questionnaires. Estimated time to fill out the questionnaires and intake form was 20 minutes. Parents of children who met the eligibility criteria of having both sleep and sensory difficulties moved to the next stage of the study and filled out the remaining pretest measures.

3. Pretest measures. Parents filled out pretest measures of the CBCL, the social subsection of the SPM, and with guidance from the PI, parents set three goals in the goal attainment scaling (GAS). One GAS goal was sensory related, a second GAS goal was related to sleep behaviors, and the third GAS goal was related to concerns about social participation. The initial GAS goals set at this meeting addressed anticipated outcomes, set at the middle zero score, of the scoring interval units of -2,-1, 0, +1, +2. The other four specific increments of the scaling of each goal (-2,-1,+1,+2) were finalized at the home visit. Time required to fill out the pretest measures was estimated at 35 minutes.
4. Random assignment. The child was randomly assigned to control Group A or test Group B. In control Group A, parents read a bedtime story to the child for 20 minutes, 5-7 times per week for three weeks. Group B was massaged for 20 minutes by a parent and had a bedtime story read to the child during the massage. The story and massage were applied 5-7 times per week for three weeks.

5. Training in the procedure. All parents received training in the use of a sleep log (diary) and received a sleep log for home use (see Appendix A). All parents received instructions for reading the bedtime story, including story content and time required to read the story. Parents of children assigned to Group B also received training in the massage procedure and received a written parent training manual of the procedure as provided in Appendix B (Hernandez-Reif, Field, Field, & Theakston, 1998; Hanschu, 2000). Training time was estimated at 20 minutes.

6. Assent form. At the conclusion of the intake meeting, parents received an assent form for the participating child to sign at home along with an explanation about voluntary consent of their child if the child was over seven years of age. Upon return of the assent form, the study protocol began.

7. Week one. Parents were instructed to keep a sleep log for one week before beginning the treatment protocols. Parents continued with the child’s regular bedtime routine and incorporated the protocol into the routine for maintenance of consistency in the child’s sleep habits.

8. Week two. Parents began to administer the protocol of either Group A or Group B, and kept a daily sleep log. A therapist visit was conducted on week two to observe parent administration of the moderate pressure touch massage protocol and to ensure
proper application of the technique. The importance of compliance was stressed to insure completion of the study protocol. At the home visit, the PI completed the remaining increments for each of the three GAS goals during the visit and received parent approval of the written goals. Estimated time for the home visit observation of the massage administration and GAS goal setting was 45 minutes.

9. Weeks three and four. Parents continued to administer the protocol and record sleep behaviors in the sleep log.

10. Week five. The massage and storytelling was discontinued but parents continued to fill out the sleep log. At the end of week five, parents discontinued the protocol.

11. Posttest meeting. At the end of week five, parents returned to the center and returned the sleep logs. Posttest forms were given to the parents at this visit. Parents completed the same measures as they did for the pretest forms as per the child’s status at the end of week four. The PI addressed issues that arose and closed the study.

**Threats**

Threats to validity can take several forms, including internal, construct, and external validity, as well as statistical validity of the conclusions. Internal validity addressed the determination of causality between the independent and dependent variables (Portney & Watkins, 2000). Inclusion and exclusion criteria allowed for greater homogeneity of the studied populations and removed confounding factors such as additional medical diagnoses which could have been the cause of effects noted. Use of a control group and use of random assignation to either the control or experimental group strengthened the conclusions of a causal relationship between moderate pressure input and improvements in sleep behaviors and in social participation.
Construct validity is concerned with the concept of the intervention and the ability to generalize results based on those concepts (Portney & Watkins, 2000). The study provided operational definitions to represent constructs of the ecological model of sensory modulation on a clinical level. Multiple measurements were used for each outcome variable in order to provide a multi-dimensional perspective for each construct. The construct of sensory modulation was measured by the SSP and a GAS goal. Sleep behaviors were measured by the CSHQ, a sleep log, and a GAS goal. Social participation was measured by the CBCL, the SPM social subtest, and a GAS goal.

External validity is concerned with the ability to generalize the study results to a targeted population. Adherence to protocol can enhance external validity by controlling for the types of characteristics and effects derived from a study (Portney & Watkins, 2000). In this study, distribution of a written protocol along with verbal instruction was used to ensure uniform application of the moderate pressure protocol. Additionally, a home visit was scheduled within the first 10 days to further ensure adherence to the massage protocol. Validity of the conclusions were addressed by the statistical procedures noted later in this chapter.

**Strengths and Weaknesses of the Design**

One strength of the design was the exclusion of major medical diagnoses such as autism or Down syndrome in the inclusion criteria. To date, all studies of sleep and SMD have introduced co-morbid diagnoses including autism and atopic dermatitis (Shani-Adir et al., 2009; Reynolds & Lane, 2011). Confounding diagnoses reduce the internal validity of causality between sensory modulation and sleep behaviors. Other strengths of the
design included clear and measurable operational definitions, and the use of at least two outcome measurements for each theoretical construct and related outcome variable.

Weaknesses of the design included use of convenience sampling, as opposed to random selection. Dropout rates weakened the internal validity of the study by introducing possible bias of only needy participants in the study. Other weaknesses included possible inconsistent application of the moderate pressure input by different parents. This concern was addressed by parents of all participants receiving instruction from the same therapist, manualization of the moderate pressure massage protocol, and a home visit to ensure proper application of the input. The relatively small sample size limited the ability to generalize to the wider population. Additional studies that replicate the results of this study would strengthen the ability to generalize results to a wider population.

Participants

Number

The number of participants for this experimental study was based on moderate effect size in a study involving a pretest-posttest design. A statistician calculated the sample size needed by entering the number of groups used in the design (two), the level of desired power (80%), and \( p = 0.05 \) into the statistic software program StatMate (Motulsky, 2012). The parameters entered resulted in a sample size of 25 participants per group in order to reach significance. Fifty participants was feasible to conduct this study.

Inclusion Criteria

Children who entered the study were between the ages of 6.0–11.11 years old. Children were mandated to have both SMD and behavioral sleep difficulties as noted by a
significant score on the SSP and CSHQ questionnaires. The presence of SMD was established by the following criteria for scores on the SSP, as used similarly in previous studies (McIntosh, Miller, Shyu, & Hagerman, 1999; Miller, Anzalone, et al., 2007; Miller, Coll, et al., 2007):

- A $z$ score of $\leq -3$ standard deviations (SDs) below the mean for the total score
- A $z$ score of $\leq -2.5$ on two or more sub-tests, or
- A $z$ score of $\leq -4$ on one subtest.

Initial presence of sleep difficulties was established by the cut-off score over 41 points on the CSHQ, as established by the author (Owens, 2000). Participants were primary English speakers in order to have been able to use the instruments in their English formats, thus avoiding copyright issues of using Hebrew translations.

**Exclusion Criteria**

The exclusion criteria related to SMD were similar to those used in previous studies of children with SMD (Miller, Anzalone, et al., 2007; Miller, Coll, et al., 2007) and were established as follows by parent report on the parent intake form:

- No DSM-V diagnostic categories except ADHD/ADD, learning disabilities, or anxiety symptoms. Excluded diagnoses included autism spectrum disorders (ASD), mental retardation, genetic, orthopedic, neurological, and psychiatric disorders such as bipolar disorder. This allowed for SMD to be the primary diagnosis without other confounding diagnoses.
- Children were not taking medication, such as Melatonin, for sleep disorders.
- Children did not undergo direct individual occupational therapy within the past three months (excluding group occupational therapy at school, or fine
motor intervention). No active occupational therapy intervention was scheduled during the five weeks of the study.

- No serious confounding life events were present such as the death of a parent, abuse or neglect, or residence in a foster home.

**Recruitment**

The initial pool of children was recruited from the waiting list of the Etgarim Child Development Center in Israel. Children were referred by parents who had either noticed sensory complaints by their child or who had been referred by educators for sensory complaints. Parents were notified of the study upon intake into the center. Consenting parents were invited for an initial meeting with the PI of the study. Parents of children who met the inclusion and exclusion criteria and who agreed to participate in the study followed the procedures listed in this chapter. Since the anticipated waiting list time for occupational therapy services was approximately two months, no delay in the child’s therapy time occurred.

**Ethical Considerations and Review**

Institutional Review Board (IRB) approval was obtained from Nova Southeastern University (NSU) prior to subject recruitment and implementation of the study. Parents were able to decline participation in the study with no penalties to their child. After receiving an explanation about the study, parents signed an informed consent form and participating children over the age of seven signed an assent form see (Appendix H).

**Funding**

No funding was obtained for this study.
Study Setting

Participants were recruited through the Etgarim Child Development Center located at 10 Sde Hemed Street, Modi’in Elite, Israel. The facility was used because it is a private center. Public centers are required to obtain Israeli Ethics Committee approval. This process typically takes up to a year and was not feasible given the time requirements of this study’s PI to complete the doctoral requirements of NSU. A letter of participation was submitted to the NSU IRB for the current study from the center.

Instruments and Measures

Test measures purchased by the PI included the SSP, SPM, and the CBCL (Achenbach, 1991; Dunn, 1999; Parham et al., 2007). The Pearson Corporation did not permit reprinting of the SSP questionnaire in the Appendices. To locate the SSP, the following Internet address can be accessed:
http://www.pearsonclinical.com/therapy/products/100000822/sensory-profile-2.html?cm.pid=ST1-9186-SP2. The SPM was permitted to be partially reproduced in Appendix E. The CBCL was permitted to be reproduced as a sample copy in Appendix F.

The CSHQ (see Appendix C) was available on the Internet with a statement by the author encouraging its free use (Owens et al., 2000). The sleep log (Appendix A) and GAS (Appendix G) are not standardized forms available for purchase but have descriptions for their use in books (Kirusek et al., 1994). Therefore, with the exception of the SSP, all other test instruments were included as partial or whole reproductions in the appendices.

The SSP consists of 38 questions about sensation and behavior and has seven subscale categories. The SSP required 10 minutes to complete (McIntosh, Miller, Shyu,
& Hagerman, 1999). The CSHQ is a 33-item questionnaire with eight subscale categories. The CSHQ is used for children 4-11 years of age. Ten minutes were required to complete the CSHQ (Owens et al., 2000). The social subtest of the SPM is a caregiver questionnaire with 10 questions and the version for ages 5-12 years was used. The SPM required approximately five minutes to fill out. The CBCL is a questionnaire with 112 items that describe specific behavioral and emotional problems, with 7 subscales and two clusters comprising the subscales. The version for ages 6-11 years was used. The CBCL required 15 minutes to fill out (Achenbach, 1991). Setting three measureable GAS goals took 35 minutes. The sleep log was filled out daily and took about three minutes each day to complete.

**Control Group Instrument**

Bedtime stories were used as the control group as a non-intervention technique. Parents read a bedtime story to their child for 20 minutes when the child went to sleep. Stories were read 5-7 times per week for three weeks, in a parallel manner to the experimental group which also had a bedtime story read to them, as well as having received a massage.

**Sensory Measures**

**Reliability and validity of the SSP.** Reliability is the “degree of consistency of dependability of the instrument” (Polit & Beck, 2008, p. 764). Validity is the degree to which “the instrument measures what it is intended to measure” (Polit & Beck, 2008, p. 768).

Test reliability was measured by Cronbach’s coefficient alpha for internal consistency, with 1.0 showing perfect consistency. The alpha values of the sub-sections
ranged from .47-.91. Content validity was established by 155 occupational therapists categorizing items into category placements. Therapists (80%) agreed on category placement on 63% of the items. Convergent and discriminant validity were compared with functional tasks as assessed by the School Function Assessment ([SFA], Coster et al., 1998). For convergent validity, large correlations were found between the behavioral regulation and positive interaction sections of the SFA and the modulation section of the Sensory Profile. For discriminant validity, low correlations were found between detailed school performance items and items of the Sensory Profile.

Use of the Sensory Profile has been supported in the literature. Initial studies compared children with and without disabilities using the Sensory Profile (Dunn & Westman, 1997). Item analysis was first studied by Dunn in 1994. Factor analysis was then used to support the questions used in the final version of the questionnaire (Dunn & Brown, 1997). A study of discriminant analysis of the Sensory Profile has also been published (Ermer & Dunn, 1998). Several special needs diagnoses were studied using the Sensory Profile including the Sensory Profile of children with ADHD and with autism (Dunn & Bennett, 2002; Kientz & Dunn, 1997).

The Sensory Profile was “developed in the United States but is used by therapists in New Zealand and Australia as well as other Western countries” (Brown, Morrison, & Stagnitti, 2010, p. 57). Studies using the Sensory Profile in English have been noted in additional English speaking countries such as Britain and South Africa (Backhouse, Harding, Rodger, & Hindman, 2012; Buitendag & Aronstam, 2010). Research studies have concluded that the English Sensory Profile “can be used with confidence in cross-cultural contexts” (Brown, Leo, & Austin, 2008, p. 254).
Several studies that have looked at the relationship between sleep and sensation have used the SSP. The studies include investigating the relationship between sensory hypersensitivity and sleep quality of children with atopic dermatitis, sensory over-responsivity in normal schoolchildren (Ben Sasson et al., 2009; Reynolds & Lane, 2011; Shani-Adir et al., 2009; Shochat et al., 2009).

**Goal attainment scaling.** Goal attainment scaling (GAS) is an individualized measure of parent perceived priorities and is considered to be one of the most reliable and meaningful measures for studies of SMD (Mailloux et al., 2007; Miller, Schoen, et al., 2007). In this study, GAS was used for sensory, sleep, and social outcomes. GAS typically includes three to five personalized goals with a 5-point Likert scale which ranges from -2, -1, 0, +1, +2. Goals are individualized to meet the concerns of each subject. The score is standardized by writing goals with stages that are spaced the same increment of distance between the stages (Kiresuk et al., 1994). In the five increments of scoring used in GAS, the -2 score is the child’s current performance and the 0 score is the anticipated outcome. A t-score is obtained through use of a combined total score of all the goals and by the number of goals used.

GAS has been used as an outcome measure with a variety of disabilities with good results. Diagnoses measured with GAS include traumatic brain injury, infants with motor delays, lower extremity amputation, and cognitive rehabilitation (Malec, 2001; Palisano, 1993; Rockwood, Joyce, & Stolee, 1997; Rushton & Miller, 2002).

The reliability of GAS scoring in general application has been found to be moderate to excellent (Joyce, Rockwood, & Mate-Kole, 1994; Rushton & Miller, 2002). In 2001, a federal multisite grant from the National Institutes of Health’s National Center
for Medical Rehabilitation Research supported collaboration of occupational therapists in four university-based research programs to plan for effectiveness studies in the area of SI. The group’s conclusions regarding reliability and validity of GAS was that further empirical research on reliability and validity was needed (Mailloux et al., 2007). In that same year, an intervention study of children with SMD concluded that GAS provided the most significant change out of a battery of 11 standardized tests encompassing a variety of physiological and behavioral measures (Miller, Coll, et al., 2007). GAS was selected due to its ability to reflect individual progress and addressed outcomes of importance to the family of the child with SMD.

**Sleep Measures**

Three measures were used to obtain sleep outcomes. The first measure was the CSHQ (Owens et al., 2000). The second measure used was GAS. The third sleep measure was a sleep log which was recorded daily by the parents.

Test reliability of the CSHQ was measured by Cronbach’s coefficient alpha for internal consistency, with 1.0 as perfect consistency. The alpha values of the subscales ranged from .36-.70. Test-retest measures used Pearson’s correlations and found acceptable levels for the subscales, ranging from 0.62-0.79. Discriminant validity was found in the ability of the questionnaire to discriminate between a community sample and a clinical sample (Owens et al., 2000).

Sleep logs describe a trajectory of change over time. Hierarchical linear modeling (HLM) was used to describe change over time in an A-B-B-A type manner, with weeks one and five being observation and recording of sleep patterns without pressure touch intervention in both the control and intervention groups. Weeks two through four
reflect the experimental conditions. Trajectories of change were measured for three sleep constructs, time to fall asleep, amount of night wakings, and total sleep time.

**Social Measures**

The social subtest of the Sensory Processing Measure (SPM) and the Child Behavior Checklist (CBCL) were chosen to measure social participation (Achenbach, 1991; Parham et al., 2007).

**Reliability and validity of the SPM social subtest.** The SPM is available through the Western Psychological Service (Parham et al., 2007). The SPM social subtest measures social functioning at home, at school, and in the community. The home rating form for social participation was selected for use in this study because parents applied the sensory input of moderate pressure touch. Measures of reliability used in the questionnaire were internal consistency and test-retest reliability. Internal consistency ensured that the items on the rating scale measured the same attribute (Polit & Beck, 2008). In the home rating form, internal consistency ranged from .77-.95. Test-retest reliability referred to the stability of the scores over time based on repeated administration to the same individuals (Portney & Watkins, 2000). Test-retest reliability ranged from .94-.98 (Parham et al., 2007).

Content validity and construct validity were considered by the authors of the SPM when constructing the instrument. Content validity was attained by several rounds of expert review. Construct validity was attained through structural validity of each system subscale’s item content representing a theoretical construct, and by the scale being interpreted separately from the other subscales. In exploratory factor analysis of the seven
factors that emerged, the social participation factor had the highest values of .61-.79 (Parham et al., 2007).

Convergent validity assesses the degree to which “two methods of measuring a construct are similar (i.e. converge)” (Polit & Beck, 2008, p. 750). The SPM was compared to the 125-item Sensory Profile, a commonly used sensory questionnaire to measure the sensory processing function of children (Dunn, 1994). Ten selected sensory profile scores were correlated with the SPM home form and were found to have a strong correlation. The sensory profile behavioral outcome scale also correlated strongly with the SPM social scales. The SPM was also compared to the SSP and had a strong correlation as well (McIntosh, Miller, Shyu, & Hagerman, 1999).

Criterion related validity is the degree to which “scores on an instrument are correlated with some external criterion” (Polit & Beck, 2008, p. 750). The criterion used for the SPM was the ability of the SPM to distinguish between children who would be expected to differ in sensory processing and social participation. At a cut-off point of T score = 60, the home form total score showed that 85% of children labeled with sensory problems had SMD (Parham et al., 2007). A separate sample of 345 children receiving occupational therapy intervention was used to verify that the SPM scales differentiated between typically developing children and children with special needs diagnoses (Parham et al., 2007).

In summary, the SPM scales performed well on two measures of reliability, internal consistency and test-retest measures. The SPM was significantly correlated with the Sensory Profile questionnaire, another home-based measure of sensory processing and function, reinforcing reliability of the measure. The SPM scales were also able to
distinguish between typically developing children and children with special needs diagnoses (Parham et al., 2007).

**Reliability and validity of the CBCL.** The CBCL was published by the ASEBA Company. The version used in this study was the child form, ages 6-18 years. Reliability of the CBCL is noted by inter-rater reliability and by test-retest reliability. Inter-rater reliability was assessed by using an intra-class correlation coefficient (ICC). The overall ICC score was 1.0 for 20 items that rated competency and .95 for the 112 specific problem items (< .001), which are high scores. Test-retest reliability was assessed by Pearson correlations. Reliability was high, between .80-.90 for most of the scales (Achenbach, 1991).

Other studies of SMD have noted that “construct, content, and criterion validity of the CBCL for discriminating social and behavioral issues is well established” (Miller et al., 2007, p. 164). Over the course of four decades, items have been developed, omitted, and refined with further pilot testing and research. Content validity of the CBCL has been found to significantly discriminate between typically developing children and clinic samples of children (Achenbach, 2001). For criterion-related validity, the CBCL employed use of multiple regression analyses to predict associations between specific question items, external criteria of demographics, and socio-economic standing on scales of competence and adaptive functioning. As competence and adaptive scores increased, the probability that a score was from the clinical sample decreased. As scores on the total CBCL score increased, the probability that a score was from the clinical sample increased to 65% (Achenbach, 2001). In order to support the strength of construct validity, constructs of the CBCL were compared with the *Diagnostic and Statistical Manual of*
Mental Disorders -IV (DSM-IV). Correlations ranged from .43-.80. Correlation of the CBCL with the Connors Rating Scale ranged from .71-.85 (Achenbach, 2001).

Equipment

The technique used in the study was parent application of moderate pressure touch, also called parent massage in this study. Parents received verbal and written instructions detailing the procedure (see Appendix D). Parents also received a sleep log (Appendix A) in instructions for use. For the reading of bedtime stories, parents used books that were readily available in the home. No further equipment was needed for this study.

Data Collection Procedures

Parents filled out the SSP and CSHQ (see Appendix C) at the initial meeting, after agreeing to participate in the study via an informed consent explanation and signature (see Appendix H). If the scores on the two questionnaires met the inclusion criteria, the parents completed the remaining pretest measures, the social subsection of the SPM and the CBCL. Three goals for GAS were written, together with the PI, for the child’s present level of functioning. A sleep log (Appendix A) was distributed to parents with an explanation on instructions for use. Children were randomly assigned to either the control or intervention groups and parents were informed of the experimental condition to which their child was assigned.

Parents in the control group filled out the sleep log during each of the five weeks of the study. Parents in the experimental group filled out the sleep log during the first week, but only began the experimental condition from week two. The experimental condition continued from week two to week four. At week two, a home visit was
conducted. Parent application of the massage protocol was checked by the PI, and the full range of each GAS goal was set. During week five parents again recorded the child’s sleep in the sleep log, but without experimental procedures during week five. Parents returned to the center at the end of week five and completed the posttest measures of the SSP, CSHQ, the social subsection of the SPM, and the CBCL. The final outcomes of the three GAS goals were completed, together with the PI. After a summary discussion with the parents, participation in the study was concluded.

**Data Analysis**

The study analyzed the statistical significance of the experimental intervention condition in comparison with the control group. The number of groups and the level of measurement used determined the types of statistical tests used for analysis. Many behavioral outcome measures use Likert scales. Likert scales used in test instruments in this study were the Short Sensory Profile (SSP), the CSHQ, the CBCL, and the SPM.

Likert scales can approximate an interval level of measurement if the scale has equidistant levels between each of the items. Although debate surround the use of parametric analysis for Likert scales, some researchers justify the use of the Central Limit Theorem when the condition of equidistance has been met (Carifio & Perla, 2007). Parametric statistical tests such as analysis of variance can then be applied and that data is considered to be continuous data (Norman, 2010).

All outcome measures chosen in this study used parametric statistics in their test manuals. Measures based on standard deviation are found in the manuals of the Sensory Profile, the SPM, and the CSHQ (Dunn, 1999; Owens et al., 2000; Parham et al., 2007). GAS score results of $t$ tests and analysis of variance were used (Kiresuk et al., 1994;
Mailloux et al., 2007). The CBCL test manual also used $t$ tests in the scoring of the data (Achenbach, 2001). Use of parametric measures in studies using these instruments is documented in the occupational therapy literature (Ermer & Dunn, 1998; Miller et al., 1999; Miller, Schoen, et al., 2007; Tomchek & Dunn, 2007).

**Analysis of the SSP, CSHQ, SPM Social Subtest, and the CBCL**

The following research questions were analyzed:

- What is the effect of the sensory input of moderate pressure touch on the quality of sleep in children with SMD who have sensory and sleep disturbances as compared to children who do not receive this input?
- What is the effect of the sensory input of moderate pressure touch on social participation in children with SMD who have sensory and sleep disturbances as compared to children who do not receive this input?
- Is the effect of moderate pressure input on social participation in children with SMD due to the sensory or the sleep behaviors?

Results were analyzed using data from the following instruments: the SSP sensory questionnaire, the CSHQ sleep behavior questionnaire, the social subtest of the SPM, and the CBCL social participation questionnaire. One GAS goal for each outcome measure of sensory, sleep, and social participation was set. A sleep log was used to record nightly sleep patterns.

The following statistical analyses were performed, in accordance with the consulting statistician’s recommendations: Mixed design analysis of variance (ANOVA) was used to test the difference between the two treatment groups, control and moderate pressure input intervention groups, where one factor was fixed and the other factor was
subject to change, in order to analyze the differences between the groups and to
determine if an interaction effect existed between the two groups for total sensory scores,
total sleep scores, total social scores, as well as sub-group scores in those measures. In
this study, the fixed between-participants group consisted of assignation to either the
control or intervention condition. The variable within-participant measure were sleep and
social outcomes at the initial pretest time, labeled Time 1 (henceforth T1) and the final
posttest time, labeled Time 5 (henceforth T5). ANOVA was used because there were
multiple group comparisons due to sub-section comparisons of each instrument. Values at
< 0.05 were considered statistically significant.

**Analysis of the Amount of Contribution of Sleep and Sensory Variables to Social
Outcomes**

To examine whether the change in sensory and sleep measures over time
predicted the change in social related measures, hierarchical regression analysis was
conducted. In the first step of the analysis, measures of social problems that were
assessed at Time 1 (SPM or CBCL) were introduced. This step enabled the creation of a
model of change in social problems by statistically controlling the initial severity of the
problems in order to establish a baseline for assessing the change. In the second step of
the analysis, four predictors were added, the initial level of sensory sensitivity, the
amount of change in sensory sensitivity over time, the initial level of sleep-related
problems, and the amount of change in sleep-related problems over time. To this end,
differences between the scores at Time 5 and the score at Time 1 were calculated. This
step enabled the PI to examine whether the initial levels of sensory problems and sleep
problems assessed in Time 1 were more important in predicting the change in social-
related measures, or whether the amount of change in these measures between Time 1 and Time 5 were more important to the prediction.

**Analysis of GAS**

To examine whether participants of the intervention group had greater increases in individualized goals than controls, an independent samples $t$ test was conducted in which the control and intervention groups served as the independent measures and the individualized participants’ goals served as the dependent measures.

**Analysis of the Sleep Logs**

The sleep log plotted a trajectory of change over time to visually graph progress through use of HLM (Raudenbush, Bryk, & Congdon, 2004). Measures of change in the sleep log were the amount of time taken to fall asleep in minutes, waking frequency, and sleep duration as measured by total sleep time in minutes. To measure these changes, a series of latent trajectory (LT) models was estimated to test a hypothesis of change over time and to predict such change (McArdle, 1988; Meredith & Tisak, 1990).

The basic LT begins with the premise that a set of repeated measures are functionally related to the passage of time. The function that relates the repeated measures and time can be linear or take on a variety of other forms. These kinds of models are known as unconditional LTs. LTs predict the initial level of the measure and its degree of change. To estimate the LTs, HLM was used (Raudenbush et al., 2004).

**Analysis of Demographic Information**

The demographic information included nominal levels of measurement with dichotomous data including gender, marital status, parental employment status, and the presence or absence of ADHD. Ratio levels of measurement were used for child age,
parent age, and years of education, which are continuous measures. Mode and
frequencies were used to analyze nominal measures. Means and standard deviation were
used to analyze ratio measures and to ensure equal distribution between the intervention
and control groups.

**Presentation of Results**

Frequency tables, means and standard deviation tables were used to describe
demographic information. Tables of means and standard deviation were displayed using
information gained from ANOVA analyses, as well as bar graphs. Tables and bar graphs
were used to present between-groups results for comparisons of sensory, sleep, and social
parameters, including the sub-groups and total scores of the measures. Tables with
coefficients of variance were used to predict whether the change in sensory and sleep
measures over time predicted the change in social related measures. Latent trajectories
were used to depict change over time in the sleep logs.
Chapter 4: Results

Demographics

Fifty participants were randomly assigned to two groups, experiment and control, with 25 participants in each group as shown in Table 1. The experimental group had 16 males and nine females, and the control group had 15 males and 10 females. Distribution of males to females was equivalent using a mode distribution. The average age of the child was 7.4 years for the experimental group and 7.1 years for the control group. The experimental group had two children diagnosed with ADHD, and four whose parents suspected ADHD. The control group had one child diagnosed with ADHD and two whose parents suspected ADHD.

The average parent age in the experimental group was 35.7 years and 32.68 years in the control group. The average for parent education was 14.44 years in the experimental group and 14.24 in the control group. Both groups had 18 parents who worked and nine parents who stayed at home. No parents were divorced in either group.

Attrition and Compliance

Fifty participants completed the study protocol. Attrition of six participants was noted as follows: Five participants did not meet inclusion criteria, and one participant was unable to be contacted during the study and was removed from the study. All participants’ parents completed GAS measures and questionnaires of the SSP, CSHQ, SPM social sub-test, and the CBCL. Forty-five participants’ parents returned completed sleep logs. Five participants’ parents did not complete the sleep logs, two from the
experimental group and three from the control group. All participants in the experimental group documented providing moderate pressure touch massage for a minimum of five days per week during the three weeks of the massage protocol.

Table 1

Demographics

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</tbody>
</table>

Associations

Scores from the experimental participants were grouped together with the control participants to review general trends in the pretest data. Analysis was performed on the association between sensory modulation, sleep difficulties, and social participation of all the children at intake, prior to analysis of the intervention data.
To examine the pattern of association between the sensory measures (tactile sensitivity, taste/smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual/auditory sensitivity, and overall sensory problems) and the sleep measures (bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night waking, parasomnias, sleep disordered breathing, daytime sleepiness, and overall sleep problems), a series of Pearson correlations were conducted on all 50 participants. Pearson correlation coefficients and their level of significance were presented in Table 2. In this study, 0.1-0.29 were considered modest correlations, 0.3-0.49 were moderate correlations, 0.5 and over were strong correlations, with < 0.1 considered weak correlation, and 1.0 a perfect correlation (Rumsey, 2011).

The analyses indicated that total sensory problems did not significantly correlate with overall sleep problems. However, modest associations between subgroups were noted. Greater daytime sleepiness was associated with heightened tactile sensitivity and taste/smell sensitivity (r = .28, p < .05). Night wakings were associated with lower movement sensitivity (r = .28, p < .05). Parasomnias were modestly related to lower energy (r = .27, p < .05), as was sleep onset delay (r = .28, p < .05). Finally, greater sleep anxiety was modestly linked with higher visual/auditory sensitivity (r = .28, p < .05).
Table 2

**Pearson Correlation Coefficients for assessing the associations between Sensory and Sleep Measures**

<table>
<thead>
<tr>
<th></th>
<th>Tactile sensitivity</th>
<th>Taste/smell sensitivity</th>
<th>Movement sensitivity</th>
<th>Sensation seeking</th>
<th>Auditory filtering</th>
<th>Low energy</th>
<th>Visual/Auditory sensitivity</th>
<th>Overall sensory score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedtime Resistance</td>
<td>-.16</td>
<td>.07</td>
<td>-.25</td>
<td>-.25</td>
<td>-.18</td>
<td>-.15</td>
<td>-.08</td>
<td>-.24</td>
</tr>
<tr>
<td>Sleep Onset Delay</td>
<td>-.02</td>
<td>.17*</td>
<td>-.20</td>
<td>-.10</td>
<td>.06</td>
<td>-.28</td>
<td>.04</td>
<td>-.07</td>
</tr>
<tr>
<td>Sleep Duration</td>
<td>-.23</td>
<td>.05</td>
<td>-.05</td>
<td>.04</td>
<td>-.13</td>
<td>-.18</td>
<td>-.01</td>
<td>-.14</td>
</tr>
<tr>
<td>Sleep Anxiety</td>
<td>.04</td>
<td>.19*</td>
<td>.01</td>
<td>-.01</td>
<td>.02</td>
<td>-.03</td>
<td>.28*</td>
<td>.11*</td>
</tr>
<tr>
<td>Night Waking</td>
<td>-.13</td>
<td>-.06</td>
<td>-.28</td>
<td>-.11</td>
<td>-.17</td>
<td>.17*</td>
<td>-.25</td>
<td>-.18</td>
</tr>
<tr>
<td>Parasomnias</td>
<td>.15*</td>
<td>-.09</td>
<td>.13*</td>
<td>.15*</td>
<td>-.05</td>
<td>.27*</td>
<td>.07</td>
<td>.17*</td>
</tr>
<tr>
<td>Sleep Disordered Breathing</td>
<td>.02</td>
<td>-.11</td>
<td>.01</td>
<td>.05</td>
<td>.15*</td>
<td>.11*</td>
<td>.16*</td>
<td>.09</td>
</tr>
<tr>
<td>Daytime Sleepiness</td>
<td>.28*</td>
<td>.28*</td>
<td>.05</td>
<td>-.16</td>
<td>.06</td>
<td>.09</td>
<td>.25*</td>
<td>.22*</td>
</tr>
<tr>
<td>Overall sleep problems</td>
<td>.05</td>
<td>.17*</td>
<td>-.09</td>
<td>-.13</td>
<td>-.07</td>
<td>.05</td>
<td>.15*</td>
<td>.04</td>
</tr>
</tbody>
</table>

Note: * *p < .05, r > .1 modest, r > .3 moderate, r > .5 robust correlation.
To examine the pattern of association between the sensory measures (tactile sensitivity, taste/smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual/auditory sensitivity, and overall sensory problems) and the social measures (overall social problems according to the SPM, overall social problems according to the CBCL, anxiety, withdrawal, social problems, thought problems, rule breaking, aggressiveness, external problems, and internal problems), a series of Pearson correlations was conducted on all 50 participants. Pearson correlation coefficients and their level of significance were presented in Table 3.

The analyses indicated that overall sensory problems in the SSP were moderately linked to overall social problems (r = .30, p < .05) in the SPM and were strongly linked to overall social problems in the CBCL (r = .50, p < .01). Overall sensory problems were strongly linked to the social subgroups of anxiety (r = .56, p < .001), and the cluster of internal problems (r = .59, p < .001). Overall sensory problems were also moderately linked to social subgroups of thought problems (r = .30, p < .05), aggressiveness (r = .31, p < .05), withdrawal (r = .48, p < .001), social problems (r = .47, p < .001), and attention problems (r = .39, p < .01).

Specific sensory problems were related to specific social problems in the CBCL. Strong associations were found in anxiety (r = .59, p < .001), withdrawal (r = .50, p < .001), and the cluster of internal problems (r = .61, p < .001). Heightened tactile sensitivity was moderately associated with social problems (r = .32, p < .05), auditory filtering was moderately correlated with anxiety (r = .43, p < .01), withdrawal (r = .37, p < .01), social problems (r = .42, p < .01), thought problems (r = .39, p < .01), aggressiveness (r = .46, p < .01)
.001), and clusters of external \((r = .42, p < .01)\) and internal problems \((r = .43, p < .01)\).

Auditory filtering was significantly related to attention problems \((r = .63, p < .001)\).

A moderate correlation was found between sensory seeking and thought problems \((r = .34, p < .05)\), social problems \((r = .40, p < .01)\), and attention problems \((r = .45, p < .001)\).

A moderate correlation was found between Visual/Auditory sensitivity and withdrawal \((r = .35, p < .05)\), with anxiety \((r = .45, p < .001)\) and with the cluster of internal problems \((r = .47, p < .001)\). Moderate associations were found in taste/smell sensitivity with withdrawal \((r = .35, p < .05)\) and with the cluster of internal problems \((r = .32, p < .05)\). Low energy was modestly correlated with the cluster of internal problems \((r = .27, p < .05)\) and negatively correlated with rule breaking \((r = .27, p < .05)\).
Table 3

Pearson Correlation Coefficients for assessing the Associations between Sensory and Social Measures

<table>
<thead>
<tr>
<th>Overall social problems (SPM)</th>
<th>Tactile sensitivity</th>
<th>Taste/sense sensitivity</th>
<th>Movement sensitivity</th>
<th>Sensation seeking</th>
<th>Auditory filtering</th>
<th>Low energy</th>
<th>Visual/Auditory sensitivity</th>
<th>Overall sensory score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall social problems (CBCL)</td>
<td>.36**</td>
<td>.14</td>
<td>.13</td>
<td>.35**</td>
<td>.58**</td>
<td>.14</td>
<td>.22</td>
<td>.50**</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.50**</td>
<td>.22</td>
<td>.25</td>
<td>.01</td>
<td>.43*</td>
<td>.27</td>
<td>.45*</td>
<td>.56**</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>.50**</td>
<td>.35*</td>
<td>.19</td>
<td>-.03</td>
<td>.37*</td>
<td>.16</td>
<td>.35*</td>
<td>.48*</td>
</tr>
<tr>
<td>Social problems</td>
<td>.32*</td>
<td>.11</td>
<td>.07</td>
<td>.40*</td>
<td>.42*</td>
<td>.24</td>
<td>.20</td>
<td>.47*</td>
</tr>
<tr>
<td>Thought problems</td>
<td>.08</td>
<td>.02</td>
<td>.23</td>
<td>.34*</td>
<td>.39*</td>
<td>.08</td>
<td>.08</td>
<td>.30*</td>
</tr>
<tr>
<td>Attention problems</td>
<td>.10</td>
<td>-.08</td>
<td>.12</td>
<td>.45*</td>
<td>.63**</td>
<td>.14</td>
<td>.15</td>
<td>.39*</td>
</tr>
<tr>
<td>Rule breaking</td>
<td>-.03</td>
<td>.04</td>
<td>-.15</td>
<td>.25</td>
<td>.20</td>
<td>-.27</td>
<td>-.19</td>
<td>-.01</td>
</tr>
<tr>
<td>Aggressiveness</td>
<td>.25</td>
<td>.12</td>
<td>.02</td>
<td>.23</td>
<td>.46*</td>
<td>.01</td>
<td>.06</td>
<td>.31*</td>
</tr>
<tr>
<td>External problems</td>
<td>.18</td>
<td>.11</td>
<td>-.04</td>
<td>.26</td>
<td>.42*</td>
<td>-.09</td>
<td>-.02</td>
<td>.23</td>
</tr>
<tr>
<td>Internal problems</td>
<td>.61**</td>
<td>.32*</td>
<td>.24</td>
<td>-.04</td>
<td>.43*</td>
<td>.27*</td>
<td>.47*</td>
<td>.59**</td>
</tr>
</tbody>
</table>

Note: * p < .05, ** p < .01, *** p < .001.
To examine the pattern of association between the sleep measures (bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night waking, parasomnias, sleep disordered breathing, daytime sleepiness, and overall sleep problems) and the social measures (overall social problems according to the SPM, overall social problems according to the CBCL, and social subgroups of anxiety, withdrawal, social problems, thought problems, rule breaking, aggressiveness, external problems, and internal problems), a series of Pearson correlations were conducted on all 50 participants. Correlation coefficients and their level of significance were presented in Table 4.

The analyses indicated that overall social problems were not significantly correlated to overall sleep problems. Two moderate correlations were noted in subgroups of sleep problems. Shorter sleep duration was linked with more thought problems ($r = .33, p < .05$) and the cluster of internal problems was associated with greater daytime sleepiness ($r = .31, p < .05$). Sleep disordered breathing was modestly linked with anxiety ($r = .29, p < .05$).
### Table 4

**Pearson Correlation Coefficients for assessing the associations between Sleep and Social Measures**

<table>
<thead>
<tr>
<th></th>
<th>Bedtime Resistance</th>
<th>Sleep Onset Delay</th>
<th>Sleep Duration</th>
<th>Sleep Anxiety</th>
<th>Night Waking</th>
<th>Parasomnias</th>
<th>Sleep Disordered Breathing</th>
<th>Daytime Sleepiness</th>
<th>Overall sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall social problems (SPM)</td>
<td>-.08</td>
<td>.05</td>
<td>.03</td>
<td>.07</td>
<td>.01</td>
<td>.10</td>
<td>.10</td>
<td>-.03</td>
<td>.03</td>
</tr>
<tr>
<td>Overall social problems (CBCL)</td>
<td>-.05</td>
<td>.11</td>
<td>.02</td>
<td>.12</td>
<td>.03</td>
<td>.11</td>
<td>.23</td>
<td>.09</td>
<td>.13</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-.05</td>
<td>-.01</td>
<td>-.01</td>
<td>.22</td>
<td>-.14</td>
<td>.20</td>
<td>.29</td>
<td>.21</td>
<td>.19</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>-.10</td>
<td>.25</td>
<td>-.05</td>
<td>.04</td>
<td>-.14</td>
<td>-.06</td>
<td>.02</td>
<td>.24</td>
<td>.06</td>
</tr>
<tr>
<td>Social problems</td>
<td>-.26</td>
<td>.11</td>
<td>.04</td>
<td>-.01</td>
<td>.06</td>
<td>.01</td>
<td>.09</td>
<td>.11</td>
<td>.02</td>
</tr>
<tr>
<td>Thought problems</td>
<td>-.02</td>
<td>.20</td>
<td>.33*</td>
<td>-.03</td>
<td>-.12</td>
<td>.01</td>
<td>.20</td>
<td>-.09</td>
<td>.06</td>
</tr>
<tr>
<td>Attention problems</td>
<td>-.24</td>
<td>.06</td>
<td>-.14</td>
<td>-.03</td>
<td>.09</td>
<td>.07</td>
<td>.12</td>
<td>-.10</td>
<td>-</td>
</tr>
<tr>
<td>Rule breaking</td>
<td>.14</td>
<td>.16</td>
<td>.06</td>
<td>-.03</td>
<td>.10</td>
<td>.12</td>
<td>.08</td>
<td>.04</td>
<td>.16</td>
</tr>
<tr>
<td>Aggressiveness</td>
<td>.06</td>
<td>-.02</td>
<td>-.09</td>
<td>.13</td>
<td>.11</td>
<td>.03</td>
<td>.17</td>
<td>-.06</td>
<td>.03</td>
</tr>
<tr>
<td>External problems</td>
<td>.10</td>
<td>.04</td>
<td>-.05</td>
<td>.09</td>
<td>.12</td>
<td>.07</td>
<td>.16</td>
<td>-.03</td>
<td>.08</td>
</tr>
<tr>
<td>Internal problems</td>
<td>-.02</td>
<td>.10</td>
<td>-.02</td>
<td>.23</td>
<td>-.12</td>
<td>.13</td>
<td>.23</td>
<td>.31*</td>
<td>.23</td>
</tr>
</tbody>
</table>

Note: * $p < .05$. 

*Note: * $p < .05$. 
**Improvement of Sensory Scores After Intervention**

To examine whether intervention improved participants' sensory scores as compared with controls, a series of mixed-design analysis of variance (ANOVA) was conducted, in which the study group (intervention, control) served as the between-subject independent measure, and the time of assessment (T1, T5) served as the within-subject independent measure. The dependent measures were the sensory measures (tactile sensitivity, taste/smell sensitivity, movement sensitivity, sensation seeking, auditory filtering, low energy, visual/auditory sensitivity, and overall sensory problems, in which a separate analysis was conducted for each dependent variable. Means and standard deviations were presented in Table 5. ANOVA statistics and effect sizes were presented in Table 6.

The analyses revealed effects for time on all of the sensory related measures: participants' sensitivity was better at Time 5 than at Time 1. In order to correct for multiple comparisons, a simple main effects tests with Bonferroni adjustment was conducted. The analysis indicated that whereas sensory levels remain unchanged among the control group, they significantly improved (scores became lower; all $p < .001$) over time among the intervention group for the overall sensory score ($F = 76.91, p < .001$), tactile sensitivity ($F = 25.36, p < .001$), Taste/smell sensitivity ($F = 17.67, p < .001$), auditory filtering ($F = 35.35, p < .001$), and visual/auditory sensitivity ($F = 19.50, p < .001$). Moderately strong results were obtained in movement sensitivity ($F = 10.70, p < .01$), sensation seeking ($F = 11.47, p < .01$), and low energy ($F = 12.91, p < .01$), as seen in Figure 3.
Table 5

**Means and Standard Deviation for Examining the Differences between Intervention and Control in Sensory Measures over Time**

<table>
<thead>
<tr>
<th>Sensory Measure</th>
<th>Intervention</th>
<th></th>
<th></th>
<th>Control</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time 1</td>
<td>Time 5</td>
<td></td>
<td>Time 1</td>
<td>Time 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Overall sensory score</td>
<td>98.20</td>
<td>18.73</td>
<td>75.96</td>
<td>18.51</td>
<td>87.88</td>
<td>22.22</td>
</tr>
<tr>
<td>Tactile sensitivity</td>
<td>18.60</td>
<td>6.89</td>
<td>13.92</td>
<td>5.64</td>
<td>15.24</td>
<td>6.84</td>
</tr>
<tr>
<td>Taste/smell sensitivity</td>
<td>10.64</td>
<td>5.32</td>
<td>8.04</td>
<td>4.41</td>
<td>11.56</td>
<td>5.45</td>
</tr>
<tr>
<td>Movement sensitivity</td>
<td>5.64</td>
<td>3.17</td>
<td>4.48</td>
<td>2.12</td>
<td>4.36</td>
<td>2.83</td>
</tr>
<tr>
<td>Sensation seeking</td>
<td>20.64</td>
<td>6.63</td>
<td>16.04</td>
<td>6.11</td>
<td>19.04</td>
<td>5.63</td>
</tr>
<tr>
<td>Auditory filtering</td>
<td>19.00</td>
<td>4.67</td>
<td>14.56</td>
<td>5.17</td>
<td>17.32</td>
<td>5.60</td>
</tr>
<tr>
<td>Low energy</td>
<td>12.68</td>
<td>5.27</td>
<td>10.56</td>
<td>4.43</td>
<td>10.72</td>
<td>5.73</td>
</tr>
<tr>
<td>Visual/Auditory sensitivity</td>
<td>11.00</td>
<td>4.30</td>
<td>8.36</td>
<td>3.63</td>
<td>9.64</td>
<td>4.46</td>
</tr>
</tbody>
</table>

Table 6

**ANOVA statistics and Effect Sizes for Examining the Differences between Intervention and Control in Sensory Measures over Time**

<table>
<thead>
<tr>
<th>Sensory Measure</th>
<th>Study group</th>
<th>Time</th>
<th>Study group X Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$F_{(1, 48)}$</td>
<td>$\eta^2$</td>
<td>$F_{(1, 48)}$</td>
</tr>
<tr>
<td>Overall sensory score</td>
<td>.07</td>
<td>.00</td>
<td>59.34***</td>
</tr>
<tr>
<td>Tactile sensitivity</td>
<td>.09</td>
<td>.00</td>
<td>10.64**</td>
</tr>
<tr>
<td>Taste/smell sensitivity</td>
<td>2.75</td>
<td>.05</td>
<td>10.78**</td>
</tr>
<tr>
<td>Movement sensitivity</td>
<td>.61</td>
<td>.01</td>
<td>4.62*</td>
</tr>
<tr>
<td>Sensation seeking</td>
<td>.002</td>
<td>.00</td>
<td>34.65***</td>
</tr>
<tr>
<td>Auditory filtering</td>
<td>.34</td>
<td>.01</td>
<td>21.29***</td>
</tr>
<tr>
<td>Low energy</td>
<td>.33</td>
<td>.01</td>
<td>10.29**</td>
</tr>
<tr>
<td>Visual/Auditory sensitivity</td>
<td>.02</td>
<td>.00</td>
<td>9.95**</td>
</tr>
</tbody>
</table>

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. $\eta^2$ = partial eta-square, which serves as an effect size.
Figure 3. Improvement in sensory measures post intervention - means.
Did Intervention Improve Sleep Scores of the Experimental Group as Compared to the Control Group? Research Question 1

To examine whether intervention improved participants' sleep scores as compared with controls, a series of mixed-design analysis of variance (ANOVA) was conducted in which the study group (intervention, control) served as the between-subject independent measure, time of assessment (T1, T5) served as the within-subject independent measure, and sleep measures (bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night waking, parasomnias, sleep disordered breathing, daytime sleepiness, and overall sleep problems) as the dependent measures (separate analysis for each dependent variable). Means and standard deviations were presented in Table 7. ANOVA statistics and effect sizes were presented in Table 8.

The analyses revealed main effects for time on all of the sleep-related measures except for sleep disordered breathing: participants' sleep-related behaviors were better at Time 5 than at Time 1. The analyses also revealed main effects for study group on measures of bedtime resistance and sleep onset delay, sleep anxiety and parasomnias, and daytime sleepiness: participants in the intervention group had significantly better (i.e. lower scores) bedtime resistance, sleep onset delay, sleep anxiety, parasomnias, and daytime sleepiness than controls. However, the effects of either study group and/or time on overall sleep problems, sleep onset delay, sleep duration, sleep anxiety, parasomnias, and daytime sleepiness were moderated by the expected interactions between study group and time, as seen in Figure 4. A simple main effects test with Bonferroni adjustment indicated that whereas sleep related scores remain unchanged among the control group, they significantly improved (scores became lower) over time among the intervention
group. Overall sleep scores were of strong significance \((F = 24.71, p < .001)\), and parasomnias were of moderately strong significance \((F = 13.98, p < .01)\). Sleep onset delay \((F = 8.88, p < .05)\), sleep duration \((F = 6.70, p < .05)\), sleep anxiety \((F = 8.30, p < .05)\), and daytime sleepiness \((F = 8.57, p < .05)\) achieved significance as well.

Table 7

Means and Standard Deviation for Examining the Differences between Intervention and Control in Sleep Measures over Time

<table>
<thead>
<tr>
<th>Sleep Measure</th>
<th>Intervention</th>
<th>Control</th>
<th>Study group X Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time 1</td>
<td>Time 5</td>
<td>Time 1</td>
</tr>
<tr>
<td>Overall sleep</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Bedtime Resistance</td>
<td>53.84</td>
<td>8.37</td>
<td>44.16</td>
</tr>
<tr>
<td>Sleep Onset Delay</td>
<td>9.96</td>
<td>2.64</td>
<td>8.00</td>
</tr>
<tr>
<td>Sleep Duration</td>
<td>2.14</td>
<td>.85</td>
<td>1.64</td>
</tr>
<tr>
<td>Sleep Anxiety</td>
<td>4.80</td>
<td>2.06</td>
<td>3.76</td>
</tr>
<tr>
<td>Night Waking</td>
<td>7.32</td>
<td>2.25</td>
<td>5.76</td>
</tr>
<tr>
<td>Parasomnias</td>
<td>4.96</td>
<td>1.40</td>
<td>4.20</td>
</tr>
<tr>
<td>Sleep Disordered Breathing</td>
<td>10.52</td>
<td>2.26</td>
<td>8.72</td>
</tr>
<tr>
<td>Daytime Sleepiness</td>
<td>3.68</td>
<td>1.07</td>
<td>3.32</td>
</tr>
</tbody>
</table>

Table 8

ANOVA statistics and Effect Sizes for Examining the Differences between Intervention and Control in Sleep Measures over Time

<table>
<thead>
<tr>
<th>Sleep Measure</th>
<th>Study group</th>
<th>Time</th>
<th>Study group X Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(F_{1, 48})</td>
<td>(\eta^2)</td>
<td>(F_{1, 48})</td>
</tr>
<tr>
<td>Overall sleep</td>
<td>3.73</td>
<td>.07</td>
<td>32.74***</td>
</tr>
<tr>
<td>Bedtime Resistance</td>
<td>9.87**</td>
<td>.17</td>
<td>10.45**</td>
</tr>
<tr>
<td>Sleep Onset Delay</td>
<td>7.60**</td>
<td>.14</td>
<td>6.52*</td>
</tr>
<tr>
<td>Sleep Duration</td>
<td>8.98**</td>
<td>.16</td>
<td>2.22</td>
</tr>
<tr>
<td>Sleep Anxiety</td>
<td>.90</td>
<td>.02</td>
<td>9.19**</td>
</tr>
<tr>
<td>Night Waking</td>
<td>3.83</td>
<td>.07</td>
<td>4.60*</td>
</tr>
<tr>
<td>Parasomnias</td>
<td>3.25</td>
<td>.06</td>
<td>15.28***</td>
</tr>
<tr>
<td>Sleep Disordered Breathing</td>
<td>1.14</td>
<td>.02</td>
<td>7.68**</td>
</tr>
<tr>
<td>Daytime Sleepiness</td>
<td>.002</td>
<td>.00</td>
<td>12.81***</td>
</tr>
</tbody>
</table>

Note: \(p < .05\), ** \(p < .01\), *** \(p < .001\). \(\eta^2\) = partial eta-square, which serves as an effect size.
Figure 4. Improvement in sleep measures post intervention-means.
Did Intervention Improve Social Scores of the Experimental Group as Compared to the Control Group? Research Question 2

To examine whether intervention improved participants’ social scores as compared with controls, a series of mixed-design analysis of variance (ANOVA) was conducted in which the study group (intervention, control) served as the between-subject independent measure, time of assessment (T1, T5) served as the within-subject independent measure, and social measures (overall social problems according to the SPM, overall social problems according to the CBCL, anxiety, withdrawal, social problems, thought problems, rule breaking, aggressiveness, external problems, and internal problems) as the dependent measures (separate analysis for each dependent variable). Means and standard deviations are presented in Table 9. ANOVA statistics and effect sizes were presented in Table 10.

The analyses revealed main effects for time on all of the social related measures where participants' scores were better at Time 5 than at Time 1, except for withdrawal. These effects were moderated by the expected interactions between study group and time, as seen in Figure 5. The analyses also revealed an interaction between study group and time on rule breaking. A simple main effects test with Bonferroni adjustment indicated that whereas social-related scores remain unchanged among the control group, they significantly improved (scores became lower) over time among the intervention group. Overall social problems improved with strong significance in both the SPM \( (F = 15.48, p < .001) \) and the CBCL \( (F = 32.10, p < .001) \), as well as in the social subtests of the CBCL of anxiety \( (F = 15.98, p < .001) \), social problems \( (F = 14.17, p < .001) \), thought problems \( (F = 18.58, p < .001) \), the cluster of external problems \( (F = 14.03, p < .001) \), and the
cluster of internal problems ($F = 15.74$, $p < .001$). Moderately strong significant results were obtained in attention problems ($F = 8.90$, $p < .01$) and aggressiveness ($F = 11.15$, $p < .01$). Strongly significant results were found in rule breaking ($F = 5.11$, $p < .05$).

Table 9

*Means and Standard Deviation for Examining the Differences between Intervention and Control in Social Measures over Time*

<table>
<thead>
<tr>
<th>Social Measure</th>
<th>Intervention</th>
<th></th>
<th></th>
<th>Control</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time 1</td>
<td>SD</td>
<td>Time 5</td>
<td>M</td>
<td>SD</td>
<td>Time 1</td>
</tr>
<tr>
<td>Overall social problems (SPM)</td>
<td>22.68</td>
<td>6.38</td>
<td>18.32</td>
<td>5.10</td>
<td>20.80</td>
<td>5.82</td>
</tr>
<tr>
<td>Overall social problems (CBCL)</td>
<td>58.12</td>
<td>24.42</td>
<td>38.12</td>
<td>22.77</td>
<td>51.44</td>
<td>20.33</td>
</tr>
<tr>
<td>Anxiety</td>
<td>8.36</td>
<td>3.84</td>
<td>4.84</td>
<td>3.76</td>
<td>6.80</td>
<td>4.40</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>2.68</td>
<td>2.43</td>
<td>1.84</td>
<td>2.01</td>
<td>2.52</td>
<td>2.73</td>
</tr>
<tr>
<td>Social problems</td>
<td>7.44</td>
<td>3.57</td>
<td>5.04</td>
<td>2.96</td>
<td>6.36</td>
<td>4.00</td>
</tr>
<tr>
<td>Thought problems</td>
<td>7.00</td>
<td>4.59</td>
<td>3.72</td>
<td>3.22</td>
<td>5.96</td>
<td>2.91</td>
</tr>
<tr>
<td>Attention problems</td>
<td>7.76</td>
<td>4.10</td>
<td>7.32</td>
<td>4.05</td>
<td>7.56</td>
<td>4.06</td>
</tr>
<tr>
<td>Rule breaking</td>
<td>3.84</td>
<td>3.46</td>
<td>2.64</td>
<td>2.48</td>
<td>3.12</td>
<td>2.54</td>
</tr>
<tr>
<td>External problems</td>
<td>17.56</td>
<td>9.49</td>
<td>12.12</td>
<td>8.17</td>
<td>15.52</td>
<td>8.01</td>
</tr>
<tr>
<td>Internal problems</td>
<td>13.00</td>
<td>6.50</td>
<td>7.56</td>
<td>6.00</td>
<td>11.00</td>
<td>7.04</td>
</tr>
</tbody>
</table>
Table 10

ANOVA statistics and Effect Sizes for Examining the Differences between Intervention and Control in Social Measures over Time

<table>
<thead>
<tr>
<th>Social Measure</th>
<th>Study group X Time</th>
<th>Study group</th>
<th>Time</th>
<th>Study group X Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(F_{(1, 48)})</td>
<td>(\eta^2_p)</td>
<td>(F_{(1, 48)})</td>
<td>(\eta^2_p)</td>
</tr>
<tr>
<td>Overall social problems (SPM)</td>
<td>0.10 .00</td>
<td>11.12** .19</td>
<td>15.48**</td>
<td>.24</td>
</tr>
<tr>
<td>Overall social problems (CBCL)</td>
<td>0.13 .00</td>
<td>51.15*** .52</td>
<td>32.10**</td>
<td>.40</td>
</tr>
<tr>
<td>Anxiety</td>
<td>0.01 .00</td>
<td>31.80*** .40</td>
<td>15.98**</td>
<td>.25</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>0.35 .01</td>
<td>1.45 .03</td>
<td>3.83</td>
<td>.07</td>
</tr>
<tr>
<td>Social problems</td>
<td>0.01 .00</td>
<td>16.20*** .25</td>
<td>14.17**</td>
<td>.23</td>
</tr>
<tr>
<td>Thought problems</td>
<td>0.34 .01</td>
<td>22.58*** .32</td>
<td>18.58**</td>
<td>.28</td>
</tr>
<tr>
<td>Attention problems</td>
<td>0.35 .01</td>
<td>14.56*** .23</td>
<td>8.90**</td>
<td>.16</td>
</tr>
<tr>
<td>Rule breaking</td>
<td>0.01 .00</td>
<td>3.42 .07</td>
<td>5.11*</td>
<td>.10</td>
</tr>
<tr>
<td>Aggressiveness</td>
<td>0.07 .00</td>
<td>21.30*** .31</td>
<td>11.15**</td>
<td>.19</td>
</tr>
<tr>
<td>External problems</td>
<td>0.03 .00</td>
<td>21.21*** .31</td>
<td>14.03**</td>
<td>.23</td>
</tr>
<tr>
<td>Internal problems</td>
<td>0.03 .00</td>
<td>30.23*** .39</td>
<td>15.74**</td>
<td>.25</td>
</tr>
</tbody>
</table>

Note: * \(p < .05\), ** \(p < .01\), *** \(p < .001\). \(\eta^2_p\) = partial eta-square, which serves as an effect size.
Figure 5. Improvement in social participation measures post intervention—means.
Did the Change in Sleep or Sensory Measures Predict the Change in Social Measures? Research Question 3

To examine whether the change in sensory and sleep measures over time predict the change in social-related measures, hierarchical regression analysis was conducted. Standardized and unstandardized coefficients were presented in Table 11. The analysis indicated that both the initial level of sensory sensitivity and the change in sensory sensitivity significantly predicted the change in social-related measures, of both the SPM and the CBCL. Conversely, the sleep-related measures did not predict the change in social-related measures. Specifically, it was found that the lower the participants' initial level of sensory sensitivity and the greater their improvement in sensory sensitivity, the greater the improvement in social related measures. Overall, the model explained 23% of the change in participants' social problems as assessed by the SPM, and 13.8% of the change as assessed by the CBCL.
Table 11

Standardized and Unstandardized Coefficients in Predicting Social-Related Measures by Sensory and Sleep-Related Measures

<table>
<thead>
<tr>
<th>Ste</th>
<th>Predictor</th>
<th>Social problems (SPM)</th>
<th>Social problems (CBCL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>b</td>
<td>SE</td>
</tr>
<tr>
<td>Ste I</td>
<td>Initial level of social problems</td>
<td>.5</td>
<td>.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R² = 42.5%***</td>
<td>R² = 64.1%***</td>
</tr>
<tr>
<td>Ste II</td>
<td>Initial level of social problems</td>
<td>.5</td>
<td>.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Difference in sensory problems</td>
<td>.1</td>
<td>.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Difference in sleep problems</td>
<td>.0</td>
<td>.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Initial level of sensory problems</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Initial level of sleep problems</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>ΔR²</td>
<td></td>
<td>= 23.0%***</td>
<td>ΔR² = 13.8%***</td>
</tr>
</tbody>
</table>

Note. * p < .05, ** p < .01, *** p < .001. R² = explained variance (1% = weak effect, 3% = moderate effect, 5% = strong effect).

**Improvement in GAS Scores**

To examine whether participants of the intervention group had greater increases in individualized goals than controls, an independent samples t test was conducted in which the study group (intervention, control) served as the independent measures and the individualized goals score as the dependent measure.

The analysis indicated that the improvement in individualized goals score was greater for participants of the intervention group (M = 69.71, SD = 11.23) than controls (M = 26.82, SD = 6.02, t(48) = 16.83, p < .0001, Cohen's d = 4.96).
Differences in the Sleep Log Between the Groups

This section examined whether participants of the intervention group differed from controls in the trajectory of change over time in the following sleep diary measures: time to fall asleep, waking frequency, and sleep duration. The initial level of the time taken to fall asleep, the frequency of waking at night, and the total time of sleep duration were predicted, as well as the change in these measures over time for the intervention group (= +0.5) and the control group (= -0.5). On the lower level of the hierarchical linear modeling (HLM) analysis (repeated measures level), the sleep-related measures were predicted by the variable of time (coded as 0, 1, 2, 3, 4 to account for Time 1 to Time 5 of the assessment). On the upper level of the analysis (person level), the measure of study group and the interaction between study group and time was added. A significant interaction would indicate that the trajectory of change over time, in time to fall asleep, waking frequency, and sleep duration differ between the intervention and control groups.

HLM coefficients were presented in Table 12. The LTs indicated that the intervention and study groups differed significantly in the trajectory of change in time taken to fall asleep and waking frequency (see Figures 6 and 7). The groups did not differ in sleep duration (see Figure 8). The intervention group had significantly greater improvement in the time taken to fall asleep and waking frequency.
Table 12

**HLM Coefficients in Predicting the Change in Sleep Log Measures over Time**

<table>
<thead>
<tr>
<th>Source</th>
<th>Fall asleep</th>
<th>Waking frequency</th>
<th>Sleep duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
<td>$SE$</td>
<td>$t_{(221)}$</td>
</tr>
<tr>
<td>Time</td>
<td>43.83</td>
<td>2</td>
<td>3.10**</td>
</tr>
<tr>
<td>Study group</td>
<td>22.07</td>
<td>7</td>
<td>0.45</td>
</tr>
<tr>
<td>Time X study group</td>
<td>44.30</td>
<td>9</td>
<td>2.19*</td>
</tr>
</tbody>
</table>

Note: * $p < .05$, ** $p < .01$.

**Figure 6.** Trajectory of change in time taken to fall asleep.
Figure 7. Trajectory of change in waking frequency.

Figure 8. Trajectory of change in sleep duration.
Chapter 5: Discussion

The person-environment-occupational performance (PEOP) model of performance, participation, and well-being was the framework for interpreting the results of this dissertation study’s research questions. The PEOP model was selected due to its emphasis on occupational performance as the means to meaningful engagement in occupation. In the PEOP model, personal and environmental factors interact in a transactional manner where the child experiences and performs occupations in ways that support or restrict participation (Christiansen & Baum, 2005). In this study, the environment factor of bedtime routines at home was constant for each subject throughout the study.

The first research question addressed the effect of a sensory intervention on the occupational therapy domain of sleep, and focused on the intrinsic person factor of physiology in the PEOP model. The second research question addressed the effect of a sensory intervention on social participation and focused on occupation of socializing. Finally, in the third research question, the principal investigator (PI) studied the causal effect of sensory modulation disorder (SMD) and sleep in order to determine the extent that each influenced the occupational performance of social participation.

The PEOP model defined actions, tasks, and occupation in an ascending order (Christiansen & Baum, 2005). The PI adapted and built from the PEOP model, formulating an original occupation building model which is hierarchical and processed based. The PI developed an occupation building model as an adaptation to the PEOP
model to help explain study findings. The occupation building model is intended to enhance understanding of how children with SMD build up components of occupation, and how children transition from level to level, as illustrated in Figure 9.

![Model of Occupation building](image)

**Figure 9.** Model of Occupation building.

For children with SMD, transition from action to task (Level 1 to Level 2), consistency of action is required to consolidate the task. For transition from task to occupation (Level 2 to Level 3) in children with SMD, accurate interpretation for mobilizing to problem solve and develop strategies builds tasks into occupation. The PI developed core constructs of consistency and of accurate interpretation for mobilization
from the study results. These core constructs are considered central to the ability to attain the level of an occupation.

The method of inquiry in this dissertation promoted and used forward chaining for planning and achieving goals by proposing a mechanism of change prior to choosing an intervention, and then working with the targeted intervention logically through to the outcomes. The mechanism of dysfunction in children with SMD was posited to be a dysregulation of arousal levels. The proposed mechanism of change was that moderate pressure touch elicits a para-sympathetic nervous system response through the release of neurotransmitters such as dopamine and serotonin to regulate and balance arousal levels (Degangi, 2000; Diego et al., 2005; Field et al., 2004; Kramer & Hinojosa, 1999). Therefore, to continue the forward chaining, the proposed intervention of parent massage was expected to maintain a level of activity consistent with the ability to perform task repetition, and to subsequently mobilize effort to problem solve and persevere in social interactions.

Thus, as the study began with a theorized mechanism of dysfunction and a theorized mechanism of change, and then progressed to an intervention that targeted that process, moderate pressure massage intervention yielded outcomes that supported the theorized dysfunction and process of change. Through this study’s use of forward chaining, it was possible to target intervention options based on disruption of the process of achieving occupational performance. Although this study used moderate pressure touch, other interventions that regulate arousal levels could have similarly been chosen, such as proprioceptive inputs of physical exercise, or drumming, or use of vestibular input such as swinging or riding a bike. Outcomes would be reviewed for the
effectiveness of the chosen sensory input to attain the desired goals. Use of forward chaining allows for targeted and more effective intervention, and allows for generalization of outcomes because the focus is on disruption of the process rather than on a specific treatment.

In backwards chaining, which seems to be used all too often in occupational therapy, a specific treatment is chosen, whether it be massage, yoga or karate, or cognitive behavioral therapy, and then attempts are made to find a reason why it worked. Thus, even with successful outcomes, researchers are unable to generalize the results to other interventions because they do not know which process caused the intervention to succeed or why the outcomes were successful.

**Disruption in Transformation From Actions to Tasks in SMD: The Process of Moving From Level 1 to Level 2**

The occupation building model was next used to understand how children with sensory modulation disorder (SMD) build components of occupation to advance to a higher level of function. Children in this study exhibited difficulties in sensory modulation, of the sensory over-responsivity sub-type, and of the sensory seeking sub-type. The results of the data suggested that the sensory over-responsivity sub-type was related to a higher arousal level which influenced sleep and internal social participation behaviors such as anxiety, withdrawal, social and thought problems. The active sensory seeking sub-type seemed to be related to external changes such as attention problems and aggressiveness. However, the majority of findings related to the sensory over-responsivity sub-type.
Associations of Sleep with SMD: A Physiological Connection

Analysis of the pretest data investigated the associations between sensory difficulties and sleep problems of all the participants at intake. The results of the connection between sensory dysfunction and difficulty in sleep behaviors provided initial evidence to support a weak link between sensory modulation difficulties and behavioral sleep disorders.

Scores from both experimental and control participants, were grouped together to review general trends between sensory and sleep behaviors. Overall sensitivity scores of the Short Sensory Profile (SSP) were not significantly correlated with overall sleep scores of the Child Sleep Habits Questionnaire ([CSHQ], see Appendix C). However, two sub-patterns, tactile sensitivity and taste/smell sensitivity were modestly correlated with daytime sleepiness \((r = .28, p < .05)\) and visual/auditory sensitivity correlated with sleep anxiety \((r = .28, p < .05)\). The results corroborated previous studies of sleep and SMD in which one study by Shochat et al. (2009) found that tactile sensitivity was correlated with the overall sleep score of the CSHQ in typically developing children, and a study by Reynolds et al. (2012) found that visual and auditory sensitivity discriminated bad sleepers from good sleepers.

An Intervention to Establish Consistent Sleep Behaviors

For research question one, sleep behaviors were chosen as a dependent measure because they reflected a body process that affected functional behaviors. Atypical physiology of children with SMD, as noted by a higher baseline arousal level, has been used in studies to distinguish children with SMD from typically developing children (McIntosh, Miller, Shyu, & Hagerman., 1999; Miller et al., 1999; Schaaf et al., 2010).
This dissertation study found that overall sleep scores improved significantly in the experimental group as a result of the moderate pressure touch intervention ($F_{(1,48)} = 24.71, p < .001$). Specific sub-group scores that showed improvement occurred in sleep onset (falling asleep) ($F_{(1,48)} = 8.88, p < .01$), sleep anxiety (difficulty falling asleep or sleeping alone) ($F_{(1,48)} = 8.30, p < .01$), parasomnias (nightmares, confusional arousal) ($F_{(1,48)} = 13.98, p < .001$), and daytime sleepiness ($F_{(1,48)} = 8.57, p < .01$).

Furthermore, the parent reported sleep logs detailing their children's sleep patterns indicated that children woke up less often at night ($t_{(221)} = 2.02, p < .05$) and needed less time to fall asleep ($t_{(221)} = 2.19, p < .05$). Intervention was not found to influence total sleep time. With cessation of the moderate pressure touch application on week four, the improvement in both time to fall asleep and reduced night wakings reversed in week five. The children again took longer to fall asleep and woke up more often. These results add support for the effectiveness of moderate pressure touch input improving sleep behaviors.

While effectiveness of massage touch has been noted in the literature in children with a myriad of other diagnoses, as detailed in chapter 2, results of this study indicate that moderate pressure touch input was effective for children with SMD. According to the occupation building model, by regulating the child’s arousal level, the child will perform repetitive actions that will transform the activity from Level 1 of actions into Level 2 of task performance.

To address this idea, the first research question investigated if an occupational therapy sensory intervention of moderate pressure touch input could affect the child’s arousal level and provide a consistent and regulated experience in an activity. The study hypothesized that inconsistent arousal in children with SMD may have led to difficulty in
performing and sustaining actions repeatedly over time, as required to transform tasks into purposeful activity. In the domain of sleep, in order to establish a bedtime routine, a child with SMD must attain an optimal state of arousal nightly which is consistent with bedtime. Once in bed, the child with SMD needs to sleep deeply enough to prevent reawakening. At intake, the children in this study were unsuccessful in achieving success in the sleep categories of bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night awakening, parasomnias, and daytime sleepiness. When provided with moderate pressure touch input, the participants became able to perform bedtime routines of going to bed in a timely manner without resistance, $t_{(221)} = 2.19, p < .05$, and they woke less often, $t_{(221)} = 2.02, p < .05$, as noted in the sleep log measures. The difficulty in task performance seemed unrelated to skill deficiency, but rather was related to difficulty in the process of achieving a regulated level of arousal that made it possible to perform repetitive behaviors consistently.

**Disruption in Transformation from Tasks to Occupation: Moving from Level 2 to Level 3**

Ascending a level in the occupation building model, an effort was made to identify where a disruption next occurred in the process of occupation building. If advancing from action level to task level was based on difficulties of over or under-responsivity in children with SMD, wherein lay the difficulty to successfully transition from Level 2 of task performance to the Level 3 of occupation? The noted occupation in this study was social participation. The data on social participation at intake indicated that children with SMD did not reach the level of social participation as occupation. In the occupation building model, this difficulty may be attributed to an inability to attain one’s
goals for that occupation. Goal attainment motivates the child to mobilize effort, increase persistence, and develop strategies for success; thus, enabling the formation of occupations (Latham, Bardes, & Locke, 2011). In the occupation building model, failure of children with SMD to attain their goals can indicate a failure in developing effective strategies for forming clusters of purposeful activities.

In this dissertation study, the change in social participation was used to infer the transformation process from Level 2 to Level 3. Social behaviors were chosen because they reflect a process of goal-directed behavior, which requires the ability to mobilize efforts in order to perform clusters of multi-dimensional meaningful tasks. The process of disruption in social participation was thought to arise from over- or under-responsivity to sensory stimuli, such as a peer’s voice being uncomfortably loud, with subsequent cognitive misinterpretation, for example that the peer was yelling at him, followed by a behavioral response of aggressiveness or avoidance by the child with SMD. Another hypothetical example would be a child with SMD who over-responds to a slight bump from a book bag of a passing student, feeling the bump as a strong knocking blow; the child may interpret the student’s action as intentional harm. The student carrying the book bag might have no idea that anything untoward occurred at all. The child with SMD might mistakenly perceive a need to defend him or herself, and the student might either hit back and truly become angry at the child with SMD, or simply reduce future social interactions. Associations and results of social participation in this study are now presented.
Associations of Social Participation with SMD: A Pragmatic Motivational Connection

This dissertation study supported an association between sensory modulation difficulties and social impairment. Intake scores of the entire study group, experimental and control participants were grouped together to look at general associations between sensory and social behaviors in Table 2. Overall sensory scores of the SSP were moderately correlated with overall social scores of the CBCL ($r = .50, p < .05$). Additionally, several sub-group scorings between sensory and social problems are of note.

Social problems within the CBCL were divided into two main types, internal and external problems. Internal problems such as anxiety were associated with tactile ($r = .59, p < .001$), visual and auditory sensitivity ($r = .45, p < .01$), whereas sensation seeking was associated with external problems such as socializing ($r = .40, p < .01$) and attentiveness ($r = .45, p < .01$). Difficulty in auditory filtering was associated with both internal ($r = .43, p < .01$) and external social problems ($r = .42, p < .01$), and was strongly correlated to overall social problems ($r = .58, p < .001$). This study focused on the internal problems of socialization as related to over-responsivity seen in children with SMD. Studies have suggested a strong link between sensory sensitivity and overall social performance in children with autism (Hilton et al., 2007). The results of this study suggest initial evidence for a link between SMD to social participation which is independent of the presence of autism.
An Intervention to Promote Successful Social Participation

In the second research question, social scores were compared from the beginning of the five weeks of the experiment to the end of week four of the experiment. Significant improvement of overall social scores \(F_{(1,48)} = 32.10, \ p < .001\) and individual sub-group social scores was found, with the exception of the social sub-group withdrawal. No such gains were found in the control group. Externalizing sub-group behaviors of attention problems \(F_{(1,48)} = 8.90, \ p < .05\), rule breaking \(F_{(1,48)} = 5.11, \ p < .05\), and aggressiveness \(F_{(1,48)} = 11.15, \ p < .01\) showed improvement; however, the improvement was less significant than the internalizing behaviors of anxiety \(F_{(1,48)} = 15.98, \ p < .001\), social problems \(F_{(1,48)} = 14.17, \ p < .001\), thought problems \(F_{(1,48)} = 18.58, \ p < .001\). These results are similar to outcomes in the literature where massage improved intrinsic measures more than extrinsic measures (Robles et al., 2012; Silva et al., 2011). The results support the PI’s assumption that physiologic calming through massage promotes accurate cognitive interpretation and may provide motivation for children with SMD to endeavor to actively interact socially, rather than choosing to avoid socializing experiences.

In this study, as participants improved, anxiety and problematic thoughts decreased and their social participation improved. Behavioral outcomes of aggressiveness and rule breaking also decreased. These results suggest a mechanism of change that was based on being calm enough to participate in social interactions without over-reacting, and which allowed for positive experiences in socializing. However, improved social participation also requires actual participation. The increase in actual social participation
was reflected by improvement in the overall social scores, and by improvement in the individual GAS score, which was a compilation sensory, sleep, and social scores.

Children with SMD have less friends than typically developing children (Cosbey et al., 2010). One possible explanation is that misinterpretations of the social setting can begin a repeated experience of failure over time. As children with SMD over- or underrespond to sensory stimuli and then develop behavioral patterns of avoidance, the actual lack of experience in developing strategies for overcoming difficulty produces a reality of social difficulty (Dunn, 1997; Miller, 2005).

An additional conclusion is that because improvement in social skills of children with SMD was noted after just three weeks of moderate pressure touch and the improvement was comprehensive in the types and complexity of social skills noted, the PI’s assertion of difficulty in process rather than difficulty in skill appears to be supported. Socialization skills and ability were present, however the children were likely unable to access the skills due to the difficulty to achieve and maintain the regulated level of arousal required for social participation.

Results suggesting that moderate pressure touch affected a complex process such as social participation were unexpected. As noted, gains occurred in reduced anxiety levels, less thought problems, less social problems, less rule breaking, and less aggressive behaviors. The children in the study appeared to more accurately interpret the social behaviors and reactions of their peers after the intervention. With improved accuracy of interpretation, the children seemed to mobilize to persevere in social participation, and engaged in experiences which they had previously refrained from. In only three weeks,
the children appeared to produce a stream of goal-directed behaviors that transformed into the occupation of social participation.

**Improvement in Social Participation**

The third research question queried if improvement in social participation could be due to sleep parameters rather than sensory influences. No correlation was found linking overall sleep scores with overall social scores of the entire study group at intake. However, daytime sleepiness was modestly correlated with internal problems \( r = .31, p < .05 \) and sleep duration was modestly correlated with thought problems \( r = .33, p < .05 \). Children who are anxious and worried may not have restful sleep, and may become tired in the daytime, or sleep less at night.

To address causality, a regression analysis was performed to determine the extent of the sleep and sensory influences on the social outcomes. Sensory measures were found to explain 23% of the change in participants’ social problems as measured by the SPM social subtest, and explained 13.8% of the variance as measured by the CBCL. Results of the regression analysis found that sleep related measures did not predict change in social participation, as noted in Figure 2. Therefore, sleep appears to be a separate outcome measure affected by the moderate pressure touch input, just as social participation was affected by the sensory intervention.

**Limitations**

The main threats to validity in this study include internal and external concerns. Threats to internal validity included possible bias in subject selection. Volunteer participants were recruited by a convenience sample and not by random selection. Parent bias in answering questionnaires must be considered as a threat to internal validity, as
well as use of parent response instead of direct child response. Examiner bias must also be included as a limitation because even though random assignment to treatment condition was used, conditions were not blinded to the PI. In addition, a testing effect of filling out the instruments at pretest may have affected how parents filled out the same instruments at posttest. Consistent application of moderate pressure touch was unable to be confirmed, notwithstanding initial instruction, and a home visit to ensure consistent application of pressure. Threats to external validity included the limited ability to generalize to wider populations due to small sample size and due to subject selection from a single site, which limited sample diversity.

**Implications for Practice**

Findings from this study support the view of an approach in intervention for children with SMD that considers the child’s responsivity to sensory input. This study found that the sensory input of moderate pressure touch effectively lowered arousal levels in both sensory and sleep measures. When the sensory intervention was discontinued, immediate worsening of sleep patterns were noted. This is the first intervention study which investigated the efficacy of moderate pressure touch in children with SMD without other comorbid diagnoses. This knowledge may be used when planning effective treatment choices in SMD, particularly for goals of improved sleep behavior and social participation.

Prior to this study, interventions in SMD were not specifically based on a mechanism of change of lowering arousal levels. Therefore, a focus of the practicing occupational therapist would be to provide activities that influence regulation of the
child’s arousal level, or encourage family members to provide the regulation, and then provide opportunities for repeated experiences of meaningful chosen tasks.

This study also highlighted the possibility that moderate pressure touch may influence social participation. Significantly, the improvement in social participation occurred in a short time frame of three weeks of intervention. This information directs therapists to include the development of social strategies and gathering social experiences in their intervention approach when working with children with SMD.

This study offered an alternative to traditional therapist treatment of SMD by training parents to deliver a home intervention. Parent massage is both cost-effective to the health system and supports principles of the World Health Organization’s International Classification of Functioning, Disability and Health that supports function and participation within the context of family life (World Health Organization, 2001). Use of parent massage offers families a way to obtain significant improvement without extensive visits to a therapy clinic, does not interrupt the daily flow of family life, and empowers families to participate in improving the well-being of their child. This approach is consistent with the vision of the profession of occupational therapy of empowerment and of family-centered practice.

This study strengthened the use of occupational therapy intervention for the domain of sleep. The addition of sleep to the domains in the Occupational Therapy Practice Framework occurred in 2008 (AOTA, 2008). In the past six years, initial consideration of sleep as an occupational therapy domain for children with SMD focused on the correlation with sleep problems. This study marks the first time that a sensory intervention was successful in improving sleep behaviors in children with SMD,
specifically moderate pressure touch. Therapists should inquire about sleep habits when treating children with SMD and should include sleep improvement in the goals for these children. Particular attention should be paid to lowering arousal to a level consistent with sleep, and noting improvement in bedtime resistance behaviors.

This study promoted use of forward chaining from theory to practice for occupational therapists when choosing intervention strategies. Effective outcomes are the goal of every practitioner. However, in order to replicate outcomes to wider populations or use other similar but effective techniques that may better meet a client’s particular situation, inclusion of a hypothesized mechanism of change prior to intervention is recommended. When using backwards chaining of beginning with intervention and then attempting to use a theoretical base to explain the results, interventions are unfocused and “hopeful,” but not targeted and efficient (Rogers, 1999). Therefore, when planning targeted effective intervention, it is suggested to begin with a hypothetical reason that may cause the problem of dysregulated arousal levels in children with SMD.

**Recommendations and Implications for Future Research**

This dissertation study contributes to the growing body of knowledge regarding the ability to influence arousal levels in children with SMD and how this knowledge may be used to build occupations in these children. The study provided initial evidence that providing moderate pressure touch to children with SMD can improve behavioral sleep difficulties and social problems. The results of this study raised more questions and possibilities for targeted research.

To strengthen the initial claims of a link between behavioral sleep problems and children with SMD, physical measures such as actigraphy or polysomnography to further
investigate these conclusions would add support and are within the scope of occupational therapy research instruments. Such measures would be worth studying both for evaluative baseline levels and before, during, and post intervention.

To develop knowledge about the effects of a targeted sensory input on lowering arousal levels, several questions are worth researching. Studies could be conducted to see which of the SMD sub-types are most influenced by moderate pressure touch. Additionally, the study protocol worked best for the SMD sub-type sensory over-responsivity. However, no specific standardized assessment for sensory over-responsivity is available. As the test instruments develop, future intervention studies may focus specifically on sensory over-responsivity, and not of all sub-types of SMD. Additionally, investigating the effect of other types of sensory inputs, such as proprioceptive and vestibular, would expand knowledge and offer a greater range of intervention options.

The majority of intervention efficacy in the literature focused on outcomes and not on the manner of delivery. Intervention studies of SMD tend to espouse general sensory techniques or focus on outcomes without specifying the delivery of the input (Miller et al., 2007; Smith et al., 2005). A typical “sensory diet” program in comprised of at least five activities per day (Wilbarger & Wilbarger, 1991). This study achieved significant results with input given once daily, but with a longer amount of time of application of the moderate pressure touch input. Future research could measure the effectiveness of sensory input with different service delivery configurations.

Social measures improved in children with SMD in the current study. It is important to identify factors that influence the process of successful social participation in children with SMD. Implications for future research include breaking down the steps
in the transformation of an action to a task, and in the transformation of a task to an occupation. For example, bedtime routines were considered to be a consistent environmental factor on the PEOP model in this study. However, the nature of bedtime routines could be investigated to see the variety and nature and to then view their effect on sleep behaviors.

The current study expanded the knowledge about the effect of SMD on sleep behaviors and social participation. The great majority of application research of SMD beyond basic knowledge research includes comorbid diagnoses, especially autism spectrum disorders and ADHD. While inclusion of comorbid diagnoses may reflect the expression of SMD in reality, or may reflect the appropriation of research dollars, the result is an inability to conclusively claim causality due to SMD factors. In particular, minimal research has been undertaken in the domain of sleep and SMD. Only one study of SMD and sleep or SMD and social problems did not include additional intake diagnoses, as noted, and that study was correlational only (Shochat, 2009). Thus, the current study marks the first time that an intervention study was researched with the SMD diagnosis exclusive of other major diagnoses. Future research should continue to isolate SMD in their inclusion criteria in order to obtain clear and targeted outcomes and conclusions. As well, further studies should be conducted with SMD in all domains of function, including but not limited to sleep and social participation.

This dissertation study confirmed the sensitivity of the SSP, CSHQ, and the CBCL instruments used to achieve meaningful results. The instruments were chosen based on the Miller, Schoen, et al. (2007) study, where numerous instruments were given to participants and the measures that showed sensitivity included the SSP, the CBCL, and
GAS. The results of this study support the use of all three measures in occupational therapy research, as well as the CSHQ. The SPM did not yield new information or more in-depth knowledge than the CBCL. Therefore, use of the CBCL was preferred by this PI. Poor sensitivity of instruments has been a major flaw in sensory integration research and has led to denial of insurance reimbursement and dismissal of the sensory integration approach by other disciplines (Blue Cross and Blue Shield Association, 2000; Shaw, 2002). The importance of identifying sensitive instruments is important to all occupational therapy research, but is especially crucial to sensory research. It is recommended that future researchers in SMD take note of the instruments in the current study which yielded sensitive measures of change.

Finally, the area of process in the building of occupations could be further developed and expanded to the general field of occupational therapy, and would contribute to the wider understanding of how occupations are developed.

**Summary**

This dissertation study used the PEOP model as a theoretical guide when investigating the influence of moderate pressure touch input on the building of the occupations of sleep and social participation in children with SMD. Using quantitative methodology, the PI found that parent application of moderate pressure touch sensory input improved sleep behaviors and social participation of children with SMD. The PI conceived an original model of occupation building for children with SMD that promoted transitioning from actions to tasks to occupation, for optimal engagement and participation in life.

The findings of this dissertation study support a conceptual model of regulating arousal levels of children with SMD in order to achieve consistency of repeated
experience for transformation of actions to purposeful tasks. In the second stage of intervention, the child would need accurate interpretation of sensory input from the environment, in order to mobilize and make the effort to problem solve and develop strategies for socialization. When the child is able to engage in and sustain sequences of goal-directed behaviors, a stream of purposeful tasks would transform into occupations. The results of this study suggest that children with SMD were able to effectively improve social participation in a short time frame without therapist facilitation, and this supports the claims of the occupation building model.

This experimental study underscored the importance of forming a continuous forward chain from theory to practice to research when planning intervention for targeted focused outcomes. The outcomes of this study suggested further topics for research.

This intervention study isolated SMD in the inclusion criteria, and investigated the effects of moderate pressure touch as an effective intervention for children with SMD without including other significant diagnoses, thus providing more substantive support for the gains being specific to children with SMD. Significantly, an occupational therapy intervention in the domain of sleep in children with SMD was researched for the first time. Intervention for social participation in children with SMD with no additional major diagnoses was also researched for the first time.

Finally, development and use of the hierarchical model of occupation-building is suitable for general application when working with clients who experience a disruption in process in other domains of function. The practitioner would evaluate and identify at which level the client is currently performing and identify the personal or extrinsic factors that disrupt transformation to the next higher level. Application of occupational
therapy skills of problem analysis in conjunction with client-centered goals would plan a targeted effective intervention to promote optimal occupational performance. The ultimate goal of the occupation building model would be engagement for well-being and participation in life. More research is needed to elucidate the process of building occupations, and to use such knowledge to promote optimal occupational performance.
References


Cohn, E., Miller, L. J., & Tickle-Degnen, L. (2000). Parental hopes for therapy


Dunn, W., & Bennett, D. (2002). Patterns of sensory processing in children with


Field, T., Grizzle, N., Scafidi, F., Abrams, S., Richardson, S., Kuhn, C., & Schanberg,


Appendix A

Sleep Logs

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Leave the times your child is awake blank. Put an X for the time you read a bedtime story. Put a downward arrow when they lie down to sleep. Shade in the times when they sleep. If there is a gap between when they lie down and fall asleep leave that time unshaded. Put an upward arrow when they awaken. Circle the day of the week that you began to record this week.

Complete this log in the evening and in the morning. Do not complete this log during the night. Read the bedtime story 5-7 times per week. Enter any comments in the line below each day.

**Features to be monitored:**
- Time child lies down
- Time child falls asleep
- Time child awakens in morning
- Night awakenings and gaps in continuous sleep
- Total sleep hours per night
Experimental group:
First week- Observe your child's sleep this week. No massages or bedtime stories.

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**Week Two: Begin the massages and bedtime stories.**

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Last week - Week five: Observe your child's sleep this week. No massages or bedtime stories.

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Leave the times your child is awake blank. Put an X for the time you read a bedtime story. Put a downward arrow when they lie down to sleep. Shade in the times when they sleep. If there is a gap between when they lie down and fall asleep leave that time unshaded. Put an upward arrow when they awaken. Circle the day of the week that you began to record this week.

Complete this log in the evening and in the morning. Do not complete this log during the night. Read the bedtime story 5-7 times per week. Enter any comments in the line below each day.

Features to be monitored:
Night awakenings and gaps in continuous sleep. Total sleep hours per night.
Control group:

First week- Observe your child’s sleep this week. No bedtime stories.

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Comments:
Last week - Week five: Observe your child’s sleep this week. No bedtime stories.

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Comments:
## Appendix B

**Parent Intake Form**

### Basic Information

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Any medical conditions or diagnoses? including ADHD, Autism, CP, Developmental delay/ Down Syndrome, or other issues:

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Do you suspect that your child has poor attention and concentration difficulties?

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<th>Circle: Yes / No</th>
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When was the last time your child received occupational therapy services, if at all?

### Parent Information

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</tr>
<tr>
<td>Years of education</td>
<td></td>
</tr>
<tr>
<td>Circle: Employed</td>
<td>At home</td>
</tr>
<tr>
<td>Circle: Married</td>
<td>Divorced</td>
</tr>
</tbody>
</table>

Thank you for your participation in this study!

Geela Spira

Phone: 054-2494588

Fax: 1533-7261832

Email: spira@nova.edu
Appendix C
Child Sleep Habits Questionnaire
Child's Sleep Habits
(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: 

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

Sleep Behavior
Child's usual amount of sleep each day: ________ hours and ________ minutes
(combining nighttime sleep and naps)

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

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CSHQ with coding
### Sleep Behavior (continued)

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Usually (5-7)</th>
<th>Sometimes (2-4)</th>
<th>Rarely (0-1)</th>
<th>Problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child reports body pains during sleep. If so, where?</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child grinds teeth during sleep (your dentist may have told you this)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child snores loudly (16)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child seems to stop breathing during sleep (19)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child snorts and/or gasps during sleep (20)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child has trouble sleeping away from home (visiting relatives, vacation)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child complains about problems sleeping</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child awakens during night screaming, sweating, and inconsolable (22)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child awakens alarmed by a frightening dream (23)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

### Waking During the Night

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Usually (5-7)</th>
<th>Sometimes (2-4)</th>
<th>Rarely (0-1)</th>
<th>Problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child awakes once during the night (24)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child awakes more than once during the night (25)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child returns to sleep without help after waking</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

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

### Morning Waking

Write in the day child usually wakes in the morning: __________________

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Usually (5-7)</th>
<th>Sometimes (2-4)</th>
<th>Rarely (0-1)</th>
<th>Problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child wakes up by him/herself (11)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child wakes up with alarm clock</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child wakes up in negative mood (27)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Adults or siblings wake up child (28)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child has difficulty getting out of bed in the morning (29)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child takes a long time to become alert in the morning (30)</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child wakes up very early in the morning</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Child has a good appetite in the morning</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

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2

CSHQ with coding
### Daytime Sleepiness

<table>
<thead>
<tr>
<th>Coding</th>
<th>[3] Usually ((8-7))</th>
<th>[2] Sometimes ((2-4))</th>
<th>[1] Rarely ((0-1))</th>
<th>Problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[] [] []</td>
<td>[] [] []</td>
<td>[Yes] No N/A</td>
<td>[Yes] No N/A</td>
<td>[Yes] No N/A</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Not Sleepy</th>
<th>Very Sleepy</th>
<th>Falls Asleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play alone</td>
<td>[] [] []</td>
<td>[] [] []</td>
</tr>
<tr>
<td>Watching TV ((32))</td>
<td>[] [] []</td>
<td>[] [] []</td>
</tr>
<tr>
<td>Riding in car ((33))</td>
<td>[] [] []</td>
<td>[] [] []</td>
</tr>
<tr>
<td>Eating meals</td>
<td>[] [] []</td>
<td>[] [] []</td>
</tr>
</tbody>
</table>

### Subscale Items

Children’s Sleep Habits Questionnaire (CSHQ)

Numbers in parentheses refer to CSHQ item number

1. **Bedtime Resistance** (6 items)
   - Goes to bed at same time \((1)\) \((R)\) \[^4^\]
   - 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 \((6)\)
   - 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)
   - Wakes 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)
   - Schnore loudly \((18)\)
   - Stops breathing \((19)\)
   - Snores 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)

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

\[^4^\] Note: Some items \((R)\) should be reversed in scoring, so that a higher score reflects more disturbed sleep behavior.

\[^5^\] 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 D

Parent Massage Instructions

**Bedtime Story Instructions**

The bedtime story is to be read to your child 5-7 times a week, for twenty minutes each time, for three weeks. You may choose the story but it should not include frightening content, or content that would overly excite your child. The child may lie in bed, stand or sit next to you, or use any position that you both find comfortable. Record the times and dates that you read the story to your child in the sleep log in the space provided for that and also record the times and dates that you massaged your child in the space provided for that in the sleep log.

**Parent massage procedure**

The use of moderate pressure touch input to bring about relaxation through physical and chemical means will be called "massage" from this point on. The massage will be administered by parents who have read this protocol and who have been instructed by Geela Spira, the principal investigator of this research study. We thank you for your participation in this study.

**The massage:** The massage is to be administered 5-7 times a week, for twenty minutes each time, for three weeks. The child may lie in bed, stand or sit next to you, or use any position that you both find comfortable. The massage should be administered at your child's bedtime. Record the times and dates that you massaged your child in the sleep log in the space provided for that. Feel free to add in comments about the massage experience and about your child's behavior as the days go by.

The parts of the body that will be massaged are the arms, both upper and lower, the upper back, and the lower legs. Do not massage sensitive areas such as the inner arms or behind the knees as this may cause your child to feel unpleasant and to react with defensiveness instead of relaxing.

**The massage procedure:** The hand pressure will come from the palm of your hand. The fingers may rest on the body part, but take care not to squeeze with your fingertips. The pressure will be moderate, not light. Take care not to scrub back and forth, such as when trying to get a dirty spot out of a garment, for redness will occur and histamines will be released. The massage itself is to the muscles. The direction of motion is up and down the arm or leg.

The movements begin from the hand or ankle, and move up and down to the joint and back down again. For the arms, massage from the wrist all the way to the shoulder and back down again. For the legs, massage from the ankle to the knee and back down again. The movements on the upper back may be massaged in all directions, as long as the movements are slow, calming, and use enough pressure.
The wave technique: Divide the area of the skin to be massage into four equal parts. In the wave technique, move the massaging hand up and down slowly and firmly over an area of skin, and then move a quarter circle to the next area of skin, and then another quarter circle until all of the area of the arm or leg has been massaged. Continue on to the next body part-lower arm, lower leg, upper arm or the upper back. Maintain contact with the skin when changing directions from up to down, or down to up.

The squeezing technique: In the squeezing technique, use the same directionality as in the wave technique. However, instead of a massaging wavelike movement, use your palm and fingers to squeeze along the arm or leg with all fingers and the thumb for 5 seconds per squeeze. Move the squeezes up and down the extremity. Adjust the pressure to your child's comfort level, as long as the pressure is moderate.

**The Step by step procedure**

- The full massage is to be done for twenty minutes in two sets, for ten minutes each set. Each of the five body parts is to be massaged two minutes at a time, in each set.
- The order of the massage is: right arm, left arm, the upper back, left leg, right leg.
- On the first set of the massage, the hand movement of the parent is wavelike.
- On the second set of massage, the hand movement of the parent is firmly squeezing.

Enjoy the experience with your child!
Appendix E
Partial Reproduction of the Sensory Processing Measure

Attached are questions 1-5 of the SPM by permission as follows:

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Appendix F

Sample Copy of the Child Behavior Checklist
Please print. Be sure to answer all items.

Below is a list of items that describe children and youths. For each item that describes your child now or within the past 6 months, please circle the number which best describes how true of your child. Circle the 0 if the item is not true of your child. If the item is not true of your child, circle the 0. Please answer all items as well as you can, even if some do not seem to apply to your child.

<table>
<thead>
<tr>
<th>Item Description</th>
<th>0 = Not True (as far as you know)</th>
<th>1 = Somewhat or Sometimes True</th>
<th>2 = Very True or Often True</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acts too young for his/her age</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinks alcohol without parents’ approval</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argues a lot</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fails to finish things he/she starts</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is very little he/she enjoys</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bowel movements outside toilet</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bragging, boasting</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can’t concentrate, can’t pay attention for long</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can’t get his/her mind off certain thoughts; obsessions (describe)</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can’t sit still, restless, or hyperactive</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clings to adults or too dependent</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complains of loneliness</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confused or seems to be in a fog</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cries a lot</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruel to animals</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruelty, bullying, or meanness to others</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daydreams or get too much in his/her thoughts</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deliberately harming his/her parents' safety</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demands a lot of attention</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destroys his/her own toys</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destroys things belonging to his/her family or others</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disturbed at home</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disobedient</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doesn’t eat well</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doesn’t get along with other kids</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doesn’t seem to feel guilty after misbehaving</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Easily jealous</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaks rules at home, school, or elsewhere</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fears certain animals, situations, or places, other than school (describe)</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fears going to school</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fears he/she might think or do something bad</td>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PAGE 2: Be sure you answered all items. Then see other side.
<table>
<thead>
<tr>
<th></th>
<th>0 = Not True (as far as you know)</th>
<th>1 = Somewhat or Sometimes True</th>
<th>2 = Very True or Often True</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>57. Physically attacks people</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>58. Picks nose, skin, or other parts of body (describe):</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>59. Plays with own sex parts in public</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>60. Plays with own sex parts too much</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>61. Poor school work</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>62. Poorly coordinated or clumsy</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>63. Prefers being with older kids</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>64. Prefers being with younger kids</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>65. Refuses to talk</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>66. Repeats certain acts over and over; compulsions (describe):</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>67. Runs away from home</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>68. Screams a lot</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>69. Secretive, keeps things to self</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>70. Sews things that aren't there (describe):</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>71. Self-conscious or easily embarrassed</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>72. Sets fires</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>73. Sexual problems (describe):</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>74. Shaving off or drawing</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>75. Too shy or timid</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>76. Sleeps more than normal</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>77. Stays more than normal in day and/or night (describe):</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>78. Inattentive or easily distracted</td>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>79. Speech problem (describe):</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>80. Stares blankly</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>81. Steals at home</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>82. Steals outside the home</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>83. Steals up too many things he/she doesn't need (describe):</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>84. Strange behavior (describe):</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>85. Strange ideas (describe):</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>86. Stubborn, sulker, or irritable</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>87. Sudden changes in mood or feelings</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>88. Sucks a lot</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>89. Suspicious</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>90. Swearing or obscene language</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>91. Talks about killing self</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>92. Talks too much</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>93. Teases a lot</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>94. Temper tantrums or hot temper</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>95. Thinks of self as too much</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>96. Thinks of others</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>97. Thinks too much</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>98. Thinks too little</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>99. Thinks too much</td>
</tr>
<tr>
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<td>1</td>
<td>2</td>
<td>100. Trouble sleeping (describe):</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>101. Trounces, skips school</td>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>102. Underactive, slow moving, or lacks energy</td>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>103. Unhappy, sad, or depressed</td>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>104. Unusually loud</td>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>105. Uses drugs for nonmedical purposes (don't include alcohol or tobacco) (describe):</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>106. Vandalism</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>107. Wets self during the day</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>108. Wets the bed</td>
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<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>109. Whining</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>110. Wishes to be of opposite sex</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>111. Withdrawn, doesn't get involved with others</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>112. Wories</td>
</tr>
</tbody>
</table>
| 0 | 1 | 2 | 113. Please write in any problems your child has that were not listed above:
Appendix G

Goal Attainment Scaling

**Functional Sensory Goal:**
-2
-1
0
+1
+2

Intake score = Exit score =

**Sleep Goal:**
-2
-1
0
+1
+2

Intake score = Exit score =

**Social Goal:**
-2
-1
0
+1
+2

Intake score = Exit score =

Principles in writing goals for goal attainment scaling include:
- Discrete measurements
- Equal distances between measurements
- -2 score is the current performance
- 0 score is the anticipated performance
- Functional meaningful goals scaled into levels of expected outcomes
- Goals chosen by the client and the client's family
Appendix H

Informed Consent and Assent Forms
Consent Form for Participation in the Study Entitled
"A sensory intervention to improve sleep behaviors and social participation of children in Israel with Sensory Modulation Disorders"

Funding source: None

IRB protocol # 03071302Exp

Principal Investigator:
Gilbela Spira, MS' OTR
POB 23953
Jerusalem, Israel 91239
03 (7261832) – Work
03 (7261832) – Fax
spira@nova.edu

Co-Investigator:
Max Ito PhD, OTR-L
Director, PhD Program
Nova Southeastern University
Occupational Therapy Dept
3200 S. University Drive
 Ft. Lauderdale, FL 33328
954-262-1227 – Work
954-262-2290 – Fax
itmax@nova.edu

For questions/concerns about your research rights, contact: Human Research Oversight Board (Institutional Review Board or IRB) Nova Southeastern University (954) 262-5369/Toll Free: 866-499-0750 IRB@nova.edu

Site Information:
Eshagrin Developmental Center
Site Herod St
Modim Elit, Israel

Elia HaDass Center
6 Ben Zeov St
Jerusalem, Israel

What is the study about?
This study will look at the relationship between sleep difficulties in children who have difficulty with sensation. The purpose of this research is to see using touch massage can reduce the difficulties in their sleep behaviors and improve their social participation in order to give this information to occupational therapists, who can then take it into account when planning further programs with other parents and their children.

Why are you asking me?
We are inviting you to participate in this study because you have a child between the ages of 5 and 11 years with sensory complaints. There will be 50 participants in this study.

Initials: __________ Date: __________

Page 1 of 3
What will I and my child be doing if I agree to be in the study?
There will be an intake meeting. At this meeting you will be given a series of questionnaires to fill out. The questionnaires include questions about your child's sensation, sleep behaviors, and social participation. Based on the questionnaires, you will either be excluded from further participation in the study, or accepted into the study. Your child will be randomly assigned to either a non-treatment group where only bedtime stories are read to your child, or into a treatment protocol massage group where you will read a bedtime story to your child as well as massaging him or her. The assignment to the groups is random and you may be assigned to either one of the groups.

The intake meeting will include training where you will be given instruction on filling out a daily sleep log, and about the experimental condition that you will be assigned to—either bedtime stories, or bedtime massage together with bedtime stories. The intake meeting should take no longer than 75 minutes.

You will be asked to keep a sleep diary for five weeks, and to administer your experimental condition for three weeks (week 2 through week 4 during this time). The sleep log is to be filled out daily during the five weeks of the study and will require approximately three minutes per day to fill out. Also, for participants in the bedtime massage protocol, Geela Spira will come to your home sometime in the first week that you begin the massages to ensure that they are being properly administered and are manageable for your child.

You will be asked to fill out all the questionnaires and measures at the end of the study that you filled out at the beginning of the study. Some of the questions are potentially sensitive. They include questions about your child and drug use, sexual problems, and suicidal thoughts or attempts.

There is no audio or video recording being done.

What are the dangers to me or my child?
Loss of confidentiality is a risk. Other risks to your child are minimal, meaning they are not thought to be greater than other risks you experience every day. Your child may not want to participate at some point during the study. You may call Ms. Spira to discuss options or if you are concerned immediately, you may discontinue administering the study protocol. If you have questions about the research, your research rights, or if you experience an injury because of the research, please contact Ms. Spira at 503-3494368. You may also contact the Nova Southeastern University IRB at the numbers indicated above with questions about your research rights.

Are there any benefits to me for taking part in this research study?
There are no direct benefits to you for participating. There is a possibility of alleviating sleep difficulties and of improved social participation as a result of the intervention protocol.

Will I get paid for being in the study? Will it cost me anything?
There are no costs to you or payments made for participating in this study.

Initials: Date: 
How will you keep my information private?
Information will be entered into the computer in a manner that does not identify personal information about you or your child. The questionnaires will be destroyed 36 months after the study ends. All information obtained in this study is strictly confidential unless disclosure is required by law. The Nova Southeastern University Institutional Review Board may review research records.

What if I do not want to participate or I want to leave the study?
You have the right to leave the study at any time or refuse to participate. If you or your child do decide to leave or you decide not to participate, your child will not experience any penalty or loss of services that your child has a right to receive. If you choose to withdraw, any information collected about your child before the date you leave the study will be kept in the research records for 36 months from the conclusion of the study and may be used as a part of the research.

Other considerations:
Up to two follow up phone calls may be made to check information and ask further questions based on information given in the questionnaires and intake materials. Upon request, results of the questionnaires will be provided to you.

If significant new information relating to the study becomes available, which may relate to your willingness to continue to participate, this information will be provided to you by the investigators.

Voluntary Consent by Participant:
By signing below, you indicate that
• This study has been explained to you
• You have read this document or it has been read to you
• Your questions about this research study have been answered
• You have been told that you may ask the researchers any study related questions in the future or contact them in the event of a research-related injury
• You have been told that you may ask Institutional Review Board (IRB) personnel questions about your study rights
• You are entitled to a copy of this form after you have read and signed it
• You voluntarily agree to participate in the study entitled “A sensory intervention to improve sleep behaviors and social participation of children in Israel with Sensory Modulation Disorders”

Child’s name: ___________________________ Date: ______________

Parent/Guardian Signature: ___________________________ Date: ______________

Parent/Guardian Name: ___________________________ Date: ______________

Signature of Person obtaining consent: ___________________________ Date: ______________

Initials: __________ Date: __________
Assent Form - Children/Adolescents ages 7-11 for participation in the study entitled
"A sensory intervention to improve sleep behaviors and social participation of children in Israel with Sensory Modulation Disorders"

IRB Protocol No 03071302Exp

What is a research study?
We're asking you to be in a research study. Research is a way to help us learn
new things. Only people who decide they want to help will be in the study. We'll
tell you about the study and then you should take time to make your decision.
You should talk to your parents before you decide.

Why is this study being done?
This study is to find out if bedtime activities with your parents help your body to
sleep better.

What will happen to me?
Half of the children in the study will have their mother or father read a bedtime
story for a few weeks, and half of the children will have their mother or father
give a bedtime massage and a bedtime story for a few weeks. They will ask
you at the end how it felt and if it helped you sleep better, or if it was easier to
play with your friends in the daytime better.

What are the good things about being in the study?
There are two good things that might happen:
1. You might find it easier to get to sleep, sleep longer, or more comfortably.
2. You might find that you are able to play more, or more happily with your
friends.

Will being in the study hurt me?
If being massaged doesn't feel good to your body, you can ask to stop.

How long will I be in the study?
You will be in the study for five weeks. One of your parents will read you a
bedtime story for twenty minutes. If you are in the experimental group, they
will also give you a massage at the same time.

Do I have other choices?
You can decide not to be in the study and be read bedtime stories and get
massaged in the regular way that you may do now with your parents.

Will people know that I am in the study?
Only Geela Spira and the people at her University will know that you are in the
study, but they won't tell anyone else. If they talk about the study or write
about it, they won't use your name.
Who can I ask questions?
If you have any questions you can ask Geeta Spira at the Etgarim Center or Eitz Hayyim Center. Remember, you should also talk with your parents about this study.

Is it OK if I say “No, I don’t want to be in the study”? You do not have to be a part of this study if you don’t want to. No one will be mad or upset. If you change your mind, you can decide during the study to stop being in the study. If you do stop during the study, we will keep the information that we got while you were in the study.

Do you understand and do you want to be in the study? I understand. All my questions were answered.
   o I want to be in the study.
   o I don’t want to be in the study.

Your name: ____________________________ Date: ______________
Your signature: _________________________ Date: ______________
Signature of Person explaining the study _________________________ Date: ______________

Institutional Review Board
Approval Date: MAY 01 2013
Continuing Review Date: APR 30 2014