Sensory Modulation Disorder: Impact on Coping and Occupational Performance

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Sensory Modulation Disorder: Impact on Coping and Occupational Performance

A dissertation submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy at Virginia Commonwealth University

by

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Abstract

SENSORY MODULATION DISORDER: IMPACT ON COPING AND OCCUPATIONAL PERFORMANCE

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2013

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Occupational therapists theorize that behavioral responses to sensory stimuli are reflective of a child’s underlying ability to process sensory information in a manner that allows the child to engage in childhood occupations meaningfully. If a child’s ability to process sensory information is compromised, then occupational performance is compromised. Similarly if coping skills are less than adequate, successful engagement in occupations is limited. What is less clear is how sensory modulation and coping interact to influence occupational performance. This study examined the interplay between sensory modulation, coping, and occupational performance in a sample of children referred for sensory processing difficulties. Two hundred sixty children, ages 4 – 9 years of age, referred to Occupational Therapy Associates at The Koomar Center in Watertown, MA, for sensory processing concerns were examined for Sensory
Modulation Disorder (SMD), coping abilities, and occupational performance. Results indicate that while sensory modulation is a strong predictor of occupational performance, it only accounts for approximately 20% of the variance in this model. As such, there are additional factors that contribute to occupational performance; these were not identified in the current study. Children with SMD appear to have mild coping deficits, and the interaction between the two, SMD and coping, remains unclear. Additional exploratory analyses revealed significant overlap between subtypes of SMD. Findings from this study laid the foundation for an emerging model reflecting the coping process of children with SMD. Testing the model in future studies will help elucidate these relationships.
Chapter One: Introduction

Imagine the sound of fingernails scraping a chalkboard, a mildly irritating sound to a typical person. To get a sense of how this particular sound may be perceived by a child with sensory processing disorder (SPD), with over-responsiveness to sound, multiply and amplify the fingernails on the chalkboard 100 fold. Now the sound is loud, potentially hurtful to the ears. This is stressful, most likely eliciting a flight, fight, or fright response. While many of us dislike the sound, or even the thought of fingernails on a chalkboard, for a child with over-responsivity to sound the response is exaggerated, and the response may be triggered by other non-noxious sounds in everyday routines.

Now, imagine going through a day wearing shoes on the wrong feet. Typically the wearer would notice right away, or at least in the first couple of steps taken. A child with sensory processing disorder that involves sensory under-responsiveness may go through the whole day and not notice something as obvious as shoes on the wrong feet.

The examples above are very simple illustrations of Sensory Modulation Disorder (SMD), a subtype of SPD. The conceptual framework of SPD is grounded in sensory integration theory developed by A. Jean Ayres, which describes the process of organizing sensory information from the environment and a person’s body (Ayres, 1972; Ayres, 1972/2005; Brown & Nicholson, 2010). Sensory processing disorder is hypothesized to result from the inadequate processing of this sensory information. Three categories of SPD have been proposed: sensory
modulation disorder (SMD), sensory-based motor disorder (SBMD), and sensory discrimination
disorder (SDD). Sensory modulation disorder was the focus of this study.

**Sensory Modulation**

Sensory modulation is a function of the central nervous system: it is the ability to grade
responses to sensory information in order to meet the demands of the body and the environment
(Lane, 2002; Miller, Reisman, McIntosh, & Simon, 2001; Schaaf, et al., 2010; Williamson &
Anzalone, 2001). A modulation disorder exists when a behavior is not consistent with a stimulus
and environmental demand; when there is a mismatch between demand and the subsequent
behavior. Bauman, et al. (2007) defines SMD as “persistent atypical response patterns to neutral,
everyday, ‘non-noxious’ sensory stimuli” (p. 26). When compared to typically developing
children of the same age and developmental skill, a child with SMD may exhibit impairments in
typical daily routines, activities, or occupations due to atypical sensory responsivity.

An atypical response to sensation may be reflected in an inability to detect, regulate,
interpret, and organize responses to sensory stimuli, such that abilities to attend, regulate
emotion, problem-solve, and generate appropriate motor responses may be impaired. Sensory
modulation difficulties may occur in one or more of the sensory systems: tactile, auditory,
olfactory, taste, visual, vestibular, or proprioception (Schaaf, et al., 2010). Response patterns
may vary throughout the day and across contexts or situations depending upon the sensory
stimuli present in a given environment. Over-responsivity, under-responsivity, and sensory
seeking/craving are three patterns of sensory modulation identified (Miller, et al., 2007). Dunn
(1999) identifies these patterns along with sensory avoiding.

Sensory processing disorders have received much attention over the past few years.
Articles in mainstream publications and radio interviews report that parents increasingly seek an
accurate diagnosis for their child with difficulties dealing with ordinary routines (Brand & Speisel, 2009; Carey, 2007; Rubin, 2010; Sinnema, 2010; Wallis, 2007; Weintraub, 2010). Parents report their children as having difficulties with: coordination; sensitivities to sound which impact the ability to attend in a classroom or sleep at night; difficulties with wearing particular clothing items; not wanting to engage in play activities such as finger-painting or playing in a sandbox (Weintraub, 2010). The behaviors children exhibit may lead to evaluations for attention deficit/hyperactivity disorder or even autism. Often these medical diagnoses are unconfirmed and parents feel that these labels do not accurately represent functional problems of their children. Medication may be recommended; and, not wishing to medicate their child, parents seek an alternative explanation and intervention for their child’s behavior. Parents have sought therapy services for problems in everyday activities and identify that they want their children to fit in with their peers, develop coping mechanisms, and achieve greater competence in activities. For themselves parents wish to learn how to support their child, and to have their feelings regarding parenting validated (Cohn, 2001; Cohn, Miller, & Tickle-Degnen, 2000).

**Mechanisms of sensory modulation.** As modulation is a function of the central nervous system, physiological mechanisms can be examined to gain a deeper understanding of a child’s responses to sensory stimuli. Several studies have focused on understanding these mechanisms. A child’s physiological responses to sensory stimuli can be measured using electrodermal response (EDR), changes in skin conductance which occur in the presence of threatening stimuli (Mangeot et al., 2001; McIntosh, Miller, Shyu, & Hagerman, 1999b, Miller & Summers, 2001). EDR reflects activity of the sympathetic nervous system; and as such, this work has its roots in a desire to understand the flight, fight, or fright responses of children with over-responsiveness to sensory stimuli (Lane, Reynolds, & Thacker, 2011). McIntosh, et al. (1999b) found that children
with SMD showed physiological differences in response to sensory stimuli relative to children without SMD. A few children with SMD in the sample showed no EDR to sensory stimuli while the remainder of the sample with SMD showed increased frequency and magnitude of EDR. Parents of this later group of children reported higher frequencies of behaviors that interfered with daily routines, suggesting a strong link between underlying physiology and its manifestation in behavior.

Working alongside the sympathetic nervous system is the parasympathetic nervous system, which has also been examined as a physiologic measure of response to sensory stimuli. Parasympathetic nervous system activity, as measured by cardiac vagal tone, was found to be decreased in children with SMD as compared to a sample of typically developing children (Schaaf, Miller, Seawall, & O’Keefe, 2003). Decreased or disorganized parasympathetic activity can be a predictor of stress and vulnerability, as a state of equilibrium is not achieved and the individual is at risk for being unable to develop adequate coping strategies (Schaaf, Miller, Seawall, & O’Keefe, 2003).

**Sensory Processing Disorder and Occupational Performance**

Much of the research focused on SPD has sought to identify behavior responses and patterns, while fewer studies have examined the impact of SPD on occupational performance. Occupational therapists theorize that behavioral responses to sensory stimuli are reflective of a child’s underlying ability to process sensory information in a manner that allows the child to engage in childhood occupations in a meaningful manner (White, Mulligan, Merrill, & Wright, 2007). If a child’s ability to process sensory information is compromised, then occupational performance is compromised. White, et al. (2007) stress the importance of assessing occupational performance in a child who has possible atypical sensory processing.
Sensory processing differences have been associated with autism spectrum disorders, Fragile X Syndrome, and attention deficit hyperactivity disorder (ADHD) (Schaaf et al., 2010b). Differences in occupational performance have been examined in children with these diagnoses. Study results suggest that sensory processing differences impact occupational performance. Children with autism spectrum disorders have been shown to have more feeding difficulties than typically developing children (Provost, Crowe, Osbourn, McClain, & Skipper, 2010; Schreck, Williams, & Smith, 2004), and a higher frequency of sleep problems (Allik, Larsson, & Smedje, 2006; Honomichl, Goodlin-Jones, Burnham, Gaylor, & Anders, 2002; Shocat, Tzischinsky, & Engel-Yeger, 2009). They have also been shown to participate less in social and recreation activities (Solish, Perry, & Minnes, 2010), and showed less diversity and spent less time in functional play (Williams, Reddy, & Costall, 2001). Baranek, et al. (2002) reported lower levels of participation and performance in school and self-care activities in a sample of boys with Fragile X Syndrome and SPD.

Examining the impact of sensory processing deficits on occupational performance in children without medical diagnoses, such as those mentioned above, White, et al. (2007) suggested that children with sensory processing difficulties demonstrate difficulties in the areas of self-care and instrumental activities of daily living. Examination of children with sensory modulation disorder, a subtype of SPD, revealed that the degree of impairment from the disorder influenced a child’s participation in academics, play, and leisure activities (Bar-Shalita, Vatine, & Parush, 2008). Increased severity led to poorer functional performance in daily activities.

Improvements in occupational performance have been reported following occupational therapy intervention for SPD. After receiving occupational therapy treatment for sensory modulation disorder, parents perceived improvement in their child’s abilities, which enhanced
participation in organization, play, and personal care activities (Cohn, 2001). A case report by Schaar and Nightlinger (2007), recorded improvements in sensory processing skills leading to improved motor skills for participation in age-appropriate play, self-care, social, fine, and visual-motor activities.

**Stress and Coping**

Stress is an integral part of life. Stress is a reaction to a stressor, an actual internal or external event. Stressors may be perceived as harmful, threatening or challenging and are experienced cognitively, emotionally, and physically (Zeitlin & Williamson, 1994). Throughout daily activities, there is an optimal level of stress necessary for motivation, mastery, and learning (Zeitlin & Williamson, 1994). Stress arises from a perceived lack of resources to manage a problem, and coping strategies and coping resources develop from stress responses (Aldwin & Werner, 2007). It is the initial perception of the stressor that impacts the process of coping (Zeitlin & Williamson, 1994).

Coping is the process of managing stress and meeting personal demands and demands of the environment (Lazarus & Folkman, 1984; Williamson & Szczepanski, 1999; Zeitlin & Williamson, 1994). Coping strategies include cognitive processes and behaviors to manage problems and negative emotions (Lazarus & Folkman, 1984). Once adequate coping resources are developed, the problem or challenge can be tackled and addressed. Once this happens, the stressor is removed (Aldwin & Werner, 2007). Prolonged exposure to stress can lead to emotions such as depression and anxiety, as well as physiological symptoms, such as a compromised immune system. Successful coping is flexible, allowing for adaptation in order for children to manage daily activities, skill development, and development of self-esteem (Aldwin & Werner, 2007; Zeitlin & Williamson, 1994). Developmentally appropriate levels of stress
facilitate growth and maturation because they support the development and use of coping strategies; likewise, increased or decreased levels of stress interfere with the growth process (Lengua & Long, 2002; Zeitlin, 1981).

**Sensory Modulation Disorder, Stress, and Coping**

Examination of sensory integration and coping theories revealed many overlapping constructs, yet the interactions between stress, coping and sensory modulation difficulties have not been well studied. When individuals are faced with the stressors of everyday sensory challenges, a coping response is elicited. For typically developing children the challenge is successfully met using available coping strategies, and the stress response is turned off. This may not be the case for children with SMD. It is hypothesized that children with limited sensory modulation abilities negatively impact the coping resources to overcome everyday sensory challenges. Sensory integration theory identifies this resource deficit as the inability to organize incoming sensory experiences for use. Both sensory integration and coping theories recognize that sensory challenges must be overcome for participation and maturation. Used in conjunction with each other, they provide a foundation for a deeper understanding of the impact of sensory modulation disorder on occupational performance.

**Purpose Statement and Research Questions**

The proposed study examined the interplay between SMD, coping, and occupational performance, in a sample of children referred for sensory processing difficulties.

The following research questions were proposed for study:

Question 1: What is the relationship between coping and sensory modulation?

Question 2: What is the relationship between sensory modulation and occupational performance?
Question 3: What aspects of coping predict occupational performance in children with SMD?

Question 4: Does sensory modulation have moderating or mediating effects on the relationship of coping and occupational performance?

**Delimitations**

The proposed study sought to answer the above research questions through examination of an existing database owned and managed by The Spiral Foundation at Occupational Therapy Associates – Watertown (OTA Watertown) in Watertown, Massachusetts. The database was created for research purposes and has been used in several research projects (Ham, 2003; May-Benson, Koomar, & Teasdale, 2009). Created in 2001, data collection is ongoing with approximately 40 cases being added each year. Data from 2001 to 2010 was used in this study.

**Significance**

Within the field of occupational therapy this is a particularly important time as a scientific work group has been conducting research to garner evidence for the inclusion of SPD in the revised *Diagnostic and Statistical Manual of Mental Disorders (DSM)*, the *DSM-V* (Ahn & Miller, 2010; SPDF, 2007). The *DSM-V* is expected to be published in May 2013 (APA, 2010). Currently, SPD is on the list of conditions under consideration for inclusion in the revision, and was open for comment until June 2011 (APA DSM-5 Development, 2010; SPDF, 2010). Clinical descriptions contained in the *DSM* lead to greater opportunities for epidemiological research, replicable research, and outcomes of care (Miller, 2008). Results of this study have added to the body of knowledge of SPD by increasing the clinical description of SMD and identifying functional implications of the disorder.
In the context of everyday routines, there is evidence that SMD compromises a child’s ability to cope with personal and external demands (Bar-Shalita, et al., 2008; Lane, 2002; White, et al., 2007; Schaaf & Nightlinger, 2007). The links between SMD, coping, and occupational performance have not been established. This proposal examined the links between these variables. Examining occupational performance from the perspective of both sensory processing and coping may provide greater insights into assessment and intervention.
Chapter 2: Review of the Literature

Life is made enjoyable and meaningful by the variety of occupations in which people engage. For adults, daily routines of bathing and dressing for work provide meaning in that these routines are in preparation to meet daily challenges. Occupations of children are comprised of routines and activities in play, personal care, education, and socialization (Primeau & Ferguson, 1999). Occupational performance is successful engagement in selected occupations, which involves interaction between the individual, context, environment and activity (AOTA, 2008; Primeau & Ferguson, 1999). Sensory experiences are an integral part of everyday routines and activities (Dunn, 2007). For a child with difficulty processing sensation, the ability to engage in typical childhood occupations is at risk and impacted by the manner in which a child copes with sensory stimuli. Little is known about the relationship of Sensory Modulation Disorder, a subtype of SPD, and occupational performance or coping. This study sought to examine this relationship.

The investigation was grounded in the theoretical foundations of sensory integration theory and frame of reference coupled with coping theory. Based on sensory integration theory, the sensory integration frame of reference offered a comprehensive foundation upon which this study is based as it provides function-dysfunction continua, an outline for evaluation, assumptions regarding change, and application to intervention, (Hinojosa, Kramer, & Luebben, 2010). Theoretical constructs from coping theory have been woven into the structure provided
by the sensory integration foundation to examine coping abilities of children with sensory modulation disorder (SMD), as well as the impact on occupational performance.

**Sensory Integration Theory**

**Sensory integration.** Developed by Ayres (1972; 1972/2005), sensory integration (SI) is most simply defined as “the organization of sensations for use” (1972/2005, p. 5). Sensory integration is an unconscious process of the brain that organizes sensory information, gives meaning to the information, and allows an individual to act or respond in a purposeful manner (Ayres 1972; 1972/2005). Individuals are constantly bombarded at all times by sensory stimuli from a variety of sources: lights, sounds, tactile sensations, body movement, and feedback from orientation in space. In order to produce a purposeful, functional response to an environmental demand, information relevant to the demand must be filtered from miscellaneous information. This ability to organize sensations for use is what Ayres proposed as the foundation for learning and social behavior.

Ayres postulated that in the sensory integrative process the nervous system acts as the organizer that locates, sorts, and orders sensations received from outside and inside the body (Ayres, 1972/2005). Sensations are used by the brain to form perceptions, and then lay the foundation for behavior and learning. Learning and behavior involve the entire nervous system and evolves throughout development. For instance, early in life an infant learns and gains information through sensorimotor exploration and play. The interaction of the motor and sensory systems gives meaning to sensations and purpose to movement. As a child grows sensorimotor experiences are enhanced by cognitive and social responses, and meanings attached to sensations help to form cognitive and abstract thoughts. It is this process of normal sensory
integration which allows for meaningful and purposeful participation in a variety of daily occupations throughout life (Roley, Blanche, & Schaaf, 2001).

Ayres (1972; 1972/2005) hypothesized that given appropriate challenges the nervous system would experience neuronal growth through the production of an adaptive response. Ayres (1972/2005) defined an adaptive response as “a purposeful, goal-directed response to a sensory experience” (p. 7). Production of adaptive responses assists the brain to develop and organize itself. Roley, et al. (2001) describes adaptive responses as being both an indicator and promoter of sensory integration: an indicator of the accuracy of the interpretation of the sensory event and a promoter of sending organized sensory information to the brain. Adaptive responses serve to further organize and integrate the nervous system. In novel situations, a child will draw from previous experiences to organize behavior and respond to the current demands (Schaaf, et al, 2010b). When a child is responding in an adaptive manner, we hypothesize that the brain is organizing sensory experiences in an efficient manner. Successful adaptive responses give the child increased skill, motivation, and confidence to accept future challenges of increasing complexity (Ayres 1972/2005; Schaaf, et al., 2010). Most simply, when a challenge is mastered, something new is learned (Ayres 1972/2005).

Ayres’ conceptualization of sensory integration reflects the processing and integration of sensations for use in identifying, organizing, and implementing an adaptive response. However, it is important to note that sensory integration theory is dynamic, and has continued to evolve since Ayres’ time. Concepts from neuroscience, temperament, and development provide a backdrop for the work of Ayres. Advances in neuroscience have led to increased understanding of nervous system function and much more is known about the ability of the nervous system to process sensory information (Schaaf, et al., 2010). As knowledge increases some theorists have
broadened the concept of ‘sensory integration’ to ‘sensory integration and processing’. Here sensory processing is broadly defined as “the reception, modulation, integration, and organization of sensory stimuli, including the behavioral responses of sensory input” (Miller & Lane, 2000, p. 2), with sensory integration a component of sensory processing. (Miller & Lane, 2000). In the current study the term ‘sensory integration and processing’ are used to reference this broader theoretical perspective.

**Models of Sensory Integration and Processing**

Ayres likened difficulties of the brain in processing sensory information to a traffic jam (Ayres, 1972/2005). Sensory information may get caught in a “traffic jam” which results in certain parts of the brain not being able to perform adequately. When the brain is not processing sensory information effectively, behavior is not being directed effectively and learning is hampered. As seen in Figure 1, Ayres hypothesized that the processing and integration of sensory information were integral to what she termed ‘end products’. Based on this model, it can be seen how sensory integration and processing deficits may impact a child’s ability to regulate level of arousal, sustain attention to task, manage emotions, execute a motor response, and react in a manner that is consistent with the demands of a given context, which in turn, potentially impacts adaptive responses (Bundy & Murray, 2002; Schaaf et al., 2010). Participation in daily life age appropriate routines and activities may be impaired (Ayres, 1972/2005; Parham & Mailloux, 2004).

Drawing from the work of Ayres, Bundy, Lane & Murray (Figure 2; 2002), illustrate the main categories of sensory integrative dysfunction that Ayres (1972) had described: modulation and practic dysfunction. Much of Ayres work focused on the latter (Bundy & Murray, 2002).
Figure 1. Diagram depicting how sensory information is integrated to form functions that a child needs to be successful. Sample items from the Sensory Integration and the Child copyright © 2005 by Western Psychological Services. Reprinted by A. Kane, Virginia Commonwealth University, for scholarly display purposes by permission of the publisher, WPS, 12031 Wilshire Boulevard, Los Angeles, California 90025, USA. Not to be reprinted in whole or in part for any additional purpose without the expressed, written permission of the publisher (rights@wpspublish.com). All rights reserved.
In this model sensorimotor sequelae are linked to sites of central nervous system dysfunction.

Sensory modulation arises as distinct from other disorders of sensory integration and processing.

**Sensory Modulation**

Sensory modulation is the ability to grade responses to sensory information in order to meet the demands of the body and the environment (Lane, 2002; Miller, Reisman, McIntosh, & Simon, 2001; Schaaf, et al., 2010; Williamson & Anzalone, 2001). Modulation can be examined
at both a behavioral and a physiologic level (Lane, 2002; Miller et al., 2001). From a behavioral perspective as a child grows and develops and the nervous system matures, the ability to modulate behavior matures and is individualized. Social relationships, culture, and environment play a role in this process of individualization (Ayres, 1972; Lane, 2002; Miller et al., 2001). A child develops his or her own repertoire of skills for coping with sensory stimuli.

Models of Sensory Modulation Dysfunction

Ayres identified poor modulation and poor praxis, as ways in which sensory integration dysfunction is manifested, either individually or combined. Ayres was the first to apply the term modulation to sensory integration, laying the foundation for those who continued her work. In her early work, Ayres (1972) described modulation as the interrelationship of facilitatory or excitatory and inhibitory processes. The brain facilitates the flow of information when a sensory challenge is perceived (Ayres, 1972; 1974). Some responses are inhibited, or the flow of some sensory information may be limited or hindered. Modulation occurs when the two processes work in harmony, assisting a child in handling a sensory challenge (Ayres, 1974). When the facilitatory system dominates this relationship, resulting behaviors include hyperactivity and distractibility. Ayres (1974) further described a continued imbalance between the two processes as “aggravating its own condition” (p. 91), producing anxiety. Anxiety is not only a result of dominance of facilitatory processes, but is also described as a causative factor. This concept of anxiety as a cause and result of the modulation is a theme that will emerge later in the discussion of the subtypes of SMD, particularly in the work of Miller et al. (2007).

The work of Miller et al. (2007) and Dunn (1997; 2007) are outgrowths of Ayres’ work and models of sensory modulation that are currently in use in the field of occupational therapy. The models are similar in that they suggest that observable behaviors are linked to sensory
integration and processing dysfunction and that these observable behaviors are disruptive to occupational performance.

**Dunn’s model of sensory modulation.** Based on the work of Ayres, Dunn (1997; 2007) developed a model of sensory modulation as a means of explaining the relationship between observable behaviors and their potential relationship to the central nervous system. Dunn identified four patterns of sensory modulation disorder. The patterns as seen in Figure 3, are Low Registration, Sensation Seeking, Sensory Sensitivity, and Sensation Avoiding.

*Figure 3* Dunn’s Model of Sensory Processing

<table>
<thead>
<tr>
<th>Thresholds/Reactivity</th>
<th>Responding/Self-Regulation Strategies</th>
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</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td>Passive</td>
</tr>
<tr>
<td></td>
<td>Low Registration</td>
</tr>
<tr>
<td></td>
<td>Active</td>
</tr>
<tr>
<td></td>
<td>Sensory Seeking</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>Sensory Sensitivity</td>
</tr>
<tr>
<td></td>
<td>Sensory Avoiding</td>
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</table>


The border on the left side is reflective of nervous system function and the border on the top is reflective of range of behavior. Nervous system function is represented by neurological thresholds, a continuum of responses ranging from “high” at one end, indicating that much sensory input is required for activation, and “low” at the opposite end, indicating that very little stimuli is required for activation of sensory processing (Dunn, 1999). From a behavioral
perspective, individuals with low thresholds notice and respond to sensory stimuli more readily than typical, as it takes little to activate the central nervous system. In contrast, an individual with a high threshold may not notice the same stimuli, since a stronger stimulus is needed to reach threshold (Dunn, 2007). The behavioral continuum on the top of the figure represents the self-regulation strategies employed by the individual (Dunn, 2007). At one end of the continuum individuals act in accordance with their neurological thresholds using passive behavioral strategies, at the other end are individuals attempting to compensate for their neurological threshold, using active strategies (Dunn, 2007; Schaaf, et al., 2010b). Dunn (2007) uses the example of a child playing in a noisy play area to illustrate this pattern. Depending upon the individual neurological threshold, a child using passive strategies may continue to remain in the play area, despite being irritated by the noise and other stimuli present in the situation; another child using this same passive strategy may appear uninterested or unmotivated by the activity. A child using active strategies attempts to control the amount of sensory stimuli, either by avoiding the play situation or engaging further in order to increase the amount of stimuli. Dunn (2007) points out that individuals typically have more than one pattern of sensory modulation across the different sensory systems. For example, a child may be sensitive to auditory stimuli, but seek out experiences that provide an intense amount of proprioceptive input.

Support for Dunn’s model (1997, 2007) comes from a series of studies used in the development of the Sensory Profile (Dunn, 1999) and the Short Sensory Profile (SSP; McIntosh, et al., 1999). The SSP (McIntosh, et al., 1999), developed from the Sensory Profile, is intended to measure sensory modulation abilities (McIntosh, et al., 1999). Both measures are caregiver questionnaires. Based on sensory integrative and neuroscience frames of reference, the Sensory Profile (Dunn, 1999) and SSP (McIntosh, et al., 1999) assess sensory integration and processing
abilities and their effect on childhood occupations (Dunn, 1999). The interaction of neurological thresholds and behavioral responses describe how a child processes sensory information. Thirty-eight items from the 125 item Sensory Profile (Dunn, 1999) were retained for the Short Sensory Profile (McIntosh, et al., 1999a). These 38 items were found to be most reflective of sensory modulation. Not included in the SSP (McIntosh, et al., 1999a) were items related to fine motor development and social/emotional skills, as these are products of sensory modulation rather than direct responses to sensory stimuli (McIntosh, et al., 1999a). Children with and without disabilities were included in the factor analysis portion of test development of the Sensory Profile. Studies supporting the validity of Dunn’s model (1997, 2007) indicated that test items cluster not on sensory systems, but rather by the individual’s responsiveness to sensory stimuli (Dunn, 2001).

**Miller et al.’s. (2007) model of sensory integration and processing.** Miller et al.’s (2007) model, while inclusive of all aspects of SPD, most clearly delineated SMD. The model seeks to increase specificity for the diagnosis of SMD, to allow for empirical research and enhance intervention for diagnostic subtypes. Figure 4 depicts the proposed classification scheme. Miller et al. (2007) identify three categories of SPD; Sensory Modulation Disorder (SMD), Sensory-Based Motor Disorder (SBMD), and Sensory Discrimination Disorder (SDD). Sensory Modulation Disorder was the category of SPD of interest to this study, and the three subtypes are described following Dunn’s model of sensory processing.

**Disorders of Sensory Modulation**

A range of responses to sensation are described in the models by both Dunn (1999) and Miller et al. (2007). Ayres (1972) also alluded to ranges of responses, most clearly defining tactile sensitivity. Tactile defensiveness would be included in the sensory sensitive and sensory


Table 1

Comparison of Dunn’s (1999) and Miller et al.’s. (2007) terminology

<table>
<thead>
<tr>
<th>Dunn’s (1999) patterns of sensory modulation</th>
<th>Miller et al’s. (2007) patterns of sensory modulation</th>
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<tr>
<td>Sensory sensitive</td>
<td>Sensory over-responsive (SOR)</td>
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<tr>
<td>Sensory avoiding</td>
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<tr>
<td>Poor registration</td>
<td>Sensory under-responsive (SUR)</td>
</tr>
<tr>
<td>Sensory seeking</td>
<td>Sensory seeking (SS)</td>
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Sensory over-responsivity (SOR). Sensory over-responsivity (SOR) is the subtype of SMD that has received the most attention in recent research, as it may be the most easily identifiable. Children with SOR respond to sensory information quicker and with more intensity than children with typical sensory processing (Hanft et al, 2000; Miller et al., 2007). Responses to sensory information may also occur for a longer duration. Over-responsivity may occur in one sensory system or in multiple systems, and may prevent children from successful participation in routine activities. Observable behaviors with SOR may appear as active, negative, aggressive, impulsive, withdrawing or avoidant. Emotional responses include irritability or moodiness, inability to be consoled and poor ability to socialize. Children with SOR may appear rigid and controlling. The sympathetic nervous system fight, flight, fright or freeze responses are believed to be activated and a child may be actively working to avoid sensory information that is a trigger. It may be difficult to determine a particular trigger as sensory input has a cumulative effect. A response to a seemingly trivial event may actually be a response to sensory experiences over a period of time (Miller, et al., 2007).

Children with SOR have been found to have higher frequencies of social-emotional problems and lower levels of social competence as compared to those children without elevated scores. The SensOR (Schoen, et al., 2008b) is an instrument in which caregivers rate sensory responses of a child (Ben-Sasson, Carter, & Briggs-McGowan, 2009; Reynolds, Lane, & Gennings, 2010). The SensOR is intended to identify individuals with over-responsivity to sensory stimuli. Using the SensOr in a longitudinal study, Ben-Sasson, et al. (2009) collected data on a random sample of typically developing, school-aged children, at three points in time, twice in early childhood when the children were between 11 and 56 months of age, and then again when the children were in second to third grade. The third data collection point utilized
the tactile and auditory scales of the SensOR, focusing on these scales because these sensitivities are the most common disruptions in the sensory systems. Findings indicated that 16.5% of the sample at elementary school-age showed elevated scores on the SensOR as indicated by being bothered by four or more sensations. Tactile sensations were the most bothersome. Children with elevated SOR scores showed early social-emotional problems at both the early childhood points, and were more likely to have lower scores on a measure of adaptive social behavior, indicating lower levels of social competence. This study did not include children with developmental disabilities, so the prevalence of SOR may be higher than 16.5% in a sample that includes children with developmental disabilities (Ben-Sasson, et al., 2009). Risk factors for SOR included lower socio-economic status, shorter gestation but still full-term, and lower birth weight. Findings from this study are interesting and raise questions related to causation. While SES was found to be a risk factor, it is not clear if there is simply more disorganization in a lower income household that would challenge a child predisposed to SOR. Similarly with regard to social-emotional functioning, it is not clear whether SOR impacts the emergence of social-emotional skills or if social-emotional problems impact a child’s ability to cope with over-responsivity.

The relationship between SOR and anxiety in children with autism spectrum disorders was explored by Green & Ben-Sasson (2010). The authors explored the hypotheses that SOR is caused by anxiety, or vice versa, as well as the possibility that the two are associated with a common risk factor or there is diagnostic overlap. From a review of the literature the authors pointed out that SOR may be the result of heightened vigilance and difficulty in regulating responses to aversive stimuli (Green & Ben-Sasson, 2010). Firstly, conditioning and avoidance the association of sensory over-responsiveness to particular stimuli is strengthened. In
contrast SOR may contribute to anxiety as particular negative sensory experiences elicit conditioned responses of anxiety. The anxiety response could be triggered by an object alone, or location or context in which a negative sensory experience occurred (Green & Ben-Sasson, 2010). Increased heart rate and skin conductance response are both physiological indicators of SOR and anxiety. Also both SOR and anxiety involve the misperception of a threat, which point to what may be a diagnostic overlap between SOR and anxiety (Green & Ben-Sasson, 2010). Regardless of the relationship between SOR and anxiety, occupational therapists seek to determine what sensory experiences in everyday activities may be negatively impacting a child’s ability to participate successfully in childhood occupations.

Sensory over-responsivity was found to be strongly linked to anxiety in a recent study from Lane, Reynolds, & Thacker (2011). Findings indicated that the magnitude of a child’s response to a sensory challenge not only impacts the initial state of arousal and attention prior to a challenge, but also impacts the ability of the nervous system to recover from the challenge and impacts anxiety. This lends support to Green & Ben-Sasson’s (2010) hypothesis that SOR causes anxiety. Sensory experiences elicit conditioned responses of anxiety, contributing to a state of hypervigilance evidenced in the findings of Lane, et al, (in press). From this discussion it can be seen that children with SOR tend to have behavioral responses to sensory challenges and demonstrate differences in baseline states of arousal and attention. This may prompt caregivers to seek solutions to children’s behavior as it impacts occupational performance. As will be seen other subtypes of SMD may not have the same behavioral presentation.

**Sensory under-responsivity (SUR).** In contrast to SOR, sensory under-responsivity is not as clearly understood and has been less well studied. Children with SUR are slow to respond or may not notice sensory stimuli in their environments (Dunn, 1999; Hanft et al, 2000; Miller et
al., 2007). Children may appear as inattentive, self-absorbed, lethargic, apathetic, and unmotivated as they do not register possibilities for action. Given typical sensory intensity in context, it is theorized that sensory processing and integration in children with SUR are inadequate to generate a response. High intensity or increased duration of sensory input is required for these children to become involved in a task or interaction. In a clinical sample of children with SMD, sensory-under-responsivity emerged as one of two distinct clusters based on behaviors of attention, sensation, and emotion (James, Miller, Schaaf, Nielsen, & Schoen, in press). These children showed difficulties with movement sensitivity, were more withdrawn, and demonstrated low energy/weakness.

Sensory under-responsivity is more difficult to recognize and may go unnoticed longer (Miller, et al., 2007; Schaaf, et al., 2010b). In early childhood a child with SUR may be described as a “good baby”. Children with SUR may not have difficulty at home, but may exhibit difficulty in the school setting when new and more complex task demands are required. Children with SUR appear as passive and behavior is considered “good”, although they are missing salient features of a lesson or task.

**Sensory Seeking craving (SS).** Children with SS seek an extreme amount of sensory input (Miller, et al., 2007). These children are very active, continuously engaged with their environments, and often have invasive, unsafe, and impulsive behaviors that impact social interactions. Children with SS may be described as attention-seeking, demanding, and as trouble-makers; they appear to crave sensory input and are active in getting this need met, a response to SUR. Sensory seeking behavior may also occur as compensation for SOR, children may seek sensory input in one sensory domain (i.e. proprioception) to compensate for SOR in another sensory domain (i.e. auditory) (Miller, et al., 2007). Sensory seeking behaviors disrupt
a child’s attention to a task at hand so that occupations such as learning, play, and activities of daily living are compromised.

**Physiological Measures of Sensory Modulation**

It is inferred that behavior is the observable entity of neurophysiological responses to sensation driven by the autonomic nervous system (Lane, 2002; Miller et al., 2001). The autonomic nervous system is comprised of sympathetic and parasympathetic nervous systems, which the majority of the time are acting in a complementary manner to maintain physiological homeostasis (Porges, 1995). The sympathetic nervous system mobilizes the body for quick responses in the face of external challenges, thought of as “fight or flight” responses. In contrast, the parasympathetic nervous system works to conserve energy and maximize the function of vital organs, focusing on ‘rest and digest’.

In an effort to better understand the underlying physiologic responses to sensation, investigators have begun to examine sympathetic nervous system activity using electrodermal activity, the hypothalamic-pituitary-adrenal response to stress using cortisol, and electroencephalography (EEG) (Davies & Gavin, 2007; Lane, Reynolds, & Thacker, 2010; Mangeot et al., 2001; McIntosh, Miller, Shyu, & Hagerman, 1999b; Reynolds, et al., 2010).

Cardiac vagal tone index has been used as a measure of parasympathetic nervous system activity (Schaaf, et al., 2010a; Schaaf, Miller, Seawell, & O’Keefe, 2003). Current work has capitalized on the Sensory Challenge Protocol (SCP) developed as a consistent manner to introduce sensory challenges (Miller et al., 2001). A full description is contained in Appendix A.

Electrodermal responses (EDR) are a measure of changes in skin conductance that occur in response to stress (McIntosh, et al., 1999b). In early work to characterize SMD, McIntosh and colleagues (1999b) collected EDR on a matched sample of typical children and children with
cantly identified SMD. Investigators identified both over- and under-responsivity in the sample with SMD (McIntosh, et al., 1999b). When EDR patterns in children with SMD were examined relative to behavioral measures children with both over- and under-responsivity were found to have scores outside the typical range on a test version of the Short Sensory Profile (SSP). Similarly, Mangeot, et al. (2001) found linkages between behavioral and physiological responses in children with ADHD; increased reactivity and increased magnitude of EDR after presentation of the SCP were identified in children with ADHD, 77% of whom scored at least 1SD below the mean on the SSP. Lane, et al. (2010) also reported findings of high baseline arousal levels during recovery from the SCP, reflected in higher recovery electrodermal activity, in a group of children with ADHD and identified sensory over-responsivity. Together these findings suggest that children with SMD have different physiological responses to sensory stimuli than children without SMD.

Cortisol is known to be released in response to stress, so it stands to reason that increased cortisol levels would be present in response to challenging or startling sensory events. Lane and colleagues (2010) and Reynolds and colleagues (2010) examined this possibility, finding a trend toward elevated cortisol levels following presentation of sensory stimuli in accordance with the SCP in children with ADHD and sensory over-responsivity; children with sensory over-responsivity and no other diagnosis also showed a trend toward higher cortisol levels. The authors pointed out that using measures of electrodermal activity, as discussed in the previous paragraphs, may be a better measure of stress responses to sensory stimuli, as EDR are quick responses, while cortisol may be more useful as an indicator of a chronic response to stress.

In contrast to peripheral measures of sensory processing, Davies and Gavin (2007) proposed that a more accurate assessment of sensory processing by the brain can be obtained
utilizing electroencephalography (EEG) and event-related potentials (ERPs), direct measures of electrical activity in the cortical regions of the brain. These investigators have used two auditory paradigms: sensory gating, which investigates the brain’s ability to filter auditory information; and sensory registration, which provides information on the ability of the brain to organize sensory information. Children with SMD, identified using the Sensory Profile (Dunn, 1999) and clinical observations, were compared with typically developing children. With both paradigms, differences, approaching significance, were noted between the groups (Davies & Gavin, 2007). Children with SMD showed less sensory gating ability as noted on ERP waveforms, indicating that the brain is not prepared for further incoming auditory stimuli beyond an initial, conditioning stimulus. Differences between the conditioning stimulus and test stimuli showed that children with SMD responded in a more variable manner, some over-responsive and some under-responsive. Children with SMD also showed sensitivity to changes in intensity and frequency of stimuli. The sample of children used in this study ranged from five to 12 years of age. When the authors investigated sensory gating ability and age, a significant difference was found between the two groups. Typically developing children showed improved sensory gating ability with age, children with SMD did not.

Continuing on with their examination of sensory gating, Davies, Chang & Gavin (2008) examined the maturational process of sensory gating, comparing gating abilities of a group of adults, ages 20-55 years, typically developing children, five to ten years of age, and a group of children with SPD, five to 12 years of age. Children with SPD demonstrated significantly less gating abilities than either of the other two groups (Davies, et al, 2008). Typically developing children showed less gating ability than the adult group, leading the authors to conclude that sensory gating improved as the child matured. Consistent with the findings of the previous
study, typically developing children showed improved gating abilities with age, whereas gating abilities were not improved in children with SPD as related to age. For children with SPD, gating abilities, or the ability to filter irrelevant sensory stimuli, did not appear to mature along the same trajectory as that of typically developing children. Just one sensory modality, auditory, was used in the studies of Davies & Gavin (2007) and Davies, et al, (2008). If children with SMD experience a minimal amount of disorganization with just one modality, as demonstrated in these two studies, it would stand to reason that the variety of sensory modalities in the context of everyday life would be highly disorganizing for a child with SMD.

Combined processing of auditory and somatosensory input was examined initially in a group of typically developing children and then in a group of children with SOR. For two studies, auditory stimuli consisted of click sounds in both ears, somatosensory stimuli was delivered via electrical pulses from a bar electrode placed above the right wrist, and both modalities were delivered simultaneously to examine multisensory integration (MSI: Brett-Green, Miller, Gavin, & Davies, 2008; Brett-Green, Miller, Schoen, & Nielsen, 2010). Event related potentials were recorded at 32 electrode sites on the scalp while children watched a silent cartoon. Responses to unisensory auditory and somatosensory input were summed and compared to the simultaneous delivery of auditory and somatosensory stimulation (Brett-Green, et al, 2008; Brett-Green et al, 2010). Four time windows: 60-80 milliseconds, 80-110 ms, 110-150 ms, and 180-220 ms, were examined. For typically developing male children ages six to thirteen years of age, significant MSI was seen in the central/posterior-central scalp regions of the hemisphere opposite the side of somatosensory stimulation in the 60-80 ms time frame and in the ipsilateral hemisphere at 110-150 ms (Brett-Green, et al, 2008). At the 180-220 ms time window, significant multisensory integration was seen in both hemispheres and midline scalp
regions. The authors concluded that processing of multisensory stimuli was different as compared to unisensory stimulation (Brett-Green, et al, 2008)

When examined in a group of male children with SOR, multisensory integration was found to be significant at the earliest and latest time windows at midline and in the hemisphere opposite stimulation (Brett-Green, et al, 2010). No significant integration was seen at the ipsilateral electrode sites, as was in the previous study with typical children. The authors concluded that multisensory processing can be reliably measured in children with SOR and that processing of multisensory information occurred both early and later in the course of processing of sensory information (Brett-Green, et al, 2010). This study of multisensory processing in children with SOR was not a comparison study to Brett-Green, et al’s, (2008) previous study, but rather an exploration of multisensory processing in children with SOR; however, it should be noted that just a simple examination of the results indicate that there could be differences in MSI in children with SOR and typically developing children.

Parasympathetic activity has also been used to investigate sensory processing abilities (Schaaf et al., 2003, Schaaf et al., 2010a). Cardiac vagal tone index (Porges, 1995), a measurement of heart rate oscillations in relation to respiration has been used as an estimate of parasympathetic activity. When challenged with sensory stimuli using the SCP, children with SMD showed significantly lower cardiac vagal tone than typically developing children in the sample. A more recent study elaborating on cardiac vagal tone as an indicator of parasympathetic nervous system activity found that baseline vagal tone was lower in a group of children with SMD as compared to typical children (Schaaf et al., 2010). In addition, children in the SMD group were noted to have increased vagal tone in response to sensory stimuli as compared to typical children who showed minimal changes in vagal tone in response to stimuli.
Using scores on the SSP (McIntosh et al., 1999), the SMD group was further stratified into three groups based on severity of symptoms. The subgroup with the severest symptoms was found to have lower cardiac vagal tone at baseline and decreased adaptive behavior, indicative of lower parasympathetic nervous system regulation. Results of this study indicate that children with SMD are less able to return their systems to homeostasis and may in fact be hypervigilant, not dissimilar to Green & Ben-Sasson’s (2010) proposition that a relationship may exist between SOR and anxiety.

Children with SMD were found to have lower baseline vagal tone, an indicator of resting level of parasympathetic nervous system activity (Schaaf, et al., 2010a). In response to sensory stimuli as part of the SCP, the group of children with SMD showed increased vagal reactivity as compared to typically developing peers. Children with SMD were further divided into groups based on severity of SMD as determined by latent class analysis (Schaaf, et al., 2010a). The children with severe SMD showed significantly decreased baseline vagal tone and lower vagal tone during auditory sensory challenges, than either the groups of children with borderline SMD, moderate SMD or typical group. These findings contribute further to the idea that children with SMD are less organized and have difficulty maintaining a state of homeostasis.

The above studies provide initial evidence indicating that children with SMD may be in a state of physiologic disorganization in response to sensory stimuli. With seemingly increased sympathetic nervous system responses to sensory stimuli as seen in the above studies by McIntosh, et al. (1999b), Mangeot, et al. (2001), Lane, et al. (2010), Reynolds, et al. (2010), and Davies and Gavin (2007), as well as depression of parasympathetic nervous system activity as demonstrated by Schaaf, et al., (2003, 2010a), it is not difficult to see that children with SMD would likely have difficulties with self-regulatory abilities and coping.
**Prevalence**

Studies including children from suburban middle class to a study sample with the majority of the sample living below the poverty line, have been conducted to determine the prevalence of SMD. Despite the diversity of the samples, the prevalence of SMD identified has proven to be similar. In a sample of kindergartners (ages 4-6 years) Ahn, Miller, Milberger, & McIntosh (2004) estimated the prevalence of sensory processing deficits to be 5.3% - 13.7%. This convenience sample was taken from a Western, suburban, public school district, with the majority race being Caucasian (82%). All parents of kindergarteners in the district were given the SSP; 39% completed and returned the parent questionnaire. Assuming that the children whose parents did not return the questionnaire (non-responders) did not show sensory modulation deficits, 5.3% of the sample met the criteria for sensory modulation disorder. If the non-responders’ rates of sensory modulation deficits were consistent with responders’ rates, then the prevalence of these deficits in the total sample would rise to 13.7%. This study is not without limitations as the sample was not as diverse as the United States population in terms of race and educational level of the parents (Ahn, et al., 2004). This study was inclusive of all kindergarten students, so the possibility exists that a percentage of the students had some level of disability.

Within a sample of different socio-economic status than the previously mentioned study, Reynolds, Shepherd, and Lane (2008) examined the prevalence in children 3-5 years of age attending a Head Start program. Ninety percent of this sample was below the poverty line, and 80% came from single-parent homes. Again the SSP was used, with results showing an overall prevalence of sensory processing deficits at 17.6%. When compared to the previous study, this sample was two-and-a-half to three times more likely to meet criteria for a disorder of sensory processing (Reynolds, et al., 2008). Consistent with the Ahn, et al.’s., (2004) study, this study did
include the entire population, and over the course of the school year, 10% were diagnosed with a school-based disability. Ahn et al., (2004) recognize that a disability would be present at some level.

**Prevalence of SMD with Other Disorders**

Sensory integration and processing disorder is known to occur with developmental disabilities, Attention-deficit-hyperactivity disorder, Fragile X Syndrome, autism spectrum disorders, learning disabilities, and mood disorders (Dunn, 1999; Dunn, 2007, Schaaf et al., 2010b). Some studies examined the impact of deficits in sensory processing on occupational performance.

**Prevalence in ADHD.** In the previously mentioned neurophysiological studies, Mangeot et al. (2001) reported 77% of children with ADHD scored at least one standard deviation below the mean on the Sensory Profile. Lane, et al. (2010) reported 46% of their sample of children with ADHD showed SOR as measured by the SenSOR. Forty three percent of Reynolds, et al’s. (2010) sample of children with ADHD had at least one score outside two standard deviations on the SenSOR. Different measures and interpretation points have been reported so it is difficult to determine an exact rate of prevalence for children with ADHD; however, given the significant percentages, it is clear that sensory modulation deficits are often a feature of ADHD.

In a small sample of boys with Fragile X Syndrome (FXS), Baranek et al. (2002), found 11/15, or 73%, the boys had sensory modulation deficits determined by the Sensory Profile. Many showed a pattern of sensory avoiding as defined by Dunn (1999), and also showed lower levels of participation in school activities, less independence in self-care, and shorter periods of play with novel toys.
**Prevalence in autism.** Ninety five percent of a sample of children with autism were found to exhibit sensory modulation difficulties as measured by the SSP (McIntosh, et al., 1999) (Tomchek & Dunn, 2007). When compared to typically developing children, differences were seen on all sections of the SSP (McIntosh, et al., 1999), as well as in total score. Within the sample of children with ASD, 90% showed significant differences in Under-responsive/Seeks Sensation section. Differences were also noted in auditory filtering and tactile sensitivity, 77.6% and 60.9% respectively (Tomchek & Dunn, 2007). Both patterns of over- and under-responsiveness were noted in this study. Schoen, Miller, Brett-Green, & Hepburn (2008a) and Baranek, David, Pose, Stone, & Watson (2006) found similar patterns using a different assessment.

Two patterns of sensory reactivity were found within a sample of children with ASD, (Schoen, et al., 2008a). The Sensory Challenge Protocol was used to determine the feasibility, reliability, and variability of EDA in children with high functioning autism or autism. Ninety five percent of those tested completed the protocol; and it was determined that using EDA to measure sensory reactivity was feasible for this population. Reliability was established as test-retest reliability was stable. No differences were found between the original two groups of high functioning autism or autism; therefore, the groups were treated as one (Schoen, et al., 2008a). Two distinct patterns of sensory reactivity arose from this single group, a pattern of over-arousal or under-arousal. Patterns of over-arousal prior to the initiation of the SCP showed these children were more reactive to sensory stimuli than the under-aroused group. In addition the under-arousal group habituated to sensory stimuli quicker than the over-aroused group. The authors concluded that it should not be assumed that children with ASD possess the same pattern of sensory reactivity (Schoen, et a., 2008a).
In a sample of children with autism, pervasive developmental disorder, mental retardation/developmental disability, and typical development, the children with autism showed significantly higher overall sensory symptoms, i.e. over-responsive and under-responsive patterns to sensory stimuli (Baranek, et al., 2006). Patterns of over- and under-responsiveness discriminated children with autism from all of the other groups, pointing to a unique pattern of sensory modulation for these children. In particular, children with autism showed a significant difference in under-responsiveness to sensory stimuli in social contexts. The authors pointed out that the sample was a convenience sample and was a cross-sectional study, which provided a glimpse of a child’s performance at that particular observation (Baranek et. al., 2006). The Sensory Experiences Questionnaire (SEQ; Baranek, et al., 2006), a caregiver report tool, was used. The SEQ (Baranek, et al., 2006) relied upon parent report, which had both strengths and limitations. Internal consistency of the SEQ was excellent (alpha = 0.80; ICC = .92) (Little, et al., 2011).

**Sensory Modulation and Self-Regulation**

The concepts of self-regulation and adaptive behavior are found in both the occupational therapy and psychology literature. Both concepts are related to the coping process. In the OT literature, Dunn (2007) describes self-regulation as the manner in which a child responds to sensory experiences. The manner in which a child responds to sensory experiences encompasses cognitive perception, emotional regulation, and context of the experience. This is consistent with definitions of self-regulation, in the psychology literature, as defined by Buckner, Mezzacappa, & Beardslee, (2009) and Lengua & Long, (2002). Self-regulation contributes to a child’s ability to respond to stress, in other words, a child’s ability to cope (Buckner et al., 2009; Lengua & Long, 2002).
The modulation of sensory information supports self-regulation (Lane, 2002). Self-regulation is the ability to regulate and maintain attention, activity, arousal, and emotions in response to the demands of a task (Schaaf et al., 2010b; Williamson & Anzalone, 2001). Adequate self-regulation allows recruitment of needed resources for internal order and control of arousal (Reeves, 2001). Suppression of information is just as vital as activation. An example is being able to focus on the task of dissertation writing in the student center, despite the noise of other students studying, noise from street traffic, and music playing in the background. This ability to attend to relevant information and suppress extraneous or miscellaneous information forms the basis for the organization of behavior, motivation to act, interaction with the environment, and adaptation to environmental demands, all of which lead to occupational engagement (Schaaf et al., 2010b). In other words, participation or occupational performance is an end product of adequate sensory modulation and self-regulation. Schaaf et al., (2010b) conceptualized this relationship as a pyramid (Figure 5). Sensory modulation on the bottom layer supports self-regulation in the next layer, eventually leading to participation in occupations. Sensory processing is best considered from a developmental perspective. Children are born with the capacity for modulation and self-regulation (Lane, 2002). Meaningful interaction with the environment is supported by self-regulation, beginning in infancy (Reeves, 2001). As a child grows and develops, the ability for self-regulation improves and a child begins to function more independently (Skonkoff & Phillips, 2000). Typical infants are able to maintain sleep states for long periods of time, interact for short periods, cry when they are hungry, and calm themselves by sucking on fingers or a pacifier. Foundations for higher level skills of motor activity, emotional regulation and social skills are laid in infancy via nurturing and caregiving (Schaaf et al., 2010b). As a child grows and develops, experiences provide both positive and negative
feedback; behavioral patterns are developed as a child learns what does or does not work in given situations with particular sensory stimuli. Patterns of coping with self and environment are learned. It is when a child is unable to function appropriate for age in meeting the challenges of everyday life that dysfunction is considered.

A link between early difficulties with self-regulation in infancy and sensory processing deficits in childhood was found by DeSantis, Coster, Bigsby, and Lester (2004). Infant fussing is considered to be reflective of self-regulation deficiencies and can impact parent-child bonding.
and an infant’s ability to cope with environmental challenges. Infants, who were referred for excessive crying at ages four to 12 weeks, revealed retrospectively, that those infants who had increased hours of fussing in infancy had less efficient sensory processing skills, and attention/behavioral regulation problems between the ages of three and eight, as determined by a follow-up study with parents and teachers as cross-informants. Seventy five percent of this sample demonstrated sensory processing deficits in childhood as assessed using Dunn’s Sensory Profile (1999). Other concerns were noted with these children’s ability to cope with environment, attentional problems and behavior regulation.

**Sensory Modulation and Occupational Performance**

Adequate sensory modulation allows a child to respond appropriately to the degree, nature, and intensity of a sensory experience (Schaaf et al., 2010b). Successful participation in daily occupations is thought to be an outcome of successful sensory integration (Dunn, 1997; Dunn 2001; Schaaf et al., 2010b). For children daily occupations include activities of daily living, education, play, and social participation (Schaaf et al., 2010b). Successful participation in these everyday routines involves the production of adaptive responses to environmental and task demands. When a child’s ability to respond and adapt to sensory experiences in daily life activities is compromised or disrupted, SMD should be considered. In the context of everyday routines, SMD may compromise a child’s ability to cope with self and his or her environment (Lane, 2002).

**Disruption of Occupational Performance**

Autism has received much attention over the past decade due to a seemingly higher rate of occurrence; and as a result, there is an abundance of scholarly work examining autism. Although sensory modulation deficits are not a diagnostic feature of autism they are commonly
seen and studies of children with autism can be used to examine the impact of sensory processing difficulties on occupational performance. Difficulties for children with autism have been noted in childhood occupations of sleep, eating, and play.

**Sleep.** The incidence of sleep disturbances in children with autism is high. Fifty-four percent of parents reported sleep disturbances in a sample of children diagnosed with Pervasive Developmental Disorder (PDD), a disorder under the umbrella of Autism Spectrum Disorders (ASD) (Honomichl, Goodlin-Jones, Burnham, Gaylor, & Anders, 2002). Common sleep problems for these children were a longer time to fall asleep, more waking once asleep, and once awake, staying awake for longer periods of time. Data for this study was collected by parent report and compared to data from a sleep diary and the Children’s Sleep Habit Questionnaire (Owens, Spirito, & McQuinn, 2000). Data from all sources was found to be consistent, indicating that parental perception is accurate. Similarly, Allik, Larsson, & Smedje (2006) found 59% of parents reported sleep problems in their children with Asperger syndrome or high functioning autism. Again difficulties falling asleep, waking in the night and difficulty returning to sleep were common problems. Although these two studies did not examine sensory modulation, possible reasons for sleep disturbance were attributed to high physiological arousal and difficulty with regulating circadian cycles, which are both suggestive of sensory modulation difficulties.

A recent research brief offers an explanation for the above mentioned sleep problems. Reynolds and Lane (2011) sought to examine the relationship between sensory responsiveness and sleep behaviors in children with autism. When compared to typically developing peers, a higher rate of sensory processing deficits as defined by the Sensory Profile (Dunn, 1999) and a higher rate of sleep disturbances was reported in a group of children with autism. Reynolds and
Lane indicated that sensory avoiding most strongly correlated with sleep problems in children with autism. These findings are similar to those of Shocat, Tzischinsky, & Engel-Yeger (2009) who found that the presence of SMD was a predictor of sleep disturbances in a population of typically developing elementary school children.

Referring back to Dunn’s model (1997; 2007) in Figure 2.3, a child with a sensory avoiding pattern has a low threshold for sensory stimuli and uses active strategies to counteract the low threshold. Sensory avoiding children may have difficulty with sleep as they have difficulty lowering their level of arousal or in filtering sensory information. This would impact a child’s ability to fall asleep and also to lower his or her level of arousal once awoken from sleep.

**Eating.** Mealtime, part of the childhood occupation of self-care, is another area in which children with autism have difficulty and an area that may be impacted by the increased incidence of sensory processing deficits. Two studies are notable with regard to eating challenges. Both studies focused on eating problems of children with autism as compared to those without, and did not focus on sensory modulation. Similar to issues of sleep noted in the previous paragraphs, sensory modulation difficulties, particularly sensory over-responsiveness, may provide an explanation of the more frequent occurrence of eating preferences and mealtime behaviors of children with autism.

Schreck, Williams, & Smith (2004) found that when compared to a group of typically developing children, children with autism: had increased tendencies to refuse foods, required specific utensils or food presentation, accepted foods of lower texture, and ate fewer foods from each food group. A later study, with a much smaller sample size, also documented significant differences in mealtime behaviors between a control group and a group of children with autism (Provost, Crowe, Osbourn, McClain, & Skipper, 2010). Children with autism tended to have
increased negative behaviors around mealtime including tantrums, resistance to sitting at the table, throwing/dumping food, gagging, and mouthing of non-food items. A review of the children’s early histories showed that 47% of mothers reported difficulties in breastfeeding as compared to 20% of the typically developing group. No significant differences regarding feeding concerns were reported prior to the age of one year, however there was a significant difference in parent report of feeding concerns for children with autism above the age of three years. Children’s diets are generally bland and stable during the first year of life. As children grow older they become more exposed to a wider of variety of textures and tastes, which may account for the difference after the age of three. Three years of age would be a time when children are expected to eat in a manner similar to their parents.

**Play.** Although play is the primary occupation of children, few studies have examined play in children with SMD (Case-Smith, Law, Missiuna, Pollock, and Stewart, 2010). Children with SMD, as defined by the SSP (McIntosh, et al., 1999a) were found to engage in more sedentary play activities than typically developing children (Bundy, Shia, Qi & Miller, 2007). Engaging in sedentary play activities allowed children with SMD to be just as playful as typically developing children engaged in active play as measured by scores on the Test of Playfulness (ToP; Bundy, 2005). In active play children with SMD appeared less playful. Bundy, et al. (2007) concluded that children with SMD may find engaging in active play more challenging due to difficulties with maintaining optimal arousal and attention necessary to learn new motor tasks.

**Parent perception of occupational performance.** When seeking intervention for their children with SMD, parents identified aspects of self-regulation and sensory modulation, specifically: a desire for their children to “fit in” at school and in the community, improved
ability for children to regulate their own behavior, and improved self-confidence (Cohn, Miller, & Tickle-Degnen, 2000). These child-focused expectations arose from a study in which Cohn, et al, (2000) examined parent expectations for occupational therapy treatment for SMD. In a follow-up study, using a different sample, parents perceived an improvement in their child’s ability to participate in self-care activities as an outcome of occupational therapy treatment for SMD (Cohn, 2001). Other outcomes that were identified included enhanced participation in activities and improved self-worth. Both studies indicate that a goal of treatment may not be to improve underlying skill deficits but rather improve a child’s ability to adapt and cope with internal and external demands for successful participation in occupation.

Coping

Lazarus and Folkman (1984) defined coping as “constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person” (Lazarus & Folkman, 1984; p.141). As the study of coping has evolved to include the study of coping in children, Compas, et al. (2001) expanded the definition to include a developmental aspect. They defined coping as “conscious volitional efforts to regulate emotion, cognition, behavior, physiology, and the environment in response to stressful events or circumstances. These regulatory processes both draw on and are constrained by the biological, cognitive, social and emotional development of the individual.” (Compas, et al., 2001, p.89).

In the field of psychology, coping theory came to prominence in the 1970’s with the cognitive movement (Lazarus, 1992). Early theories on coping focused on coping as a personality style, with styles ranging hierarchically from healthy to dysfunctional. This limited the study of coping in that type of stressor, context, prior experience, and outcome was not
evaluated, as the style of coping was an inherent personality trait. Research over the years has identified that there are many other mediating variables such as temperament, cognitive processes, social supports, culture, belief, and health that impact an individual’s coping resources (Zeitlin & Williamson, 1994). More current conceptualizations include coping as a process, successful adaptation or resilience, the ability to control emotions, problem-solving, and person-environment relationship, as well as considering developmental factors. (Compas, et al., 2001).

Coping is broadly defined as the process of responding to stress (Skinner, Edge, Altman & Sherwood, 2003). Stress is an inevitable part of life for all individuals, but it is the ability to cope with stress that makes each individual unique (Zeitlin & Williamson, 1994). For children with SMD, who have difficulty processing sensory information, sensory experiences within everyday routines and activities may be a source of stress, and responding in a manner that is consistent to the demand of the task, may be challenging.

**Role of Stress**

Stress is a key concept in understanding coping theory. Stress is a reaction to an event that is perceived as threatening, harmful or challenging (Zeitlin & Williamson, 1994). Stress can be experienced in a cognitive, emotional, or physical manner, usually in some combination of these three. Stress arises from many sources with stressors being the actual events. Stressors can be internal or external, and are not limited to traumatic events, but can be events associated with the demands of daily living. Compas et al., (2001) identify volitional and involuntary stress responses. Volitional responses involve conscious effort and involuntary responses are automatic. Both types of stress responses may influence each other. Involuntary stress responses in infancy lead to the development of more sophisticated volitional response processes and greater self-regulation abilities (Compas et al., 2001). Involuntary responses may include
physiological responses to stress such as those described earlier in the studies with cortisol and EDR as measures of stress. Volition, or the ability of a child to regulate responses to these stressors, is acquired through learning and experience. Examples of volitional responses in early childhood may include seeking support from others, using objects for self-soothing, and withdrawing from threats.

Stress is present in a child’s everyday life. An optimal amount of stress is necessary for growth and development, while too much stress can interfere with the growth process (Lengua & Long, 2002; Zeitlin, 1981). Stress must be developmentally appropriate and not overwhelming to be constructive (Zeitlin & Williamson, 1994). It is not the stressor itself that is most important; it is the availability of resources and ability to use those resources to cope with the stress that is important (Mayberry, Steer, Reupert, & Goodyear, 2008). Coping with stress does not equate to successful elimination of the stressor (Amirkhan & Auyeung, 2007; Taylor & Stanton, 2007). Coping may be successful in reducing stress, but can also be ineffective and inefficient. The continued use of ineffective coping strategies can place children at risk developmentally (Taylor & Stanton, 2007).

**Measuring Coping**

Coping researchers have identified that coping is a difficult construct to measure; there exists a lack of consensus of the definition, assessment, and intervention of coping (Compas, et al., 2001; Maybery, et al., 2008; Skinner, et al., 2003; Zeitlin & Williamson, 1994). In a discussion of coping theory, Maybery, et al. (2009) found anywhere from eight to 18 different types of coping identified in discussions of coping theory. Compas et al. (2001) conducted a review of assessments of child and adolescent coping and found that very few assessments used the same categories of coping and very few assessments reported construct validity or internal
validity. The authors recommended that greater consideration be given to determining whether measurement is designed to address coping style or response to a particular stressor. Compas et al. (2001) further pointed out that failure to clearly differentiate between coping style and response to a specific stressor has significantly compromised the ability to generalize results across studies. In addition, assessments are of various types (e.g. questionnaires, checklists, interviews, and self-report measures), each of which has value and varied usefulness across developmental stages.

**Development of Coping.**

A child’s developmental level influences what coping internal resources are available and what coping strategies or efforts might be employed (Compas et al., 2001). It is widely accepted that the development of coping processes begins in infancy (Compas et al., 2001; Skinner et al., 2003; Taylor & Stanton, 2007). As the child acquires new skills and abilities and interaction with the environment increases, coping efforts and coping styles are developed (Zeitlin & Williamson, 1994). The emergence of cognitive, behavioral, and motor capacities that allow a child to regulate self and successfully act on the environment influence the development of the coping process (Compas et al., 2001; Zeitlin & Williamson, 1994). Zeitlin & Williamson (1994) describe a reciprocal relationship between expansion of skills and the development of coping. As a child gains skills, options for coping are expanded. When coping efforts are found to be effective, a child’s sense of competence is increased.

Similar to the development of sensory integration, initial coping efforts mainly consist of involuntary responses and reflexes that are present at birth (Compas et al., 2001; Zeitlin & Williamson, 1994). Sucking for feeding and sucking on a finger or pacifier for self-calming are examples of coping efforts that an infant might use to reduce stress. A child initially learns to
interact with his environment primarily through movement as the first year is dominated by gross motor development. The development of language and cognition in early and middle childhood contributes to a child’s coping efforts being more goal-directed (Compas et al., 2001). In middle childhood to adolescence diversity and flexibility of coping efforts are increased.

The study of coping in children is important as the development of coping styles in childhood are thought to be precursors to coping in adulthood (Compas et al., 2001). Coping resources have direct and indirect effects on mental and physical health (Taylor & Stanton, 2007). A lack of coping resources is known to exist with mental health diagnoses such as schizophrenia, depression, anxiety disorders, and autism (Taylor & Stanton, 2007). A lack of coping resources in childhood could be a clinical symptom of a mental health disorder or a developmental risk factor (Taylor & Stanton, 2007). The development of effective and competent coping resources and coping efforts lead to resilience as an outcome (Compas et al., 2001).

Resilience

Resilience is defined as successful adaptation to stressful events (Werner, 1989). Compas et al. (2001) described resilience as the “effective and adaptive manner” by which an individual has employed coping responses (p. 89). Given this definition, resilience is a desired outcome and an indicator of adaptive functioning. Little is known about resilience of children with SMD, however there are two cornerstone studies that investigated the development of resilience in typical children.

Murphy & Moriarity (1976) are cited in almost every discussion of the development of coping, with much of the outcome focusing on resilience. In 1953, they began a series of studies exploring coping resources in children two to five years of age, following them into adolescence.
The study used descriptive data collected by the research team of Escalona and Leitz, and spanning the years 1948-1952, in which the behavior of 128 infants was recorded. Murphy & Moriarity (1976) took 32 subjects from this sample and followed them to adolescence. The study included typically developing children from Topeka, Kansas, from relatively stable economic status and average IQ of 116.

In the rich descriptions reflecting their observations, Murphy & Moriarity (1976) identified early influences of coping and contributors to resilience. They identified that coping begins at birth and revolves around rest and activity rhythms, or the ability to self-regulate. Early influences on coping include the following:

- Mothers and infants’ responses, dynamics of individuality of infants, activity level, sensory reactivity, precursor to ambivalence, visual differences, oral drives, developmental balances and imbalances, problems in maintaining internal integration, capacity for self-regulation, resilience, recovery, and stress management, and continuity and change. (pp. 338-342)

The authors pointed out that coping should be viewed in the context of stress or challenges experienced by a child. As a child grows and matures, resilience is reinforced by increasing confidence in capacities and skills and the development of a wide range of coping resources. Two concepts of coping arose from this study: coping with environment, and maintenance of internal integration, which later researchers and scholars have referred to as coping with self. Murphy & Moriarity (1976) further discussed the importance to resilience of internal integration and differences in integrative functions described as the ability to control or inhibit responses to sensory stimuli. It is interesting to note that a model of sensory modulation did not exist at the time of this study.

In another well-known large scale, longitudinal study, Werner (1989) followed a birth cohort of 698 infants, for 30 years into adulthood. Approximately one third of the infants were
classified as “at risk” due to such factors as perinatal stress, poverty, being raised by mothers with low education, and turbulent family environment. Of these at risk children, two thirds developed learning and behavior problems by age ten or had legal involvement, mental health issues, or teenage pregnancy by age 18. The remaining one third had no such difficulties.

When all the high-risk children were retrospectively studied, results indicated differences with the resilient children as early as infancy (Werner, 1989). Resilient infants were described as being able to gain attention in a positive manner, and as having fewer eating and sleeping problems, as compared to the two thirds that developed learning and behavior problems. As toddlers and school-aged children the resilient group tended to be more independent; have better communication, reading and reasoning skills; and positive self-esteem.

Werner (1989) identified the characteristics of resilient children as protective factors. These include: family support, establishing a close bond with someone outside the family, average intelligence and communication, and having an internal locus of control. At different developmental stages these protective factors enhance a child’s resilience or ability to cope and adapt to stressful events. Protective factors have a more generalized effect on a child’s ability to cope than do specific risk factors or stressful events. The balance of risk factors and protective factors changes with developmental stages. Resilience is compromised when specific risk factors or stressful events outweigh protective factors.

While resilience is an outcome of coping and self-regulation, and it is important to acknowledge such, it was not included as part of the current study; the current study relied on an existing data set in which resilience was not captured. However, examining the concept of resilience should be considered in future investigations of children with SMD.
Coping Model in OT

Occupational therapists emphasize the use of coping resources to meet environmental challenges (Case-Smith et al., 2010; Williamson & Szczepanski, 1999; Zeitlin & Williamson, 1994). Coping resources aid in the coping process and are both internal and external (Taylor & Stanton, 2007; Zeitlin & Williamson, 1994). Internal coping resources include coping style, beliefs and values, developmental skills, and physical and affective states. External resources include human and environmental supports. Coping style consists of learned strategies or actions used to manage stress (Zeitlin & Williamson, 1994). Occupational therapists continually evaluate a child’s internal and external resources, and coping style (strategies) that a child uses to meet challenges (Case-Smith et al., 2010). When a child possesses the underlying resources to meet demands, strategies that are flexible, and both human and environment are supportive to facilitate performance, successful coping occurs.

The coping process of children is based on a cognitive behavioral model (Williamson & Szczepanski, 1999). The model, depicted in Figure 6, is relevant to the lifespan, and takes into account the effect of stress and response to stress, the basic definition of coping. The model views coping as a four-step process. The first step of the coping process occurs when a child experiences an event, identified as stressful. At this point the coping process is initiated (Williamson & Szczepanski, 1999). The child then develops a plan for how to manage a stressor with available internal and external coping resources (step 2). Aspects of self and environment are coping resources that influence the plan of how to respond to a stressor. A coping effort is then produced to attempt to manage the stressor, or manage emotions caused by the stressor (step 3). An outcome is produced by the coping effort and a child receives feedback from both the social and physical environments. With this feedback a child can then evaluate the effectiveness

of his or her coping effort. If the coping effort is effective, stress will be reduced or eliminated. If not effective, stress continues and another coping process is initiated. Williamson & Szczepanski (1999) point out that the effectiveness of the coping effort is dependent upon the child’s perspective and not the adult observer’s perspective.

Occupational therapists consider this model in the context of development and what skills a child may possess to meet challenges, present and future. Changes in coping style are anticipated as development unfolds. Occupational therapy also considers context of the individual and applies this model to all areas of occupational performance, with a focus on optimal functioning given different environments and circumstances.
**Relationship of Sensory Modulation and Coping**

As both modulation and coping are individualized neurological and developmental processes, the relationship between the two should be considered. Review of the literature indicated that SMD impacts occupational performance. From the resilience studies coping impacts the ability to generate adaptive responses. The question that begs to be explored is what is the nature of the relationship of modulation and coping.

Examining both behavioral responses and difficulties with participation in daily activities, occupational therapists can determine what sensory events may be stressful for a child (Dunn, 2007). While children with SMD have not been specifically shown to have poor coping abilities, observed behaviors would suggest that children with SMD have less than adequate resources for effective coping or that coping resources are less than adequate as children with SMD have increased amounts of stress.

The current study sought to examine the relationship between sensory modulation and coping and the impact on occupational performance by considering a model of moderation. Baron and Kenny (1986) provided the classic reference for the definition of a moderating variable. Moderating variables affect the strength of the relationship between independent and dependent variables; that is, the relationship between the two variables changes as a function of the moderator variable (Baron & Kenny, 1986). The following figure, Figure 7, demonstrates the moderating and model, which was used to examine the effects of the variables of sensory modulation, on coping, and occupational performance. This model depicts sensory modulation as interacting with coping to modify occupational performance. The interaction between coping and sensory modulation must be significant for this model to be supported (Baron & Kenny, 1986). Occupational performance may be impacted in a positive or negative manner as a
function of sensory modulation. With adequate sensory modulation, occupational performance would be successful. Decreased or inadequate sensory modulation would decrease the effectiveness of coping leading to decreased occupational performance.

**Summary**

Adequate processing and integration of sensory input is an important contributor to the development of an adaptive response (Roley, et al., 2001). Successful adaptive responses are necessary for successful occupational performance. In order to be successful in participation in occupational activities, a child must have adequate resources, be supported by the environment, persons in the environment, as well as appropriate task demands. Sensory modulation and coping play an important role in tying all of these pieces together.

Both coping and modulation are individualized neurological and developmental processes, and can be considered in relation to each other in Williamson & Szczepanski’s (1999) model of the coping process in children (Figure 6). It seems likely that for children with SMD,
information filtered through beliefs and values combined with internal and external resources, impact the first step of the coping process in determining the meaning of sensory event. This is reflected in Figure 8. The meaning of a sensory event is perceived as stressful and the remainder of the coping process is impacted.

*Figure 8 The Coping Process of Children Including Sensory Modulation*

Sensation is an external event. Modulation serves as an internal resource that may act as a filter through which a child processes sensory information comparing and evaluating in respect to previous experiences. Modulation may be reflected as a neurophysiological response, such as vagal tone or electrodermal activity. Furthermore, as a child evaluates outcome in Step 4, the effectiveness of coping is internalized, and shapes future experiences and subsequent responses. Externally, modulation can be considered in assessing the environment and context in which the coping process is activated. Is the environment supportive of the child and is the child developmentally able to meet the task demands? If the coping effort is effective from the child’s perspective, an adaptive response has been achieved leading to increased skill, motivation, confidence, all of which lead to successful participation in daily occupations.
Adequate processing and integration of sensory input is important to the development of an adaptive response (Roley, et al., 2001), in this case coping. Without adequate modulation, a less than effective coping effort may be produced, which would serve to perpetuate the coping efforts. This process is reflected in the studies that examined physiological responses to sensory stimuli which indicated that children with SMD may be in a state of physiologic disorganization in response to sensory stimuli. Sympathetic nervous system responses are increased, while parasympathetic activity is depressed, leaving children with decreased ability to regulate attention and emotion, and to produce adequate coping efforts for successful engagement (Davies & Gavin, 2007; Lane, et al., 2010; Mangeot et al., 2001; McIntosh, et al., 1999b; Reynolds, et al., 2010, Schaaf, et al., 2003, 2010a).

From this perspective it can easily be seen how SOR and anxiety may be related, or that SOR may be the cause of anxiety. Sensory over-responsivity was found to be strongly linked to anxiety in a recent study from Lane, et al, (2012). The authors indicated that a child’s response to a sensory challenge also impacts the ability of the nervous system to recover from a sensory challenge, which may contribute to anxiety, as negatively perceived sensory experiences elicit conditioned responses (Green & Ben-Sasson, 2010). Conversely it has also been postulated that anxiety precedes SOR as over-responsivity may be the result of heightened vigilance and is strengthened through conditioning and avoidance of a particular stimuli.

Sensory modulation is an integral part of the resources that a child utilizes to cope with sensory stimuli on a daily basis. Questions worth exploring include does sensory modulation predict occupational performance or does it influence a child’s ability to adequately cope with daily life stressors. Given these interdependent relationships, a better understanding of the interaction between sensory modulation and coping is necessary. Understanding how these
factors work together to influence the production of adaptive behaviors and occupational
performance can inform both assessment and treatment. Examination of modulation, coping, and
occupational performance formed the foundation for the current study. These variables are
discussed further discussed in Chapter Three.
Chapter 3: Methodology

Research Design

Using an existing dataset a non-experimental, exploratory, and correlational study was conducted in order to examine the relationship between SMD and coping and the relationship of both to aspects of occupational performance.

Institutional Review Board

An application for exempt review was submitted to the Institutional Review Board (IRB) of Virginia Commonwealth University (VCU). The proposed study met the criteria of an exempt review as it used a secondary dataset consisting of de-identified data. The IRB of the Spiral Foundation approved the use of this particular dataset for research purposes. After VCU IRB approval, analyses of the data began.

Research Questions and Hypotheses

The following questions and hypotheses were developed to examine the impact of SMD on a child’s ability to cope with challenges present in daily life activities.

Question 1: What is the relationship between coping and SMD?

• Hypothesis 1.1: As severity of SMD increases, higher total score on Short Sensory Profile (SSP) (McIntosh, Miller, Shyu, & Dunn, 1999), coping skills are decreased, as indicated by lower ABI score on Coping Inventory (Zeitlin, 1985).
• Hypothesis 1.2: Children with SMD, as indicated by scores on the SSP will demonstrate less effective coping identified by performance on the Coping with Self and Coping with Environment subscores on the Coping Inventory.

**Question 2: What is the relationship between SMD and occupational performance?**

• Hypothesis 2.1: As severity of SMD increases, as indicated by scores on SSP, performance in self-care activities decreases, as indicated by scores on the Evaluation Completion Form (OTA-Watertown).

• Hypothesis 2.2: As severity of SMD increases, as indicated by scores on SSP, competence in activities will decrease, as indicated by scores on Competence Scales the Child Behavior Checklist (CBCL) (Achenbach, 1991).

**Question 3: What aspects of coping predict occupational performance in children with SMD?**

• Hypothesis 3.1: Performance in areas of self-care, as reflected by scores on ECF, can be predicted from level of sensory modulation disorder (SMD) (as measured by the SSP) and coping style (as measured by scores on the Coping Inventory).

• Hypothesis 3.2: Performance in activities, school, and social activities, as measured by scores on CBCL, can be predicted from sensory modulation disorder (SMD) (as measured by the SSP) and coping style (as measured by scores on the Coping Inventory).

**Question 4: Does sensory modulation have a moderating effect on the relationship between coping and occupational performance?**

• Hypothesis 4.1: Coping styles, as indicated by coping with self and coping with environment scores on Coping Inventory, will be less adaptive as the severity of SMD, as measured by the SSP, increases and performance in self-care activities, as measured by the ECF, decreases.
• Hypothesis 4.2: Coping styles will be less adaptive as the severity of SMD, as measured by the SSP, increases and competence in activities, as measured by the CBCL, decreases.

Sample and Population

The proposed study examined data owned by The Spiral Foundation at Occupational Therapy Associates – The Koomar Center in Watertown, Massachusetts. The database was begun in 2001 with ongoing data collection; as of December 2010 this database consisted of anonymously coded data from 250 children ages 4 years to 9 years. Parents of the children included in the data set sought occupational therapy using a sensory integration approach (OTSI) and chose services at OTA Watertown. Approximately 99% of the children that sought OTSI agreed to participate in data collection. Baseline data was gathered at intake, prior to treatment. Data was collected for research purposes and there are currently several projects that are using this same data set. This investigation utilized the following data that was collected for each child in the database:

  • Child Behavior Checklist (Achenbach, 1991)
  • Short Sensory Profile (McIntosh, et al., 1999a)
  • Coping Inventory (Zeitlin, 1985)
  • Watertown Evaluation Completion Form

Children with a diagnosis of autism or a motor diagnosis were excluded from data collection. Children with attention deficit hyperactivity disorder (ADHD), other Axis I diagnoses such as depression, anxiety, and post traumatic stress disorder (PTSD), and gross motor, fine motor, or speech delays, were included in data collection. Children that had received services for sensory processing issues prior to this episode of care were included in the data
collection as well. For the purposes of this study only those children with complete data were included.

**Instrumentation**

Assessments of interest for the current study included the Short Sensory Profile (SSP; McIntosh, et al., 1999a), Coping Inventory (Zeitlin, 1985), Child Behavior Checklist (CBCL; Achenbach, 1991), and Evaluation Completion Form (ECF). The SSP, Coping Inventory, and CBCL are standardized assessments, completed by caregivers. Caregiver questionnaires were completed by caregivers most familiar with the child being assessed; and therefore, provided accurate and consistent descriptions of a child’s behavior. The ECF is an unpublished and non-standardized measure, created by OTA Watertown to rate clinical observations and a child’s ability to engage in self-care tasks.

**Short Sensory Profile (McIntosh, et al., 1999a).** The SSP (McIntosh, et al., 1999a; Appendix B) was developed in 1999 from the Sensory Profile (Dunn, 1999). The Sensory Profile is a judgement-based caregiver questionnaire designed to measure a child’s sensory processing abilities (Dunn, 1999). The Sensory Profile (Dunn, 1999) consists of 125 items. Scores from the Sensory Profile may yield certain preferences, patterns of performance, or sensory responsiveness that are indicative of difficulties with sensory processing. The Sensory Profile (Dunn, 1999) has been found to be a reliable and valid instrument. Internal consistency values ranged from .47 to .91 (Dunn, 1999). Construct validity was established by correlating scores with various functional tasks of the School Function Assessment (Coster, Deeney, Haltiwanger, & Haley, 1998).

The SSP consists of 38 items from the Sensory Profile (Dunn, 1999) that are more discriminative of sensory modulation, measuring modulation in daily activities (McIntosh, et al.,
It is most appropriately used as a screening instrument to quickly identify children most likely to have sensory processing difficulties, so that they can be referred for a more comprehensive evaluation. The SSP has been shown to distinguish the presence of SMD in an age and gender matched sample of typically developing children and children with SMD (McIntosh, et al., 1999a). Both the Sensory Profile (Dunn, 1999) and the SSP (McIntosh, et al., 1999a) are most appropriate for 5- to 10-year old children, but can be used with 3- and 4-year olds. A caregiver who has daily contact with the child completed the questionnaire by reporting the frequency with which a given behavior occurred.

The SSP consists of seven sections, added to obtain a total score (McIntosh, et al., 1999a). The sections of the SSP (McIntosh, et al., 1999a) and constructs of a child’s responses that are measured are listed in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Sections of the SSP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section</strong></td>
</tr>
<tr>
<td>Tactile Sensitivity</td>
</tr>
<tr>
<td>Taste/Smell Sensitivity</td>
</tr>
<tr>
<td>Movement Sensitivity</td>
</tr>
<tr>
<td>Underresponsive/Seeks Sensation</td>
</tr>
<tr>
<td>Auditory Filtering</td>
</tr>
<tr>
<td>Low Energy/Weak</td>
</tr>
<tr>
<td>Visual/Auditory Sensitivity</td>
</tr>
</tbody>
</table>
The SSP (McIntosh, et al., 1999a) should take 10 minutes for a caregiver to complete. The
caregiver rates the frequency of a given behavior on a scale ranging from the child never
responding in a given manner, to the child always responding in a given manner.

For example, item #4 “reacts emotionally or aggressively to touch”, the caregiver rates the
frequency with which the child reacts to touch, using a 5-point scale: always, frequently,
occasionally, seldom, or never. The rater then translates the caregiver’s responses to the
numerical score. Each section is totaled and the section raw score totals are added for the SSP
raw score total. Each section score is plotted in the appropriate classification column, which
identifies if the child’s behavior shows Typical Performance (at or above 1 SD below the mean),
Probable Difference (at or above 2 SD below the mean) or Definite Difference (below 2 SD
below the mean). Lower scores on the SSP indicate potential dysfunction. A scoring summary
is provided in Table 3.

Table 3

*Scoring the Short Sensory Profile*

<table>
<thead>
<tr>
<th>Frequency of Behavior</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
<td>Child always, responds in this manner, 100% of the time</td>
<td>1</td>
</tr>
<tr>
<td>Frequently</td>
<td>Child responds in this manner frequently or 75% of the time.</td>
<td>2</td>
</tr>
<tr>
<td>Occasionally</td>
<td>Child responds in this manner 50% of the time.</td>
<td>3</td>
</tr>
<tr>
<td>Seldom</td>
<td>Child responds in this manner about 25% of the time.</td>
<td>4</td>
</tr>
<tr>
<td>Never</td>
<td>Child never responds in this manner</td>
<td>5</td>
</tr>
</tbody>
</table>

Section Scores and Total Score

<table>
<thead>
<tr>
<th>Typical Performance</th>
<th>At or above 1 SD below the mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable Difference</td>
<td>At or above 2 SD below the mean</td>
</tr>
<tr>
<td>Definite Difference</td>
<td>Below 2 SD below the mean</td>
</tr>
</tbody>
</table>

*Reliability.* Internal reliability for SSP total and section scores was calculated using
Cronbach’s alpha (McIntosh, et al., 1999a). Internal reliability scores ranged from .70 to .90
indicating good internal reliability as .70 or higher is considered acceptable (Polit & Beck, 2008).

Validity. Internal validity of the SSP was measured by examining the correlations of the total and section scores (McIntosh, et al., 1999a). The factor structure of the SSP is supported by intercorrelations of .25 to .76, significant at $p < .01$, indicating the sections of the SSP include key factors and sections useful for determining the presence of sensory processing deficits (McIntosh, et al., 1999a).

Construct validity was established using electrodermal responses (EDR) as a measure of the physiological response to sensory stimuli (McIntosh, et al., 1999a). Unusually high or unusually low EDR are considered atypical. The sample of children with atypical EDR, scored significantly lower on all sections of the SSP ($p < .05$) (McIntosh, et al., 1999a).

The SSP (McIntosh, et al., 1999a) was used in the current study to determine the presence or absence of SMD, as reflected by the total score. It is a widely used and recognized tool that has been shown to be good at discriminating the presence of SMD (McIntosh, et al., 1999a). Children scoring in the “Probable Difference” and “Definite Differences” ranges, or all scores below 1 SD below the mean (Table 3) were considered to have SMD.

Coping Inventory (Zeitlin, 1985). The Coping Inventory is a criterion-referenced assessment designed to examine behavior patterns and skills used as resources for coping with self and adapting to environmental demands (Zeitlin, 1985). The Coping Inventory yields information on the effectiveness of coping, coping style, specific coping resources, and areas of vulnerability. Items on the Coping Inventory were developed from data collected by Murphy and colleagues in her longitudinal study of coping skills from early childhood to adolescence.
Factor analysis of this data yielded two factors, coping with self and coping with environment.

The Coping Inventory is useful as part of a comprehensive evaluation for children ages 3 years to 16 years old (Zeitlin, 1985). The inventory consists of two factors, Coping with Self and Coping with Environment, each rated on three dimensions: productive, active, and flexible. Coping with Self describes how an individual manages his or her relationship with the environment, adapting personal needs of survival and growth. Coping with Environment describes an individual’s ability to cope with opportunities and challenges in the environment. Caregivers rate each item on a scale of one to five, indicating the effectiveness of the coping behavior. A score of 1 suggests an ineffective behavior, while 5 reflects a consistently effective behavior. Raw scores are calculated for all dimensions within both factors, self and environment. Raw scores are then converted to a scale score and summed for the total self or environment score. Summed scores are then added together to obtain the Adaptive Behavior Index (ABI), an indicator of the strength of a child’s coping resources.

The rating scale of one to five is used for all possible items (Zeitlin, 1985). Ratings are clustered and identified with key words for descriptive purposes as follows:

1 – Behavior is not effective
2 – Behavior is minimally effective
3 – Behavior is effective in some situations, but not all
4 – Behavior is effective most of the time
5 – Behavior is consistently effective (Zeitlin, 1985)

Ratings also contain a tenth place-holder, further delineating effectiveness of behavior. Rules for decimal places are as follows:
• .1 from the whole number, plus or minus: key word for that whole number is used to
describe. Example: 3.1 or 2.9 – Behavior is effective in some situations (Zeitlin, 1985).
• .2 to .5 higher than the whole number: key words of that whole number are used and the
key words of the higher whole number are added to indicate that the behavior is more
effective than the lower whole number. Example: 2.2 to 2.5 – Behavior is minimally
effective, but effective in some similar situations (Zeitlin, 1985).
• .6 to .8 higher then the whole number: key words of the next highest whole number are
used with key words of the lower whole number added to indicate that the behavior is
less effective. Example: 2.6 to 2.8 – Behavior is effective in some situations and
minimally effective in others (Zeitlin, 1985).
Dimensions along which coping style is assessed are dichotomous: productive –
nonproductive, flexible – rigid, and active – passive (Zeitlin, 1985). Definitions are as follows:
• Productive – nonproductive. Describes the influence and control of a child’s ability in
meeting personal and environmental demands. Productive behaviors have a desirable
outcome and enhance self-esteem. Non productive behaviors are the opposite in
producing less than the desirable results and diminish self-esteem (Zeitlin, 1985).
• Flexible – rigid. Describes the ability to respond differently to varying situations and
demands. A flexible coping style involves the use of a variety of strategies, and cognitive
approaches. Children with rigid coping styles tend to use the same strategies regardless
of the outcome of those strategies (Zeitlin, 1985).
• Active – passive. Describes a child’s approach to meeting situational demands. Children
using an active style of coping will initiate and sustain the effort. A child with a passive
coping style may not initiate or sustain an effort or may withdraw from the situation (Zeitlin, 1985).

The Coping Inventory (Zeitlin, 1985) yields a wealth of information about the strength and effectiveness of a child’s coping resources as well as coping styles that are employed to meet personal and environmental demands. In this study it was used to examine these constructs in children with SMD.

**Reliability.** Inter-rater and internal consistency were obtained from the field sample, and indicate that adaptive behaviors are consistently measured by the Coping Inventory (Zeitlin, 1985). Inter-rater reliability coefficients for all subsections and ABI, ranged from .78 - .94 when pairs of raters rated a sample of handicapped and non-handicapped children.

**Validity.** The current version of the Coping Inventory is the fourth revision of the original instrument (Zeitlin, 1985). Items for the Coping Inventory were derived from factor analysis of behaviors that emerged from Murphy and Moriarty’s (1976) longitudinal study of coping and vulnerability in children. The Coping Inventory was field-tested several times, originally with a preschool population, then subsequently with handicapped and non-handicapped children, then finally with a sample of children ages 3 – 16 years old with a range of capabilities.

To further establish validity the Coping Inventory was compared against instruments that measure adaptive behavior, cognitive ability, self-concept, and achievement outcomes (Zeitlin, 1985). No significant correlations were found between the Coping Inventory and the measures of adaptive behavior and cognitive ability. When compared against a measure of self-concept a weak correlation ($r = .17$, $p < .02$) was observed with the total score and significant relationships were observed with several factors of self-concept: intelligence and school status, physical
appearance and attributes, and popularity. When compared against measures of achievement outcomes, correlations between measures ranged from .62 to .78, which indicates the presence of weaker relationships.

**Child Behavior Checklist/4-18 (Achenbach, 1991).** The Child Behavior Checklist/4-18 (CBCL), an assessment first published in 1983, is designed to provide standardized descriptions of a child’s behavior (Achenbach, 1991). The CBCL (Achenbach, 1991) is a parent scored assessment, composed of two separate sections, the Competence Scales, and the Syndrome and Total Problem Scales. The Competence Scales assess social competence and are discriminative of children who are adapting successfully versus children who may be in need of intervention for behavioral and/or emotional problems. The Problem Scales assess behavioral/emotional problems. The CBCL (Achenbach, 1991) is intended to be used as a portion of comprehensive assessment. Achenbach (1991) proposed a multi-axial assessment with the five axes of parent report, teacher report, cognitive assessment, physical assessment and direct assessment of the child. The CBCL (Achenbach, 19991) would fulfill the parent report axis. Information from the multi-axial assessment could be used to inform diagnosis.


The Competence Scales, used in this study, consisted of 20 items (Refer to CBCL/4-18 in Appendix A). Parents reported on quantity and quality of a child’s activities in the areas of
sports, hobbies, organizations, jobs/chores, friendships, getting along with others, and academic performance. Scores were assigned for the number of activities and quality was rated. Items were then grouped into three scales: Activities, Social, and School. The total Competence score was the sum of the raw scores of these three scales. Non-sports activities were eliminated from the total Competence score as analyses revealed equal means for children referred for services and those not referred (Achenbach, 1991).

Parent responses are translated to numerical values; scores are summed for each scale and plotted in the appropriate age column on the appropriate CBCL profile (Achenbach, 1991) (Refer to score sheet in Appendix A). Percentile and $T$ scores are obtained from the profile. The Activities, Social, and School scales are summed to obtain a total score. A total $T$ score is obtained from the table on the far right of the profile sheet. $T$ scores below 37 were considered in the clinical range, scores of 37 to 40 represented the borderline clinical range (Achenbach, 1991).

**Reliability:** The CBCL was found to be a reliable instrument based on inter-interviewer reliability and test-retest reliability (Achenbach, 1991). Inter-parent agreement was not found to be significant; however, this was expected as parents observe their child in different settings and situations (Achenbach, 1991). From a non-referred sample of 241 matched triads on age, sex, ethnicity, and socio-economic status, intra-class correlation coefficient (ICC) analysis of variance revealed high reliability, ICC = .927 ($p < .001$). Test-retest reliability of competence items after one week showed high reliability as well, ICC = .996 ($p < .001$). For competence scale scores after seven days, Pearson’s $r$ was significant at $p < .01$, indicating that there were no significant changes in scores.
Validity. Achenbach (1991) pointed out that prior to the development of the CBCL there existed very few instruments with solid constructs and operational definitions of children’s behavior by which to measure behaviors. Achenbach relied primarily on criterion-related validity to establish validity of the competence scales. Using the normative sample and a clinical sample of referred children, and controlling for the effects of demographic variables, multiple regression analyses showed that non-referred children had higher scores on the competence scales ($p<.01$) (Achenbach, 1991). This finding was consistent across age groups and between males and females. The school and social scales were found to be significant predictors of referred versus non-referred children. In the normative sample, raw scores for the Competence Scales were negatively skewed, indicating that most of the low scores on the competence scales are clinically significant. This was further confirmed through discriminant analyses when establishing validity.

In the current study the CBCL (Achenbach, 1991) scores on the Competence Scales were used as a measure of occupational performance and examined activity preferences for sports and hobbies of children with SMD. In light of revisions of the CBCL (Achenbach, 1991), described above, four to five year old children may need to be considered separately during analysis. If the number in this age group is low, the group may possibly be removed from analysis.

Evaluation Completion Form (ECF). Occupational Therapy Associates – Watertown (OTA Watertown) developed a form to be used by the therapist in rating a child’s functional problems. The form contains ten categories composed of various numbers of items. The items of interest for this study are in the Functional Problems category: Feeding, Self-care/Dressing, Sleeping, Toileting, Leisure Skills and Social Interaction (See Appendix A). The therapist completing the evaluation completes the ECF, rating the child independently in each category on
a scale of one to four, with one indicating definite difficulty with the task and four indicated no difficulty, performance is age-appropriate. In the current study the ECF was used to examine functional problems in daily activities. Functional problems take into consideration performance in tasks that compromise each area of occupation. These are described as follows:

- **Feeding.** Includes setting up food, selection of appropriate utensils, use of utensils, taking food and liquid to mouth, cleaning face and clothing, oral motor skills, and swallowing.
- **Self-care/Dressing.** Selecting appropriate clothing and accessories for weather and events, obtaining clothing, sequencing of dressing and undressing, ability to manipulate fasteners and adjust clothing.
- **Sleeping.** Ability to maintain a regular sleep/wake cycle, easily falling asleep and waking, sleeping through the night.
- **Toileting.** Obtaining and utilization of appropriate supplies, management of clothing, transferring to and from toilet, maintaining position, and completing toileting hygiene.
- **Leisure Skills.** Pleasurable avocational activities that are engaged in for fun or relaxation, such as sports, crafts, reading, etc…
- **Social Interaction.** Accessing opportunities for interactions with others, interacting in appropriate context and cultural manner to meet emotional and physical needs.

**Reliability.** Inter-rater reliability was established using a group of therapists at OTA Watertown. Interclass correlation coefficient was found to be .99 for the Functional Problems category.
Variables

The variables of interest in the current study included SMD, coping resources, coping styles, occupational performance and activity patterns. Table 4 lists the variables of interest.

Specific instruments used for measurement a particular variable and the criteria for measurement are identified. In addition the type of variable and level of measurement are included.

Table 4

Variables of Interest

<table>
<thead>
<tr>
<th>Variable of interest</th>
<th>Instrument used to measure</th>
<th>Type of variable</th>
<th>Level of measurement</th>
<th>Criteria for measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory modulation</td>
<td>Short Sensory Profile (McIntosh, et al., 1999a)</td>
<td>Categorical</td>
<td>Ordinal</td>
<td>0 = no SMD; score in Typical Performance range 1 = SMD score in Probable Difference range 2 = SMD, score in Definite Difference range</td>
</tr>
<tr>
<td>Coping</td>
<td>Coping Inventory (Zeitlin, 1985) Adaptive Behavior Index, Coping with Self, Coping with Environment</td>
<td>Discrete</td>
<td>Ordinal</td>
<td>ABI score ≤ 2.5 = less effective coping resources Factor scores ≤ 2.5 = less effective coping.</td>
</tr>
</tbody>
</table>
Data Analysis

Variables and statistical methods that were used to examine each research question are presented in Table 5 along with the research questions and proposed hypotheses.

Table 5

Research Questions, Hypotheses, and Data Analysis

Question 1: What is the relationship between coping and SMD?

Hypothesis 1.1: As severity of SMD increases, higher total score on Short Sensory Profile (SSP) (McIntosh, Miller, Shyu, & Dunn, 1999), coping skills are decreased, as indicated by lower ABI score on Coping Inventory (Zeitlin, 1985).

Data Analysis: Pearson’s $r$ was calculated to examine the relationship between the SSP and the ABI (Polit & Beck, 2008). Additional exploratory analysis was conducted as needed.

Hypothesis 1.2: Children with SMD, as indicated by scores on the SSP will demonstrate less effective coping identified by performance on the Coping with Self and Coping with Environment subscores on the Coping Inventory.

Data Analysis: Multiple regression was used to investigate the relationship between the SSP and the Coping with Self and Coping with Environment subscores of the Coping Inventory. Additional exploratory analysis was conducted as needed.

Question 2: What is the relationship between SMD and occupational performance?

Hypothesis 2.1: As severity of SMD increases, as indicated by scores on SSP, performance in self-care activities decreases, as indicated by scores on the Evaluation Completion Form (OTA-Watertown).

Hypothesis 2.2: As severity of SMD increases, as indicated by scores on SSP, competence in activities will decrease, as indicated by scores on Competence Scales the Child Behavior Checklist (CBCL) (Achenbach, 1991).

Data Analysis: Pearson’s $r$ was calculated to examine the relationship between SMD as indicated by the SSP and occupational performance as indicated by self-care activities as reported on the Evaluation Completion Form and the activities section of the CBCL (Polit & Beck, 2008). Additional exploratory analysis was conducted as needed.
Table 5 continued

Question 3: What aspects of coping predict occupational performance in children with SMD?

Hypothesis 3.1: Performance in areas of self-care, as reflected by scores on ECF, can be predicted from level of sensory modulation disorder (SMD) (as measured by the SSP) and coping style (as measured by scores on the Coping Inventory).

Hypothesis 3.2: Performance in activities, school, and social activities, as measured by scores on CBCL, can be predicted from sensory modulation disorder (SMD) (as measured by the SSP) and coping style (as measured by scores on the Coping Inventory).

Data Analysis: Multiple regression was used to investigate the impact of SMD (as measured by the SSP) and coping styles (as measured by the Coping Inventory) and occupational performance (as measured by the ECF and the CBCL). Additional exploratory analysis was conducted as needed.

Question 4: Does sensory modulation have a moderating or mediating effect on the relationship between coping and occupational performance?

Hypothesis 4.1: Coping styles, as indicated by coping with self and coping with environment scores on Coping Inventory, will be less adaptive as the severity of SMD, as measured by the SSP, increases and performance in self-care activities, as measured by the ECF, decreases.

Hypothesis 4.2: Coping styles will be less adaptive as the severity of SMD, as measured by the SSP, increases and competence in activities, as measured by the CBCL, decreases.

Data Analysis: Multiple hierarchical regression was used to investigate the moderating effect of coping, as measured by the Coping Inventory, on SMD, as measured by the SSP, and occupational performance, as measured by the ECF and CBCL. Additional exploratory analysis was conducted as needed.

Limitations

All investigations using existing datasets face limitations. In the proposed study one limitation is related to homogeneity. First, the dataset is homogenous with respect to the population and self-selection. Families seeking services at OTA Watertown did so because difficulties in sensory processing for their child were suspected. Because the population is self-
referred to a practice specializing in treatment of SMD, the number of children without SMD disorder may be underrepresented, presenting difficulty when analyzing group means, increasing the opportunity for a Type II error. Statistical analyses may not be sensitive enough to detect differences between groups of children with SMD and those without SMD. This will also limit the generalizability of findings.

As discussed in Chapter Two, there is a lack of consensus surrounding the construct of coping (Compas, et al., 2001; Maybery, et al., 2009; Skinner, et al., 2003; Zeitlin & Williamson, 1984). In this study, efforts have been made to use definitions of coping efforts, resources, and strategies found in the literature. The Coping Inventory’s (Zeitlin, 1985) use of coping constructs are well-defined. The use of the Coping Inventory (Zeitlin, 1985) in research is limited, however valuable information can be gained from the inclusion of this assessment in this study.

The CBCL (Achenbach, 1991) is a well-accepted instrument. While the version of the CBCL (Achenbach, 1991) used for data collection is not the most current edition of the assessment, it does not appear to be a major limiting factor as the competence scales were unchanged between the CBCL/4-18 version (Achenbach, 1999) and the current CBCL/6-18 (Achenbach, 2010).

Using the total score of the SSP (McIntosh, 19991a) will not clearly differentiate between sensory over-responsivity and sensory under-responsivity. Responses to sensory stimuli when children have over- versus under-responsiveness will be identified by the total SSP score, and either group might experience difficulties in occupational performance and activity engagement. Use of the total score will allow examination of sensory modulation as a broad construct.

While limitations with existing data exist, this dataset is one of the largest data sets with SMD that is currently available for examination. The data which includes a larger battery of
assessments in addition to those selected for this study, has been carefully collected for research purposes and will allow the examination of the impact of SMD on coping, and occupational performance. This valuable information will uniquely contribute to increasing the understanding of SMD.
Chapter 4: Analysis of Data

The purpose of this study was to examine the interplay between SMD, coping and occupational performance. An existing database owned and managed by The Spiral Foundation was used as the sample for this study. The database was created in 2001, and collection continues with approximately 30 children being added each year. For this study data from years 2001 to 2010 was included. Two hundred sixty one children were included in the dataset. One case was eliminated immediately as only data for one assessment was reported, leaving the total number of children for analysis at 260. The statistical analysis package, SPSS 20.0, was used for data analysis.

Descriptive Statistics

Analysis of the 260 children included in the dataset revealed that the majority of the group was male (74%), with a mean age of 6 years and 8 months. The frequencies and percentages of children by gender, age, ethnicity, family status, and parent education are presented in Table 6. All percentages refer to the percentage of data available for that particular variable. The group was overwhelmingly of Caucasian ethnicity (91%). Most children came from a two-parent household (90%). Included in this group for evaluation were 23 adopted children and one child in foster care. Fifty two percent of mothers and 56% of fathers had graduate or doctoral levels of education. The variables of ethnicity, family status, and parent education were each condensed due to small groupings on values.
Table 6

*Demographics of Sample*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>$n$</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>191</td>
<td>73.5</td>
</tr>
<tr>
<td>Female</td>
<td>69</td>
<td>26.5</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Months</td>
<td>260</td>
<td>82.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range: 50 - 119</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td>Percentage</td>
</tr>
<tr>
<td>Caucasian</td>
<td>237</td>
<td>91.2</td>
</tr>
<tr>
<td>Other - African American, Hispanic</td>
<td>18</td>
<td>6.9</td>
</tr>
<tr>
<td>Asian, Native American, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>234</td>
<td>90.0</td>
</tr>
<tr>
<td>Not Married – Separated, Divorced,</td>
<td>15</td>
<td>5.8</td>
</tr>
<tr>
<td>Widowed, or Single</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School Graduate, Some college</td>
<td>23</td>
<td>8.8</td>
</tr>
<tr>
<td>Earned Bachelor’s Degree</td>
<td>90</td>
<td>34.6</td>
</tr>
<tr>
<td>Graduate, Doctorate, Post Doctorate</td>
<td>137</td>
<td>52.7</td>
</tr>
<tr>
<td>Father Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School Graduate, Some college</td>
<td>30</td>
<td>11.6</td>
</tr>
<tr>
<td>Earned Bachelor’s Degree</td>
<td>75</td>
<td>28.8</td>
</tr>
<tr>
<td>Graduate, Doctorate, Post Doctorate</td>
<td>141</td>
<td>57.1</td>
</tr>
</tbody>
</table>

Two hundred sixty children composed the sample used for analysis. The original dataset included 261 children, however one child was eliminated, as there was only information on one of the three assessments available. There was found to be missing data within each of the key variables, leading to variability in samples used in the specified analyses. Where appropriate this variability is reflected in tables and statistical reporting.
Diagnoses

Children with autism or a neuromotor diagnosis that may impact development, such as cerebral palsy, were excluded. Children with ADHD, other Axis I diagnoses, such as depression, anxiety, and Post Traumatic Stress Disorder, gross motor, fine motor, or speech delays were included in the study sample. Children with previously identified sensory processing issues were included in data collection as well. The category “Other Diagnoses” included children with diagnoses of Osteogenesis Imperfecta, Developmental Delay, Fetal Alcohol Syndrome, Gastroesophageal Reflux, Seizures, Failure to Thrive, Diabetes, Immunodeficiency, Seizures, Ventricular Septal Defect, and Tics. It should be noted that diagnoses are not mutually exclusive. Table 7 shows frequencies and percentages of diagnoses, reported at intake. Thirty-five children in this sample had more than one diagnosis. Children who had previously received services were eligible to be included in the study sample, so there are children (6%) that were reported to have been previously diagnosed with Sensory Processing/Sensory Integration Deficits. Included in this category were children with reported diagnoses of Apraxia, Dyspraxia, and Developmental Coordination Disorder, which are included in Miller et al.’s., (2007) model of Sensory Processing Disorders (Figure 4). Table 8 provides information regarding the frequency of one or more diagnoses. Of the children receiving an occupational therapy evaluation, 63% had no diagnosis on admission. Twenty four percent of the children had one diagnosis, and 10% had two diagnoses. Included in these figures are children who already had a previously diagnosed sensory processing disorder.

Key Variables

Preliminary data analyses. Assumptions of normality and linearity were examined for each variable. Examination of z-scores and P-plots indicated that all variables met assumptions
Table 7

*Diagnoses Included in Data Collection*

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD/ADHD</td>
<td>35</td>
<td>13.5</td>
</tr>
<tr>
<td>Mental Health</td>
<td>23</td>
<td>8.8</td>
</tr>
<tr>
<td>Learning Disability</td>
<td>17</td>
<td>6.5</td>
</tr>
<tr>
<td>Sensory Processing/Sensory Integration Deficits</td>
<td>15</td>
<td>5.7</td>
</tr>
<tr>
<td>Motor Skills Delays</td>
<td>13</td>
<td>5.0</td>
</tr>
<tr>
<td>Non-Verbal Learning Disability</td>
<td>13</td>
<td>5.0</td>
</tr>
<tr>
<td>Other Diagnoses</td>
<td>11</td>
<td>4.2</td>
</tr>
<tr>
<td>Language Delays</td>
<td>9</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Table 8

*Frequency of One or More Diagnoses (N = 260)*

<table>
<thead>
<tr>
<th>Number of Diagnoses</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children with no diagnoses</td>
<td>163</td>
<td>62.7</td>
</tr>
<tr>
<td>Children with one diagnosis</td>
<td>62</td>
<td>23.8</td>
</tr>
<tr>
<td>Children with two diagnoses</td>
<td>26</td>
<td>10.0</td>
</tr>
<tr>
<td>Children with three diagnoses</td>
<td>7</td>
<td>2.7</td>
</tr>
<tr>
<td>Children with four diagnoses</td>
<td>2</td>
<td>0.8</td>
</tr>
</tbody>
</table>

of correlation, normality and linearity. Missing value analyses revealed no evidence for patterns of missing values. In subsequent analyses missing values were deleted pairwise.

**Sensory modulation disorder (SMD).** The Short Sensory Profile (SSP) was used to determine the presence of SMD. The total raw score on the SSP, as well as subsection raw scores and summary scores were used for analysis. Individual scores on the SSP range from one to five, with one indicating that a behavior is always present through five, indicating that a given behavior never occurs (McIntosh, et al., 1999a).

Of the original 260 children, there were a total of 63 children (24.2%) with missing values, resulting in 197 useable scores on the SSP. Sixty one percent of the remaining children
scored in the Probable or Definite Difference ranges of the SSP thus indicating the presence of SMD. Table 9 shows percentages of groups by summary scores.

Table 9

*Sensory Modulation by Summary Score (N = 260)*

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Performance</td>
<td>39</td>
<td>15.0</td>
</tr>
<tr>
<td>Probable Difference</td>
<td>43</td>
<td>16.5</td>
</tr>
<tr>
<td>Definite Difference</td>
<td>115</td>
<td>44.2</td>
</tr>
<tr>
<td>Missing</td>
<td>63</td>
<td>24.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>260</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The subtypes of SMD as identified by Miller et al., (2007), SOR, SUR, and SS, were examined using several subsections of the SSP. Six of the seven subsections of the SSP were used and the subsection of Auditory Filtering was eliminated as it reflects a combination of subtypes. Sensory over-responsivity is reflected in the subsections of Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, and Visual/Auditory Sensitivity. A summary of the findings is presented in Table 10. A summary score of “1” indicates Typical Performance, “2” indicates Probable Difference, and “3” indicates Definite Difference. Tactile Sensitivity and Visual/Auditory Sensitivity were the most commonly identified indicators of SOR, both with over 50% occurrence in the sample. Regression analyses confirmed that Tactile Sensitivity ($F_{(1, 219)} = 93.07, p < .000$) and Visual/Auditory Sensitivity ($F_{(1, 219)} = 65.47, p < .000$) are both predictors of SOR.

For these analyses, the subsection Under-responsive/Seeks Sensation was considered to be reflective of sensory seeking. Items included in this section reflect noticing and responding to sensory events in the environment (McIntosh, et al., 1999). In contrast, SUR was reflected in the
Table 10

*Examination of SOR by Summary Score*

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Mean</th>
<th>Median</th>
<th>Percentage of Children with scores in Probable Difference and Definite Difference ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory Over-responsivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tactile Sensitivity</td>
<td>1.9</td>
<td>2.0</td>
<td>55.8</td>
</tr>
<tr>
<td>Taste/Smell Sensitivity</td>
<td>1.5</td>
<td>1.0</td>
<td>36.5</td>
</tr>
<tr>
<td>Movement Sensitivity</td>
<td>1.6</td>
<td>1.0</td>
<td>42.7</td>
</tr>
<tr>
<td>Visual/Auditory Sensitivity</td>
<td>1.7</td>
<td>1.5</td>
<td>50.0</td>
</tr>
</tbody>
</table>

Low Energy/Weak section as the items in this section are focused on decreased proprioceptive function. Frequencies of all subtypes are displayed in Table 11.

Table 11

*Frequency of SOR, SUR, and SS (N = 260)*

<table>
<thead>
<tr>
<th>Variable</th>
<th># of children</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory Over-responsivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probable Difference</td>
<td>43</td>
<td>16.5</td>
</tr>
<tr>
<td>Definite Difference</td>
<td>81</td>
<td>31.2</td>
</tr>
<tr>
<td>Total</td>
<td>124</td>
<td>47.7</td>
</tr>
<tr>
<td>Sensory Under-responsivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probable Difference</td>
<td>27</td>
<td>10.4</td>
</tr>
<tr>
<td>Definite Difference</td>
<td>122</td>
<td>46.9</td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>57.3</td>
</tr>
<tr>
<td>Sensory Seeking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probable Difference</td>
<td>45</td>
<td>17.3</td>
</tr>
<tr>
<td>Definite Difference</td>
<td>118</td>
<td>45.4</td>
</tr>
<tr>
<td>Total</td>
<td>163</td>
<td>62.7</td>
</tr>
</tbody>
</table>

As seen in Table 12, the occurrence of each subtype in the sample ranged from 45% to 57%. Given these values, there is obviously overlap among the subtypes. The overlap of subtypes is presented in Table 12.
Table 12

*Overlap of Subtypes of SMD (N = 260)*

<table>
<thead>
<tr>
<th>Number of subtypes</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children with no subtype of SMD</td>
<td>18</td>
<td>6.9</td>
</tr>
<tr>
<td>Children with one identified subtype</td>
<td>53</td>
<td>20.4</td>
</tr>
<tr>
<td>Children with two identified subtypes</td>
<td>71</td>
<td>27.3</td>
</tr>
<tr>
<td>Children with three identified subtypes</td>
<td>57</td>
<td>21.9</td>
</tr>
</tbody>
</table>

Eighteen of the children in this dataset scored in the Typical Performance range of every subsection of the SSP, and would be determined to not have SMD. However, an additional 21 children received summary scores within the Typical Performance range, who also received one or more subsection scores indicative of Probable Difference or Definite Difference. On further examination these children scored as Probable Difference or Definite Difference in either SUR (eight children) or SS (12 children), or in one case, both SUR and SS.

Chi-square (two-sided) results indicated no statistically significant relationship between SOR and SS. However there was a statistically significant relationship between SOR and SUR, as well as SUR and SS. The analyses indicated that a large percentage of children showed some pattern of overlapping subtypes. Chi-square analyses of co-occurrence of SMD subtypes are displayed in Table 13 and 14. In looking at the co-occurrence of SMD, one pattern that does emerge is that children scoring in the Definite Difference range for one sensory modulation concern had a high likelihood of scoring in the same range for another sensory modulation concern.

**Coping resources.** From the Coping Inventory, Adaptive Behavior Index scores as well as Coping with Self and Coping with Environment scores were used to examine coping. A Likert scale is used for individual items. Scores of one indicate ineffectiveness of a behavior,
Table 13

**Co-occurrence of SOR, SUR, and SS**

<table>
<thead>
<tr>
<th></th>
<th>Sensory Over-responsivity</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typ Perf</td>
<td>Prob Diff</td>
<td>Def Diff</td>
<td>$\chi^2$</td>
<td>(p)</td>
</tr>
<tr>
<td>Sensory Seeking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typ Perf</td>
<td>35(17.1%)</td>
<td>12(5.8%)</td>
<td>18(8.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob Diff</td>
<td>15(7.3%)</td>
<td>6(2.9%)</td>
<td>15(7.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Def Diff</td>
<td>43(21%)</td>
<td>23(11.2%)</td>
<td>38(18.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>93(45.4%)</td>
<td>41(20.0%)</td>
<td>71(34.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory Over-responsivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory Under-responsivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typ Perf</td>
<td>49(23.2%)</td>
<td>13(6.1%)</td>
<td>22(10.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob Diff</td>
<td>11(5.2%)</td>
<td>2(1.0%)</td>
<td>7(3.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Def Diff</td>
<td>35(16.6%)</td>
<td>26(12.3%)</td>
<td>46(21.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>95(45.0%)</td>
<td>41(19.4%)</td>
<td>75(35.5%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14

**Co-occurrence of SUR and SS**

<table>
<thead>
<tr>
<th></th>
<th>Sensory Under-responsivity</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typ Perf</td>
<td>Prob Diff</td>
<td>Def Diff</td>
<td>$\chi^2$</td>
<td>(p)</td>
</tr>
<tr>
<td>Sensory Seeking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typ Perf</td>
<td>29(11.8%)</td>
<td>10(4.1%)</td>
<td>32(13.1%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob Diff</td>
<td>11(4.5%)</td>
<td>6(2.4%)</td>
<td>27(11.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Def Diff</td>
<td>50(20.4%)</td>
<td>10(4.1%)</td>
<td>56(26.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>90(36.7%)</td>
<td>26(10.6%)</td>
<td>115(46.9%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

while five indicates that a behavior is consistently effective (Zeitlin, 1985). Scores below 2.5 reflect less than effective coping skills, as defined by the Coping Inventory Manual (Zeitlin, 1985). Upon initial analysis using 2.5 as a cut-point yielded a small sample. For the normative sample of typical non-handicapped children, the mean ABI score was 3.9 (SD = .73), 3.8 (SD = .79) for Coping with Self, and 4.0 (SD = .77) for Coping with Environment (Zeitlin, 1985). Thus, the typical mean + 1 SD suggests that an ABI of < 3.17, a Coping with Self score of < 3.01, and a Coping with Environment score of < 3.23 are reflections of difficulty. Given these
values, a new cut-point that takes into account the actual typical mean + 1 SD may be more reflective of clinically significant difficulty in coping. For this reason, the data was re-examined using these new values as cut-points. As seen in Table 15, this yielded a larger sample. Twenty percent of the sample had missing values for the Coping Inventory.

Table 15

_Adjusted Cut-point for Coping Resources_

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Percentage with coping problems using ≤ 2.5 as cut-point</th>
<th>n</th>
<th>Percentage with coping problems, using adjusted cut-points</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive Behavior Index</td>
<td>208</td>
<td>3.5</td>
<td>8.2</td>
<td>17</td>
<td>29.8</td>
<td>62</td>
</tr>
<tr>
<td>Coping with Self</td>
<td>208</td>
<td>3.3</td>
<td>12.0</td>
<td>25</td>
<td>35.1</td>
<td>73</td>
</tr>
<tr>
<td>Coping with Environment</td>
<td>209</td>
<td>3.6</td>
<td>6.7</td>
<td>14</td>
<td>26.8</td>
<td>56</td>
</tr>
</tbody>
</table>

When coping resources were examined for those children with SMD, most children with SMD had deficits in coping. Sixty-two children in the total sample showed deficits in coping as indicated by the ABI, 44 of these were children with SMD, with 40 of these 44 showing significant deficits in sensory modulation abilities. Table 16 reflects children with SMD and less then effective coping resources. Similar patterns were seen when examining Coping with Self and Coping with Environment. Most of the children with Definite Differences in sensory modulation showed less then effective coping resources, in contrast to the number of children with Probable Difference in SMD, who did not show the degree of deficits in coping resources.

**Occupational performance.** The OTA-Watertown Evaluation Completion form (ECF) provided a measure of occupational performance in areas of Feeding, Self-Care/Dressing, Sleeping, Toileting, Leisure Skills and Social Interaction. Scores less than four signified difficulty with a task. Table 17 displays percentages for each area.
Table 16

*Children with SMD and Less Than Effective Coping Resources (n = 130)*

<table>
<thead>
<tr>
<th>Sensory Modulation Disorder</th>
<th>Probable Diff</th>
<th>Definite Diff</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive Behavior Index (≤ 3.17)</td>
<td>4</td>
<td>40</td>
<td>44(33.8%)</td>
</tr>
<tr>
<td>Coping with Self (≤ 3.01)</td>
<td>8</td>
<td>46</td>
<td>54(41.5%)</td>
</tr>
<tr>
<td>Coping with Environment (≤ 3.23)</td>
<td>3</td>
<td>38</td>
<td>41(31.5%)</td>
</tr>
</tbody>
</table>

Table 17

*Areas of Occupational Performance as Measured by ECF*

<table>
<thead>
<tr>
<th></th>
<th>Feeding n = 203</th>
<th>Dress n = 203</th>
<th>Sleep n = 194</th>
<th>Toilet n = 194</th>
<th>Leisure n = 203</th>
<th>Social n = 210</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite Difficulty (1)</td>
<td>8.5%</td>
<td>6.2%</td>
<td>5.4%</td>
<td>3.5%</td>
<td>8.1%</td>
<td>13.8%</td>
</tr>
<tr>
<td>Moderate Difficulty (2)</td>
<td>15.4%</td>
<td>25.0%</td>
<td>11.9%</td>
<td>7.7%</td>
<td>28.1%</td>
<td>35.7%</td>
</tr>
<tr>
<td>Mild Difficulty (3)</td>
<td>18.1%</td>
<td>28.1%</td>
<td>15.8%</td>
<td>12.3%</td>
<td>24.2%</td>
<td>30.5%</td>
</tr>
<tr>
<td>No Difference/Not expected for age (4)</td>
<td>36.2%</td>
<td>18.8%</td>
<td>41.5%</td>
<td>51.2%</td>
<td>17.7%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Missing</td>
<td>21.9%</td>
<td>21.9%</td>
<td>25.4%</td>
<td>25.4%</td>
<td>21.9%</td>
<td>19.2%</td>
</tr>
</tbody>
</table>

Another measure of occupational performance was provided by the Competence Scales of the Child Behavior Checklist. Total competence scores as well as scores on Activities, Social, and School scales were examined. Table 18 presents these results using the T score cut-off of 30, which indicates scores within the clinical range. School scores were not reported for children under six years of age; 33% of the sample was below the age of six years. Missing data for School and Social scales beyond 33% are due to data not being reported. The average number of reported activities was between four and five for each scale.

The Relationship Between Coping and SMD

**Hypothesis 1.1.** This first hypothesis sought to examine the relationship between the severity of SMD, as indicated by the SSP scores, and coping skills, as indicated by the Adaptive
Table 18

**CBCL Scales and Total Competence**

<table>
<thead>
<tr>
<th>Difficulty (T scores ≤ 30)</th>
<th>Activities n = 248</th>
<th>Social n = 247</th>
<th>School n = 164</th>
<th>Total Competence n = 158</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty (T scores ≤ 30)</td>
<td>4.2%</td>
<td>15.4%</td>
<td>10.0%</td>
<td>5.4%</td>
</tr>
<tr>
<td>No Difficulty (T scores &gt; 30)</td>
<td>91.2%</td>
<td>79.6%</td>
<td>53.1%</td>
<td>55.4%</td>
</tr>
<tr>
<td>Missing</td>
<td>4.6%</td>
<td>5.0%</td>
<td>36.9%</td>
<td>39.2%</td>
</tr>
</tbody>
</table>

Behavior Index score on the Coping Inventory. The variables were positively correlated ($r_{(160)} = .45, p \leq .000$). The results are presented in Table 19. The hypothesis that as severity of SMD increases, coping skills will decrease is confirmed by this analysis.

Table 19

**Scores on SSP and ABI - Correlation**

<table>
<thead>
<tr>
<th>SSP Raw Score</th>
<th>Adaptive Behavior Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
</tbody>
</table>

**Hypothesis 1.2.** The prediction of SMD on the effectiveness of coping, was examined through individual regression analyses. Raw scores on the SSP, reflecting SMD, were positively correlated with the Adaptive Behavior Index ($r_{(130)} = .35, p \leq .001$). The results of prediction were statistically significant ($F_{(1, 128)} = 17.69, p \leq .001$). The Adaptive Behavior Index is a composite of Coping with Self and Coping with Environment ordinal scores, leading to the conclusion that Coping with Self and Coping with Environment would show statistical significance when regressed with SMD. When examined this was found to be the case: Coping with Self ($F_{(1,128)} = 12.52, p \leq .001$) and Coping with Environment ($F_{(1,128)} = 19.34, p \leq .001$).
This regression analysis confirmed the hypothesis that children with SMD would demonstrate less effective Coping with Self and Coping with Environment.

Also examined was the prediction of the SMD subtypes on the effectiveness of coping. Positive correlations were seen between the subtypes SOR and SUR, and coping as indicated by the Adaptive Behavior Index: SOR/coping \(r_{(208)} = .25, p < .001\); SUR/coping \(r_{(208)} = .19, p < .001\). The two subtypes of SOR and SUR were found to be statistically significant in the prediction of coping: SOR \(F_{(1, 206)} = 13.19, p < .001\); SUR \(F_{(1, 206)} = 7.76, p < .01\). The subtype of sensory seeking was not found to be significantly correlated with coping and was therefore independent of coping \(F_{(1, 206)} = 1.55, p > .001\).

**The Relationship Between SMD and Occupational Performance**

**Hypothesis 2.1.** It was hypothesized that as the severity of SMD increases, quality of performance in everyday activities would decrease. Examining total scores on the ECF, SMD significantly predicts occupational performance \(F_{(1, 124)} = 6.13, p < .05\), when examining the ECF total score. The only section of the ECF that was not predicted by SMD was Social Interaction. Correlations ranged from .03 - .45 and \(R^2\) values, an indication of variance ranged from .00 - .21. Table 20 displays the results of the regression analyses.

Table 20

<p>| SMD Predicting Occupational Performance in Everyday Activities (ECF) – Regression Analyses |</p>
<table>
<thead>
<tr>
<th>Variable</th>
<th>(B)</th>
<th>(SE)</th>
<th>(\beta)</th>
<th>(t)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eval Completion Form ((F_{(1,124)} = 6.13, p &lt; .05))</td>
<td>.07</td>
<td>.03</td>
<td>.22</td>
<td>2.48</td>
<td>.05</td>
</tr>
<tr>
<td>Feeding ((F_{(1, 117)} = 30.15, p &lt; .001))</td>
<td>.03</td>
<td>.01</td>
<td>.45</td>
<td>5.49</td>
<td>.21</td>
</tr>
<tr>
<td>Self Care/Dressing ((F_{(1, 120)} = 8.86, p &lt; .01))</td>
<td>.01</td>
<td>.01</td>
<td>.26</td>
<td>2.98</td>
<td>.07</td>
</tr>
<tr>
<td>Sleeping ((F_{(1, 114)} = 3.91, p &lt; .05))</td>
<td>.01</td>
<td>.01</td>
<td>.18</td>
<td>1.98</td>
<td>.03</td>
</tr>
<tr>
<td>Toileting ((F_{(1, 114)} = 4.65, p &lt; .05))</td>
<td>.01</td>
<td>.01</td>
<td>.20</td>
<td>2.16</td>
<td>.04</td>
</tr>
<tr>
<td>Leisure Skills ((F_{(1, 119)} = 5.51, p &lt; .05))</td>
<td>.01</td>
<td>.01</td>
<td>.21</td>
<td>2.35</td>
<td>.04</td>
</tr>
<tr>
<td>Social Interaction ((F_{(1, 122)} = .11, p &gt; .05))</td>
<td>.00</td>
<td>.01</td>
<td>.03</td>
<td>.33</td>
<td>.00</td>
</tr>
</tbody>
</table>
Overall the sum total of all areas of everyday activities, as indicated by the ECF, was not strongly correlated with SMD ($r_{(126)} = .22; p < .05$). The area that showed the strongest correlation to SMD was Feeding ($r_{(119)} = .45; p < .01$). The remaining correlation coefficients ranged from .18 - .26, indicating weak relationships (Cohen, 1988). Based on these regression analyses, performance in daily activities appears to decrease as a function of SMD, therefore this hypothesis is confirmed. Additional analyses examined the subtypes of SMD and occupational performance.

The subtypes of SMD were examined in relation to occupational performance. Individual regression analyses were used for the total ECF score, as well as for each area. While SOR does not predict occupational performance as measured by the total ECF score ($F_{(1,210)} = 1.26, p > .05$), it does predict feeding ($F_{(1,201)} = 15.57, p < .001$) as indicated in Table 21. The correlation of SOR and Feeding was found to be weak ($r_{(203)} = .27; p < .01$) (Cohen, 1988).

Table 21

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$SE$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eval Completion Form (n= 212)</td>
<td>.02</td>
<td>.02</td>
<td>.08</td>
<td>1.12</td>
<td>.262</td>
</tr>
<tr>
<td>Feeding (n = 203)</td>
<td>.02</td>
<td>.00</td>
<td>.27</td>
<td>3.95</td>
<td>.000**</td>
</tr>
<tr>
<td>Self Care/Dressing (n = 203)</td>
<td>.01</td>
<td>.00</td>
<td>.12</td>
<td>1.75</td>
<td>.081</td>
</tr>
<tr>
<td>Sleeping (n = 194)</td>
<td>.01</td>
<td>.00</td>
<td>.11</td>
<td>1.49</td>
<td>.139</td>
</tr>
<tr>
<td>Toileting (n = 194)</td>
<td>.00</td>
<td>.00</td>
<td>.05</td>
<td>.63</td>
<td>.531</td>
</tr>
<tr>
<td>Leisure Skills (n = 203)</td>
<td>.01</td>
<td>.00</td>
<td>.12</td>
<td>1.76</td>
<td>.081</td>
</tr>
<tr>
<td>Social Interaction (n = 210)</td>
<td>.01</td>
<td>.00</td>
<td>.10</td>
<td>1.45</td>
<td>.148</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01

Similarly, SUR was not predictive of the total ECF score ($F_{(1,210)} = .75, p > .05$), however it was predictive of three areas; Feeding ($F_{(1,201)} = 4.02, p < .05$), Self-care/Dressing ($F_{(1,201)} =$
7.62, *p < .01*), and Leisure Skills (*F*₁, 201) = 8.32, *p < .01*) with weak correlations observed between the variables. The results are presented in Table 22.

Table 22

**SUR Predicting Occupational Performance in Everyday Activities (ECF) – Regression Analyses**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eval Completion Form (n= 212)</td>
<td>.04</td>
<td>.05</td>
<td>.06</td>
<td>.86</td>
<td>.389</td>
</tr>
<tr>
<td>Feeding (n = 203)</td>
<td>.02</td>
<td>.01</td>
<td>.14</td>
<td>2.01</td>
<td>.046*</td>
</tr>
<tr>
<td>Self Care/Dressing (n = 203)</td>
<td>.02</td>
<td>.01</td>
<td>.19</td>
<td>2.76</td>
<td>.006**</td>
</tr>
<tr>
<td>Sleeping (n = 194)</td>
<td>-.01</td>
<td>.01</td>
<td>-.07</td>
<td>-.94</td>
<td>.347</td>
</tr>
<tr>
<td>Toileting (n = 194)</td>
<td>.01</td>
<td>.01</td>
<td>.08</td>
<td>1.11</td>
<td>.268</td>
</tr>
<tr>
<td>Leisure Skills (n = 203)</td>
<td>.02</td>
<td>.01</td>
<td>.20</td>
<td>2.88</td>
<td>.004**</td>
</tr>
<tr>
<td>Social Interaction (n = 210)</td>
<td>-.01</td>
<td>.01</td>
<td>-.04</td>
<td>-.62</td>
<td>.535</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01

As with the others subtypes, SS was not predictive of overall occupational performance when examining the ECF total score (*F*₁, 210) = 1.05, *p > .001*), nor was it predictive of occupational performance in any of the activities examined. Results are presented in Table 23.

Table 23

**SS Predicting Occupational Performance in Everyday Activities (ECF) – Regression Analyses**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eval Completion Form (n= 212)</td>
<td>-.05</td>
<td>.05</td>
<td>-.07</td>
<td>-1.03</td>
<td>.307</td>
</tr>
<tr>
<td>Feeding (n = 203)</td>
<td>-.00</td>
<td>.01</td>
<td>-.01</td>
<td>-.10</td>
<td>.917</td>
</tr>
<tr>
<td>Self Care/Dressing (n = 203)</td>
<td>.00</td>
<td>.01</td>
<td>.03</td>
<td>.48</td>
<td>.634</td>
</tr>
<tr>
<td>Sleeping (n = 194)</td>
<td>.02</td>
<td>.01</td>
<td>.13</td>
<td>1.79</td>
<td>.075</td>
</tr>
<tr>
<td>Toileting (n = 194)</td>
<td>-.00</td>
<td>.01</td>
<td>-.03</td>
<td>-.36</td>
<td>.723</td>
</tr>
<tr>
<td>Leisure Skills (n = 203)</td>
<td>-.01</td>
<td>.01</td>
<td>-.08</td>
<td>-1.13</td>
<td>.259</td>
</tr>
<tr>
<td>Social Interaction (n = 210)</td>
<td>-.01</td>
<td>.01</td>
<td>-.07</td>
<td>-.97</td>
<td>.336</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01
Hypothesis 2.2. Occupational performance as measured by the CBCL was hypothesized to decrease as a function of SMD. Raw scores from the CBCL were used in all analyses. Sensory modulation disorder was found to be predictive of decreased occupational performance as indicated by the total competence score of the CBCL ($F_{(1,88)} = 6.14, p < .05$). The relationship was shown to be weak ($r_{(90)} = .26, p < .05$). No significant relationship was found between SMD and the individual sections of the CBCL, voiding the hypothesis that occupational performance would decrease as a function of SMD. Table 24 presents the results of the regression analyses.

Table 24

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$SE_B$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Competence (n= 90)</td>
<td>.04</td>
<td>.02</td>
<td>.26</td>
<td>2.48</td>
<td>.015*</td>
</tr>
<tr>
<td>Activities (n = 152)</td>
<td>.01</td>
<td>.01</td>
<td>.12</td>
<td>1.49</td>
<td>.140</td>
</tr>
<tr>
<td>Social (n = 152)</td>
<td>.01</td>
<td>.01</td>
<td>.06</td>
<td>.70</td>
<td>.487</td>
</tr>
<tr>
<td>School (n = 194)</td>
<td>.01</td>
<td>.01</td>
<td>.16</td>
<td>1.58</td>
<td>.117</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01

Examining the subtypes of SMD, results of regression analyses revealed that none of the subtypes was found to be predictive of occupational performance using the total competence score of the CBCL. Tables 25 - 27 display the results of the regression analyses.

Coping and Occupational Performance in Children with SMD

Hypothesis 3.1. Multiple regression was used to determine if sensory modulation and coping styles, from the Coping Inventory, were predictors of difficulties in everyday activities, as measured by the ECF total score. Only the presence of SMD ($r_{(104)} = .29, p < .01$) was found to be correlated with the dependent variable. Correlation coefficients are presented in Table 28.
Table 25

*SOR Predicting Occupational Performance in Everyday Activities (CBCL) – Regression Analyses*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Competence (n= 164)</td>
<td>.00</td>
<td>.01</td>
<td>.00</td>
<td>.04</td>
<td>.968</td>
</tr>
<tr>
<td>Activities (n = 248)</td>
<td>.00</td>
<td>.01</td>
<td>.03</td>
<td>.421</td>
<td>.674</td>
</tr>
<tr>
<td>Social (n = 247)</td>
<td>.01</td>
<td>.01</td>
<td>.05</td>
<td>.792</td>
<td>.429</td>
</tr>
<tr>
<td>School (n = 164)</td>
<td>-.00</td>
<td>.01</td>
<td>-.02</td>
<td>-.27</td>
<td>.785</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01

Table 26

*SUR Predicting Occupational Performance in Everyday Activities (CBCL) – Regression Analyses*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Competence (n= 158)</td>
<td>.04</td>
<td>.03</td>
<td>.12</td>
<td>1.49</td>
<td>.138</td>
</tr>
<tr>
<td>Activities (n = 248)</td>
<td>.02</td>
<td>.01</td>
<td>.11</td>
<td>1.68</td>
<td>.095</td>
</tr>
<tr>
<td>Social (n = 247)</td>
<td>.00</td>
<td>.01</td>
<td>.00</td>
<td>.04</td>
<td>.969</td>
</tr>
<tr>
<td>School (n = 164)</td>
<td>.01</td>
<td>.01</td>
<td>.11</td>
<td>1.37</td>
<td>.173</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01

Table 27

*S S Predicting Occupational Performance in Everyday Activities (CBCL) – Regression Analyses*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Competence (n= 158)</td>
<td>-.02</td>
<td>.03</td>
<td>-.05</td>
<td>-.64</td>
<td>.526</td>
</tr>
<tr>
<td>Activities (n = 248)</td>
<td>-.02</td>
<td>.01</td>
<td>-.07</td>
<td>-1.05</td>
<td>.294</td>
</tr>
<tr>
<td>Social (n = 247)</td>
<td>.01</td>
<td>.01</td>
<td>.05</td>
<td>.840</td>
<td>.402</td>
</tr>
<tr>
<td>School (n = 164)</td>
<td>-.01</td>
<td>.01</td>
<td>-.08</td>
<td>-.99</td>
<td>.324</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01

Overall the combination of these variables was not statistically significant ($F(7, 96) = 1.8, p > .05$).

The beta coefficients are presented in Table 29.
Table 28

*Areas of Self-care and Predictor Variables (N = 104) - Correlations*

<table>
<thead>
<tr>
<th>Variable</th>
<th>SMD</th>
<th>Prod Self</th>
<th>Active Self</th>
<th>Flex Self</th>
<th>Prod Env</th>
<th>Active Env</th>
<th>Flex Env</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECF Total</td>
<td>.287**</td>
<td>.155</td>
<td>.108</td>
<td>.113</td>
<td>.021</td>
<td>.139</td>
<td>.106</td>
</tr>
<tr>
<td>Predictor variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMD Raw Score</td>
<td>--</td>
<td>.286**</td>
<td>.216*</td>
<td>.232**</td>
<td>.235**</td>
<td>.306**</td>
<td>.378**</td>
</tr>
<tr>
<td>Self Productive</td>
<td>--</td>
<td>.713**</td>
<td>.773**</td>
<td>.730**</td>
<td>.576**</td>
<td>.740**</td>
<td></td>
</tr>
<tr>
<td>Self Active</td>
<td>--</td>
<td></td>
<td>.608**</td>
<td>.673**</td>
<td>.484**</td>
<td>.508**</td>
<td></td>
</tr>
<tr>
<td>Self Flexible</td>
<td>--</td>
<td></td>
<td></td>
<td>.653**</td>
<td>.546**</td>
<td>.712**</td>
<td></td>
</tr>
<tr>
<td>Env Productive</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td>.610**</td>
<td>.722**</td>
<td></td>
</tr>
<tr>
<td>Env Active</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.704**</td>
</tr>
<tr>
<td>Env Flexible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* *p < .05; ** p < .01

Table 29

*Summary for SMD and Coping Styles Predicting Performance in Areas of Self-care (N = 104) – Multiple Regression*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD Raw Score</td>
<td>.071</td>
<td>.027</td>
<td>.27</td>
<td>2.59</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Self Productive</td>
<td>1.42</td>
<td>1.31</td>
<td>.21</td>
<td>1.09</td>
<td>.280</td>
</tr>
<tr>
<td>Self Active</td>
<td>.28</td>
<td>1.07</td>
<td>.04</td>
<td>.26</td>
<td>.793</td>
</tr>
<tr>
<td>Self Flexible</td>
<td>.17</td>
<td>.94</td>
<td>.03</td>
<td>.18</td>
<td>.861</td>
</tr>
<tr>
<td>Env Productive</td>
<td>-1.71</td>
<td>1.18</td>
<td>-.24</td>
<td>-1.44</td>
<td>.153</td>
</tr>
<tr>
<td>Env Active</td>
<td>.70</td>
<td>.83</td>
<td>.12</td>
<td>.85</td>
<td>.396</td>
</tr>
<tr>
<td>Env Flexible</td>
<td>.59</td>
<td>1.08</td>
<td>-.10</td>
<td>-.54</td>
<td>.590</td>
</tr>
<tr>
<td>Constant</td>
<td>6.99</td>
<td>3.79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. R² = .12; F(7,96) = 1.83, p > .05*

**Hypothesis 3.2.** Multiple regression was used to examine the impact of two independent variables, SMD and coping, on competence as indicated by the CBCL scales, Activities, School, and Social. No correlations between independent and dependent variables were found, as shown in Table 30. However, the combination of variables was statistically significant (F(7,66) = 2.29, p
Table 30

Performance in Activities, School, and Social and Predictor Variables (N = 74) - Correlations

<table>
<thead>
<tr>
<th>Variable</th>
<th>SMD</th>
<th>Prod Self</th>
<th>Active Self</th>
<th>Flex Self</th>
<th>Prod Env</th>
<th>Active Env</th>
<th>Flex Env</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBCL Total</td>
<td>.210</td>
<td>.279</td>
<td>.222</td>
<td>.317</td>
<td>.264</td>
<td>.315</td>
<td>.169</td>
</tr>
</tbody>
</table>

Predictor variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>SMD</th>
<th>Prod Self</th>
<th>Active Self</th>
<th>Flex Self</th>
<th>Prod Env</th>
<th>Active Env</th>
<th>Flex Env</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD Raw Score</td>
<td>--</td>
<td>.270**</td>
<td>.283**</td>
<td>.269**</td>
<td>.353**</td>
<td>.366**</td>
<td>.325**</td>
</tr>
<tr>
<td>Self Productive</td>
<td>--</td>
<td>--</td>
<td>.764**</td>
<td>.741**</td>
<td>.753**</td>
<td>.668**</td>
<td>.734**</td>
</tr>
<tr>
<td>Self Active</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.639**</td>
<td>.728**</td>
<td>.610**</td>
<td>.668**</td>
</tr>
<tr>
<td>Self Flexible</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.683**</td>
<td>.632**</td>
<td>.774**</td>
</tr>
<tr>
<td>Env Productive</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.692**</td>
<td>.792**</td>
</tr>
<tr>
<td>Env Active</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.729**</td>
</tr>
<tr>
<td>Env Flexible</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01

< .05). The adjusted $R^2$ value for the model was .20, indicating that 20% of the variance of total score on the CBCL was explained by this model. Table 31 displays the beta coefficients. Only Coping with Environment along the Rigid/Flexible continuum was shown to contribute to competence on the Activities, School, and Social scales of the CBCL.

Table 31

Summary for SMD and Coping Styles Predicting Performance in Activities, School and Social (N = 74) – Multiple Regression

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD Raw Score</td>
<td>.019</td>
<td>.021</td>
<td>.111</td>
<td>.921</td>
<td>.361</td>
</tr>
<tr>
<td>Self Productive</td>
<td>.400</td>
<td>.847</td>
<td>.099</td>
<td>.472</td>
<td>.638</td>
</tr>
<tr>
<td>Self Active</td>
<td>-.289</td>
<td>.826</td>
<td>-.065</td>
<td>-.350</td>
<td>.728</td>
</tr>
<tr>
<td>Self Flexible</td>
<td>1.24</td>
<td>.652</td>
<td>.363</td>
<td>1.90</td>
<td>.062</td>
</tr>
<tr>
<td>Env Productive</td>
<td>.705</td>
<td>.903</td>
<td>.163</td>
<td>.781</td>
<td>.438</td>
</tr>
<tr>
<td>Env Active</td>
<td>1.01</td>
<td>.641</td>
<td>.276</td>
<td>1.58</td>
<td>.118</td>
</tr>
<tr>
<td>Env Flexible</td>
<td>-1.87</td>
<td>.827</td>
<td>-.507</td>
<td>-2.26</td>
<td>.027</td>
</tr>
<tr>
<td>Constant</td>
<td>8.31</td>
<td>2.66</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $R^2 = .20; F_{(7,.66)} = 2.29, p < .05$
Sensory Modulation as a Moderator of Coping and Occupational Performance

Hypothesis 4.1. The moderating effect of sensory modulation on occupational performance, as measured by the ECF total score, was examined using multiple hierarchical regression. The analysis consisted of two blocks. In the first step, coping styles were entered, and in the second step, the interaction of coping and sensory modulation, raw score of SSP, was entered. The interaction of coping styles and modulation was not significant, therefore the hypothesized model of modulation is not confirmed. Results are displayed in Tables 32 and 33.

Table 32

*Coping with Self and Sensory Modulation on Occupational Performance as Measured by ECF – Multiple Hierarchical Regression*

<table>
<thead>
<tr>
<th>Predictors</th>
<th>β</th>
<th>$R^2$</th>
<th>$R^2$ change</th>
<th>Sig F change</th>
</tr>
</thead>
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<tr>
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<tr>
<td>Coping with Self</td>
<td>.029</td>
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<td></td>
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<tr>
<td>Modulation</td>
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<td>.192</td>
<td>.192</td>
<td>.000</td>
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<tr>
<td>Step 2</td>
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<tr>
<td>Coping with Self</td>
<td>-.457</td>
<td></td>
<td>.248</td>
<td>.688</td>
</tr>
<tr>
<td>Modulation</td>
<td></td>
<td>.339</td>
<td>.192</td>
<td>.001</td>
</tr>
<tr>
<td>CopingwithSelf x Modulation</td>
<td>.736</td>
<td></td>
<td>.197</td>
<td>.387</td>
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Table 33

*Coping with Environment and Sensory Modulation on Occupational Performance as Measured by ECF – Multiple Hierarchical Regression*

<table>
<thead>
<tr>
<th>Predictors</th>
<th>β</th>
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<th>$R^2$ change</th>
<th>Sig F change</th>
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<td>Modulation</td>
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<td>Coping with Environment</td>
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<td>Modulation</td>
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<tr>
<td>CopingwithEnv x Modulation</td>
<td>.339</td>
<td></td>
<td>.192</td>
<td>.001</td>
</tr>
</tbody>
</table>
**Hypothesis 4.2.** Multiple hierarchical regression was used to examine the moderating effect of sensory modulation on occupational performance as measured by the CBCL. The interaction of coping styles and modulation was not significant. The hypothesized model of moderation is not confirmed. Tables 34 and 35 present the results.

Table 34

*Coping with Self and Sensory Modulation on Occupational Performance as Measured by CBCL - Multiple Hierarchical Regression*

<table>
<thead>
<tr>
<th>Step 1</th>
<th>β</th>
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<th>$R^2$ change</th>
<th>Sig F change</th>
</tr>
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<tr>
<td>Coping with Self Modulation</td>
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<td>.017</td>
<td>.139</td>
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<td></td>
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<tr>
<td>Coping with Self Modulation</td>
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<td>-.214</td>
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<td>Coping with Self x Modulation</td>
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<td>.404</td>
<td>.002</td>
<td>.703</td>
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</tbody>
</table>

Table 35

*Coping with Environment and Sensory Modulation on Occupational Performance as Measured by CBCL - Multiple Hierarchical Regression*

<table>
<thead>
<tr>
<th>Step 1</th>
<th>β</th>
<th>$R^2$</th>
<th>$R^2$ change</th>
<th>Sig F change</th>
</tr>
</thead>
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<td>Coping with Environment Modulation</td>
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<td>-.008</td>
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<td>Step 2</td>
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<tr>
<td>Coping with Environment Modulation</td>
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<td>Coping with Environment x Modulation</td>
<td>.332</td>
<td>.332</td>
<td>.001</td>
<td>.703</td>
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Chapter 5: Discussion of Findings

Within the context of everyday routines there is evidence indicating that SMD compromises a child’s ability to maintain attention, activity, arousal, and emotional responses in order to meet the demands of a given task (Bar-Shalita et al., 2008; Lane, 2002; White, et al., 2007; Schaaf & Nightlinger, 2007, Schaaf, et al., 2010b; Williamson & Anzalone, 2001). However, specific links between SMD, coping, and occupational performance have not been well established. This study examined the relationship between SMD, coping and the impact on occupational performance.

A high percentage of children included in this sample were found to have SMD as indicated by total scores on the SSP. This finding is not surprising given that parents of the children in this study sought occupational therapy services using a sensory integration approach and chose services at OTA Watertown. What is surprising about the frequency of occurrence of SMD in this sample is that children with ASD were excluded and most of the children (63%) did not have a medical diagnosis such as ADD/ADHD. Discussion in recent literature suggests SMD, particularly the SOR subtype, is a stand-alone diagnosis (Ben-Sasson, et al., 2009; Reynolds & Lane, 2011). The identification of a large proportion of children in the current sample were found to have SMD, in the absence of a medical diagnosis, lends support to the consideration of SMD as a stand-alone diagnosis.
As noted in Chapter Two, SMD can be reflected in three patterns of responsivity, SOR, SUR, and SS (Miller, et al, 2007). Sensory over-responsivity is well-represented on the SSP, with several sections examining over-responsiveness across several sensory domains: Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, and Visual/Auditory Sensitivity. The Low Energy/Weak section appears to describe SUR, however all items are focused on decreased proprioceptive responses, so if decreased responsivity is present in other sensory domains, it is not captured on the SSP. Items on the Underresponsive/Seeks Sensation section are thought to primarily reflect SS. Most of the items in this section are related to seeking vestibular and proprioceptive input with some items having a tactile and auditory component. It is important to keep in mind that the SSP is good at identifying SMD, however it does not discriminate SOR, SUR, and SS, and within this particular sample of children, overlap between the three subtypes of SMD is apparent and should be kept in mind in interpretation of the data. However, examining sections of the SSP indicative of the various subtypes of SMD adds to our knowledge of SOR and allows us to begin to characterize SUR and SS.

In the current literature, sensory over-responsivity is reported as having a higher incidence, has received the most attention in occupational therapy research, and is thought to be more easily identifiable (Ben-Sasson, et al, 2009). In the studies examining SOR, it is difficult to know if the samples of children had any co-occurring SUR or SS, as the studies only examined SOR, using the SensOR, which is intended to identify only over-responsivity (Schoen, et al, 2008b). Sensory under-responsivity is more difficult to recognize and may go unnoticed longer (Miller, et al., 2007; Schaaf et al., 2010b). Children with SUR have inadequate sensory processing and require increased intensity and frequency of sensory stimuli to generate a
response (Dunn, 1999; Hanft, et al, 2000; Miller et al, 2007). Children may be described as unmotivated, lethargic, inattentive, apathetic, and self-absorbed, with their behavior not being disruptive. With these behaviors being less obvious, it may be that the prevalence of SUR is more difficult to recognize and therefore, under-reported. In contrast to SUR behaviors, children with SS are described as very active, seeking extreme amounts of sensory input (Dunn, 1999; Miller, et al, 2007). This subtype of SMD may be under-reported as well as these children may be labeled as ADHD given their level of activity.

In this study, children with SMD demonstrated higher incidences of SS (63%) and SUR (57%) relative to SOR (48%). Further, substantial overlap between subtypes was found in that over 49% of this sample were identified to have two or more subtypes of SMD. To date there have been no large-scale studies to examine the co-existence or overlap of the three subtypes of SMD, so the findings of this study are unique. This outcome is interesting in light of Miller et al’s., (2007) proposition that sensory seeking may co-occur with SOR as children may seek sensory information from one domain to compensate for SOR in a different sensory domain. Current analyses did not show a statistically significant relationship between SOR and SS, with only about 15% of the children in this sample meeting criteria for both SOR and SS on the SSP. However while not statistically significant, even 15% may be clinically important. Further, while, children with ASD were excluded from this study, similar patterns of over- and under-responsivity and sensory seeking have been found in samples of children with autism (Baranek et al, 2006; Schoen, et al, 2008a; Tomchek & Dunn, 2006). Perhaps the co-occurrence of sensory responsivity patterns are more a function of SMD than a function of a specific diagnosis such as of ASD. Additional investigation is warranted.
Major Findings

**SMD and Occupational Performance.** Grounded in the work of Ayres (1972; 1972/2005), Miller et al.’s. (2007) and Dunn’s (1997, 2007) models of sensory modulation dysfunction are currently employed within the practice of occupational therapy. Both models postulate that a child’s behaviors are related to sensory integration and processing, and that with dysfunction atypical behaviors are observed and disruptive to occupational performance. Successful engagement in occupations of childhood is occupational performance. While the construct of occupational performance is not explicit in either model, Ayres’ original work and both later models clearly describe behaviors arising from faulty sensory integration and processing as impacting a child’s ability to meet task demands that are inherent in everyday activities (Ayres, 1972/2005; Dunn, 1997; Dunn, 2007; Miller et al, 2007).

Findings from this study lend support to these relationships. Occupational performance for the children in the current study was derived from the ECF and the Competence Scales of the CBCL. The ECF captures the child’s level of difficulty with the self-care activities, Feeding, Self-care/Dressing, Sleeping, and Toileting, as well as Leisure Activities and Social Interaction, all pieces of Activities of Daily Living Skills, one area of occupation defined by the OT Practice Framework (AOTA, 2008). This form is completed by the evaluating therapist as the last component of comprehensive assessment at OTA Watertown. The therapist determines the rating based on information from parent report, the child’s performance, and clinical observations. The Competence Scales of the CBCL measure competence in the areas of Activities, School, and Social. The CBCL is a parent-report measure. Scores on each scale are derived from the caregiver’s report of quantity of an activity as well as participation.
When examining only children with SMD, those who scored in the Probable or Definite Difference ranges on the SSP, five areas of the ECF were found to be significantly correlated with scores on the SSP: Feeding, Self-care/Dressing, Toileting, Sleeping, and Leisure Skills.

It is not surprising that Feeding was strongly correlated with SMD as feeding is a multi-sensory task, involving several sensory systems as well as the motor system. Feeding difficulties in the current study were shown to be linked with SOR. Currently there are no studies that have examined SMD in relationship to feeding in children with only SMD, or feeding in relationship to other diagnoses represented in this study. However, the finding of feeding linked to SOR is consistent with research documenting a high occurrence of feeding difficulties in children with autism, who also tend to have high over-responsive patterns of behavior (Baranek, et al., 2006; Schoen, et al., 2008a; Tomchek & Dunn, 2007). In addition to supporting the link between feeding and SOR, the current study supports an association between feeding and SUR, but not between feeding and SS. This relationship adds to our knowledge of occupational performance and SMD, and has not been addressed in other investigations.

Examining the items on the SSP reflected in the SUR category reveal that they are indicative of decreased proprioceptive function through the larger joints of the body, leading to difficulties with perception of the body in space. There is much proprioceptive input in feeding, with jaw movements such as chewing, grinding, and swallowing. Feeding difficulties in children with SUR may occur as a result of inadequate trunk stability to produce and grade fine jaw movements required to manage a variety of food textures. Once food is in the mouth, a child with SUR may have difficulty controlling oral musculature to manipulate a bolus in the mouth or to keep food in the mouth.
Self-care/Dressing, Toileting and Leisure Skills tasks were also significantly correlated with SMD, reflecting that in this study, children with SMD showed poorer abilities in meeting the daily demands of these tasks. Given the variety of task demands, sensory modalities associated with each, frequency of performance, and attention to detail it seems prudent to examine these areas in relation to SOR, SUR, and SS.

It is interesting to note that while Toileting was found to be associated with SMD overall, it had no particular relationship with any of the three subtypes. Toileting is a multi-sensory activity and behaviors associated with difficulty in toileting may be suggestive of any of the three subtypes. For example, a child with SOR who may be sensitive to tactile stimuli may show difficulties with toileting as it involves pulling clothing up and down. On the other hand, a child with SUR may not be responsive to the internal cues to eliminate. This is an area that is ripe for further investigation.

Self-care/Dressing tasks were associated with only SUR, not SOR or SS. Self-care/Dressing tasks usually occur once a day in the morning, a time when children with SUR may not have had much opportunity to “activate” their systems for appropriate attention to task and sensation to complete the task. Coupling this with typical family morning routines that may be busy and fast-paced, parents may rate children with SUR as performing poorly with dressing. From a clinical perspective there is logic in this finding that these children would have difficulty with the tasks requirements of morning dressing routines, as children with SUR are described as slow to respond to sensory stimuli, lack awareness, are inattentive, and unmotivated (Dunn, 1999, Hanft et al, 2000; Miller et al, 2007). The same reasoning may explain the finding that Leisure Skills was associated with only SUR, particularly for children with SUR involved in team activities, where at times they may be removed from immediate engagement in the activity.
Think of an outfielder in baseball or a soccer player that must wait to receive the ball. If not immediately engaged in action, receiving intense and frequent sensory stimuli, children with SUR may become disengaged from the action. Certainly information on the types of leisure activities in which children with SUR prefer would help to further understand this relationship.

It is most surprising that all areas of the ECF were not associated with SMD given the high percentages of difficulties in each area reflected in the whole sample (Table 17). In examination of the variance of modulation that contributes to occupational performance, the percentage was small, 0% - 21% (Table 10), indicating that there are other factors that are impacting this relationship. Because this sample was drawn from a clinical population seeking occupational therapy intervention using sensory integration, it is quite possible that other types of sensory processing disorders are influencing a therapist’s ratings on the ECF, and the range of sensory processing disorders should be considered. Recall from Miller, et al’s (2007) model (Figure 4) that SMD is one of three types of sensory processing disorders. The two remaining types, Sensory Discrimination Disorder (SDD) and Sensory-Based Motor Disorder (SBMD) have characteristics that would also influence occupational performance.

The ability to discriminate quality, similarities, and differences of sensory stimuli are impaired by SDD (Miller, et al., 2007). As with SMD, various sensory modalities can be impacted. As an example, when the proprioceptive, tactile, and/or vestibular systems are compromised by SDD, a child may appear clumsy and less competent in motor activities, and may also require more time to process various aspects of a sensory activity. This is a very similar presentation to what was previously described for SUR. Sensory Discrimination Disorder has been hypothesized to commonly co-occur with SUR, with the combination of the two resulting in motor planning deficits or dyspraxia (Miller, et al., 2007).
Dyspraxia, a subtype of SBMD, is the compromised ability to determine, plan, and execute a novel action (Miller, et al., 2007). In performance of daily occupations, children with dyspraxia have been reported to have difficulty with fasteners and clothing, and handwriting (May-Benson, Ingolia, & Koomar, 2002). These difficulties are likely to be reflected in a therapist’s perception of inadequate performance across many areas of the ECF. Postural disorder, the other type of SBMD through to be another result of inadequate sensory processing. A child with a postural disorder may appear clumsy and unable to meet the demands of the environment or a task due to postural instability. As with SDD, clinicians identify overlap of SBMD and the subtypes of SMD, particularly SOR and SUR. Given the small percentage of variance of occupational performance that was accounted for by modulation, poor sensory discrimination and/or sensory based motor disorders should be considered as factors contributing to the variance of occupational performance. Miller et al.’s. (2007) model appears to identify distinct types of sensory processing disorders, however results from this study point to the possibility of multiple types of sensory processing dysfunction contributing to decreased occupational performance. This is certainly an area that would benefit from future study.

It appears that there is a sub-clinical group within the sample, children without SMD, that experience difficulties in some everyday activities. This may be explained by the mean young age of the children included in this dataset, who perhaps are in the process of mastering self-care tasks that are performed on a daily basis. While the finding that Feeding was linked with SOR is not surprising, it was most surprising to find that SOR was not predictive of Sleeping. Based on Dunn’s model (1997; 2007) sleep disturbances appear to be associated with SOR, and there have been high instances of sleep disturbances in children with ASD with a potential association with poor sensory modulation (Allik, et al., 2006; Honomichl, et al., 2002; Reynolds & Lane, 2011;
Shocat, et al., 2009). Reynolds et al. (2011) demonstrated a relationship between sleep and SOR in both children with ASD and children with no medical diagnosis. It is important that the current sample excluded children with ASD, which may have made it more challenging to identify the relationship between SOR and sleep behaviors. The relationship between sleep and SOR in the current study is not consistent with what has been previously reported. In the current study, Sleeping is included in the ECF, which is completed by the evaluating therapist, based on information gathered through clinical observations and history reported by the parent, thus making it unclear which party is actually identifying sleep as a problem. It might be that therapists are identifying sleep problems whereas parents are not. In interviews, parents of children with SMD were asked to identify their occupational performance goals for treatment and comment on actual outcomes (Cohn, 2001; Cohn, et al, 2000). What parents identified was a desire for their child to “fit in” at school and in the community, improved ability for their child to regulate his or her own behavior, and improved self-confidence as expectations for treatment of SMD. In the later study, Cohn (2001) found that parents perceived improvement in their child’s ability to participate in self-care activities, enhanced participation in activities, and improved self-worth after occupational therapy treatment for SMD. While these studies were not exclusive to SOR, parents did not appear to identify sleep as a problem area for seeking intervention or as an outcome of intervention.

While poor modulation was suggestive of less than optimal occupational performance, as reflected by some everyday activities on the ECF, competence in occupational performance as measured by the competence scales of the CBCL yielded different results. The Competence Scales of the CBCL assess a child’s proficiency in three areas of occupation, Activities, School, and Social. A correlation was found between the overall competence score and SMD, in other
words lower competence scores were noted for children who scored within the Probable Difference and Definite Difference ranges of the SSP, however overall children in this study were considered by their caregivers to be competent in the activities in which they engage. This finding in itself is not unexpected as low percentages of difficulty were indicated for all three scales and Total Competence Score of the CBCL (Table 18), and there was much missing data.

Individual competence scales consist of caregiver report on the number of activities, time engaged in activity in relation to peers, and how well the child performs each reported activity in relation to peers. All of these are a caregiver’s perception of a child’s competence. It seems likely that parents may be selecting only activities in which they feel their young child will be able to successfully engage and participate, and this may be contributing to the lack of findings from the CBCL. For this sample, little is known about the qualities of activities reported on the Activities scale, i.e. are activities more sedentary versus active play? What type of play is characteristic of the reported activities, solitary versus associative or cooperative play? For example, sedentary play might include activities such as video games, constructing with blocks, coloring, etc… versus playing on the playground, or engaging in kickball with other children or a similar goal-oriented group activity. Children with SMD may prefer to engage in activities that limit sensory experiences, or for those children that are sensory seeking, may choose activities much sensory input. Bundy, et al., (2007) found that children with SMD were just as playful as typically developing children even though they tended to engage in more sedentary play. Examination of the qualities of activities may yield valuable information on types of activities in which a child with SMD chooses to engage. Additionally, difficulties within the School scale of the CBCL may not have been as apparent given the young age of the sample. Modifications may be made within the school setting, as children of this age are typically just entering the school
system and allowances may be made for adjusting to the new role of student in the occupational performance area of school.

The Activities scale of the CBCL consists of parent report of how many sports, activities, hobbies, games, and chores a child engages in as well as participation and quality of performance relative to peers. This is similar to Leisure Skills from the ECF, which includes pleasurable, avocational activities, such as sports and crafts, that are engaged in for fun. It is interesting to note that while the SMD was not correlated with the Activities scale of the CBCL, SMD was significantly correlated with Leisure Skills from the ECF. The ECF is a measure that is completed by the evaluating therapist at the completion of standardized and clinical assessment. The CBCL is a parent report measure. The discrepancy here may be related to the therapist’s evaluation of a child’s ability to engage in activities and be playful. Playfulness is not a construct of the CBCL, and would be a construct that is evaluated by a therapist.

**SMD and Coping.** Given the large percentage of children with SMD in this sample, it seemed likely that difficulties with coping would exist. Interestingly this was not found to be the case when the published cut-point score of 2.5 was used. Instead when a higher cut-point, representing $\pm 1$ SD from the mean was used, 34% of the children with SMD having difficulties with coping (Table 15). In addition, a higher percentage showed difficulty in Coping with Self, indicating that deficits in coping resources may not be global, and that children with SMD may have differing abilities in Coping with Self and Coping with Environment. Coping Inventory scores within the range of 2.9 – 3.1 indicate effective coping in similar situations (Zeitlin, 1985). In this study, most of the children with SMD would be considered to have mild deficits in coping, which is supported by the finding of many more children with SMD showing difficulties in coping when the higher cut-points were used. When considering coping, SMD, and
occupational performance, the findings of this study did not support a strong relationship between these three variables. It may be that everyday routines of the young children in this sample, are not varied and therefore their coping abilities have not yet been challenged, or it may be that a child’s resilience assists him or her in persisting with and overcoming stressful situations.

Recall that resilience is the successful adaptation to stressful events, and is the result of coping responses (Compas, et al., 2000; Werner, 1989). Despite challenges presented by chaotic environments, chronic strains, and negative life experiences, children have been found to be resilient based on the presence of protective factors (Buckner, Mezzacappa, & Beardslee, 2003). Protective factors of resilient children include: family support, parental monitoring, an established close bond with someone outside the family, average intelligence and communication, and having an internal locus of control (Buckner, et al., 2003; Werner, 1989). Many of these protective factors appear to be intact for the children included in this study given that ninety percent of the children in the sample were from a two-parent household and sixty three percent of the sample had no diagnosis identified at intake. Despite the large percentage of the children with SMD in this sample, the presence of inadequate coping is relatively small, which may be in large part due to the resilient capacity of these children.

**SMD as a Moderator of Coping and Occupational Performance.** Moderating variables affect the strength of the relationship between independent and dependent variables, that is the relationship between the two variables changes as a function of the moderator variable (Baron & Kenny, 1986). It was proposed that sensory modulation acts as a moderator in the coping process. The interaction between coping styles and modulation was not found to be
significant, therefore sensory modulation does not seem to be a moderator of occupational performance as hypothesized.

**Relationship of Modulation, Coping and Occupational Performance.** If modulation is not a moderator of coping and occupational performance, is it possible that modulation acts as a mediator of this relationship? Returning to the Baron and Kenny (1986) classic reference for the definition of moderating and mediating variables, moderating variables affect the strength of the relationship between independent and dependent variables, while mediating variables explain how or why effects occur between independent and dependent variables. In a model of mediation as shown in Figure 9, a relationship exists between coping and occupational performance and sensory modulation is introduced as an intervening variable influencing occupational performance.

*Figure 9 Mediating Model*

Were sensory modulation a mediator of the relationship between coping and occupational performance, its introduction into the above model should significantly account for variations in occupational performance, such that there is no longer a significant relationship between coping and occupational performance (Baron & Kenny, 1986). From the current analyses, a mediating model was unconfirmed as small proportions of variance were attributed to sensory modulation.
The absence of moderation or mediation continues to beg the question, what is the nature of the relationship between sensory modulation, coping and occupational performance.

Returning to Williamson & Szczepanski’s (1999) model of coping, a cognitive behavioral model that views coping as a four-step process (Figure 6). The first step involves identification of an event as stressful, with the coping process being initiated. Once the coping process is initiated, the child determines how to manage the stressor with available coping resources, the second step. In the third step, a coping effort is produced, and in the fourth step, the effectiveness of the coping effort is evaluated. If the effort was effective, the stress is eliminated or reduced and the coping process ceases, if not another coping process is initiated. Figure 10 introduces a revised version of William & Szczepanski’s (1999) model of coping based on the results of the current study. This is depicted in the unshaded boxes of Figure 10.

Figure 10 The Coping Process of Children with Sensory Modulation Disorder

It was hypothesized that sensory modulation would impact the coping process early, in Step 1 and most likely prior to Step 1. This differs from the original model of Williamson & Sczezpanski (1999), in which sensory modulation contributed to the coping process in Step 2.
The revised model indicates that for children with SMD, previous experience with sensory stimuli contributes to his or her beliefs and values, which could lead to the development of potentially faulty internal resources. These internal resources then play a part in how a child determines meaning of a sensory experience. For children with SMD, sensory experiences are determined to be stressful. This event that has now been identified as stressful, leads to the development of an action plan and execution of coping efforts that are less than effective, leading to decreased occupational performance. However, the results of the current study did not definitively identify the role of sensory modulation in the coping process. This process certainly warrants further investigation. Perhaps different assessments would more accurately identify the role that sensory modulation plays in the coping process. The current analyses did not lend support to sensory modulation as a moderator of coping and occupational performance, which has been removed from Figure 10, however there continues to be sufficient evidence to propose this as a model for the complex relationship of sensory modulation, coping and occupational performance. The use of different assessments may assist with identifying this relationship more clearly.

Coping skills and sensory modulation vary in the same direction, as noted by positive correlation between these two variables. From this it can be assumed that children with SMD do not possess the underlying resources (Coping with Self) to meet demands, utilize flexible strategies, and utilize human and environmental characteristics (Coping with Environment) to facilitate occupational performance. Children with SMD showed more deficits in Coping with Self versus Coping with Environment and even more than coping in general as measured by the ABI. This suggests that adequate processing and integration of sensory input may play a larger role in coping than either environmental considerations or a combination of the two.
This conceptualization of modulation, coping and occupational performance becomes significant when considering treatment of SMD. One implication is the point at which intervention should occur. At the neurophysiological level, sensory processing and integration can be shaped by the provision of appropriate challenges as described by Ayres (1972; 1972/2005), then the process of coping would be more adaptive and occupational performance successful. Also the teaching of coping skills may provide a child with SMD greater and improved resources for coping with environmental and internal stressors. Inherent in this is that coping skills and resources be evaluated prior to initiation of treatment, and absolutely necessary to evaluate a child’s previous experience with sensory stimuli, and beliefs and values that have emerged from experience.

**Additional Findings**

Some incidental findings from this study included those related to subtypes and the characterization of subtypes. First, the data revealed an overlap between subtypes of SMD. It is evident from analyses that children with SMD may have co-occurrence of any combination of the three subtypes. The combinations of SOR and SUR, and SUR and SS were the most likely, however specific patterns are not evident. As discussed earlier, there is evidence from the literature for the combination of SOR and SS, although this was not found to be the case with the current analyses.

Across the three subtypes of SMD, children with SOR and SUR appeared to have more difficulty in particular areas of occupational performance, while children with the subtype of SS seem to have better performance. Much less is known about SS, and it is identified to a lesser extent than the other two subtypes. Children with any of the three subtypes appear to do well in some aspect of activities, with children with SOR appearing to manage well in school. The
school environment tends to be more predictable for a child, so children with SOR would do well in this arena. This is an area that might be expected to present challenges for a child with SS, however from this analyses it was discovered that children with SS appear not to have difficulties with occupational performance in school. This seems to be in contrast to what Miller, et al., (2007) discuss in relation to SS. Sensory seeking may occur as the result of a child attempting to increase his level of arousal or to in an effort to gain sensory input when reduced proprioception is perceived. These behaviors would be expected to be disruptive to a child’s context and are certainly disruptive to a child’s ability to attend. It should also not be assumed that children with SS have adequate coping. Dunn’s (1997; 2007) model of sensory processing describes that children with SS use active strategies in an attempt to compensate for their neurological threshold, making it seem very unlikely that children with SS have adequate coping resources to manage their environments and personal needs. What has been hypothesized about SS was not supported by the findings of this study. SS was not predictive of occupational performance or coping, which is not consistent with how SS has been characterized.

There appeared more similarities between SOR and SUR. Both Coping with Environment and Coping with Self were related to SOR and SUR, indicating that children with SOR or SUR both appear to utilize a variety of coping strategies in managing their environments as well as managing their personal needs and the use of coping resources improves as sensory modulation is improved.

Limitations

Most of the limitations of this study revolve around the demographics of the dataset, resulting in a need for caution in generalizing findings. Children included in this dataset in general can be described as being Caucasian, from a two-parent household, with parents who are
most likely to hold a graduate or doctoral degree. This is in stark contrast to demographics reported by the United States Census Bureau for the country. The population of the United States is composed of 72% Caucasian, 16% Hispanic, 13% Black, with smaller percentages of Asian (5%) and American Indian (.9%) (U.S. Census Bureau, 2011). Ethnicity for this dataset was composed of 91% Caucasian with 7% representing Black, Hispanic, Asian and Native American. The percentage of children with married parents for this dataset was 90%, with 6% being unmarried, divorced, widowed, or single. No data on family status was given for the remaining 4%. Data for children living in single-parent homes, was reported to be 35% for the national average and 31% for the state of Massachusetts (The Annie E. Casey Foundation, 2012). With regards to educational achievement, 10.3% of the United States population holds an advanced degree, with 16.4% of the population of Massachusetts holding an advanced degree, while in this dataset 53% of mothers and 56% of fathers were reported to hold an advanced degree (U.S. Department of Commerce, 2012). This dataset is homogenous with respect to race and parents’ educational level, and children were not recruited for inclusion in data collection, rather their parents sought services through OTA Watertown. The discrepancies in demographics limit the ability to generalize findings to the larger population of children in the state of Massachusetts or across the United States, but they do support a need to examine a more representative sample.

Fifty six percent of children in this sample showed SMD on the SSP. This is a very high percentage compared to previous studies, which have shown levels of SMD to be around 14% - 17% (Ahn, et al., 2004; Reynolds, et al., 2008). Ahn, et al’s., (2004) study was not as diverse as the population of the United States in terms of race and educational level of parents. Reynolds, et al’s., (2008) sample were children attending a Head Start program in which 80% of the
children lived below the poverty line and 80% were from single-family households. It should also be noted that this study examined SMD exclusively, and that does not preclude a diagnosis of SPD. Miller et al., (2007) identified three categories of SPD: SMD, Sensory-Based Motor Disorder, and Sensory Discrimination Disorder (Figure 4). It is possible that SMD could occur with another category, or that some children in this study may another category of SPD, but not SMD specifically. This was beyond the scope of the current study. The high occurrence in SMD in this study points to the self-selection of the sample. Despite this self-selection, this is a large dataset with multiple pieces of information, which allows for in-depth study of SMD.

The mean age of the dataset is 6 years, 8 months. This is a relatively young age and at this time, many children may still be reliant upon their parents or other caregivers for success. Children of this age may still require some assistance and supervision to complete self-care activities (Shepherd, 2012). In the school setting, children this age may appear more successful as there may be a predictable daily routine, and accommodations are being made as a young child adapts to this new occupation. With regards to participation in activities outside school and the home, it may be that parents have controlled activities in which their children participate, and therefore their child would have limited opportunity for failure or would not be included in activities that may pose some degree of difficulty. A broader perspective on occupational performance would be gleaned with a somewhat older sample.

The assessments used in this study must also be examined. Likert scales are the basis for measurement on the SSP, the Coping Inventory, and the CBCL. Likert scales are widely used to quantify behavior, attitudes and opinions, as responses usually indicate the degree of agreement or disagreement with a proposed statement (Hulley, Cummings, Browner, Grady, & Newman, 2001; Polit & Beck, 2008). A respondent’s choice receives a numerical score. Because the
responses are on an agree/disagree continuum, there is no regular, predictable interval between the scores, rather scores are ordinal. In summing responses of individual Likert scores to obtain a total score, information may be lost at the item level, which could potentially reduce the power to determine interaction effects (Russell & Bobko, 1992). The use of Likert scales requires the respondent to choose a particular rating that is most appropriately reflective of their child’s behavior. At issue with this method is that perhaps a behavior is present in one environment or situation, and not in another. Likert scales are widely used response method on assessments, and can be a more “friendly” manner of gathering information (Hinojosa, et al., 2010).

The SSP, Coping Inventory, and CBCL are all three, parent report measures. In the past the usefulness of parent report measures have criticized as parents have been thought to over-estimate their child’s behavior or not interpret behaviors accurately (Long, 1992). On the other hand, caregiver report is thought to provide personalized and individualized responses, which may include context and supports that are available to a child (Hinojosa, Kramer, & Crist, 2010). Current models for service delivery include parents as an integral part of a child’s evaluation and treatment.

While the SSP has been used much in recent research, use of the Coping Inventory and CBCL is very limited. Based on a review of several databases, neither the Coping Inventory nor the Competence Scales of the CBCL have widespread use in research. The Syndrome and Total Problem Scales of the CBCL have been used extensively in research, so the utility and validity of the Competence Scales as a research tool is unknown. The Coping Inventory is not acknowledged in two separate articles that discuss the definition of coping, and include a review of various instruments used to assess coping (Compas, et al., 2001; Skinner, et al., 2003). Perhaps indicating that the Coping Inventory is not thought to be a useful measure of coping or is
out-dated, as the line of research on coping has continued to evolve since the Coping Inventory was created in 1985. However, reliability and validity data are available for both the CBCL and Coping Inventory, indicating that they are sound instruments for use in evaluation.

Responses on the CBCL seem to indicate a bias towards high performance in activities. In this geographic region of the country, children are expected to and frequently participate in sports activities (T. May-Benson, personal communication, March 28, 2013). In addition, many parents reported a high number of activities for their children as well as adequate performance. It may be that on this particular assessment, parents have not rated their child accurately.

As is the case with most existing data set, missing data was reported for all assessments. The SSP was missing scores for 24% of the sample. For sections of the ECF, 19% - 25% of data were missing. The CBCL had the highest percentages of missing data, perhaps accounting for the failure to find a significant relationship between competence in occupational performance and SMD in the current study. Missing data would be expected on the School scale as school activities are not reported for children below the age of 5 years, however on the Social scale 53% of data was missing. For the overall total competence score on the CBCL, 39% of the data was missing. In addition to 20% of data missing on the Coping Inventory. Analyses showed no pattern to the missing data. Despite the missing data, the amount that was present was sufficient enough for meaningful analyses and interpretation.

Conclusions

Implications for Research. The SSP is a useful tool for identifying SMD, however information from this is limited and in order to deepen our understanding of SMD, subtypes must be examined separately and in relationship to each other. From this study data suggest that SOR, SUR and SS are not mutually exclusive subtypes and that SMD is multidimensional as opposed
to occurring along a continuum. Sensory modulation disorder may be a complex interplay of over- and under-responsiveness. This may explain why it has been difficult to characterize SUR and SS. What was found from this investigation is a characterization of coping and occupational performance as related to sensory modulation and its subtypes. Sensory over-responsivity has been the most investigated and these results serve to deepen the understanding of SOR. Knowledge of SUR and SS is not as broad and these results can be used to begin to refine the definitions of these two subtypes.

Although there are limitations inherent in this investigation, clinically useful findings were generated. The study involved a homogenous population, which appears to be middle to upper class, a population with less turmoil and greater family stability as opposed to what has been reported for lower socio-economic status. Reynolds et al., (2008) found that in a sample of children attending a Head Start Program, children were two-and-a-half to three times more likely to meet the criteria for disorder of sensory processing. Ben-Sasson, et al., (2009) found lower SES to be a risk factor for SOR. With the current data, characteristics of each subtype can be examined in the context of a more stable environment. Results from this study indicate that even within such a stable environment, SMD is frequently identified.

Further investigation of activities reported on the Activities, School, and Social scales of the CBCL may yield insightful information into the types of activities in which children with SMD engage. A parent interview may be helpful in providing further information regarding a child’s activities and interests. It would also be interesting to compare findings of this study with a sample of older children. The dataset owned by The Spiral Foundation includes the same data for children up to the age of 12 years. It would be interesting to examine and compare the same questions to an older age group. This would provide insight into modulation and coping
resources that children of different ages possess, as well insight into the stability or changeability of those resources.

**Implications for Practice** What is clear is that subtypes of SMD show a high likelihood of overlap. Clinicians must recognize that a child may be exhibiting behaviors characteristic of both sensory over- and under-responsiveness and it is the role of the clinician to assist in determining what sensory modalities are triggers for which type of behavior. It should also be considered that the SSP may not be fully capturing a child’s clinical presentation. There were several cases in this study that scored in the Probable and Definite Difference ranges in one area, but had a total raw score on the SSP that did not indicate SMD. Additional investigation of the identified areas of concern (e.g. using parent and child interview) would seem to be warranted in order to fully understand the child’s strengths and needs. In addition this study found that coping impacts occupational performance. Thus, it appears useful to address the coping process, considering inclusion of coping in assessment as well as in treatment.

Knowledge and concepts gained through this study could be applied more broadly. It is apparent that the process of coping, is quite complex and the influence of resources may not always be linear. While the Williamson and Szczepanski model suggested that resources would impact coping in the second step of the process, factors influencing coping may enter the model at different points, depending on what resources a child possesses. For instance, for a child with a motor impairment or dyspraxia, the coping process may not be significantly impacted until the child must produce a coping effort, a motor response in this case. Results presented here suggest this is different for a child with SMD. The revised model suggests that the perception of early sensory experiences will shape internal coping resources, thus influencing the model in earlier stages. The model for coping used in this study could be applied to a variety of impairments in
order to determine what factors and resources contribute to coping. Results of this study suggest that for a child identified with SMD and intact protective factors, coping deficits tend to be relatively mild, but occupational performance is still impacted. Interventions targeted at improving protective factors would potentially increase a child’s success in typical childhood occupations. These concepts could be applied to a variety of practice settings, such as the Neonatal Intensive Care Unit (NICU), where infants are facing chronic strain from birth-related issues. The NICU environment is filled with a variety of sensory stimuli, from auditory to tactile, and an infant may be constantly exposed to a variety of noxious stimuli. Based on the proposed model of coping, an infant’s filter is shaped by previous experience with sensory stimuli. By intervening to reduce stress from an environmental perspective and facilitate parent-infant interactions, an infant’s coping abilities may be enhanced.

It is evident from this study that multiple factors impact a child’s ability to engage in typical childhood occupations. Sensory modulation and coping deficits accounted for some deficits in occupational performance, but other factors must also be in play. The larger question then becomes, what are the other factors and how do all factors interact and impact occupational performance. Clinical expertise in identifying additional contributors to occupational performance abilities will be crucial in teasing this out.

In conclusion, this study provided the opportunity to examine SMD, coping, and occupational performance in a relatively large sample. Given the high percentage of SMD present in this sample, it was expected that there would be an impact on occupational performance and coping, this substantiated in this study. However it is apparent that there are additional factors outside the scope of the current study that contribute to a child’s occupational performance. Children with SMD were found to have difficulties in several areas of everyday
activities. Children with SMD were also found to have difficulties with coping and appear to have differing abilities with respect to coping with internal stressors versus external stressors. From these findings a model for the coping process of children with SMD has emerged. Most importantly the results of this study have served to deepen the understanding of SMD and have begun further characterization of the three subtypes.
References


Lazarus, R.S. (1992). Foreword. In M. Perrez & M. Reicherts, Stress, coping and health, 
a situation-behavior approach: Theory, methods, applications (pp. i – iv). 
Lewiston, NY: Hogrefe & Huber.

Springer Publishing.

Lengua, L.J. & Long, A. C. (2002). The role of emotionality and self-regulation in the 
appraisal-coping process: Test of direct and moderating effects. Applied 

Little, L.M., Frueler, A.C., Houser, M.B., Guckian, L., Carbine, K., David, F.J., & 

Pediatric Physical Therapy, 4, 74 – 77.

Mangeot, S. D., Miller, L. J., McIntosh, D. N., McGrath-Clarke, J., Simon, J., Hagerman, 
R. J., & Goldson, E. (2001). Sensory modulation dysfunction in children with 
attention-deficit-hyperactivity disorder. Developmental Medicine & Child 
Neurology, 43, 399 – 406.

May-Benson, T., Ingolia, P., Koomar, J. (2002). Daily living skills and developmental 
coordination disorder. In S.A. Cermak & D. Larkin (Eds.), Developmental 


dysfunction. In Roley, S.S., Blanche, E.I., & Schaaf, R.C., Understanding the nature of
sensory integration with diverse populations (pp.57 – 88). San Antonio, TX: Therapy
Skill Builders.

Miller, L.J., Reisman, J.E., McIntosh, D.N., & Simon, J. (2001). An ecological model of
sensory modulation: Performance of children with fragile X syndrome, autistic
disorder, attention-deficit/hyperactivity disorder, and sensory modulation
dysfunction. In Roley, S.S., Blanche, E.I., & Schaaf, R.C., Understanding the
nature of sensory integration with diverse populations (pp.57 – 88). San Antonio,
TX: Therapy Skill Builders.

Murphy, L., & Moriarty, A. (1976). Vulnerability, coping, and growth. New Haven,
CT: Yale University Press.

questionnaire: Psychometric properties of a survey instrument for school-

Parham, L.D., Cohn, E.S., Spitzer, S., Koomar, J.A., Miller, L.J., Burke, J.P.,
Brett-Green, B., Mailloux, Z., May-Benson, T.A., Roley, S.S.,
integration intervention research. American Journal of Occupational
Therapy, 61, 216-227.

Occupational therapy for children, fifth edition (pp. 356 - 396 ). Maryland Heights, MO:
Mosby Elsevier.


doi:10.1080/15402000802577777.


Appendix A

Coping Inventory
OBSERVATION FORM

Child's Name ___________________________ Date Completed ___________________________
Birth Date ___________________________ Chronological Age ___________________________
Observer ___________________________ Relationship to Child ___________________________
Place(s) of Observation ___________________________

COPING INVENTORY

a measure of adaptive behavior

by Shirley Zeitlin, Ed.D.

Published by:
SCHOLASTIC TESTING SERVICE, INC.
Bensenville, IL 60106-1617
Introduction

The Coping Inventory assesses the adaptive and maladaptive coping habits, skills, and behaviors that a child uses to manage the world.

Adaptive coping habits, skills, and behaviors help a child to be more effective in daily routines and in life’s stress-causing situations (such as illness, death of someone close, natural disasters, the hurtful behavior of others, etc.). They enable a child to manage these situations in ways that help him or her to learn and grow rather than feel sad and helpless. Maladaptive coping habits, behaviors, and skills interfere with a child’s ability to manage the world and may create more stress.

The Coping Inventory has two categories: Coping with Self and Coping with Environment. Coping with Self includes the behaviors a child uses to meet personal needs. Coping with Environment includes the behaviors a child uses to adapt to the demands and pressures of the world.

Each of these two categories has three dimensions that describe a child’s coping style: Productive, Active, and Flexible. Productive behaviors use personal resources in ways that help a child reach the results he or she wants. Active behaviors start things moving and keep them going. Flexible behaviors use a variety and range of strategies, and include an ability to shift plans or to change ideas already held.

Complete the Coping Inventory by following the rating instructions below. Rate the child from your knowledge of that child over a period of time. If the child is not known or is less familiar, then he or she needs to be observed in a number of different situations before rating.

Instructions for Rating

Circle the number to the right of each item that most clearly describes the effectiveness of the child’s behavior. Effective means the behavior is: a) appropriate for the situations; b) appropriate for the child’s developmental age; and c) successfully used by the child. The following scale is used to rate each item.

1. The behavior is not effective. Either the child is not able to perform the behavior, for whatever reason, or what is tried does not work.
2. The behavior is minimally effective. The child’s behavior is inconsistent, or is rigidly repetitious, or generates negative outcomes over time. That is, the child’s behavior tends to be erratic and unpredictable; or the child repeats the same type of behavior regardless of the circumstances; or the child uses behavior that reduces the stress of the moment but impedes effective adaptation and interferes with learning.
3. The behavior is situationally effective. Behavior used effectively in one type of situation is not generalized to other types of situations.
4. The behavior is effective more often than not. The child is able to generalize effective behavior to a variety of situations.
5. The behavior is consistently effective across situations.

The X score is used when the behavior has not been observed. More than three X scores in the completed Coping Inventory indicates that either more observation of the child is needed or the child is too disabled for effective use of this instrument.

If the child’s behavior falls between two points on the rating scale, select the rating that is most applicable. The manual of the Coping Inventory provides instructions for rating, scoring, and interpreting the instrument.
Coping with Self:

**Productive**

1. Child, when presented with a new or difficult situation, finds a way of handling it.  
   ![X](X) 1 2 3 4 5

2. Child responds to external control (for example, rules set by adults or peers). (1 = no response or response consistently maladaptive)  
   ![X](X) 1 2 3 4 5

3. Child uses self-protecting behaviors to control the impact of the environment (for example, limits or fends off too much stimulation, withdraws before the situation gets out of hand, stops and rests before getting over tired).  
   ![X](X) 1 2 3 4 5

4. Child compensates for things that he or she is unable to do because of physical, mental, or emotional problem(s). (Child uses strengths from other areas to help manage a situation or learning.)  
   ![X](X) 1 2 3 4 5

5. Child applies what he or she has learned to new situations (both mental and emotional).  
   ![X](X) 1 2 3 4 5

6. Child uses language to communicate needs (if prelanguage, uses sounds or behaviors).  
   ![X](X) 1 2 3 4 5

7. Child generally demonstrates a happy feeling. (1 = unhappy; 3 = mood swings, varies with situation; 5 = happy)  
   ![X](X) 1 2 3 4 5

8. Child does not frustrate easily. (1 = frustrates easily; 5 = high threshold for frustration)  
   ![X](X) 1 2 3 4 5

9. Child has a healthy pleasure in being him- or herself (sense of self-worth and well-being reflected in pride and satisfaction with self).  
   ![X](X) 1 2 3 4 5

10. Child is able to handle anxiety. (For example, when situation produces anxiety child does not act out or become unusually tense or withdrawn.)  
    ![X](X) 1 2 3 4 5

11. Child demonstrates confidence in his or her ability to learn and do things.  
    ![X](X) 1 2 3 4 5

12. Child uses mental abilities effectively. (For example, if child is a slow learner he or she functions effectively at own level; if child is of superior intelligence, he or she effectively uses that ability.)  
    ![X](X) 1 2 3 4 5

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**Raw Score**
### Coping with Self: Active

1. Child tells or shows others when he or she is angry or in disagreement.
   - X 1 2 3 4 5
2. Child asks for help when needed (either from adults or peers).
   - X 1 2 3 4 5
3. Child initiates action to get needs met (makes needs known and/or does something to get them met).
   - X 1 2 3 4 5
4. Child stays with a task until it is completed.
   - X 1 2 3 4 5
5. Child reacts to sensory stimulation (responds to changes in the level or type of stimulation: auditory, touch, temperature, visual). (1 = does not react; 2 = inconsistent, may overreact or underreact; 3 = varies with sense and or situation; 5 = reacts effectively)
   - X 1 2 3 4 5
6. Child controls his or her impulses so they do not interfere with learning or social interaction. (1 = highly impulsive; 5 = effective impulse control)
   - X 1 2 3 4 5

#### Calculation Table

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### Coping with Self: Flexible

1. Child can be creative and original (sees relationships in varied ways, expresses ideas in novel or fresh terms, seeks out and develops new ideas or ways of handling things).
   - X 1 2 3 4 5
2. Child balances independence with sufficient dependence to be able to get and use help. (1 = excessively dependent or independent; 5 = good balance)
   - X 1 2 3 4 5
3. Child can shift plans or change behavior to achieve a goal.
   - X 1 2 3 4 5
4. Child accepts substitutes when necessary (materials, ideas, activities, etc.).
   - X 1 2 3 4 5
5. Child can manage high stress situations (finds ways to reduce feelings of stress or finds solution to the stress-causing situation).
   - X 1 2 3 4 5
6. Child demonstrates independence and self-reliance (acts on his or her own without seeking directions or reassurance).
   - X 1 2 3 4 5

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Coping with Environment:  
**Productive**

1. Child plays with other children (does not avoid them).  
2. Child uses behavior appropriate to the situation.  
3. Child knows what is expected and behaves accordingly.  
4. Child understands and responds to directions without external help or support.  
5. Child reacts (verbally or with an action) to details and/or events in the environment (objects, sounds, people, changes).  
6. Child is curious (eager to find out about people, objects, situations).  
7. Child is liked and accepted by other children.  
8. Child doesn’t discourage easily (for example, does not refuse to try something because of fear of failure, doesn’t become moody or act out when unsuccessful, stays with a task long enough to work it through or appropriately give up).  
9. Child is aware of feelings of others, including angry feelings (for example, asks about other children, comments and/or reacts appropriately to demonstrations of feelings). (1 = not aware; 3 = aware of positive or negative feelings but not both, or varies with situation; 5 = aware of range of feelings)  
10. Child demonstrates a capacity for fun, zest, delight, and pleasure.  
11. Child functions with minimal amount of external structure (is self directed, can create own routine or structure).  
12. Child is aware of and reacts to cues and moods of other people (for example, facial expressions, voice tones).

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| No. of assessable items | Raw Score |
### Coping with Environment: *Active*

1. Child uses gross and fine motor skills competently (for example, is well coordinated, does things easily with hands). (1 = not competent; 3 = some skills used competently, not others, e.g., good gross motor, poor fine motor, or varies with situation; 5 = competent)
   - X 1 2 3 4 5
2. Child is stimulating to others (gets others started, enthused, involved).
   - X 1 2 3 4 5
3. Child actively involves self in situations.
   - X 1 2 3 4 5
4. Child has an activity level that is appropriate to the situation and is helpful in getting the task accomplished. (1 = hypoactive -- too little activity, or hyperactive -- too much activity; 5 = effective activity level)
   - X 1 2 3 4 5
5. Child has a positive orientation to life (expects that needs will be met, is optimistic, and sees the good side of things).
   - X 1 2 3 4 5
6. Child has an energy level that is forceful and vigorous. (1 = low energy, easily fatigued; 5 = effective energy level, good supply of energy)
   - X 1 2 3 4 5

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### Coping with Environment: *Flexible*

1. Child accepts warmth and support (for example, responds to affection and encouragement from others, likes to be held, kissed, praised).
   - X 1 2 3 4 5
2. Child gives warmth and support to others (for example, takes other child's side, demonstrates verbally or by gesture affection or encouragement).
   - X 1 2 3 4 5
3. Child tries new things or activities on own -- shows excitement, interest, and/or pleasure when he or she discovers new objects, insights, or experiences.
   - X 1 2 3 4 5
4. Child bounces back after disappointment or defeat (tries again or becomes interested in something else rather than pouting, being moody, or acting out).
   - X 1 2 3 4 5
5. Child, when necessary, uses a range of strategies to achieve a goal or solve a problem.
   - X 1 2 3 4 5
6. Child, when necessary, accepts new ideas or reformulates ideas already held (is not rigid in thinking).
   - X 1 2 3 4 5

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Appendix B

Short Sensory Profile
# Short Sensory Profile

**Child's Name:**

**Birth Date:**

**Date:**

**Sensory Profile**

Completed by:  
Ph.D., OTR, FAOTA  
Service Provider's Name:  
Discipline:

## Instructions

Please check the box that best describes the frequency with which the child exhibits the following behaviors. Please answer all of the statements. If you are unsure of the behavior, please feel free to answer according to your clinical judgment. Please do not skip any items. Please do not write in the sections raw score total row.

### Tactile Sensitivity

**Always:**  
When presented with the opportunity, your child always responds in this manner, 100% of the time.

**Frequently:**  
When presented with the opportunity, your child frequently responds in this manner, 40% to 60% of the time.

**Occasionally:**  
When presented with the opportunity, your child occasionally responds in this manner, about 25% of the time.

**Seldom:**  
When presented with the opportunity, your child seldom responds in this manner, about 10% of the time.

**Never:**  
When presented with the opportunity, your child never responds in this manner, 0% of the time.

<table>
<thead>
<tr>
<th>Item</th>
<th>Tactile Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>ALWAYS</strong></td>
</tr>
<tr>
<td></td>
<td><strong>FREQUENTLY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>OCCASIONALLY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Seldom</strong></td>
</tr>
<tr>
<td></td>
<td><strong>NEVER</strong></td>
</tr>
</tbody>
</table>

- Expresses distress during grooming (for example, fights or cries during haircuts, face washing, fingernail cutting)
- Prefers long-sleeved clothing when it is warm or short sleeves when it is cold
- Avoids barefoot, especially in sand or grass
- Reacts emotionally or aggressively to touch
- Withdraws from splashing water
- Has difficulty standing in line or close to other people
- Rubs or scratches out a spot that has been touched

### Taste/Smell Sensitivity

**Always:**  
When presented with the opportunity, your child always responds in this manner, 100% of the time.

**Frequently:**  
When presented with the opportunity, your child frequently responds in this manner, 40% to 60% of the time.

**Occasionally:**  
When presented with the opportunity, your child occasionally responds in this manner, about 25% of the time.

**Seldom:**  
When presented with the opportunity, your child seldom responds in this manner, about 10% of the time.

**Never:**  
When presented with the opportunity, your child never responds in this manner, 0% of the time.

<table>
<thead>
<tr>
<th>Item</th>
<th>Taste/Smell Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>ALWAYS</strong></td>
</tr>
<tr>
<td></td>
<td><strong>FREQUENTLY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>OCCASIONALLY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Seldom</strong></td>
</tr>
<tr>
<td></td>
<td><strong>NEVER</strong></td>
</tr>
</tbody>
</table>

- Avoids certain tastes or food smells that are typically part of children's diets
- Will only eat certain tastes (list: ________________)
- Limits self to particular food textures/temperatures (list: ________________)
- Picky eater, especially regarding food textures

### Movement Sensitivity

**Always:**  
When presented with the opportunity, your child always responds in this manner, 100% of the time.

**Frequently:**  
When presented with the opportunity, your child frequently responds in this manner, 40% to 60% of the time.

**Occasionally:**  
When presented with the opportunity, your child occasionally responds in this manner, about 25% of the time.

**Seldom:**  
When presented with the opportunity, your child seldom responds in this manner, about 10% of the time.

**Never:**  
When presented with the opportunity, your child never responds in this manner, 0% of the time.

<table>
<thead>
<tr>
<th>Item</th>
<th>Movement Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>ALWAYS</strong></td>
</tr>
<tr>
<td></td>
<td><strong>FREQUENTLY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>OCCASIONALLY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Seldom</strong></td>
</tr>
<tr>
<td></td>
<td><strong>NEVER</strong></td>
</tr>
</tbody>
</table>

- Becomes anxious or distressed when feet leave the ground
- Fears falling or heights
- Dislikes activities where head is upside down (for example, somersaults, roughhousing)

### Underresponsive/Seeks Sensation

**Always:**  
When presented with the opportunity, your child always responds in this manner, 100% of the time.

**Frequently:**  
When presented with the opportunity, your child frequently responds in this manner, 40% to 60% of the time.

**Occasionally:**  
When presented with the opportunity, your child occasionally responds in this manner, about 25% of the time.

**Seldom:**  
When presented with the opportunity, your child seldom responds in this manner, about 10% of the time.

**Never:**  
When presented with the opportunity, your child never responds in this manner, 0% of the time.

<table>
<thead>
<tr>
<th>Item</th>
<th>Underresponsive/Seeks Sensation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>ALWAYS</strong></td>
</tr>
<tr>
<td></td>
<td><strong>FREQUENTLY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>OCCASIONALLY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Seldom</strong></td>
</tr>
<tr>
<td></td>
<td><strong>NEVER</strong></td>
</tr>
</tbody>
</table>

- Enjoys strange noises/seeks to make noise for noise's sake
- Seeks all kinds of movement and this interferes with daily routines (for example, can't sit still, fidgets)
- Becomes overly excitable during movement activity
- Touches people and objects
- Doesn't seem to notice when face or hands are messy
- Jumps from one activity to another so that it interferes with play
- Leaves clothing twisted on body

### Section Raw Score Total

0761638040

145
<table>
<thead>
<tr>
<th>Item</th>
<th>Auditory Filtering</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Is distracted or has trouble functioning if there is a lot of noise around</td>
</tr>
<tr>
<td>24</td>
<td>Appears to not hear what you say (for example, does not &quot;tune-in&quot; to what you say, appears to ignore you)</td>
</tr>
<tr>
<td>25</td>
<td>Can't work with background noise (for example, fan, refrigerator)</td>
</tr>
<tr>
<td>26</td>
<td>Has trouble completing tasks when the radio is on</td>
</tr>
<tr>
<td>27</td>
<td>Doesn't respond when name is called but you know the child's hearing is OK</td>
</tr>
<tr>
<td>28</td>
<td>Has difficulty paying attention</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Low Energy/Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>Seems to have weak muscles</td>
</tr>
<tr>
<td>30</td>
<td>Tires easily, especially when standing or holding particular body position</td>
</tr>
<tr>
<td>31</td>
<td>Has a weak grasp</td>
</tr>
<tr>
<td>32</td>
<td>Can't lift heavy objects (for example, weak in comparison to same age children)</td>
</tr>
<tr>
<td>33</td>
<td>Props to support self (even during activity)</td>
</tr>
<tr>
<td>34</td>
<td>Poor endurance/tires easily</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Visual/Auditory Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>Responds negatively to unexpected or loud noises (for example, cries or hides at noise from vacuum cleaner, dog barking, hair dryer)</td>
</tr>
<tr>
<td>36</td>
<td>Holds hands over ears to protect ears from sound</td>
</tr>
<tr>
<td>37</td>
<td>Is bothered by bright lights after others have adapted to the light</td>
</tr>
<tr>
<td>38</td>
<td>Watches everyone when they move around the room</td>
</tr>
<tr>
<td>39</td>
<td>Covers eyes or squints to protect eyes from light</td>
</tr>
</tbody>
</table>

**Summary**

Instructions: Transfer the score for each section to the Section Raw Score Total column. Plot these totals by making an X in the appropriate classification column (Typical Performance, Probable Difference, Definite Difference).

<table>
<thead>
<tr>
<th>Section</th>
<th>Section Raw Score Total</th>
<th>Typical Performance</th>
<th>Probable Difference</th>
<th>Definite Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tactile Sensitivity</td>
<td>.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taste/Smell Sensitivity</td>
<td>.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Movement Sensitivity</td>
<td>.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underresponsive/Seeks Sensation</td>
<td>.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory Filtering</td>
<td>.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Energy/Weak</td>
<td>.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual/Auditory Sensitivity</td>
<td>.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>.190</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Classifications are based on the performance of children without disabilities (n = 1,037).*

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Appendix C

Child Behavior Checklist
Please print CHILD BEHAVIOR CHECKLIST FOR AGES 6-18

For office use only
ID #

CHILD'S FULL NAME
First Middle Last

PARENTS' USUAL TYPE OF WORK, even if not working now. (Please be specific — for example, auto mechanic, high school teacher, homemaker, laborer, lathe operator, shoe salesman, army sergeant.)

FATHER'S TYPE OF WORK

MOTHER'S TYPE OF WORK

CHILD'S ETHNIC GROUP OR RACE

TODAY'S DATE
Mо________ Date________ Yr.________

CHILD'S BIRTHDATE
Mo________ Date________ Yr.________

GRADE IN SCHOOL

Please fill out this form to reflect your view of the child's behavior even if other people might not agree. Feel free to print additional comments beside each item and in the space provided on page 2. Be sure to answer all items.

NOT ATTENDING SCHOOL

Your gender: ☐ Male ☐ Female

Your relation to the child:
☐ Biological Parent ☐ Step Parent ☐ Grandparent
☐ Adoptive Parent ☐ Foster Parent ☐ Other (specify)

I. Please list the sports your child most likes to take part in. For example: swimming, baseball, skating, skate boarding, bike riding, fishing, etc.

☐ None

a. ________________________

b. ________________________

c. ________________________

Compared to others of the same age, about how much time does he/she spend in each?

Compared to others of the same age, how well does he/she do each one?

Less Than Average Average More Than Average Don't Know Below Average Average Above Average Don't Know

II. Please list your child's favorite hobbies, activities, and games, other than sports. For example: stamps, coins, books, piano, crafts, cars, computers, singing, etc. (Do not include listening to radio or TV.)

☐ None

a. ________________________

b. ________________________

c. ________________________

Compared to others of the same age, about how much time does he/she spend in each?

Compared to others of the same age, how well does he/she do each one?

Less Than Average Average More Than Average Don't Know Below Average Average Above Average Don't Know

III. Please list any organizations, clubs, teams, or groups your child belongs to.

☐ None

a. ________________________

b. ________________________

c. ________________________

Compared to others of the same age, how active is he/she in each?

Less Active Average More Active Don't Know

IV. Please list any jobs or chores your child has. For example: paper route, babysitting, making bed, working in store, etc. (Include both paid and unpaid jobs and chores.)

☐ None

a. ________________________

b. ________________________

c. ________________________

Compared to others of the same age, how well does he/she carry them out?

Below Average Average Above Average Don't Know

Be sure you answered all items. Then see other side.
Appendix D

Evaluation Completion Form
## EVALUATION COMPLETION FORM / THERAPY PROFILE / DISCHARGE SUMMARY

<table>
<thead>
<tr>
<th>Client Name:</th>
<th>Desires TX at OTA</th>
<th>Available Days and Times:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Birth:</td>
<td>Age:</td>
<td>Therapist Comments:</td>
</tr>
<tr>
<td>Diagnosis:</td>
<td>May Want TX</td>
<td></td>
</tr>
<tr>
<td>Date of Eval / Rating:</td>
<td>No TX Recommended</td>
<td></td>
</tr>
<tr>
<td>Evaluation Given:</td>
<td>Will Receive TX Elsewhere</td>
<td></td>
</tr>
<tr>
<td>□ SIPT</td>
<td>□ SIM</td>
<td></td>
</tr>
<tr>
<td>□ MAP</td>
<td>□ HPHC</td>
<td>□ Other</td>
</tr>
<tr>
<td>Parent Names:</td>
<td>Needs to CK Insurance</td>
<td></td>
</tr>
<tr>
<td>Home Phone:</td>
<td>CK for School Coverage</td>
<td></td>
</tr>
</tbody>
</table>

### RESULTS OF EVALUATION

<table>
<thead>
<tr>
<th>Sensory Modulation Problems</th>
<th>Ocular Control</th>
<th>Adaptive Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>General State of Arousal</td>
<td>Separating Head &amp; Eyes</td>
<td>Respond to passive stimuli</td>
</tr>
<tr>
<td>Tactile</td>
<td>Quick Localization</td>
<td>Holds on and stays put</td>
</tr>
<tr>
<td>Vestibular</td>
<td>Pursuits</td>
<td>Moves significantly</td>
</tr>
<tr>
<td>Auditory</td>
<td>Convergence</td>
<td>Initiate activity/complete independently</td>
</tr>
<tr>
<td>Visual</td>
<td>CXML with eyes</td>
<td>Moving independently/somewhat familiar manner</td>
</tr>
<tr>
<td>Multiple Inputs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensory Discrimination Problems</th>
<th>Bilateral Control</th>
<th>Hand / Visual Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tactile</td>
<td>Establishing Dominance</td>
<td>Grasp Patterns</td>
</tr>
<tr>
<td>Vestibular</td>
<td>Crossing Midline</td>
<td>Grip Strength</td>
</tr>
<tr>
<td>Proprioceptive</td>
<td>UB Bilateral Coordination</td>
<td>Fine Motor Praxis</td>
</tr>
<tr>
<td>GI</td>
<td>UB Bilateral Coordination</td>
<td>Distal Finger Control</td>
</tr>
<tr>
<td>Vest/vis/prop interaction</td>
<td></td>
<td>Total Body Coordination</td>
</tr>
<tr>
<td>Praxis / Motor Planning</td>
<td></td>
<td>VM/Handwriting</td>
</tr>
</tbody>
</table>

### Postural Problems

<table>
<thead>
<tr>
<th>Functional Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle Tone</td>
</tr>
<tr>
<td>Shoulder Stability</td>
</tr>
<tr>
<td>Trunk Stability</td>
</tr>
<tr>
<td>Strength</td>
</tr>
<tr>
<td>Extension</td>
</tr>
<tr>
<td>Flexion</td>
</tr>
<tr>
<td>Weight Shift/Rotation</td>
</tr>
<tr>
<td>Balance Righting/Equil.</td>
</tr>
</tbody>
</table>

### Projected Action Sequence

<table>
<thead>
<tr>
<th>Social Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client Stationary/Target Stationary</td>
</tr>
<tr>
<td>Client Moving/Target Stationary</td>
</tr>
<tr>
<td>Client Stationary/Target Moving</td>
</tr>
<tr>
<td>Client Moving/Target Moving</td>
</tr>
</tbody>
</table>

### Comments:

Date: 
Evaluating Therapist: 

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Clinical/OT Clinical/Evaluation & Assessment
OT Assessment/Evaluation Completion
04-09-2008

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150
Vita

Audrey E. Kane was born March 30, 1965, in Little Rock, Arkansas. She graduated from Parkview High School in 1983. In 1987, she received her Bachelor of Arts degree from Hendrix College, Conway, Arkansas, with a major of Biology. Audrey received her Master of Science in Occupational Therapy in 1991 from the Medical College of Virginia, Virginia Commonwealth University. Audrey is currently employed as an Acute Care Occupational Therapist at Virginia Commonwealth University Health System. Her area of expertise is Pediatrics. Audrey’s research interests are neonatal feeding and development, and sensory processing.