2012

Effectiveness of Sensory Integration and Behavioral Interventions on Nonengagement in Preschool Aged Children

Tiffany Kuyper
Virginia Commonwealth University

Follow this and additional works at: https://scholarscompass.vcu.edu/etd

Part of the Occupational Therapy Commons

© The Author

Downloaded from
https://scholarscompass.vcu.edu/etd/2822

This Thesis is brought to you for free and open access by the Graduate School at VCU Scholars Compass. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of VCU Scholars Compass. For more information, please contact libcompass@vcu.edu.
EFFECTIVENESS OF SENSORY INTEGRATION AND BEHAVIORAL INTERVENTIONS ON NONENGAGEMENT IN PRESCHOOL AGED CHILDREN

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science Degree in Occupational Therapy at Virginia Commonwealth University

TIFFANY ANN KUYPER
Bachelor of Science in Occupational Therapy, Jefferson College of Health Sciences, December 2000
Candidate for Master of Science in Occupational Therapy, Virginia Commonwealth University, 2012

Director: Marie Anzalone ScD, OTR, FAOTA
Department of Occupational Therapy

Virginia Commonwealth University
Richmond, Virginia
May 2012
Acknowledgement

To my best friend and husband, Chris, I thank you for all of your love, support, and endurance during this project. You were always there when I needed you most. You are a wonderful husband, best friend, and father. Brady and Carter, when Mommy was working, thank you for being such wonderful and loving children. Thank you Gigi for always lending a helping hand to help with the boys when I had to work. Above all, thank you for your commitment, energy, and emotional support. I want to thank my dad because even though he is no longer here; he always told me I was meant for great things and that I could do whatever I wanted if I set a goal in mind. Thank you, Sue, for always being there. Thank you Kristen McNamara for your support and advice throughout this process. And, thank you to Amy Kageals and Carilion Pediatric Therapy girls for your confidence and support from start to finish. I want to thank Carilion Children’s Clinic leadership for their support in this process. I want to thank Kim Buttles for taking the bull by the horns and bringing this project to fruition. Thank you for your initiative, support, effort, and great therapeutic interventions to help me complete this project. I want to thank Christi Nicely for the time and effort on the front end of this project and your willingness to engage in the research process even though you had to leave to pursue other professional endeavors. Thank you to all of the people who supported this project in the coding process: Samantha Litz, Melissia Hamilton, Michelle Scarfe-Robinson, Greg Robinson, and Audrey Kane. You all helped make this study more sound. Thank you to Ashley Feuerstein for your guidance and help
with statistical issues. Thank you to Diane Parham for sharing the Fidelity Measure, and Sarah Schoen for sharing the SensOR in the research phases. I want to thank Maureen Conroy for your continued support as a committee member even after leaving your position at VCU. Thank you to Jayne Shepherd for your consistent feedback and effort to move me through this process. And, to Marie Anzalone, thank you for your commitment to me and this study. I learned a lot about myself during this process, and I am a far better therapist and person because of this experience.
# Table of Contents

List of Tables ...................................................................................................................................... viii

List of Figures ..................................................................................................................................... ix

Abstract ............................................................................................................................................... x

Chapter 1: Introduction ...................................................................................................................... 1
  Sensory Over-Responsivity ............................................................................................................... 3

Chapter 2: Literature Review ............................................................................................................. 6
  Sensory Modulation ...................................................................................................................... 7
  Sensory Over-Responsivity ............................................................................................................. 7
  Behaviors Associated with Sensory Over-Responsivity ................................................................. 11

Sensory Integration Theory ............................................................................................................... 12

Intervention ......................................................................................................................................... 13

Efficacy of Interventions using Sensory Integration Theory ........................................................... 15

Assessments of Sensory Integration ................................................................................................ 19

Parent Interview .............................................................................................................................. 20

Sensory Over-Responsivity Scale: Inventory ................................................................................. 20

Short Sensory Profile ....................................................................................................................... 21

Clinical Observations ....................................................................................................................... 21

Fidelity Measure of Sensory Integration .......................................................................................... 22
Fidelity to Sensory Integration ................................................................. 53
Coding for Behavioral Fidelity ............................................................... 55
Sensory Based and Behavioral Interventions ......................................... 56
Outcome Measures ................................................................................. 58
   Play Engagement and Nonengagement .............................................. 58
   Canadian Occupational Performance Measure .................................... 61
Independent Variables ........................................................................... 62
Behavioral Coding .................................................................................. 62
Dependent Variables ............................................................................... 65
Chapter 4: Results .................................................................................. 67
Subjects .................................................................................................. 67
   Parent Interview Results ................................................................. 67
   SensOR Results ................................................................................. 68
   Short Sensory Profile Results ......................................................... 69
Clinical Observation Results ................................................................. 69
   Functional Behavior Analysis Results .............................................. 70
Eligibility Results .................................................................................... 70
   Sensory Based Intervention Condition .......................................... 70
   Alternating Conditions of Sensory Based and Behavior .................. 71
   Sensory Based and Behavior Intervention ....................................... 71
Data Collection ....................................................................................... 73
Descriptive Statistics ............................................................................. 74
Data Analysis .......................................................................................... 87
Canadian Occupational Performance Measure ................................................................. 81

Chapter 5: Discussion ...................................................................................................... 86

Summary of Study ........................................................................................................... 86

Discussion ....................................................................................................................... 86

Limitations ....................................................................................................................... 90

Limitations of the Fidelity Measure ............................................................................... 90

Implications for OT ......................................................................................................... 91

Directions for Future Research ...................................................................................... 91

References ...................................................................................................................... 96

Appendix A: Parent Interview ....................................................................................... 105

Appendix B: Sensory Over-Responsivity Scale: Inventory (SensOR) ......................... 107

Appendix C: Clinical Observations of Vestibular Processing .................................. 110

Appendix D: Clinical Observations of Tactile Processing ......................................... 113

Appendix E: Fidelity Measure ....................................................................................... 115

Appendix F: Informed Consent ..................................................................................... 133

Appendix G: Pre-Research Video Consent .................................................................. 139

Appendix H: Post-Research Video Consent .................................................................. 141

Appendix I: Fidelity of Behavioral Interventions ....................................................... 143

Appendix J: Operational Definitions ............................................................................ 145

Vita .................................................................................................................................. 146
List of Tables

Table 1: Cut-off scores for SOR as identified by the SensOR .........................................................48
Table 2: Guidelines of the Fidelity Measure Influencing Sensory Integration.................................54
Table 3: Timeline for Outcome and Fidelity Measures .....................................................................61
Table 4: Independent Variables and Treatment Conditions ............................................................63
Table 5: Dependent Variables for Nonengagement and Play Engagement .....................................66
Table 6: Interval Frequencies of Subject’s Nonengagement and Play Engagement Behaviors ...75
Table 7: Mean Frequencies of Subject’s Nonengagement and Play Engagement Behaviors .....76
Table 8: Results of the Canadian Occupational Performance Measure .........................................82
List of Figures

Figure 1. Intervention Conditions ..............................................................................................................42
Figure 2. Interval Frequency of Nonengagement Between and Within Conditions ......................78
Figure 3. Interval Frequency of Play Engagement Between and Within Conditions .....................80
Figure 4. Differences in the Canadian Occupational Performance Measure from Evaluation to  
Last Treatment Session ............................................................................................................................85
Abstract

EFFECTIVENESS OF SENSORY INTEGRATION AND BEHAVIORAL INTERVENTIONS ON NONENGAGEMENT IN PRESCHOOL AGED CHILDREN

By Tiffany Ann Kuyper, OTR/L

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Occupational Therapy at Virginia Commonwealth University

Virginia Commonwealth University, 2012

Director: Marie Anzalone ScD, OTR, FAOTA

This single subject pilot study explored a combination of sensory-based interventions and behavioral interventions in a preschool aged child identified with Sensory Over-Responsivity (SOR). Children often display nonengagement associated with escaping and avoiding tactile and/or vestibular information because they perceive sensory input as negative or aversive.

The subject was a 3-year old child who engaged in alternating treatments over the course of six weeks of occupational therapy. The first condition was a sensory-based intervention (SB), a widely used intervention approach for sensory over-responsivity. The alternating condition was a sensory-based intervention combined with behavioral interventions (SBB). The behavioral intervention used tangible reinforcement as the primary technique to facilitate engagement in sensory intensive play that was part of the sensory-based interventions. It was hypothesized that nonengagement behaviors would decrease during the SBB condition and play engagement
behaviors would increase during the SBB condition. It was also hypothesized that the subject would demonstrate an improvement in perceived performance and satisfaction of daily living activities.

The outcomes of this study included frequencies of nonengagement, play engagement and the family’s perceived performance and satisfaction of a child’s performance of occupations. The frequency of nonengagement behaviors was assessed when the subject was presented with sensory intensive play that was part of sensory-based interventions in each condition. The frequencies of nonengagement and play engagement were coded over each session to determine if there was any change between and within conditions. Also, performance and satisfaction with occupations were compared from the initial evaluation and the last intervention session.

Results of this study revealed that the subject’s nonengagement behaviors actually increased throughout the interventions. This finding did not support the first hypothesis that nonengagement behaviors would decrease in the condition using a combination of sensory-based interventions and behavioral interventions. It was also found that the subject’s number of play engagement behaviors decreased within both conditions. This finding did not support the second hypothesis that play engagement behaviors would improve as result of participating in a combination of sensory-based interventions and behavioral interventions over time. However, the qualitative improvements as identified by the subject’s mother when using the Canadian Occupational Performance Measure (COPM; Law, Baptiste, McColl, Polatajko, & Pollock, 2005) improved significantly across both interventions in the home and community settings. As a result of participation in this study, the subject made improvements with regard to all occupational performance areas as initially collaborated upon in the initial evaluation.
Children learn about their physical and social environments through play. They explore their environments through the use of their senses: touch, movement, sight, sound, taste and smell. John is on the playground with his kindergarten class taking turns sliding with friends. He sees that they have to climb the ladder to reach the top of the slide. A group of kids cheer John on as he climbs the ladder. He begins to laugh as he slides fast to the bottom and his feet hit the ground. He gets high-fives and waits his turn to try again. Instances like this enable a child to interact efficiently with his or her environment and other children. Being able to engage with others in this fashion helps a child gain skills that facilitate social interactions and group participation.

In this instance, John responded in an adaptive manner to the presented challenges. John demonstrated efficient sensory modulation. Sensory modulation is the ability to respond to incoming sensory information in a graded manner relative to its degree, nature, and intensity (Miller, Anzalone, Lane, Cermak, & Osten, 2007). He processed the movement sensation with an enjoyable affect evidenced by his smiling and laughing as he moved down the slide. Once he was at the bottom, John demonstrated an affectionate response with his peers as their hands touched his with a high five indicating their approval. As John processed all of these sensations effectively, gained positive reinforcement from his peers and interacted in a reciprocal fashion of turn taking, he responded in a successful manner to the sensory information in his environment. On the other hand, when Sara goes out on the playground with her class she stands in the corner...
of the playground because the sights and sounds are a bit overwhelming. At the urge of her
teacher, Sara is led to the slide to play with the others. As she waits her turn, she is accidentally
bumped by the child behind her. Sara startles and pushes the child. The other children move
away. The teacher gets upset and places her in time-out. Finally, the teacher takes her to the
swings and places her on a swing. Sara screams “No,” jumps off, and runs back to the corner of
the playground. The teacher sighs and decides to let her go. The other children in her class look
at Sara and wonder what is wrong with her. Sara knows that this is not an appropriate response
but does not know how to change how she feels when she is in these types of sensory situations.

In this example, Sara demonstrates aggression, negativity, fear, avoidance, and escape
associated with difficulties modulating sensory input. Sara is hypersensitive to touch and
movement. When touched unexpectedly, she responds to a degree that is considered
unacceptable by adults and peers. She is overly sensitive to movement and prefers her feet on
the ground. So, activities such as climbing, sliding, and swinging are not enjoyable, and Sara
would prefer to escape any participation in these activities. By letting Sarah retreat to the corner,
the teacher has reinforced her escape behaviors, making it likely that she will respond in a
similar fashion when presented with a movement challenge. Further, Sara’s behaviors in these
situations interfere with her ability to participate in groups and engage with others. Adults and
peers perceive her as a bully when she responds by trying to protect herself or label her as a
“loner” thus making it difficult for Sara to make friends. Over time, Sara’s inconsistent
protective behaviors become established because they are reinforced by her escape of noxious or
painful stimulation. Also, Sara’s hitting responses when being touched may become more
problematic. She will need to learn appropriate and adaptive measures for coping with her
challenges.
Sensory Over-Responsivity

Individuals with Sensory Over-Responsivity (SOR) respond to incoming sensory stimulation with an automatic, quick, and more intense response and generally for a longer period of time than those with typical responsiveness (Miller et al., 2007). Behaviors associated with SOR result from the hypothesis that individuals with SOR have a nervous system that requires less intense and less frequent stimulation to respond (Reynolds & Lane, 2008). So, when a child with SOR is lightly touched, he or she may respond with a protective and perceived inappropriate response given the nature, type, and intensity of the touch. When children experience SOR, behavioral disorganization may occur resulting in hyperreactive behaviors, sensory avoidant behaviors or a combination of both. There are a range of responses including negativity, impulsivity, aggression, and avoidance. These responses often result in difficulties with play skills, socialization, activities of daily living and learning. Individuals with SOR respond with what might be perceived as problematic behaviors.

In recent years, it has been estimated that 10% to 15% of young children have mild to moderately challenging behaviors (Powell, Dunlap, & Fox, 2006) with little understanding of the basis for these behaviors. For children who have over-responsive sensory systems, some are not able to control their exaggerated reactivity. Their repertoire of escape/avoidance and sensory reactive behaviors may become problematic. Behaviors may become habitual and possibly interfere with activities of daily living skills, play skills, social participation, and education if interventions are not introduced. Many of these children may benefit from graded opportunities to engage in sensory environments that are a better fit for their sensory needs and positive behavioral supports to enhance their tolerance. It is assumed that the earlier the intervention occurs, the better the chances are to improve a child’s daily functioning, relationships,
attachments, and a sense of well-being so that he or she may perform more successfully within the home, community, and school.

The purpose of this pilot study was to determine whether a child with Over-responsive Sensory Modulation Disorder (SOR) who received a combination of sensory integration intervention and behavioral interventions would show a decrease in nonengagement within the intervention sessions and also improve behaviors within the functional contexts of home and school. The study sought to answer the following questions: Does the use of sensory integration combined with behavioral strategies decrease the frequency of challenging behaviors within a therapy session? Will a child who receives a combination of sensory integration and behavioral intervention improve his or her participation in play, activities of daily living, social participation and education?

The specific hypotheses of this study were:

1. A child with SOR receiving a combination of sensory-based interventions and behavioral interventions (Condition SBB) during occupational therapy intervention would demonstrate a decrease in nonengagement during sensory intensive play that was part of sensory-based interventions (within and across conditions).

2. A child with SOR receiving a combination of sensory-based interventions and behavioral interventions (Condition SBB) would demonstrate an improvement in play engagement in sensory intensive activities (vestibular and/or tactile) within and across conditions.

3. A child with SOR receiving occupational therapy with sensory-based interventions (Condition SB) and sensory-based interventions with a combination of behavioral interventions (Condition SBB) would demonstrate an improvement in perceived
performance and satisfaction of daily living activities in the Canadian Occupational Performance Measure scores compared to baseline.
Chapter 2: Literature Review

Sensory Over-Responsivity (SOR) is a result of difficulties registering sensory information from the environment efficiently. This is a difficulty in sensory modulation. SOR is manifested in one system or multiple systems resulting in behaviors such as aggression, hostility, negativity or avoidance when presented with sensory intensive play that is part of sensory-based interventions (Williamson & Anzalone, 2001). Sensory intensive play that is part of sensory-based interventions provides any aspect of vestibular or tactile opportunities for a child to play who is considered over-responsive in that domain. For example, a child who is gravitationally insecure (hypersensitive to movement) may have difficulty engaging in challenging movement opportunities such as swinging or jumping. A therapist practicing sensory integration may provide a child with gravitational insecurities proprioceptive input to enhance calming so that he/she might be able to participate in a graded movement challenge. Children who are identified as being over-responsive to particular sensations typically receive sensory integration intervention provided by an occupational therapist.

Sensory integration intervention provides the opportunity for children to engage in intrinsically motivating activities that gradually enable them to modulate or organize their responses to challenging sensory experiences. As a result, it is anticipated that they will not exhibit the degree of escape and avoidance previously observed as they actively participate, learn, and begin to make adaptive responses within play. While sensory integration intervention is designed to decrease the need for escape or avoidance, behavioral programs are designed to
provide an extrinsic reinforcement to encourage participation when faced with challenges. As children are reinforced for their participation, support is faded so that the child might engage in adaptive play for its intrinsic properties or for the sole sake of participation. This chapter will also provide a description and rationale for using sensory integration and behavioral interventions to support a child with SOR in adaptive play and activities of daily living.

**Sensory Modulation**

Sensory modulation is the ability to respond to incoming information in a graded manner that is appropriate to the intensity of the stimulus rather than over- or under-reacting (Parham & Mailloux, 2001). For example, a gentle touch is usually perceived as calming and does not produce a fear response. Yet, for many children with SOR, the latter response is observed. Efficient sensory modulation may result in a child’s ability to maintain an optimal zone of arousal which enables a child to learn and flexibly interact with the environment. When children are unable to respond appropriately to information from one or more sensory systems they may be considered to have Sensory Modulation Disorder (SMD). According to the proposed nosology, SMD is variable and is characterized by Sensory Over-Responsivity, Sensory Under-Responsivity or Sensory Seeking/Craving (Miller, Anzalone, Lane, Cermak, & Osten, 2007). For purposes of this study, the emphasis will be on the concept of Sensory Over-Responsivity (SOR) since many of the behaviors associated with SOR are considered problematic to the general population. If SOR is not evaluated and identified, the underlying basis for their behaviors may go untreated in a manner that is not appropriate and helpful for the child.

**Sensory over-responsivity.** Senses in which children may be over-responsive include touch, movement, sound, vision, smell, and taste. Sensitivities may occur in one sensory system or multiple systems and usually influence a child’s occupational performance (Wilbarger &
Another term frequently used to refer to sensory over-responsivity (SOR) is sensory defensiveness. Sensory defensiveness refers to multiple sensory system involvement while tactile defensiveness is usually limited to touch. Sensory defensiveness is found in the tactile, vestibular, and proprioceptive systems as well as auditory, oral, and visual systems and sense of smell (Stagnitti, Raison & Ryan, 1999). Wilbarger and Wilbarger (1999) proposed three levels of severity associated with defensive reactions including mild, moderate, and severe responses. A child’s responses are measured by the impact of the over-responsiveness to their participation in daily life. A child may be classified as having sensory preferences or as having difficulties performing activities of daily living due to sensory over-responsiveness. Bar-Shalita, Vatine, and Parush (2008) found that children with sensory modulation dysfunction have limited participation in daily living activities. The level, degree of enjoyment and frequency of participation were all significantly lower in children with sensory modulation dysfunction when compared to typically developing peers. Stagnitti et al. (1999) described mild defensiveness as a child who may be oversensitive, picky or resistant to change. An example may be that a child does not like mushy textures such as pasta but instead prefers crunchy textures such as potato chips or carrot sticks. A child who has moderate defensiveness may exhibit difficulties in two or more areas of daily living. For example, children may have difficulties with dressing and bathing or toileting and sleeping. Severe defensiveness impacts all aspects of a child’s daily functioning such as dressing, bathing, toileting, grooming and hygiene, play, learning, and social interactions (Stagnitti et al., 1999; Wilbarger & Wilbarger, 1999).

Many authors hypothesize a continuum of responsiveness from over- to under-responsiveness. This continuum is based on different sensory properties including frequency, duration, and magnitude of input and the individual’s response to that input (Baranek & Berkson,
According to Baranek and Berkson (1994), there are varying views about the processes of tactile defensiveness that include an imbalance in inhibitory responses, differing neurological thresholds or limbic system involvement. They also found a possible explanation for behavioral responses in children who met the criteria for tactile defensiveness in that they may have lower thresholds explaining the child’s responses to tactile stimuli. This would mean that gentle touch for a child with tactile defensiveness may influence his/her response to include negativity, withdrawal or avoidance to stimulation (Baranek & Berkson, 1994).

SOR is often found in children with diagnoses such as Autism, Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD). However, Reynolds and Lane (2008) describe case studies in which SOR may also occur as an isolated diagnosis. The subjects in this study were identified as having SOR through parental completion of the Sensory Over-Responsivity Inventory (SensOR), parental interview, and the affirmation that the subject had not been diagnosed with any medical conditions. Once children met the previous criteria, several assessments were used to rule out intellectual disabilities, autism, and any other psychological diagnoses. Also, it was reported that children had visited their pediatrician and had not been given any other medical diagnoses. The three case studies revealed that there were unifying links among the subjects such as over-responsivity to tactile stimulation and motor incoordination. Motor incoordination may have resulted from over-responsiveness and avoidance of sensory opportunities that support fine and gross motor skills (2008). These observations also suggested that SOR may be considered a diagnosis that stands on its own because other diagnoses were ruled out prior to participation in the study.

Parush, Sohmer, Steinberg, and Kaitz (2007) found that approximately 69% of boys diagnosed with ADHD had some degree of tactile defensiveness. Children with ADD or ADHD
tend to have difficulty processing and organizing sensory information efficiently to make appropriate responses when presented with occupational demands (Dunn & Bennett, 2002). Dunn and Bennett (2002) provided a Sensory Profile to 70 children identified with ADHD and ADD and to 70 children who did not have an identifiable diagnosis. The researchers found that there were statistically significant differences between the two groups on 118 out of 125 items. Children with ADHD obtained much lower scores on the Sensory Profile indicating more frequent problematic behaviors. These children were also found to have much lower scores on greater than half of the items pertaining to auditory, touch, multisensory, emotional/social responses and behavioral outcomes of sensory processing sections. A previous study by Dunn and Brown (1997) also found that there were four factors in the factor analysis that were highly correlated to children with ADHD including Sensory Seeking, Emotionally Reactive, Inattention/Distractibility and Fine Motor/Perceptual.

More recently, it has been hypothesized that SOR occurs in isolation (Reynolds & Lane, 2007). May-Benson and Koomar (2007) found that children who were gravitationally insecure, or over-responsive to movement, frequently display avoidance, emotional, and/or postural responses when presented with sensory intense play requiring movement. May-Benson and Koomar (2007) identified avoidance behaviors as degrees of hesitation from no hesitation to complete refusal. They discussed emotional behaviors as a range of affect from neutral to extreme fear. Postural responses were proposed as normal to stiff and rigid body movements upon presentation of the movement activity. May-Benson and Koomar’s (2007) work was related to gravitational insecurity (vestibular over-responsivity), however, based on clinical experience, these behaviors may be observed in other types of over-responsivity as well. It is anticipated that children with over-responsivity will have escape-based behaviors, and these will
be observed through a child’s avoidance, emotional, and postural responses when presented with sensory intensive play that is part of sensory-based interventions incorporating movement and/or touch.

**Behaviors Associated with Sensory Over-Responsivity.** According to Miller et al. (2007) children with SOR may present with particular behaviors more quickly and with greater intensity than those children who have typical responses to sensory intensive play. Observed problematic behaviors include negativity, impulsivity, aggression, avoidance, and withdrawal (Williamson & Anzalone, 2001). While some children with SOR may exhibit a fight response, others respond with a flight or fright response to escape sensory intensive situations.

Over-responsiveness in the tactile and vestibular systems share similar behavioral manifestations. Children who are tactile defensive or gravitationally insecure exhibit one of two behavioral patterns as identified by the *Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood: Revised Edition* (DC:0-3R; Zero to Three, 2005) and the *Diagnostic Manual for Infancy and Early Childhood* (ICDL-DMIC; ICDL, 2005). The behavioral patterns are fearful and cautious or negative and defiant. Williamson and Anzalone (2001) characterize the behavioral patterns of children who are fearful and cautious to include fear, anxiety, hypervigilance, and difficulties with transitions. Further, children who are identified as being fearful/cautious may be distractible, irritable, fussy, moody, inconsolable, and exhibit difficulties with socialization (ICDL, 2005). Children who are negative and defiant/stubborn tend to be resistant to change, difficult, angry, and compulsive (Williamson & Anzalone, 2001). They are often controlling, aggressive, and tend to avoid or engage slowly in sensory experiences (ICDL, 2005). Typically, children who have hypersensitivities in any of the sensory systems have been treated using principles of sensory integration.
Sensory Integration Theory

Sensory integration theory was developed as a result of Dr. A. Jean Ayres’ work with children who had learning disabilities in the 1960’s through the 1980’s (Ayres, 1972). The principles of this theory were derived from contemporary neuroscience, developmental psychology and occupational therapy. Ayres hypothesized that some children with learning disorders experience challenges associated with processing and integrating sensory information ultimately affecting behavior and learning (Ayres, 1972; Schaaf & Miller, 2005). Sensory integration is defined as the interpretation and organization of sensation from the environment and body to make meaningful responses (Ayres, 1979; Schaaf & Miller, 2005) when presented with occupational demands. Inherent in sensory integration theory is the premise that when underlying sensations (i.e., auditory, visual, vestibular, proprioception, tactile, olfactory, and taste) are integrated, children learn and interact with others in an adaptive manner (Kimball, 1999).

The somatosensory systems (vestibular, proprioceptive, and tactile) are the foundation of sensory integration theory (Ayres, 1972). The vestibular system provides important information about movement and the body’s relationship to gravity (Kimball, 1999). Proprioception provides information about body awareness from input received via receptors in the muscles and joints. Together, these systems support posture, balance, and muscle tone. The tactile system receives discrimination and protection signals from receptors located in the skin. The ability to organize information from touch impacts the efficiency of reflex mechanisms such as rooting and sucking, eating, and developing bonds with the child’s mother or caregiver. The integration of information from the vestibular, proprioceptive, and tactile systems along with visual, auditory, oral, and olfactory input enhances the hierarchical development of body awareness, motor
planning, bilateral coordination, activity level, attention, and emotional stability (Kimball, 1999; Ayres, 1979/2005). It is believed that the overall integration of these sensations promote efficient visual perception and the ability to engage in goal-directed activities thus enhancing one’s focus, organization, self-esteem, academic achievement, and abstract reasoning (Ayres, 1979/2005).

**Intervention.** Occupational therapists use specialized intervention techniques when treating children with Sensory Modulation Disorder (SMD) to foster adaptation and occupational performance. Therapists use a range of strategies including heavy work (proprioceptive) activities to enhance modulation (calming and organization) prior to or during sensory intensive play. Activities are chosen by the child to tap into intrinsic motivation. Therapists also use graded sensory activities within intrinsically motivating play to help facilitate a child’s ability to tolerate various types of input. For example, if a child is tactile defensive, a therapist may provide the opportunity for proprioceptive (calming and organizing input) by having the child wheelbarrow walk to find puzzle pieces in dry rice or beans prior to engaging in messy play (shaving cream or finger paints). Sensory-based strategies may also be provided in conjunction with sensory integrative intervention. Sometimes, deep pressure touch and brushing with a surgical brush (Wilbarger & Wilbarger, 1999) are used to decrease sensitivity in the tactile systems. Weighted products such as a blanket or ankle weights may be used to help a child calm and attend while they are participating in a sensory intensive activity (Olsen & Moulton, 2004).

Therapists providing intervention based on principles of sensory integration, understand that the vestibular, proprioceptive, and tactile systems are the building blocks of improved nervous system organization (Ayres, 1972). The somatosensory systems contribute to the development of body awareness, coordination, motor planning, attention, activity level, and
emotional stability. The visual and auditory systems, in conjunction with the development of the somatosensory systems, are hypothesized to provide a basis for further development in speech and language, visual perception, and eye-hand coordination. Additional outcomes of organizing sensations in an appropriate manner are self confidence, concentration, organization, and academic achievement to name a few. Often, therapists incorporate input from another or multiple systems when presenting a child with sensory intensive play.

Occupational therapists utilize sensory integrative techniques to help a child achieve a family’s identified outcomes. Key principles guiding the use of a sensory integrative approach include: “the just right challenge to support interest and achievability, adaptive responses, active participation, and child-initiated play” (Schaaf & Miller, 2005). As stated previously, occupational therapists might also utilize sensory-based activities such as swinging a child, weighted vests, weighted blankets, and compression vests (Williamson & Anzalone, 2001). When used in the context of a meaningful and functional activity, these strategies are considered sensory techniques that foster increased organization and may enable improved occupational participation. Swinging a child and providing them with weighted products may help to calm and organize a child. A committee of experts in occupational therapy developed a guideline of twelve points that are considered the core principles of sensory integration intervention when provided by an occupational therapist (Mailloux, Smith Roley, & Erwin, 2008).

The core principles serve as a guide for clinicians using sensory integration as part of a child’s therapeutic program and for researchers who are operationalizing sensory integration. Principles such as adaptive responses, praxis, “just right challenge” and intrinsic motivation are essential to this theory. When using sensory integration, it is important to be thinking in terms of adaptive responses which are purposeful and goal-directed responses that facilitate mastery and
learning (Ayres, 1972). Riding a bicycle requires adaptive responses in that the child has to coordinate his/her body to pedal, sustain balance, and be watchful for oncoming traffic in order to get from one point to another. Adaptive responses support praxis which is the ability to complete a new and challenging task. There are many components of praxis including the ability to generate ideas, sustain arousal, coordinate both sides of the body, anticipate responses, and problem solve challenges. Therapists also try to incorporate the “just right challenge,” which refers to providing a child with an activity that requires just enough difficulty that it sustains their attention and engagement. Also, by encouraging the child to choose activities it is the goal of the therapist to tap into a child’s intrinsic motivation. Intrinsic motivation relates to a child’s desire to perform an action for the simple sake of engagement. A child who is motivated does not require reinforcement in order to participate in an activity. Application of these principles, according to Ayres (1972) will lead to improved learning across the lifespan. Consistency in applying these principles in treatment may also aid in finding more effective results in studies using sensory integration.

**Efficacy of interventions using sensory integration theory.** Over the years, reports on the efficacy of sensory integration intervention have been inconsistent. Some studies have questioned the efficacy of using this approach (Hoehn & Baumeister, 1994; Vargas & Camilli, 1998). Hoehn and Baumeister (1994) critiqued seven research studies examining the effectiveness of sensory integration. In subsequent analyses of research designs, methodologies, and findings, Hoehn and Bauemiester found that there was a lack of empirical support for the efficacy of sensory integration and the idea that efficient sensory integration improved attention, behaviors, and self-esteem. Lack of support for efficacy of sensory integration was based upon difficulties with subject sampling, group assignment, blind evaluation, placebo, and possible
Hawthorne effects in some of the critiqued studies. Vargas and Camilli (1999) performed a meta-analysis of studies that compared sensory integration with no treatment; sensory integration with alternative treatments; and sensory integration, no treatment, and alternative treatments. After measuring and weighing effect sizes, these authors stated that sensory integration was not shown to be any more effective than alternative treatments with respect to identified outcomes (i.e., psychoeducational, behavior, language, motor, and sensory perceptual skills). However, in their critique, Vargas and Camilli did not identify what was considered to be alternative treatments. While there is much research to be done in sensory integration, there is evidence that suggests sensory integration is effective. The conclusion is that sensory integration, at this time, is not proven nor disproven from an empirical perspective (Miller, 2003). Further, Miller (2003) has outlined critical points for future research to include rigorous methodology, homogeneous samples, sensitive outcome measures and replicable interventions.

One of the problems identified with these studies were that the definitions of sensory integration intervention were not clearly operationalized or consistent with theory. Each study defined the use of sensory integration in different terms or did not operationally define the use of the intervention clearly or consistently. For example, while some studies may have used core principles of sensory integration, others were using sensory-based activities as part of the independent variable. Proponents of sensory integration theory have articulated the need for better research methods on which to base evidence-based practice. This includes better operationalization of independent variables (i.e. SOR versus unspecified or heterogeneous Sensory Integrative Disorder), better controls, improved validation of the diagnostics for SMD and improved experimental procedures focused on validity, reliability, and overall design. More research needs to be conducted that includes a defined independent variable; protocols that are
replicable; a fidelity of measure to ensure accuracy of interventions using a Sensory Integration approach; accurate dependent variables that are consistent with the purpose of intervention; specific and functional outcomes; and the relationship to a theoretical base that honors an occupational performance model (Schaff & Miller, 2005). Provided that researchers adhere to these principles, empirical evidence will provide a greater knowledge base from which to understand and practice sensory integration. Critical analysis of the research that is currently present will provide a springboard for clinicians and researchers to engage proactively in support of evidence.

Currently, several case studies have demonstrated promising results on the efficacy of using a sensory integration approach (Case-Smith & Bryan, 1999; Schaaf & Nightlinger, 2007). Case-Smith and Bryan (1999) utilized a single subject design to study the effectiveness of occupational therapy using a sensory integrative approach (OT-SI) on task engagement, mastery play, and interactions in a group of preschool children with Autism. Using OT-SI over the course of 10 weeks, three of five children significantly improved with regard to mastery or goal-directed play possibly due to improvements in motor planning and sensory defensiveness. Four out of five children demonstrated improvements relative to the non-engaged behaviors and were able to focus much better most likely reflecting improved sensory modulation or motor planning. This was an important finding because a child’s ability to integrate sensory information efficiently is important for play engagement and maintaining interactions with others (Case-Smith & Bryan, 1999; Wieder, 1996; Williamson & Anzalone, 1997). An optimal level of arousal promotes developmentally appropriate behaviors and enhances a child’s ability to attend to play activities and learn from his or her environment.
Schaaf and Nightlinger (2007) implemented an in-depth case study analysis of the effectiveness of using OT-SI with a 4-year old male with sensory modulation dysfunction. The subject presented with hypersensitivities in touch and movement with associated sensation avoiding behaviors. Goals were derived in collaboration with his family using Goal Attainment Scaling (Kiresuk, Smith, & Cardillo, 1994). Following 10 months of sensory integrative intervention, the subject achieved all five of his goals related to play, activities of daily living, and social participation. The subject’s occupational performance was supported in the home and community validating Ayres’ (1979) idea that efficient sensory integration will impact behavior and overall development. This study demonstrated that by engaging in sensory integrative therapy, the child was able to successfully engage in activities that were once perceived as aversive. Also, Pfeiffer, & Kinnealey (2003) studied sensory defensiveness in adults. They found that defensiveness and anxiety associated with SOR decreased following participation in sensory diets. Although this study involved adults, it provided support for interventions based on sensory integration theory to reduce defensiveness and improve quality of life and performance in activities of daily living skills that may also expand to children. Sensory diets incorporating calming and organizing input may enhance a child’s ability to engage in sensory intensive play that is part of sensory-based interventions and decrease the frequency of defiant behaviors associated with escape. While these case studies were different, they both provide evidence supporting the use of sensory integration for children with over-responsiveness to foster participation in daily activities.

Ayers and Tickle (1980) studied hyper-responsivity or SOR to touch and vestibular stimulation in children with autism. Ten children were identified as being hypo-, hyper- or normally responsive to sensory stimulation. Following one year of sensory integrative therapy at
a frequency of two times per week, six out of ten children demonstrated positive responses when re-assessed. Many of the changes were observed in social interactions, purposeful engagement, and improvements in play skills. For the remaining four subjects, improvements were reported but not as well observed as in the clinic setting. Following statistical analyses, the children who made better improvements were those that were identified as being hyper-responsive to tactile and vestibular stimulation.

In summation, research on sensory integration has yielded mixed results. It is important to note that prior research finding negative and/or neutral results on sensory integrative effects on various outcomes did not identify consistent definitions of how sensory integration was implemented. Sensory integrative techniques were varied with regard to operationalization. While some studies used the principles of sensory integration other studies were not as clear about their methods. Current research is emerging that adheres to the principles of sensory integration using rigorous methodology, sensitive measures, homogeneous samples, and replicable interventions.

**Assessments of sensory integration.** SMD is identified based on parent report measures such as the Sensory Profile (Dunn, 1999), Sensory Over-Responsivity Scales (Schoen, Miller, & Green, 2008), and the Sensory Processing Measure (Parham, Ecker, Miller-Kuhaneck, Henry, & Glennon, 2007) along with extensive family interviews and clinical observations of the child during standardized assessments and structured/unstructured play. SOR is considered a problem with sensory modulation. Assessments such as a parent interview, SensOR (Schoen et al., 2008), the Short Sensory Profile (Dunn, 1997), and clinical observations will be reviewed to identify SOR.
**Parent interview.** Overall, a parent interview will provide insight as to how the parent perceives a child to function within the home and community settings. Information obtained from a parent interview will help a therapist have a better picture of who a child is and how they function outside of the clinic setting. It is difficult to gain an understanding of a child’s development when a therapist has a limited amount of time to interact with him or her in an evaluation session. According to Engel (2002), the parent interview should be comprehensive and it is meant to elicit as much information as possible that is relevant to the child’s current developmental concerns. Questions will elicit information regarding significant medical history, previous diagnoses, development, current level of functioning, and primary concerns. Interviews provide insight into intervention planning. Information obtained from parents/caregivers details the child’s strengths and weaknesses and give parents the opportunity to identify their own values about their child’s development (Stewart, 2001). The Canadian Occupational Performance Measure (Law et al., 2005), discussed in a later section, will identify and elaborate upon a family’s identified concerns once the evaluation is completed. Refer to Appendix A for the parent interview form that was used as a guideline during the initial evaluation.

**Sensory Over-Responsivity Scale: Inventory.** The SensOR (Schoen et al., 2008) is a parent reporting method of obtaining the frequency of child’s behaviors relative to sensory modulation. The SensOR provides a quantifiable classification to assist in identifying children with over-responsivity. The SensOR will be the critical measure for eligibility into this study and will be validated by the evaluating therapist’s clinical observations. The SensOR is the primary assessment because it isolates over-responsiveness from other difficulties in sensory modulation. Refer to Appendix B for the SensOR.
**Short Sensory Profile.** One of the most frequently used measures in current practice is the Short Sensory Profile (Dunn, 1999). The Short Sensory Profile (SSP) is used to identify children who have atypical sensory processing or SMD using 38 discriminative items that were psychometrically tested (Dunn, 1999; Tomchek & Dunn, 2007). The 38 items were refined from the full Sensory Profile and several factors were obtained: Tactile Sensitivity; Taste/Smell Sensitivity; Movement Sensitivity; Under-responsiveness/Seeks Sensation; Auditory Filtering; Low Energy/Weak, and Visual/Auditory Sensitivity. The Short Sensory Profile (Dunn, 1999) has been used in many clinical practices to assist in identification of children who have over-responsiveness to various sensations.

**Clinical observations.** Skilled observations are important for identifying typical versus abnormal neuromotor responses and problematic behaviors in children. Observations make good supplements to parental reports because reports are possibly influenced by education, threshold for misbehavior, parental psychopathology, and stress (Wakschlag, Leventhal, et al., 2005). Misbehavior, as related to this study, includes any of the associated behaviors related to over-responsivity including cautious/fearful, hypervigilance, distractibility, impulsivity, irritability, aggressive, avoidance, difficulty adapting to change, and negativity. Diagnostic and clinical observations will be used in this study to assist with identification of SOR.

Observations provide information about particular skills and behaviors. In this particular study, children will be pressed for behavioral responses by being presented with sensory intensive play that was part of sensory-based interventions (i.e. touch and movement). Observations in the clinic setting are considered to be decontextualized, but when the observations are supplemented with parent reports, the information is placed into a historical context so that we have a better idea as to what prompted the family to seek occupational therapy.
services. Also, the information obtained here provides an assumed level of functioning across multiple settings (i.e., home and community). Refer to Appendix C and D for clinical observations of vestibular and tactile processing, respectively.

**Fidelity Measure of Sensory Integration**

As discussed earlier, the findings of research exploring the efficacy of sensory integration intervention have been inconsistent. As the research was studied further, it became evident that the definitions of sensory integration intervention were not operationalized clearly and consistently throughout the literature. The Fidelity Instrument (Parham, Cohn, et al., 2007) was developed in an effort to measure the consistency of sensory integration intervention to the core principles of sensory integration theory in order to guide treatment and clearly operationalize the intervention. The Fidelity Instrument is still in its research phase, but, it serves as a guideline for raters to objectively and quantitatively review the structural and process elements of interventions to measure faithfulness to sensory integration intervention. The Fidelity Instrument observes structural and process elements that should be considered when applying principles of Sensory Integration. Structural elements include therapist qualifications, record review, assessment, and the preparation that is taken prior to intervention. Process elements include various criteria upon which a therapist is observed and graded upon within a therapeutic interaction with a client. Refer to Appendix E for the Fidelity Measure.

The Fidelity Measure will provide a quantification to indicate that the clinician’s treatment is adhering to Sensory Integration Theory. The more that current research adheres to these principles, the better determination will occur that Sensory Integration is effective in the treatment of children with sensory processing difficulties. As stated earlier in the discussion of research related to sensory integration, much of the problem in analyzing the outcomes is related
to the consistency of the experimenters’ ability to define the sensory integration principles used in the former studies. Adherence to the principles of fidelity in sensory integration will support more clearly defined principles to guide treatments that are replicable and sound.

In summation, assessing the specific sensory integration problem is paramount to planning treatment and providing consistency in treatment. It is also important to assess children with sensory integration deficits in terms of their functional capacities such as their performance in play, activities of daily living, social interactions, and learning as well as the behaviors that foster or impede their participation.

**Challenging Behaviors in Preschool Aged Children Defined**

Children with Sensory Modulation Disorder (SMD) have often been identified as having problematic behaviors such as escape/avoidance, aggression (hitting, pinching, pushing, etc.), negativity, and fear. These behaviors are frequently the reason for referral for occupational therapy services. There has been an increased concern regarding the number of young children who exhibit these problematic behaviors (Benedict, Horner, & Squires, 2007) but it is not known if any of these particular children have maladaptive behaviors as a result of inefficient sensory processing. Benedict et al. (2007) surmise that typically developing children will exhibit challenging behaviors, however, the behaviors should decrease during the preschool years as emotional regulation and language skills improve. During this developmental period, most preschoolers, ages 3-5 exhibit disruptive behaviors with some being considered normal and others requiring treatment (Wackschlag, Leventhal, et al., 2005).

The preschool aged developmental period is characterized by the development of self-control (Wackshlag, Leventhal, et al., 2005). When disruptive behaviors such as hitting, biting, tantrums, screaming, defiance or decreased engagement persist, a child’s development,
interactions, and learning are affected. Behaviors such as frustration tolerance, delaying gratification, and negotiation emerge as children expand their social groups to include peers. Simultaneously, there is an increase in parental demands and limitations correlating to a normal increase of disruptive behaviors. For example, nonengagement is usually elicited within the context of “do” tasks (Do this…) and generally reflects a degree of autonomy during interactions. Clinically significant nonengagement tends to be pervasive across settings and/or within social relationships. Aggression, within the normal range, involves a relatively immature strategy used to resolve conflict rather than deliberate efforts to hurt another. Clinically significant aggression is proactive, persistent, deliberate, and/or spiteful. Negative affect, or negativity, is usually a result of frustration or fatigue and of a mild to moderate intensity with a rapid rate of recovery. Clinically significant negativity is associated with frequent tantrums that are easily initiated, long duration, and poorly modulated. Preschoolers will typically display defiant behaviors as a way to escape challenging requests. When a child has SOR with associated escape/avoidant behaviors, the child may not want to engage in age appropriate play activities with their peers and may respond in a manner that is considered defiant or aggressive when faced with sensory input that is perceived as noxious. This may be the idea that separates maladaptive behaviors as part of typical development versus behaviors related to SOR.

When it comes to identifying these behaviors and the clinical significance associated with them, it is important to look at the quality and pervasiveness of the behaviors. The quality of the behavior refers to the ability to grade the behavior and the expectation that it will occur in a particular context (Wakschlag, Briggs-Gowan, et al., 2007). Grading of a behavior addresses the intensity, flexibility (responsiveness to environmental cues), and organization (pacing, duration, and predictability). Expectability in context refers to where the behaviors typically occur. For
example, mild aggression may occur within peer play as someone is taking something from another, but, it should not be directed towards an adult. Another good clinical indicator is the pervasiveness of the behaviors and whether they occur across settings and among different people. If the behaviors occur across settings and people, then they are considered pervasive.

While the actual behavior is important, the functions of behaviors tend to provide more in-depth information because all behaviors may be considered a method of communication. Functions of behaviors have been placed into five categories (Carr, 1994; Gresham, Watson, & Skinner, 2001) including attention, access, escape, avoidance, and internal stimulation. When the primary purpose of a behavior is attention or communication, a child receives positive or negative social reinforcement when they act. Children behave in an adaptive or maladaptive manner to gain access to tangibles or preferred activities, and these items often become the reinforcers. Escape and avoidance behaviors are usually a result of being presented with aversive tasks or activities, and these tasks become negative reinforcers. Sensory activities that present a perceived aversiveness especially to those children who are over-responsive may prompt an attempt to escape/avoid. Children may also act in ways to gain internal stimulation which is known as automatic or sensory reinforcement. Automatic responses may be observed in children who have under-responsive sensory systems who behaviorally are trying to gain stimulation. Typically, for children who respond in an automatic manner, there are no observed changes in the environment prior to or following a behavior (Glasberg, 2006). From a behavioral perspective, treatment using concepts such as punishment or extinction focus on weakening the response-reinforcer connection that precedes maladaptive behaviors. Treatment that is aligned with positive behavioral support attempts to strengthen the response-reinforcer connection for adaptive behavior (Gresham et al., 2001). This point will be further discussed
when rationalizing the use of sensory integration and behavioral interventions with children who have SOR.

**Behavioral assessment.** Functional behavior assessments assist in identifying the functions, or purposes, for such behaviors and guide treatment plans. According to Reese, Richman, Belmont, and Morse (2005), children behave in ways that help them gain attention, obtain access to appealing items, escape from demands or situations or due to internal reasons (fatigue, hunger or chemical imbalances). It is also important to remember that behaviors are analyzed for avoidance and sensory reinforcement. Problem behaviors are analyzed for the precipitating situations and motivation (antecedents) and the type of reinforcement the child receives that ultimately maintains the action (consequences).

Identifying the function, or purpose, of a child’s behavior is crucial in developing a positive and proactive behavioral intervention plan. When performing an analysis of behaviors, Carr and Durand (1985) suggested that assessment include the effects of attention and task difficulty on problematic behaviors. The authors found that by providing children who demonstrated aggression, self-destruction, and disruptive behaviors with functional communication training (FCT), problematic behaviors were replaced with more socially appropriate responses and served the same function as the problematic behavior. For example, if a child talks to gain attention in the classroom, the child may be taught to raise his hand and say “May I say something?” If a child behaves inappropriately to escape a task because the level of difficulty or sensory yield is perceived as too high, the child may be taught to say “Help me please” or “I don’t like that.” In a more recent study, Durand & Carr (1992) studied the effects of FCT when they were with people who were not privy to information regarding previous interventions. They compared this group to children who had been treated with time-out
procedures. The authors found that the children who had previous FCT continued to maintain appropriate responses to gain attention whereas the children who had experienced time-out procedures demonstrated their same levels of challenging behaviors as seen at baseline. FCT, along with other positive supports, enhance children’s socially appropriate behaviors. FCT may be a strategy to be considered when working with children who have SOR. Some children with SOR may benefit from learning a functional communication alternative to escape/avoidance behaviors.

Good behavioral plans are a product of accurate behavioral assessments. For children who have SOR, it is important to address the sensory basis for the behavior along with a behavioral plan that supports play engagement. The SOR may be the underlying reason for the observed behavior. Providing children and families with sensory strategies and positive behavioral supports that are individualized to their specific needs will be the key to successful performance in the home, communities, and school.

**Functional behavior assessments.** If the behaviors continue to be problematic a functional behavior assessment may be utilized. The assessment consists of direct observations and teacher/caregiver interviews to better understand the behaviors. This process culminates in determining the function of the behavior or rather its purpose. The Individuals with Disabilities Education Act (IDEA) in 1997 and reauthorized in 2004 mandated the utilization of functional behavior assessments (FBA) and positive behavior supports (PBS) when disciplinary actions were required (Gresham et al., 2001). The principles of operant learning theory guide the concept of functionalism inherent in FBA. Functionalism addresses the functions of behavior over and above the topography of behavior which is based on the form or structure (2001). An FBA is a method of identifying variables that promote and maintain challenging behaviors with
resulting interventions manipulating the identified variables (Stichter & Conroy, 2005). Typically, FBA’s have been used in school systems, but the principles and methods may be used in any context.

Gresham et al. (2001) stated that FBA uses multiple methods for data gathering to determine the reason a behavior occurs including the antecedents and consequences. Methods involve observing a child, caregiver interviews, and record reviews in an effort to account for accuracy. FBA addresses the environmental conditions relative to the behavior manifestation or nonoccurrence of the behavior. Identifying what is going in the environment when the behaviors do not occur provide important information. Environmental conditions may be causal or correlated to the particular behavior(s) in question. Functions of behavior are represented by a change in environmental conditions (independent variable), and the dependent variable is represented by the actual change in behavior (Gresham et al., 2001; Skinner, 1953).

Gresham et al. (2001) further discuss the principles of FBA such as antecedents and consequences. Antecedents occur prior to the behavior of concern. Antecedents consist of discriminative stimuli, establishing operations or setting events. Discriminative stimuli signal that a response may be reinforced. For example, when a child hears the bells of a fire drill, he or she will leave the building. Establishing operations (EO’s) are variables that increase the strength of a stimulus as reinforcing and increase the likelihood that behaviors influence the contact with the stimulus. EO’s may also decrease the occurrence of a particular behavior (O’Reilly, Edrisinha, Sigafoos, Lancioni, & Andrews, 2006; Gresham et al., 2001; Smith & Iwata, 1997). They are viewed as being on a continuum from satiation (too much) or deprivation (too little; Glasberg, 2006). An example of EO’s in the literature includes using food as reinforcement prior to lunch when a child may be hungry. EO’s are considered to be motivators.
The food as the reinforcement becomes extremely motivating because the child has not eaten in a while. Setting events are events that influence future behaviors even though they are removed in time and place. For example, an upsetting event early in the morning between siblings may precipitate a tantrum later in the day. Consequences are behaviors that are maintained by what happens after the behavior occurs. One such consequence is positive reinforcement which encompasses attention, tangible reinforcement or access to desirable activities and sensory reinforcement.

FBA’s involve indirect, direct, and descriptive procedures (Gresham et al., 2001). Indirect methods are most common and use interviews, record reviews, and checklists. Interviews should incorporate questions regarding the caregivers’ major concerns; potential causes of behavior; behavioral and skill comparisons to peers; time behaviors occur; and frequency of behaviors, to name a few. Direct or descriptive measures are systematic observations in the setting the behaviors occur. Charts that measure the antecedent-behavior-consequences are a good source of descriptions regarding occurrences of behaviors. Direct observation measures assess the frequency, time, intensity, and permanence of behaviors. Once the FBA has been conducted, a functional analysis should be implemented. A functional analysis examines a causal relationship between the between the antecedents and consequences of a behavior and is more valid for identifying a function (Alter, Conroy, Mancil, & Haydon, 2008). A functional analysis does not have to be labor intensive but can be as simple as the provider making a hypothesis about the cause of the behavior and providing interventions to support the relationship (Glasberg, 2006).

Much of the research on FBA has been conducted in the school setting, and its utility continues to be replicated (Burke, Hagan-Burke, & Sugai, 2003; Scott, Nelson, & Zabala, 2003).
Kennedy (2002) contends that in order for interventions to be successful, anyone who has contact with the child across settings needs to be trained and involved in the implementation of intervention. Validation that change has occurred takes place when a maladaptive behavior has been decreased and an adaptive behavior has emerged in its place. Others who work with the child should be assessed for implementation of strategies to enhance the social validity of the interventions.

Once data is gathered from an FBA, an intervention plan is devised (Gresham et al., 2001). The first step is to generate a hypothesis about the function of the behavior including measurable and testable variables. While the same behavior may be maintained by several different functions simultaneously, it is imperative to identify a primary function in order to select and trial a particular intervention strategy (Alter et al., 2008). The last step is to determine the intervention techniques that will be utilized.

**Positive behavioral supports as intervention.** Once an FBA is completed and a hypothesis is generated, the positive behavioral supports are implemented. Positive behavioral supports (PBS) provide a strategy for dealing with problematic behaviors in an individualized manner to promote adaptive responses and improve quality of life (Duda, Dunlap, Fox, Lentini, & Clark, 2004). Not as many studies of PBS have included children under four years of age; however, more research is becoming available. Duda et al. (2004) examined the effects of consultative PBS with two-3 year old children. Following an A-B-A-B design, the researchers found that implementing PBS was successful in improving engagement and decreasing problematic behaviors of both children in a community preschool program.

A behavior plan that focuses on proactive strategies such as positive reinforcement and extinction has been shown to be effective in improving a child’s daily functioning, self-
regulation, social-emotional competence, academic performance, and improved participation in family routines (Powell, Dunlap, & Fox, 2006). Information obtained from a variety of studies (Anzalone & Murray, 1991/2002; Benedict, Horner, & Squires, 2007; Hobbs, 2003; Lavigna & Willis, 1992; Royeen & Duncan, 1999) provides the foundation for positive behavioral supports for children with problematic behaviors. The idea of implementing positive behavioral strategies proactively for children with SOR is particularly important since behaviors become habitual over time. Behavioral strategies that promote escape such as time-out procedures or punishment are not effective for children with SOR because they would prefer to escape an aversive situation. Providing them with time-out only reinforces the escape/avoidance they may have been initially seeking. Punishment does not teach them coping mechanisms to handle the sensory experience or teach them socially appropriate behaviors. Further, reactive strategies such as time-out and punishment only serve to gain rapid control in a particular situation (Lavigna, Christian, & Willis, 2005) but do not teach coping and functionally appropriate behaviors.

Behaviorism is a philosophy suggesting that all behaviors are a result of interactions between the environment and behavior. Lavigna and Willis (1992) report that the use of nonaversive and positive approaches to challenging behaviors are effective and applicable to various populations such as those who are considered typically developing or those who have intellectual impairments. Interventions focus on behaviors that have social implications and significance to the child. In their training program, “Positive Approaches to Solving Challenging Behaviors,” Lavigna and Willis (1992) recommend methods that will help clinicians identify the forms and functions of behavior and implement positive therapeutic programs through direct and indirect intervention strategies. Lavigna and Willis (1992) provide a useful program to base behavioral interventions.
In sum, Lavigna and Willis (1992) discuss the importance of a good behavioral assessment in that it provides the foundation for the therapeutic program and helps to identify the “why” of a behavior. With an accurate program in place, behaviors are addressed that will improve a child’s functioning. A behavioral analysis begins with an interview/assessment that provides background information including medical history, family history, and background, developmental history, previous and current treatments, cognitive abilities, communication abilities, perceptual motor abilities, self-care skills, community skills, and play skills. A functional analysis that assesses the antecedent of the behavior, the behavior and the consequence/s will also help to provide insight. The clinician should develop a hypothesis as to “why” a child behaves in a particular manner with attention to and clear descriptions of the following criteria: physical characteristics of the behavior; cycle (start and stop of the behavior); course (gradual or full-blown); and strength (frequency, duration, latency, and severity). The frequency of a behavior refers to how many times the behavior occurs within a particular time frame. The duration indicates how long the behavior/s occur. Latency period indicates the amount of time between the initiation and termination of a behavior. And the level of severity is related to the amount of damage, loudness, threat factor, and defiance/nonengagement. Also, it is important to address the history of the problematic behavior and analyze the environment by asking where the behavior is most likely to occur, with whom is the behavior most likely to occur and when is the behavior more or less likely to occur. A clear description of the behavior is necessary in order to support analysis and positive programming. Analyzing consequences serve to identify the possible reinforcer/s and punishment that may be associated with specific behaviors (1992).
Principles of reinforcement. Skinner contributed basic principles of reinforcement to operant conditioning (Kazdin, 1994). Skinner believed that learning occurred as a result of consequences. Behaviors are strengthened and weakened as a result of what occurs following their presentation. Reinforcement, punishment, extinction, and stimulus control are a few principles that serve to develop or alter behaviors. Reinforcement, the primary behavioral principle used in this study, serves to increase the frequency with which a behavior occurs. Reinforcement is used to increase the positive and adaptive behaviors. Reinforcement from a behavioral perspective differs from that of a sensory integrative approach. Reinforcement in sensory integration intervention is used to encourage a child’s actions or behaviors. For example, a therapist may say “I like the way you are playing in the finger paints” or “You are doing some good swinging.” In this manner, reinforcement is a verbal encouragement and acknowledgement of the child’s actions. Positive reinforcement, in terms of verbal, gestural, and physical praise, overlap in a behavioral and sensory intervention. Tangible reinforcement, on the other hand, provides an external reward for participating in a particular activity or challenge. Sensory integration intervention promotes that a child engages because of the intrinsic motivation associated with participation in the activity and not engagement for the sake of a reward. It seems that if a child has a negative association to participating in sensory intensive play, that tangible reinforcement along with sensory integration intervention may be used initially to foster engagement. As the child becomes better apt at coping, reinforcement should be faded so that participation becomes more intrinsic and rewarding.

Lavigna and Willis (1992) emphasized different schedules of reinforcement that could be considered for positive programming. One variation of reinforcement includes Differential Reinforcement of Other behavior called DRO’s. DRO fixed interval schedules require that when
a child goes for a fixed amount of time when the behavior does not occur (i.e., 2 minutes, 3
minutes, etc.), the child receives reinforcement. DRO progressive schedules involve the increase
of reinforcement for each consecutive interval that the behavior does not occur up to a specified
amount of time.

There were some rules that accompanied the implementation of the reinforcement
variations. For example, Lavigna and Willis (1992) refer to the Goldilocks Rule stating that the
interval has to be implemented at just the right moment. The reinforcement has to be scheduled
in small enough amounts just under the baseline that was initially observed. If a tantrum occurs
approximately every 10 minutes, the reinforcement should be provided just before the 10 minute
interval is completed. The fixed interval rule states that reinforcement should be provided at
50% of the average time between responses before intervention. So, if a child has one tantrum
per hour, the DRO should be implemented every 30 minutes. The free access rule indicates that
the maximum amount of reinforcement a child receives should be less than what they would seek
when given free access. Access to the reinforcer should be limited and restricted so that the child
is in a state of deprivation so to speak. In order to avoid satiation, you want to provide no more
than 60% of the amount he/she could potentially gain given free access. So, if the child
demonstrated problematic behaviors that were identified as attention seeking, then the therapist
would provide more attention than the child typically received. If the behavior was related to
access, then the therapist would provide access to the preferred object to a degree that was
considered above what they normally would access the preferred object. Once a child begins to
perform without the problematic behaviors, a therapist begins to fade their reinforcement. This
means that the child has learned how to cope or tolerate stressful situations, and the results
should have more long-term effects.
When choosing reinforcers to target specific behaviors, Lavigna and Willis (1992) encourage clinicians to keep several factors in mind. The reinforcers should be meaningful to the child so the child will be motivated to change the behavior. Creative delivery systems should be considered because each child is unique. Novelty is appropriate as reinforcers that are new or surprising are perceived as exciting and rewarding. A variety of reinforcers will help to avoid satiation and keep a child interested in what is coming next. The reinforcers should be fun and created in the atmosphere of a game. For example, a child who loves cars may earn tokens/cars to place along a road in order to get to an imaginary destination where the reinforcer will be provided.

Lavigna and Willis (1992) advised that reactive strategies do not teach a child anything. There are reactive strategies that are used for situational management such as ignoring, re-directing, stimulus change, and physical management. The goal of situational management is to promote change in the moment. Sometimes, this is necessary but, the long term goal is to provide children with guidance about what to do if and when they are presented with challenges.

In summation, there are many considerations when choosing and providing reinforcers for children. Lavigna and Willis (1992) outlined many of these ideas as discussed earlier such as identifying functions of behaviors and principles of reinforcement. Each child is unique and responds differently. Considerations should be made regarding the type of reinforcement and the provision schedule. The type and schedule of reinforcement are important considerations for therapists when implementing intervention. Also, it is important to think in terms of reinforcement as a proactive measure. Strategies that are used in response to a maladaptive or problematic behavior do not teach children appropriate responses or coping mechanisms.
Outcomes of Sensory and Behavioral Interventions

Today, many clinicians draw on their knowledge base and use multiple theories to guide intervention using what many call an eclectic or dynamic systems approach. Therapists draw from a wide knowledge base of particular interventions in order to facilitate improved occupational performance. One such combination would be intervention that uses sensory integration and behavioral interventions to address SOR. Theory provides insight and serves as a guide to intervention across many disciplines. There may be instances where using one particular theoretical construct in isolation is appropriate; however, many instances may require combinations of multiple approaches. Thus far, the occupational therapy literature has provided limited information regarding the use of behavioral interventions in interventions with children who have sensory modulation difficulties.

Children identified with SOR exhibit behaviors that may be considered as learned problematic behaviors that are rooted in their heightened reactivity. Family members and caregivers may not understand the reactivity of the behaviors and what they are communicating. Also, families may not know how to address the behaviors appropriately. For example, a child who is considered resistive during a dressing routine could be given time-out when really, the resistance is stemming from an aversive response to touch. A child who is gravitationally insecure may be asked to sit in time-out in gym class for not participating in team sports. These types of discipline do not match the function of the behaviors. The functions of the behaviors are escape, and/or avoidance. The time-out strategies aid in a child’s escape/avoidance of a situation and further exacerbate the underlying problems by reinforcing the undesired response (i.e., the escape/avoidance of sensory input). Time-out procedures reinforce the tendency for a child to escape and avoid sensory input.
When faced with challenging behaviors that may be related to sensory processing (i.e., aggression, impulsivity, inattention, tantrums, and/or negative responses), therapists may also choose to incorporate behavioral strategies. There is little occupational therapy research available regarding the use of behavioral strategies in response to disruptive or challenging behaviors. While therapists may use particular behavioral strategies, they may not be as well versed on functions of behaviors or understand how to manipulate antecedents to foster positive outcomes. One study explicitly exploring behavioral techniques in occupational therapy was Pimm (1998) who discussed challenging behavior as it relates to children with cerebral palsy. The author suggested strategies including: reducing the expectations when necessary; determining environmental antecedents and responding with support; identifying and developing coping techniques; addressing communication needs; and training caregivers and staff on the use of meaningful activities for the child.

Stagnitti et al. (1999) completed a case study of a child who was 5 years old and referred to OT for behavioral concerns and difficulty with socialization. The child was identified as having moderate sensory defensiveness evidenced by his aversive behavioral responses in the areas of auditory, visual, oral, touch, and movement sensations. The evaluation consisted of a parent interview, a sensory questionnaire, and observations within the home and school settings. They found that the child had no other central nervous system involvement. Clinic intervention focused on intense sensory integrative opportunities, the Wilbarger brushing protocol and a sensory diet. Following several clinic sessions, the subject’s behaviors and anxiety with regard to movement and touch improved; however, five months following intervention, his parents contacted the therapist with continued concerns of problematic behavior at school. The child returned to the clinic for two more weeks of intervention. Behavioral modification techniques
such as extinction, social stories, and communication strategies were utilized with success. At nine months post initial assessment, the subject improved in all sensory areas. He was also performing more successfully within the school setting. According to Stagnitti et al. (1999), treatment that focused on the behaviors and sensory modulation in combination were effective in the subject’s progress. When the defensiveness was addressed through sensory integration and the environment was modified to support his participation, the child’s success was evident in his participation in functional activities, play skills, and social interactions with non-family members.

Behavioral interventions in conjunction with sensory integrative interventions may be helpful for children who demonstrate problematic behaviors associated with escape and avoidance. Devlin, Leader, and Healy (2009) utilized a multi-element design to determine whether behavioral interventions or sensory integration therapy was more effective in reducing self-injurious behavior in a child with autism. They found that in each of the conditions including demand, attention, access and play, there was a decrease in the amount of hand mouthing and hand biting behaviors when behavioral interventions were used. Sensory integrative techniques were applied every two hours or contingent upon behavioral presentation. One concern with this study is that several of the strategies that were listed as part of the child’s sensory diet were actually passively applied to the child (brushing, joint compressions, swinging, hot dog wrap, and beanbag compressions). Actively, the child could rock, jump, or commando crawl with assistance, but it was not stated that the child should engage in as many heavy work activities as possible. Passive strategies are not considered to be true sensory integrative techniques thus posing a threat to this study’s conclusions.
In sum, some studies have combined sensory integration and behavioral techniques (Devlin et al., 2009); however, none have delineated the sensory interventions with adherence to fidelity or outlined behavioral interventions as well to address SOR. In this proposed study, caution will be taken to provide sensory integrative intervention that is consistent with the Fidelity Measure and to ensure that the core principles are utilized. Further, by using a combination of sensory integrative principles in conjunction with specific behavioral interventions it is anticipated that children with SOR will demonstrate a decrease in nonengagement associated with escape and avoidance resulting in improved play engagement. Traditional behavioral approaches alone are not enough to help a child with SOR learn to cope with sensory intensive challenges.

It is imperative that therapists and families understand that sensory-based behaviors, as observed in SOR, can be treated effectively with sensory and behavioral strategies. It is important to understand the functions of behaviors and the positive strategies that are available to foster a child’s occupational performance. This research study attempted to determine whether using a combination of sensory strategies with positive behavioral interventions will be effective in decreasing problematic behaviors and improving play engagement.

This study explored the utilization of sensory-integrative and behaviorally-based interventions in occupational therapy for children who have SOR and resulting behaviors. Previous studies used sensory strategies with difficulties operationalizing the intervention. Only two studies (Devlin et al., 2009; Stagnitti et al., 1999) discussed the behavioral program accompanying the sensory interventions. This study looked at specific interventions (sensory and behavioral) to determine if the combination approach was more effective than when sensory integration is used in isolation. This study sought to answer the following questions: Does the
use of sensory integration combined with behavioral strategies decrease the frequency of nonengagement within a therapy session? Will a child who receives a combination of sensory integration and behavioral intervention improve his or her play engagement within each session? Will children who receive both sensory integration and behavioral interventions make progress towards family identified outcomes?

The hypotheses are as follows:

1. A child with SOR receiving a combination of sensory-based interventions and behavioral interventions (Condition SBB) during occupational therapy intervention will demonstrate a decrease in nonengagement during sensory intensive play that was part of sensory-based interventions (within and across conditions).

2. A child with SOR receiving a combination of sensory-based interventions and behavioral interventions (Condition SBB) will demonstrate an improvement in play engagement in sensory intensive activities (vestibular and/or tactile) within and across conditions.

3. A child with SOR receiving both occupational therapy with sensory-based interventions (Condition SB) and sensory-based interventions with a combination of behavioral interventions (Condition SBB) will demonstrate an improvement in perceived performance and satisfaction of daily living activities in the Canadian Occupational Performance Measure scores compared to baseline.
Chapter 3: Methodology

Research Design

A single case study was used to explore the effectiveness of sensory-based interventions and behavioral interventions during play engagement for children identified with Sensory Over-Responsivity (SOR). The SB condition included treatments based on sensory-based interventions and sensory-based activities (e.g., passive stimulation, weighted products, and/or compression). The SBB condition included sensory-based interventions with the addition of behavioral interventions. The multi-element design provided a comparison of multiple conditions and enabled the investigator to establish a degree of experimental control and to determine if a functional relationship existed between the alternating treatment conditions (Kennedy, 2005). The two conditions (sensory-based interventions [SB] and sensory-based interventions with the addition of behavioral interventions [SBB]) were compared to determine if there was a difference in the incidence of escape and avoidance behaviors related to nonengagement during play. See Figure 1 for intervention conditions.

Subjects. Potential subjects were recruited from children referred for occupational therapy services at Carilion for sensory processing difficulties with the possibility of over-responsiveness to touch or movement. The families were provided with information about the study prior to their arrival by the principle investigator or evaluating therapist.
Eligibility criteria. Inclusion criteria for children to participate in the study included:

- Child ages 3-5 years;
- Identification of SOR by an occupational therapist in the vestibular/proprrioceptive and/or tactile systems as determined by the SensOR. The Short Sensory Profile and clinical observations supplemented the results of the SensOR;
- Exhibited the target behavior of nonengagement when presented with vestibular and/or tactile sensory intensive play that was part of sensory-based interventions as determined by clinical observations of nonengagement during the initial evaluation;
- Co-morbid diagnosis of Attention Deficit Hyperactivity Disorder or Attention Deficit Disorder could be present;
- Co-morbid diagnosis of Autism or Asperger’s Disorder with receptive/expressive language standard scores between 80-115 could be present; and
- Parents/families whose children received occupational therapy services one time per week for the duration of the six week intervention period as prescribed by a physician and recommended by an occupational therapist. If the child missed one or more sessions, the family would make efforts to make up the missed sessions within a 1-2
week time period. The family was billed and received therapy services for which they were referred throughout the duration of the study.

Exclusion criteria included:

• Intellectual disabilities, previously known as mental retardation, due to the potential magnitude of nervous system dysfunction and potentially confounding variables associated with this diagnosis;

• Genetic disorders such as Fragile X Syndrome, Down Syndrome, and Williams Syndrome;

• Cerebral Palsy and other diagnosed neuromotor impairments by parent report;

• Fetal Alcohol Syndrome and other disorders related to substance abuse as stated in the medical history/chart review; or

• A child who missed one or more therapy sessions out of a total of six sessions and who were unable to make up missed sessions. A replacement would be recruited.

Once children were identified as meeting the inclusion criteria, children and families were invited by the evaluating occupational therapist to participate in this study, read and sign an informed consent approved by the VCU IRB and Carilion Clinic IRB (Appendix F). If recruited children were not found not to be over-responsive to vestibular and/or touch according to the SensOR and clinical observations of sensory processing, they continued to receive occupational therapy intervention individualized to their needs but did not participate in this study. Over the course of eight months, only four children who had been referred for occupational therapy services seemed to fit the criteria for eligibility in this study. Of the four children identified for potential eligibility, only two met the criteria for participation in this study. The first potential subject’s family, following initial evaluation, decided that they could not commit to the 12-week
time frame initially outlined in this study. Following approved IRB changes, the time frame was changed to a 6-week study to foster a family’s willingness to participate. The fourth and final subject was evaluated and found to meet the inclusion criteria for this study. Due to the treating therapist’s schedule, the subject began the intervention course outlined in this study 1.5 years following initial IRB approval.

**Institutional review board.** The proposal and research plans were submitted to both Virginia Commonwealth University and Carilion Clinic. Informed consent and video consents were also submitted to both boards. Approval was received by both Institutional Review Boards. Refer to Appendix G and H for the pre- and post-research video consents. Revisions were submitted to both boards to reflect changes in the study’s duration from 12 weeks to 6 weeks secondary to time constraints by families. Also, revisions were submitted to change the number of subjects to one subject secondary to time constraints. Approval from both Institutional Review Boards was received.

**Confidentiality.** The subject’s mother videotaped the child and therapist during the evaluation and during each 45-minute intervention session over the course of the 6 week intervention period. Videotaping was conducted by the subject’s parent because the possibility of placing the camera in a position that was obscured from the child was difficult. The size of the gym space and the movement required within a play activity were difficult to capture without an individual actually moving the camera. While a hidden or obscure camera was preferred, this was not optimal to capture the child’s affect and verbalizations for the coders.

All videotapes were kept in a locked cabinet in the principle investigator’s office. Upon completion of the study, videotapes of the evaluations were destroyed. The mother of a child on the occupational therapy caseload agreed to have her son’s sessions videotaped for training the
coders. The child’s mother also gave permission for the principal investigator to keep a copy of the video for future training purposes. The subject’s mother signed a consent form to use the videos for educational training purposes. Refer to Appendix G and H.

**Hypotheses.** This study attempted to determine which condition, sensory-based interventions (SB) or sensory-based interventions with the addition of behavioral interventions (SBB), was more effective in decreasing the incidence of nonengagement during sensory intensive play. It was hypothesized that a combination approach using both sensory integration and behavioral interventions (tangible reinforcement) would be more effective than using either approach in isolation. Further, it was believed that children in the SBB condition would demonstrate an increased incidence of exploration and engagement in play when compared to the children receiving sensory integration intervention in isolation. Both conditions, SB and SBB, were expected to elicit overall improvements in a child’s play engagement as SI is considered best practice when providing occupational therapy for children who have SOR (American Occupational Therapy Association [AOTA], 2008). In addition, it was anticipated that participation in this study would foster improvements in play engagement with a resulting decrease in nonengagement.

Play engagement was measured by a child’s ability to initiate, sustain, and terminate a goal-directed activity. The following hypotheses were assessed:

1. A child with SOR receiving a combination of sensory-based interventions and behavioral interventions (Condition SBB) during occupational therapy intervention would demonstrate a decrease in nonengagement during sensory intensive play that was part of sensory-based interventions (within and across conditions).
2. A child with SOR receiving a combination of both sensory-based interventions and behavioral interventions (Condition SBB) would demonstrate an improvement in play engagement in sensory intensive activities (vestibular and/or tactile) within and across conditions.

3. A child with SOR receiving both occupational therapy with sensory-based interventions (Condition SB) and sensory-based interventions with a combination of behavioral interventions (Condition SBB) would demonstrate an improvement in perceived performance and satisfaction of daily living activities in the Canadian Occupational Performance Measure scores compared to baseline.

**Training of evaluating therapist.** The subject was evaluated and treated by an occupational therapist certified in the Sensory Integration and Praxis Test Administration and Interventions by Western Psychological Services. The evaluating therapist also had advanced level training in sensory integration. The evaluating therapist was provided with training on the SensOR, SSP, Clinical Observations of Vestibular and Tactile Processing, FBA’s, ABC’s, and how to conduct a brief functional analysis to assess for escape/avoidance, attention, access, and automatic reinforcement. The therapist was provided with the criteria outlined by the Fidelity Measure (Parham, Cohn, et al., 2007) as a guideline when providing sensory interventions. Refer to Appendix E for intervention guidelines.

**Evaluation of child according to study criteria.** Eligibility of the study was based on assessment of the presence of SOR and included information obtained from parental interview, the Sensory Over-Responsivity Scale: Inventory (Schoen et al., 2008), validated through the Short Sensory Profile (Dunn, 1999) and clinical observations. It was possible that information
could have been different between the SensOR and the SSP. An FBA and functional analysis was also utilized in the evaluation to determine the function of the subject’s behavior.

**Parent interview.** A parent interview was conducted during the evaluation to obtain information on the child’s medical and developmental history and to identify the family’s primary concerns. Medical information relative to pregnancy such as gestational age, medications, complications, and labor and delivery may provide insight to a child’s development. Information regarding infancy and motor skill development was discussed to determine if there are any functional manifestations of over-responsiveness. For example, children with vestibular hypersensitivities may have disliked diaper changes, and children with touch hypersensitivities may have had difficulties with activities such as feeding and dressing. Also, the family was prompted to discuss how the child participates in daily routines such as dressing, feeding, bathing, grooming and hygiene, and toileting activities. The child’s participation in play and social interactions were explored. Parents also provided information on the child’s top five preferred activities and top five preferred toys/objects. See Appendix A for a more detailed guideline for questioning during a parent interview.

**Sensory Over-Responsivity Scale: SensOR.** The Sensory Over-Responsivity Scale: Inventory (SensOR; Schoen et al., 2008) is a research edition caregiver rating scale that measures SOR in seven sensory domains (touch, auditory, visual, proprioceptive, olfactory, gustatory, and vestibular). Refer to Appendix B for the SensOR. This is the first inventory to specifically identify over-responsivity and is being used in current research (Reynolds & Lane, 2008). The SensOR provides a method of accurate identification and objectivity related to sensory modulation. The SensOR was the primary tool used to identify sensory over-responsivity in the vestibular and/or tactile systems. If there had been a discrepancy in the results of the SensOR
and the Short Sensory Profile, the evaluating therapist would have used the scores obtained from the SensOR and clinical observations to determine the presence of over-responsivity. In this study, the SensOR and SSP results both yielded scores reflecting touch and movement sensitivities.

Item selection for the SensOR was obtained from an extensive literature review, peer reviewed articles, textbooks, related chapters, and existing scales (Schoen et al., 2008). Once identified, items were placed into sensory domains. Refer to Appendix B for a copy of the SensOR. It is a forced choice scale in which the parents indicate whether the target behavior is present (‘1’) or not present (‘0’) in their child. Answers are added to provide a subtotal score. Table 1 shows scores that indicate Sensory Over-Responsivity and are 2 standard deviations outside the norm.

Table 1

<table>
<thead>
<tr>
<th>Sensory Domain</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tactile</td>
<td>At or above 10</td>
</tr>
<tr>
<td>Auditory</td>
<td>5</td>
</tr>
<tr>
<td>Olfactory</td>
<td>2</td>
</tr>
<tr>
<td>Visual</td>
<td>2</td>
</tr>
<tr>
<td>Movement</td>
<td>4</td>
</tr>
</tbody>
</table>

Note. Adapted from S. Reynolds, personal communication, August 18, 2008.

A pilot study was conducted by Schoen et al. (2008) to determine the validity and reliability of the SensOR. The SensOR has a moderate to high internal consistency indicating relative homogeneity of factored items and a moderately high inter-rater reliability among examiners who were trained to use the SensOR. Although content and construct validity were evaluated with consistent results, further research is needed.
**Short Sensory Profile.** One of the most frequently used measures in current practice is the Short Sensory Profile (Dunn, 1999). The Short Sensory Profile (SSP) is used to identify children who have atypical sensory processing or SMD using 38 discriminative items that were psychometrically tested (Dunn, 1999; Tomchek & Dunn, 2007). The items were refined from the full Sensory Profile and several factors were obtained: Tactile Sensitivity; Taste/Smell Sensitivity; Movement Sensitivity; Under-responsiveness/Seeks Sensation; Auditory Filtering; Low Energy/Weak, and Visual/Auditory Sensitivity. If the child scored two standard deviations below the mean and lower than one standard deviation below the mean, the child was more than likely to have sensory processing problems (Dunn, 1999). If the child scored two standard deviations below the mean then the child was more than likely to have sensory processing problems. Clinical observations, SensOR results, and the SSP scores confirmed the presence of SOR in the tactile and/or vestibular/proprioceptive systems. Internal reliability on the SSP ranged from .70 to .90 (Dunn, 2007). Magnitude of the internal validity was between .25 and .76 which is a low to moderate correlation supporting that these factors are measuring sensory modulation.

**Clinical observations of sensory processing.** To further validate over-responsivity in the subject, clinical and diagnostic observations of tactile and vestibular processing adapted from Blanche (2002) and May-Benson and Koomar (2007) were used. During the initial evaluation, the primary investigator made clinical observations of the subject’s vestibular and tactile processing to confirm the presence of SOR. To assess for vestibular hypersensitivity, the child was placed in situations that presented a movement challenge to observe any physical or emotional responses. Appendix C provides a list of the tasks that were used to assess for vestibular hypersensitivity. Postural control was assessed while the child was sitting and
standing on a moving surface (large therapy ball). The therapist observed the child’s nonverbal and verbal responses to the movement. Assessing the child in weight bearing positions such as wheelbarrow walking and crawling over an uneven surface provided information on postural control and vestibular functioning.

A variety of tactile experiences were presented to the child to observe the child’s responses to this type of stimulation. Refer to Appendix D for a complete list of the tasks that were used to assess for tactile hypersensitivity. The therapist observed the child’s response to light and unexpected touch in high density receptor areas such as the back of the neck, lips, palmar surfaces of the hand and soles of the feet. The therapist observed responses to social touch such as her mother giving her a kiss and the child’s responses and willingness to explore soft and rough textures, rice and beans. The child was presented with messy play substances such as finger paints and shaving cream.

**Functional behavior assessment and functional analysis.** Within the sensory activities that were presented in the evaluation and as part of the clinical observations, a functional behavior assessment was used to identify and propose a function of the child’s behavior using an A-B-C (antecedent-behavior-consequence) coding sheet. The evaluation was videotaped and two coders, trained on A-B-C, coded for each behavioral presentation when presented with sensory intensive play that was part of sensory-based interventions (antecedent) and the consequence (reinforcement or punishment) that occurred as a result of that behavior.

Within the evaluation, the evaluating therapist performed a very brief functional analysis of the escape/avoidance-based behavior to ensure that escape was, in fact, the function. The therapist presented the child with sensory intensive play. During one presentation, the therapist provided an increased amount of attention. If a nonengagement behavior was present, then it
was felt that attention was not the function. The therapist presented the same activity using escape. If the child avoided the opportunity to engage in the sensory intensive play that was part of sensory-based interventions and would not engage, then it was most likely, that an escape function was probable. The activity was also presented under an access condition. The subject was given access to a desirable object/activity. If the subject had continued to demonstrate nonengagement behaviors, then access was, most likely, not the function of the behavior. When assessing for an automatic reinforcement condition, the child was provided waiting time and access to two sensory intensive play that was part of the sensory-based interventions that were deemed safe. The child was observed for 5 minutes to see if she would engage on her own accord. In this subject’s case, she did not seek the sensory intensive play most likely because children who are over-responsive would not typically seek automatic reinforcement from perceived aversive stimuli. The coders viewed the tapes and completed an ABC coding and functional analysis to determine the function of the child’s behavior and generate a hypothesis. The coders determined that the subject’s emotional and behavioral responses to movement were related to escape/avoidance.

**Intervention**

The study was intended to compare to sensory-based interventions (SB) and sensory-based interventions with the addition of behavioral interventions (SBB) in a subject who was identified with SOR. An alternating-treatments design was used with both conditions in order to compare the effects of each of the interventions on nonengagement and play engagement in sensory intensive play. See Figure 1. Initially, the intervention was supposed to be 12-weeks, however, due to time constraints and difficulty obtaining parental commitment, intervention lasted 6 weeks. This change was approved by VCU and Carilion Institutional Review Boards.
Each condition, SB and SBB, lasted for three weeks each with sensory-based motor interventions being the first condition. It was felt that three weeks would provide enough time to make comparisons between conditions unless there were difficulties with transitional interventions, the first intervention of each condition. Sensory intensive play that was part of sensory-based interventions was considered as play that incorporated some aspect of the sensation (movement) that was perceived as noxious to the child and identified by the SensOR. The treatment was individualized to the needs of the subject and therapeutic goals were originally identified by the subject’s family. The following conditions were the independent variables:

- **Condition A (SB):** sensory-based interventions and sensory-based activities

- **Condition B (SBB):** sensory-based interventions and a behavioral intervention (tangible reinforcement)

**Training of coders.** There were a total of three coders within this study. Two coders, blind to the condition and hypotheses, were trained on the core principles of sensory integration as identified by the Fidelity Measure (Parham, Cohn, et al., 2007) and the behavioral intervention, tangible reinforcement, that were used in this study. With family consent, coders viewed videos on children in occupational therapy to practice the coding procedures and their understanding of the behavioral interventions and dependent variables (play engagement and nonengagement). Coding on practice tapes occurred over the course of three months due to the therapists’ schedules. All three coders were speech and language pathologists in the Carilion Pediatric Therapy Department. One coder left to seek employment elsewhere and coded the evaluation only along with one additional coder. During the intervention conditions, two coders were used to observe the subject’s behavior over the course of 6 weeks.
**Sensory-based intervention.** Sensory integration principles were utilized in both of the treatment conditions (SB and SBB). The treating therapist attempted to adhere to the structural and process elements outlined in the Fidelity Measure (Parham, Cohn, et al., 2007) as a guide for intervention. The treating therapist’s adherence to the fidelity scale was evaluated. The criterion for providing sensory integration treatment is its 80% adherence. The therapist did not meet the 80% adherence to sensory integration but instead obtained a score of 76. The treating therapist continued to use the structural and process elements as a guide for interventions. As a result, the intervention conditions were changed to sensory-based interventions rather than using the term sensory integration interventions. The treating therapist continued to use the criteria identified by the structural and process elements. Structural elements address the treating therapist’s qualifications and environmental needs that are considered necessary for Sensory Integration treatment. Process elements provide guidelines according to the principles of Sensory Integration Treatment. Table 2 shows an outline of the structural and process elements and coding procedures.

**Fidelity to sensory integration.** Leaders in the occupational therapy profession utilizing sensory integration are developing core principles of sensory integration. The core principles will aid in the development of a manualized approach for sensory integration interventions to foster replication in studies on the efficacy of sensory integration treatment. Sensory Integration and Praxis Test (SIPT) certification will always be the gold standard for the evaluation of children with Sensory Processing Disorders. While the SIPT certification is not related to theoretical application per se, the certificate now includes intervention courses. There are also other courses that provide training on clinical reasoning and interventions strategies related to sensory integration. Many occupational therapy practitioners are using sensory integration
<table>
<thead>
<tr>
<th>Element</th>
<th>Dimension</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>Environment</td>
<td>The environment accounts for physical space between objects and includes the lighting, auditory stimuli and the type of equipment deemed necessary to provide safe and effective treatment of sensory and motor systems.</td>
</tr>
<tr>
<td></td>
<td>Therapist</td>
<td>The therapist implementing Sensory Integration intervention has post-graduate training in Sensory Integration (SI/SIPT certification) and supervision/mentorship using Sensory Integration by a qualified expert.</td>
</tr>
<tr>
<td>Process</td>
<td>Safety</td>
<td>The therapist is aware of safety through the manipulation of equipment and physical proximity to child.</td>
</tr>
<tr>
<td></td>
<td>Presents sensory</td>
<td>The therapist provides at least two out of three types of input: tactile, proprioceptive, and vestibular.</td>
</tr>
<tr>
<td></td>
<td>opportunities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facilitates Self</td>
<td>The therapist helps child attain an adequate level of alertness and affective state supporting engagement in activities. The therapist strives to assist the child in attaining an appropriate level of arousal. Also, the child should demonstrate an enjoyable affect during sensory activities.</td>
</tr>
<tr>
<td></td>
<td>Regulation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Presents just</td>
<td>The therapist may alter the activity so that the child has to display some level of effort.</td>
</tr>
<tr>
<td></td>
<td>right challenge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Challenges</td>
<td>The therapist supports and challenges at least one of the motor challenges in postural, ocular or bilateral control within the context of play.</td>
</tr>
<tr>
<td></td>
<td>postural, ocular,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and/or bilateral</td>
<td></td>
</tr>
<tr>
<td></td>
<td>control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Challenges praxis</td>
<td>The therapist challenges the child’s ability to motor plan unfamiliar actions and organize him/herself in time and space.</td>
</tr>
<tr>
<td></td>
<td>and organization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of behavior</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaborates in</td>
<td>The therapist collaborates with child to choose activities and materials associated with those activities.</td>
</tr>
<tr>
<td></td>
<td>activity choice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ensures success</td>
<td>The therapist sets up activities so that a child can be successful and make adaptive responses when presented with challenges.</td>
</tr>
<tr>
<td></td>
<td>Fosters play</td>
<td>The therapist creates a playful atmosphere in order to engage child.</td>
</tr>
<tr>
<td></td>
<td>Establish a</td>
<td>The therapist fosters a collaborative relationship with the child that goes beyond praise and instruction.</td>
</tr>
<tr>
<td></td>
<td>therapeutic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>alliance</td>
<td></td>
</tr>
</tbody>
</table>

principles within practice and do not have advanced level training. Many employers are not reimbursing for this type of extensive continuing education for economical reasons so it is imperative to share what is known to enhance best practice to achieve a child’s outcomes and contribute to evidence-based practice.

A coder trained by Shelly Lane, an internationally renowned SI lecturer, practitioner and researcher, was found reliable in the Sensory Integration Fidelity Measure (Parham, Cohn, et al., 2007). This coder agreed to measure faithfulness to Sensory Integration, provided by the treating therapist on the first session of each alternating treatment condition. The coder was blind to the study’s purpose, hypotheses, and treatment conditions. A 10-minute videotaped session was sent to the coder via Certified Mail with a required signature. The ten minutes included the five minute segment that was also being coded for the behaviors nonengagement and play engagement and the five minutes prior to the coded segment.

Within the observations, the coder’s responsibility was to determine whether it was the intent of the therapist to meet the guidelines set forth by the Fidelity Measure. For example, the coder might score the therapist high if she presented the subject with two out of three sensory opportunities prior to or during engagement in sensory intensive play. Scores were calculated for each of the ten process elements and scored according to a Likert scale of 1 to 4. A score of “4” indicated that “certainly” a therapist intentionally used a particular strategy. A score of “1” indicated that “no,” the observer did not think that the therapist intentionally used a particular strategy. The cut-off score is 80 for an intervention session to be considered as using sensory integration (Lane, 2008).

**Coding for behavioral fidelity.** The coder, a clinical psychologist for Carilion Children’s Clinic, was trained on the use of tangible reinforcement within a treatment session by
the principle investigator. The clinical psychologist was provided with a training folder that included the training manual explaining the principles of sensory integration, sensory-based interventions, and tangible reinforcement. Over the course of one month, the clinical psychologist and principle investigator met on two occasions to view practice videos. On the two occasions, the clinical psychologist and principle investigator were 95% and 100% consistent with identification of tangible reinforcement used in the practice videos.

The coder viewed videotapes of children with SOR when presented with sensory intensive play using sensory-based interventions and tangible reinforcement. A time sampling procedure was used to code for adherence to the principle of tangible reinforcement. The coder determined whether these strategies were present or absent during a 5-minute videotaped session at 15-second intervals. Refer to Appendix I for a copy of the Fidelity to Behavioral Interventions. For example, the first condition of the sensory integration intervention (Condition SB) was coded for tangible reinforcement. It was determined that if tangible reinforcement is used during a sensory integration session more than 30% of the time (7 out of 20 time sampling opportunities), then the principle investigator would meet with the treating therapist to discuss the treatment principles. Due to the nature of human behavior, it was anticipated that therapists may inadvertently incorporate tangible reinforcement or other behavioral modifications to encourage participation from the child. Behavioral interventions were only used 1 out of 20 opportunities in the SB condition. This meant that the therapist was using a sensory integrative approach without incorporating behavioral interventions to facilitate engagement.

**Sensory-based and behavioral interventions.** Sensory-based strategies were supplemented with behavioral interventions and used in the SBB condition as a tool to further decrease nonengagement and increase play engagement in sensory intensive play. There were
certain parts of each intervention that overlapped. When working with children, therapists use behavioral strategies but may not have the language or knowledge of what behavioral interventions they are using and why they are using them. Both interventions used verbal encouragement and praise for participation. For example, participation was reinforced with verbal (‘Good job’), gestural (thumbs up), and/or physical (high five) praise. Both interventions used strategies that supported the child’s autonomy and sense of control. In Sensory Integration Theory, activity choices provide a way of promoting collaboration, child-directedness, and an experience of success. From a behavioral perspective, choices provide a child with autonomy and a sense of control. Both perspectives acknowledge the difficulty of task engagement (‘I know this is hard’) and a child’s effort to participate (‘I like the way you are trying’) because this fosters play and establish trust. Extinction, planned ignoring, while not discussed in the sensory integration literature, is often used in therapy as a measure of re-directing a child. So, positive reinforcement using verbal (‘Way to go’), gestural (thumbs up) or physical (patting on the back) praise and choices were not identified in this study since it could be inherent to both sensory and behavioral interventions.

The primary behavioral intervention for this study was tangible reinforcement discussed by Benedict, Horner, and Squires (2007) and Lavigna and Willis (1992) as a means of enhancing play engagement in sensory intensive play. Tangible reinforcement was considered to be any reward used to encourage the child to participate in sensory intensive play. To determine the tangible reinforcement that would be used in this study, the parent was asked to list the child’s top five preferred activities and the top five preferred toys. Also, during the initial evaluation, the child was provided with three to five toys/objects on the interview form. At the beginning of each condition (SB and SBB), the child would be presented with three to five toys/objects to
determine if the preference remains the same or the child chooses another toy/object that may be used as the reinforcer. The child receives a reward for an appropriate or desired behavior. The reward may be provided as a contingency for participation (‘Do this, get that) or provided upon initiation of participation in sensory intensive play. Systems such as a token economy can be used such that when a child receives a defined number of tokens, the child is able to access a desirable activity/toy. The child will “do” the task in order to gain a reward.

This principle differs significantly from the sensory integration principle of child-directedness. While sensory integration promotes child directedness and intrinsic motivation, participation for sake of interest in the activity, tangible reinforcement would provide an extrinsic reinforcer to enhance participation in sensory intensive play. The treating therapist was operating according to all other principles of sensory integration, the principles of best practice when working with children who have over-responsiveness. While the subject would not be engaging initially in support of intrinsic motivation, it was anticipated that over time, the child would begin to engage for the sole sake of participation itself. The goal would be that reinforcement is faded over time to enhance a child’s intrinsic motivation for play engagement

**Outcome measures.** Outcome measures that were utilized in this study included the information obtained from the Partial Time Sampling Data sheets and the Canadian Occupational Performance Measure (COPM; Law et al., 2005) adapted for children. The time sampling sheets provided a concurrent measure of improved behavior during intervention sessions. The COPM provided a functional measure to capture generalization of improved function outside the treatment environment.

**Play engagement and nonengagement.** Time sampling was conducted on the subject in each treatment condition (SB and SBB) and the resulting data was used to measure progress each
Interpretation of sensory-based behaviors, those associated with the presentation of sensory intensive play that was part of sensory-based interventions (tactile or vestibular) were derived from the ABC coding that occurred during the initial evaluation. Also, the initial evaluation was coded for the presence of play engagement and nonengagement as a means for comparison to the intervention conditions. There were many behaviors associated with SOR such as fear/caution, hypervigilance, impulsivity, irritability, however, for purposes of this study only nonengagement was assessed. Nonengagement was chosen as a measurable variable due to the perception that many preschool aged children can be considered resistant as part of typical development. However, SOR can result in nonengagement as a means to escape/avoid sensory intensive play when presented in sensory-based interventions affecting play and learning. So, it was important to address this behavior. Identification of SOR and resulting best practice interventions might decrease the frequency, intensity, and duration of nonengagement behaviors that are typically characterized as developmental in nature. Behaviors were analyzed to determine if the function of the behaviors was related to escape and/or avoidance. Escape behaviors were associated with the subject trying to remove herself from a demand (Carr, 1994; Gresham et al., 2001), and avoidance was the attempt to withdraw when a potential demand was perceived. It was anticipated that children with SOR used escape/avoidance. See Appendix J for the operational definitions of escape, avoidance, and nonengagement.

Nonengagement associated with SOR was identified and explored with the manipulation of the SB and SBB treatment conditions. This means that the therapist implemented sensory and behavioral interventions in order to decrease nonengagement and improve engagement in sensory intensive play. In the SB condition, the treating therapist implemented sensory-based
interventions to determine if nonengaged behaviors associated with escape and avoidance decreased as a result of this intervention.

Data was collected during each session over the course of the 6 week intervention using the time sampling sheet to determine progress related to each videotaped treatment condition. The percentage of intervals of nonengagement and play engagement were calculated during 15-second intervals within 5 minutes of sensory intensive play that was part of sensory-based interventions capturing engagement and transitions between activities. The therapist placed a demand by presenting sensory intensive play that was part of sensory-based interventions or the child anticipated a demand based on the equipment that was available at the time of treatment. In the case of the latter, a large therapy ball was visible to the subject, and the subject tried to avoid this particular activity.

A percentage of intervals totaling 20 opportunities (tallies at 15-second intervals during a 5-minute videotape) were calculated for nonengagement during each intervention session for 6 intervention sessions. This percentage determined if there were immediate improvements within each session and across sessions. It was anticipated that some aspect of nonengagement would be evident during the majority of sessions since the sensory intensive play that was part of sensory-based interventions was perceived as relatively aversive. It was anticipated that nonengagement would be ameliorated when sensory-based interventions were used.

The time sampling provided a percentage of intervals in which play engagement and nonengagement were present and served to identify whether there was change in these behaviors when presented with sensory intensive play that was part of the sensory-based intervention occurring in the initial evaluation and during each intervention condition. Time sampling determined if children demonstrated decreased escape and avoidance behaviors when presented
with sensory intensive play that was part of sensory-based interventions and whether they were able to sustain play engagement in sensory intensive play that was previously perceived as aversive. A timeline for the collection of outcome measures is provided in Table 3.

Table 3

**Timeline for Outcome and Fidelity Measures**

<table>
<thead>
<tr>
<th>Weeks</th>
<th>ABC</th>
<th>Time Sampling</th>
<th>COPM</th>
<th>SI Fidelity</th>
<th>Behavioral Fidelity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Evaluation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Canadian Occupational Performance Measure.** The Canadian Occupational Performance Measure (COPM; Law et al., 2005), an individualized outcome measure, was completed by the parent prior to and after the 6 week intervention period. The COPM obtained the family’s general goals for their child outside of the clinic setting. The primary areas assessed were self-care, productivity, and leisure.

Cusick, Lannin, and Lowe (2007) adapted the COPM (Law et al., 2005) for use in the pediatric population. They deleted the categories of “paid/unpaid work” and “household management” from the COPM as they do not pertain to young children. When the measure is used with children, parents/caregivers determine the activities that they feel are important for the child to do for themselves. The activities and goals considered are broad or more specifically defined (Tam, Teachman, & Wright, 2008). Adults rank the desired activities in terms of
importance. Once the five top problems were established, the parent identified her perception of the child’s performance and her own satisfaction with how the activity was performed. Performance and satisfaction were scored using a 10-point rating scale.

Psychometric properties were assessed for the COPM (Law et al., 2005) adapted for use with children. The COPM was found to have acceptable alpha coefficients for the performance and satisfaction scores indicating good internal consistency reliability (Cusick et al., 2007). Content validity was established as families identified the instrument as clear and applicable to their needs. Construct validity was also obtained. The adapted COPM was responsive to change after intervention.

**Independent variables.** The independent variables in this study were the intervention conditions, SB and SBB. To maintain adherence to sensory integration, the Fidelity Measure (Parham, Cohn, et al., 2007; Appendix D) was used as a guide to support play engagement and minimize nonengagement behaviors. Behavioral interventions included tangible reinforcement to facilitate play engagement and minimize non-engagement. Behavioral interventions were also measured by the Fidelity of Behavioral Interventions checklist (Appendix I). Table 4 shows the independent variables, the treatment conditions used to elicit change.

**Behavioral coding.** Nonengagement (dependent variable) behaviors were considered if any of the following behaviors occurred when a child was presented with sensory intensive play:

- Child re-directed the therapist’s attention to a different activity by requesting to do something else;
- Child said “I can’t,” “no,” “I don’t want to,” “Whoa,” or anything else that indicated the child did not want to participate;
• Child physically moved away from the activity; or
• Child screamed, cried, whined or had trembling in his/her voice.

Table 4

Independent Variables and Treatment Conditions

<table>
<thead>
<tr>
<th>Term</th>
<th>Operational Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory-based Intervention (SB)</td>
<td>Treatment provided using core principles of Sensory Integration as identified by Fidelity Measure (Appendix E). The Fidelity Measure was used as a guideline for the treating therapist in an attempt to provide sensory-based interventions as close to the principles of sensory integration as possible. A fidelity to behavior used to ensure that tangible reinforcement was used less than 30% of the time.</td>
<td>A child who is over-responsive to vestibular input may initiate play with the therapist incorporating heavy work (proprioceptive) opportunities within the context of that play to enhance calming and organization. Within the activity, the therapist may introduce a graded vestibular (movement) opportunity with the “just right challenge” in mind to foster an adaptive response and play engagement. Sensory intensive play was considered as the introduction of the aversive stimulation as identified in the initial evaluation within the presentation of sensory-based interventions.</td>
</tr>
<tr>
<td>Sensory Integration and Behavioral Interventions (SBB)</td>
<td>Treatment provided using core principles of Sensory Integration as a guideline for sensory-based interventions and as identified by Fidelity Measure (Appendix E) along with tangible reinforcement in accordance with this study. A fidelity to behavioral intervention will ensure that tangible reinforcement is used more than 30% of the time in the behavioral condition.</td>
<td>A child who is over-responsive to vestibular input may engage in the same activity described above. The therapist may also incorporate a reinforcement procedure such as “do this, then get…” as a method of enhancing play engagement and decreasing nonengagement. Sensory intensive play was considered as the introduction of the aversive stimulation as identified in the initial evaluation within the presentation of sensory-based interventions.</td>
</tr>
</tbody>
</table>

While these were not all inclusive, the definition of the child’s behavior was individualized and based on his/her presentation. Nonengagement was measured in terms of partial interval time sampling at 15-second intervals for 5 minutes within an intervention session. The partial interval time sampling was conducted via a videotape of the intervention. The presence of
nonengagement behaviors within each 15-second interval was recorded totaling 20 opportunities within a 5-minute period. Fifteen-second intervals provided adequate opportunities to observe nonengagement. A 5-minute period was chosen so as to eliminate the possibility of transitions from activity to activity where nonengagement would be difficult to assess. Also, during transitions, it was not likely that a child was presented with sensory intensive play. So, within an intervention session, the treating therapist was not aware of which 5-minute interval and which activity would be coded. The principle investigator chose the first 5-minute interval that included sensory intensive play that was part of sensory-based interventions following the first 10 minutes of the intervention session. The 5-minute intervals were also used for the sensory and behavioral coding procedures.

Play engagement (dependent variable) was when a child engaged in purposeful play either independently or following the introduction of rewards depending on the condition (SB or SBB). The play activity was initiated by the child; however, the therapist was able to provide limited choices within the environment to foster initiation of the activity when needed. Play engagement consisted of a child sustaining engagement in play even if for a small period of time. The child’s play was terminated when a goal was achieved or an end was determined. For example, she completed a necklace for herself while in the sensory-rich adventure to obtain her jewelry. Play engagement was measured via time sampling at 15-second intervals during a 5-minute videotaped intervention session. As with nonengagement, coding and scoring occurred and was specific to play engagement. Within a 15-second interval, it was possible for the child to demonstrate both nonengagement and play engagement. By coding for both, interval frequencies were obtained that demonstrate if play engagement occurred.
The family identified goals (dependent variables) were based on the COPM (Law et al., 2005). The family’s identified goals were related to the subject’s occupational performance areas (play, activities of daily living skills and social interactions) in the home and community. Progress towards these goals was identified on the last intervention session through the use of the COPM.

**Dependent variables.** The dependent variables were the frequency of nonengagement behaviors, play engagement, and parents’ perceived performance and satisfaction towards family identified goals as determined by the COPM (Law et al., 2005). The occupational therapist treating SOR used best practice methods. It was not considered ethical to withhold sensory-based interventions to have a third comparison intervention utilizing a behavioral only condition. When a child is identified as having problems associated with sensory processing, standard practice is to provide interventions using a sensory integrative approach (AOTA, 2008). Table 5 shows the dependent variables, play engagement, and nonengagement.
Table 5

*Dependent Variables for Nonengagement and Play Engagement*

<table>
<thead>
<tr>
<th>Terms</th>
<th>Operational Definitions</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonengagement</td>
<td>Child attempts to escape or avoid engagement when presented with a “do” task or when presented with the opportunity to engage in play with sensory intensive play. The child may attempt to re-direct the therapist’s attention to another activity; make negative statements about self or activity; physically move away from activity or scream, cry or whine when presented with sensory intensive play.</td>
<td>Child attempts to escape or avoid engagement when presented with a “do” task or when presented with the opportunity to engage in play with sensory intensive play. The child may attempt to re-direct the therapist’s attention to another activity; make negative statements about self or activity; physically move away from activity or scream, cry or whine when presented with sensory intensive play. The presence and/or absence of nonengagement was coded at 15-second time intervals during a randomly selected portion of the intervention session for a total of 5 minutes.</td>
</tr>
<tr>
<td>Play Engagement</td>
<td>Child initiates play independently or when an activity is presented. Child sustains engagement in play even if for a small period of time. The child terminates play when a product is achieved or an end is determined. For example, he or she makes a smiley face in shaving cream. He or she engages in an activity while swinging on a swing.</td>
<td>Number of 15-second intervals during a randomly selected portion of the intervention session was coded via video for play engagement for a total of 5 minutes. When the child demonstrated play engagement (initiation, sustaining or termination of goal-directed play in sensory intensive play that was part of sensory-based interventions the behavior was coded for presence or absence.</td>
</tr>
<tr>
<td>Canadian Occupational</td>
<td>The family identified 3-5 goals for the child and rated the goals at baseline and at the end of the 6-week intervention period with regard to perceived performance and satisfaction. The goals were related to play and activities of daily living.</td>
<td>Parents rated and scored their perceived interpretation of their child’s performance and satisfaction with that performance on selected goals. Each goal was given a score related to performance and satisfaction at evaluation and on the last intervention session. The total score at evaluation and on the last intervention was a result of the total performance or satisfaction scores divided by the number of goals. This occurred at evaluation and at the termination of the 6-week intervention.</td>
</tr>
<tr>
<td>Performance Measure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(COPM; Law et al., 2005)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4: Results

Subjects

Four subjects were initially recruited for evaluation in an outpatient hospital setting. Two of the subjects did not meet the inclusionary criteria. One subject was identified to be eligible for this study but his family could not agree to the time commitment. One subject age 3 years 3 months, meeting all entry criterion, was successfully recruited by this examiner for an occupational therapy evaluation. She had been on a wait-list for occupational therapy services for two months and the referral concern was related to sensory differences. Prior to the evaluation, the investigator contacted her mother. The subject’s mother was provided with information related to participation in this study.

Parent interview results. The subject’s mother indicated that the subject was born full-term without complications. She was delayed with babbling and had an older brother with articulation difficulties. The subject received speech therapy in early intervention but no other services were provided at that time. The subject was followed by an ophthalmologist for eye alignment and acuity. She was near-sighted and wore glasses. No other significant medical history was identified.

The mother reported the subject was a loving child. There were no concerns with sleeping. She enjoyed being outside and walking around to observe her world. She liked to play with her dollhouse and Disney princess dolls. She loved music. The mother’s greatest concerns were with the subject’s clumsiness, fear of heights/movements and not paying attention to where
she was going. The subject’s mother reported that as a baby, the subject would swing strapped into a baby swing without difficulty. Around the age of 15 months, she no longer liked to swing. The subject kept her head upright when bending over and supported or braced herself when leaning. She disliked rides at an amusement park and avoided lifting her feet off the ground. The subject was fearful of her power wheels car and disliked riding it in open spaces even if she controls the car. She only rode it in a hallway at her dad’s place of employment. At the time of this study, the subject was enrolled in gymnastics and would tumble. However, she was fearful of climbing on the high bar after she was flipped over on it, and she needed hand held assistance to move over the balance beam. She participated in swimming and liked the pool but had difficulty climbing in an out of the pool.

**SensOR results.** The subject’s mother completed the SensOR. In the area of touch, she identified her daughter’s difficulty with the following self care areas: washing and wiping face, cutting fingernails and toenails, haircuts, hair washing, brushing teeth, getting dirty, having messy hands and having a messy face. The subject was identified as not liking mud, finger paints, glue or kissing. Her scores on the tactile domain were 13 out of 28 indicating a potential over-responsivity to touch. To meet the criteria for a possible sensitivity to touch on the SensOR, the subject was required to have a score at or above 10 out of 28. The following aspects of movement were identified as bothersome: climbing, walking or climbing open stairs, experiencing heights, playing in the playground (jungle gym, swings, and slides), amusement park rides, and going up or down escalators. The subject’s score on the movement domain was 8 out of 10. To meet the criteria for identification of movement sensitivity, the subject was required to have a score of 4 out of 10.
**Short Sensory Profile results.** On the SSP, the subject obtained definite differences in the areas of tactile sensitivity, movement sensitivity, auditory filtering, low energy/weak, and visual/auditory sensitivity. The scores reflected probable differences in underresponsiveness/seeks sensation and typical presentation in the taste and smell. The subject met the criteria of possible inefficiencies to tactile and vestibular processing by scoring two standard deviations from the mean indicating that a sensory processing problem was more than likely. With regard to touch, the subject’s mother indicated that her daughter frequently expressed distress with grooming, avoided going barefoot, and reacted aggressively and emotionally to touch. In the area of movement, the subject’s mother indicated that she became anxious/distressed when her feet left the ground, braced herself, and startled to movement easily.

**Clinical observation results.** The subject crawled across an uneven surface (big foam cloud) and wheelbarrow walked with her head hanging without difficulty. When placed on a therapy ball and tilting the head backwards or when the child’s feet were placed off the ground important information regarding vestibular functioning was gleaned. The subject demonstrated extreme fear and refusal of tasks using the balls when asked to roll backwards unsupported. She tolerated sitting on the large ball with support at her thighs with encouragement to let go of the therapist. On two occasions, the subject let go for 2 seconds at a time. She was hesitant with movement side to side on the ball without holding onto the therapist. The child was observed to jump on a level surface and jump off of a step without difficulty. Clinical observations confirmed sensitivity to movement as identified by the SensOR, SSP, and parent interview.

Tactile processing was assessed with regard to light and unexpected touch and engagement in dry and messy substances. The subject received a social kiss from her mother without any concerns. The subject also played in rice and beans. The subject played in shaving
cream without any aversive responses. It was felt that tactile processing was within the typical range. In this instance, clinical observations did not confirm the presence of tactile sensitivity.

**Functional behavior analysis results.** During the evaluation, the evaluating therapist performed the functional analysis to determine a function of the subject’s behavior. In the evaluation, the evaluating therapist felt that the subject exhibited escape/avoidance behaviors when presented with movement challenges. The coders validated this assessment when coding the evaluation. It was identified by the subject’s mother that she was motivated by princess themes. So, in preparation for the sensory integration and behavioral interventions, the treating therapist used princess stickers as a reinforcer for the subject to initiate engagement in challenging movement activities.

**Eligibility results.** Following evaluation, the subject was found eligible to participate in the study. She was identified as having sensory over-responsivity in the vestibular domain. The subject exhibited nonengagement behaviors in the presence of sensory intensive play that was part of sensory-based interventions, and more specifically, movement. The coders validated the escape/avoidance behaviors in the evaluation following the FBA and functional analysis. The subject did not have any specified medical diagnoses.

**Sensory-based intervention condition.** Sensory-based intervention was randomly selected as the first experimental condition. The SB condition lasted a duration of three weeks. During this condition, the treating therapist used sensory-based strategies such as brushing, joint compressions and ankle weights during the first ten minutes as preparatory strategies. Following this transitional period, the treating therapist provided opportunities for the subject to engage in sensory intensive play that was part of sensory-based interventions using the structural and process-oriented elements from the Fidelity Measure (Parham et al., 2007) as a guide.
Alternating conditions of sensory-based and behavior. The first session of alternating conditions, SB and SBB, was anticipated to be assessed for Sensory Integration adherence. Within the process elements, the coder must have observed that at least 80% of the identified processes were being used. Initially, the first intervention session of each condition was going to be coded for Fidelity with termination of the study occurring if the therapist did not meet 80% adherence. The first condition of the SB condition was coded, and it was found that the treating therapist did not meet 80% adherence. The therapist obtained 76% adherence. Due to the time constraints of the study and difficulties associated with recruiting another subject, it was felt that the study would continue with the treating therapist’s intention to follow the principles as outlined by the Fidelity Measure (Parham, Cohn, et al., 2007). Since the therapist score was indicated borderline adherence and no standard error of measurement was provided to guide interpretation of borderline adherence, she was given feedback on the discrepancies found and she attempted to incorporate change. Fidelity was not assessed during subsequent sessions.

Treatment was considered to be sensory-based for purposes of this study, and the intervention continued with the acknowledgment that the sensory-based interventions did not optimally adhere to Ayres’ Sensory Integration ©.

Sensory-based and behavior intervention. The second condition, during weeks 4-6, was SBB. The treating therapist used the same sensory-based interventions described above during the first ten minutes of the session. The treating therapist continued to use sensory-based interventions throughout the session; however, in this instance, tangible reinforcement was used to encourage participation in the vestibular-based activities that were perceived as aversive. During the initial evaluation, the subject’s mother identified that one of the subject’s highly motivating objects/themes were princesses. In this condition, the subject responded to “Do this,
get that” using princess stickers in the presence of perceived aversive movement opportunities when the subject demonstrated any sign of nonengagement.

The coders reached 93% inter-rater agreement. Following agreement, the coders viewed videotaped intervention sessions each week for a period of 5 minutes using time sampling coding sheet (Glasberg, 2006). The videotaping and coding period began after the first 10 minutes of the treatment session to allow the child and therapist time to transition into the session. The treating therapist was blind to the specific 5-minute interval of the videotaped session that was used for coding. The coders used time sampling to code the percentage of intervals in which play engagement and nonengagement behaviors occurred at 15-second intervals using a digital timer.

The coder viewed the first 5-minute videotaped session in the sensory-based interventions and behavioral interventions treatment condition (Condition SBB) to ensure that tangible reinforcement was introduced and used as intended. To determine fidelity to behavioral interventions in the SBB condition, the presence of tangible reinforcement was recorded during each 5-minute sample at 15-second increments. During the SBB condition, it was anticipated that over time there would be a decrease in the percentage of behavioral strategies due as a result of learning and increased play engagement. In the behavioral conditions, the therapist implemented tangible reinforcement when sensory intensive play that was part of sensory-based interventions was introduced if the child was unwilling to engage. While some behavioral interventions such as positive reinforcement, extinction, and choices of activities were sometimes used in both conditions, tangible reinforcement was not aligned with sensory integration principles and should not be frequently used in an SB condition. The fidelity to the behavioral condition during the SBB condition was found to be 11 out of 20, or 55% of the time,
meaning that the treating therapist used tangible reinforcement to foster play engagement and decrease nonengagement. In contrast, the SB condition had a maximum of behavioral interventions of 30% making this condition more child-directed rather than providing reinforcement for participation.

The treating therapist engaged the subject in sensory intensive play that was part of sensory-based interventions during both SB and SBB conditions. The therapist used clinical reasoning to determine how to scaffold the environment, limit choices, and grade the activity according to sensory integration principles to support participation in sensory intensive play. In the SBB condition, the therapist added tangible reinforcement to enhance participation in conjunction with the sensory integration principles. The subject was never forced to participate in the presented activities.

**Data Collection**

Data collection included information obtained from the initial evaluation, ABC coding, time sampling, COPM (Law et al., 2005) and fidelity measure of behavioral interventions. ABC coding was used to assess behaviors related to nonengagement and engagement in play engagement when presented with sensory-based opportunities within the initial evaluation. Information obtained from the ABC coding assisted in determining if a functional relation existed between a particular intervention and decreased nonengagement and subsequently improved engagement in play with a sensory challenge. The frequency of non-engagement and play engagement data obtained from the partial time sampling is represented in scatterplot graphs for within-phase and between-phase patterns. The data provides a visual representation of behaviors related to escape/avoidance and play engagement. The COPM provided numerical identifiers on a scale of 1-10 with a parent’s perception of a child’s performance and the parent’s
satisfaction with that performance. The information was quantified as a change in parental perceptions of a child’s participation and satisfaction with performance in identified goals.

**Descriptive Statistics**

The subject participated in a 6-week intervention course. The first three weeks, SB condition, consisted of sensory-based interventions, and weeks 4-6 consisted of sensory-based interventions in combination with behavioral interventions. Over the course of the 6-weeks, two coders coded each session. The coders viewed the videotaped sessions and identified the interval frequency of nonengagement behaviors in each treatment session. Using a time sampling sheet, the presence or absence of nonengagement behaviors was assessed within twenty 15-second intervals. The interval frequency reported was the number of intervals in which behaviors were observed out of 20 opportunities. The same coders also viewed the videotaped sessions a second time and identified the frequency of play engagement behaviors in each treatment session. Using a time sampling sheet, the presence or absence of play engagement behaviors was assessed within twenty 15-second intervals. Nonengagement behaviors and play engagement behaviors were coded during the same 5 minutes at 15-second intervals. The scores between the two coders were averaged to provide mean frequencies of play engagement and nonengagement behaviors. It was possible to have play engagement and nonengagement behaviors during the same 15-second interval because the subject may have avoided the sensory intensive play that was part of sensory-based interventions but engaged when the challenge was changed to “the just right challenge” or when reinforcement was introduced. Table 6 shows the mean interval frequencies of nonengagement and play engagement during each intervention session as identified by each coder.
The mean, or level, of nonengagement behaviors and play engagement behaviors were also identified once the coders completed viewing each intervention session. In contrast to the hypothesis, the average interval frequency of nonengagement behaviors increased during the SBB condition. The average interval frequency of play engagement behaviors increased during the SBB condition. It was found that the subject started participation in this study with a high level of play engagement behaviors. Table 7 shows the mean interval frequencies of nonengagement and play engagement behaviors during each intervention.

Each interval consisted of a 15-second time span in the course of 5 minutes. In total, there were 20 intervals. The average interval frequency of total nonengagement behaviors during the SB condition, sensory-based interventions, was a total of 4.7. The subject demonstrated nonengagement behaviors approximately 24% of the 5-minute coding session (4.7 divided by 20 opportunities) in the SB condition. The average interval frequency of

### Table 6

<table>
<thead>
<tr>
<th>Treatment Session</th>
<th>Nonengagement</th>
<th>Play Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>16</td>
</tr>
</tbody>
</table>

*Interval Frequencies of Subject’s Nonengagement and Play Engagement Behaviors*
Table 7

Mean Frequencies of Subject’s Nonengagement and Play Engagement Behaviors

<table>
<thead>
<tr>
<th>Condition/Week</th>
<th>Nonengagement Average</th>
<th>Play Engagement Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB: 1</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>SB: 2</td>
<td>2</td>
<td>19.5</td>
</tr>
<tr>
<td>SB: 3</td>
<td>7</td>
<td>14.5</td>
</tr>
<tr>
<td>SBB: 4</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>SBB: 5</td>
<td>6</td>
<td>18.5</td>
</tr>
<tr>
<td>SBB: 6</td>
<td>9</td>
<td>16.5</td>
</tr>
</tbody>
</table>

nonengagement behaviors during the SBB condition was 6.3 indicating an increase in nonengagement over time and over conditions. The subject demonstrated nonengagement behaviors 32% of the 5-minute coding session (6.3 divided by 20 opportunities) in the SBB condition. The average interval frequency of total play engagement behaviors during the SB condition was a total of 17.7, which was relatively high when beginning this study. The subject demonstrated play engagement behaviors 89% of the time during the SB condition. The average interval frequency of total play engagement behaviors during the SBB condition, sensory-based interventions in combination with behavioral interventions, was 18. The subject demonstrated play engagement behaviors 90% of the time during the SBB condition. This was a slight increase in play engagement behaviors across time and over conditions.

Data Analysis

The first hypothesis was that nonengagement behaviors would decrease when the child was engaged in the sensory-based interventions in combination with the behavioral interventions. To test the hypothesis that the combination of sensory-based and behavioral interventions would reduce the incidence of nonengagement a Coefficient of determination ($R^2$) was used to visually analyze the data. There was a positive relationship between the number of sessions and the
number of nonengagement behaviors for both conditions. The sensory-based interventions and behavioral interventions were implemented weeks 4-6. During weeks 4-6 as the number of sessions progressed, the frequency of nonengagement rose. The Coefficient of determination (R²) was also used to determine the goodness of fit in linear regression. A coefficient of determination value lies between the values of 0 and 1. A value of 0 assumes that there is a relatively small correlation between the variables being tested and a value of 1 indicates a high correlation between the variables being tested (Spiegel & Stephens, 1999). The Coefficient of determination for nonengagement behaviors in the SB condition (R²=0.12) was extremely low although this may have been influenced by the second session. So, approximately 88% variability was unexplained. The Coefficient of determination for nonengagement behaviors in the SBB condition (R²=0.9) was much larger indicating a better fit of the data. The level, or mean, of nonengagement behaviors in the SB condition was found to be 4.7 and in the SBB condition, 6.3. This means that the frequency of nonengagement behaviors increased over time. The slope in both conditions was positive and with medium magnitude. In the SB condition, the variability was relatively high while the variability was low in the SBB condition. Figure 2 shows the results for nonengagement behaviors during the SB and the SBB condition.

Figure 2 represents the average data points on nonengagement behaviors for each intervention session in the SB condition and the SBB condition. The data points in the SB condition were much more variable, and the broken line associated the SB condition represents the best fit to the data and shows a relative increase in nonengagement behaviors throughout the SB condition. The SBB condition is represented by a dotted line, and the data points are much closer, indicating that the variability was less than the SB condition. There was a sharper increase in nonengagement behaviors over the course of the SBB condition which was not
expected based on the hypothesis that nonengagement behaviors would decrease as a result of a combination of sensory-based interventions with behavioral interventions. The solid line represented the best fit of the data throughout the intervention as a whole. The solid line indicates that the frequency of nonengagement behaviors increased throughout both conditions.

It was also hypothesized that a child with SOR receiving a combination of sensory-based interventions and behavioral interventions (Condition SBB) would demonstrate an improvement in play engagement in sensory intensive activities (vestibular and/or tactile) within and across conditions. The interval frequencies of play engagement behaviors were observed and compared between and within each condition. A least squares regression was utilized to determine if there was a functional relationship between the interval frequencies of behaviors within the SB and SBB conditions. The least squares regression line provided a visual representation of the slope of the lines and a means to analyze the fit of the data. A Coefficient of determination ($R^2$) was used to determine the goodness of fit and a measure of variability within the conditions. Figure 3 shows the interval frequencies of play engagement behaviors within and between conditions.
Play engagement behaviors decreased between the number of sessions and the number of play engagement behaviors for both SB and SBB. The Coefficient of determination in the SB condition ($R^2=0.12$) in the number of play engagement opportunities indicated a low amount of variability. A significant amount of variability ($R^2=0.78$) was found in the SBB condition as well. So, approximately 78% of the variability in play engagement behaviors is explained by factors in the interventions (e.g. activities, sensory intensive play, behavioral interventions, and the child’s behavioral responses) while the remaining 30% of variability are attributed to unknown causes (e.g. sleep, satiation, time, etc.). The level or mean number of play engagement behaviors in the SB condition was found to be 17.7 and in the SBB condition, 18. The subject actually started with a high level of play engagement behaviors. Within the SB condition, the slope was negative (-2.25) and in the SBB condition the slope was also negative (-1.25). This means that the interval frequency of play behaviors decreased over each condition. The magnitude, or extent of the slope, in both cases was considered to be medium. The hypothesis that play behaviors would increase within and between conditions was not confirmed as the play behaviors actually decreased within and between conditions.

Figure 3 represents the average data points for play engagement behaviors for each intervention session in the SB condition and the SBB condition. The data points in the SB condition were moderately variable and the broken line associated with the SB condition represents the best fit to the data and shows a decrease in play engagement behaviors throughout the SB condition. The SBB condition is represented by a dotted line and the data points are much closer indicating that the variability was less than the SB condition. There was a decrease in play engagement behaviors over the course of SBB condition as well which was not expected based on the hypothesis that play engagement behaviors would increase as a result of a
Figure 3. Interval Frequency of Play Engagement Between and Within Conditions. The data did not support the hypothesis that play engagement behaviors would increase within and between conditions.

combination of sensory-based interventions in combination with behavioral interventions. The solid line represented the best fit for the data throughout the intervention as a whole. The solid line indicates that the frequency of play engagement behaviors decreased throughout both.

To assess differences between play engagement and nonengagement between the SB condition and the SBB condition, between-phase patterns provided a visual representation used to analyze immediacy of effect (how quickly change would occur) and overlap of data (behaviors related to escape/avoidance and play engagement). Immediacy of effect provided a qualitative description of the data indicating whether there were rapid or slow changes between the SB and SBB conditions. Overlap showed whether each condition shared similar or different quantitative values (Kennedy, 2005). Overlap provided information as to whether one condition is more effective in reducing behaviors or if they both have similar results. For example, if data points from the SB and SBB conditions were shared, then there was overlap between the conditions and there were shared characteristics between interventions. The immediacy of effect was used to
identify the rapidity with which change may occur between the SB condition and the SBB condition. It was anticipated that the immediacy of effect would be expressed as a positive change in the level and trend of data within the SBB condition. It was hypothesized that there would be a decrease in escape/avoidance behaviors as more strategies were being used to foster participation in sensory intensive play.

In reference to between phase patterns, the Coefficient of determination was used. The Coefficient of determination ($R^2=0.083$) for play engagement between the SB and SBB conditions was low overall. The Coefficient of determination ($R^2=0.3482$) for nonengagement between the SB and SBB conditions was low as well. The immediacy of effect for play engagement in both conditions was considered to be rapid; thus, play behaviors were high at the beginning of both conditions. Overlap, or degree to which the data shared similar quantitative values, was high for play engagement. The immediacy of effect for nonengagement in both conditions was considered to be slow in the SB condition and rapid in the SBB condition. Overlap was minimal between the SB and SBB conditions when measuring nonengagement behaviors possibly due to the high variability in data points. So the hypotheses that play engagement behaviors would increase over time and nonengagement behaviors would decrease over time was not supported.

**Canadian Occupational Performance Measure.** The COPM (Law et al., 2005) was used to identify progress over time related to goals that were important to the family and identified by the goals that families chose as important for the child to address. The scores obtained from performance and satisfaction were compared from evaluation to the last session of the study. Hypothesis 3 was that children with SOR receiving occupational therapy with sensory-based interventions and sensory-based interventions with a combination of behavioral
interventions would demonstrate an improvement in COPM scores over baseline. A histogram was used to demonstrate differences in the initial and final results. It was anticipated that the final performance and satisfaction scores would improve as a result of having been exposed to both SB and SBB conditions. In this case, the hypothesis was supported. The scores were obtained by the subject’s mother according to a numerical guideline of 1-10. A score of one indicated poor performance by the child on an identified area of concern, and a score of one for satisfaction indicated the parent was not at all satisfied with the child’s performance. A score of 10 indicated performance on an identified area of concern as being optimal or independent, and a score of 10 for satisfaction indicated that the parent was completely satisfied with the child’s performance. The changes with regard to performance and satisfaction from initial evaluation to the last intervention period were significantly positive with the overall rate of change in performance as 6.2 out of 10 and the overall rate of change in satisfaction as 7 out of 10, 10 being the optimal score for performance and satisfaction. The observations submitted by the subject’s mother further validated the positive changes in the subject’s occupational performance both in the home and community.

The subject’s mother, using the COPM (Law et al., 2005), identified concerns with the subject’s performance and the parent’s satisfaction with that performance at initial evaluation. Scores were rated for each problem area. The identified concerns were used to guide treatment goals and interventions. The evaluating therapist and the subject’s mother collaborated on the following goals using the COPM as a guide:

- The subject uses utensils to feed herself with minimal physical prompts as seen 3 meals per day.
• The subject completes age appropriate self-care skills with minimum encouragement to reduce frustration as seen 5 days/week.

• The subject plays on playground equipment with contact guard assistance and moderate encouragement for novel/challenging tasks (swing, dynamic bridge and ladder) as seen with at least 2 visits to the playground.

• The subject completes arts and crafts activities with less than 2 verbal/physical aversions and use of moderate encouragement/sensory strategies as seen in 5 days.

• The subject rides a tricycle/riding toy/power wheel with moderate encouragement/sensory strategies as seen 5 days/week.

Upon completion of the 6-week intervention period following engagement in both the SB and SBB conditions, the subject’s mother rated the same problem areas with regard to performance and satisfaction. Table 8 shows the pre and post intervention scores. The overall performance and satisfaction. Table 8 shows the pre and post intervention scores. The overall

<table>
<thead>
<tr>
<th>COPM Item</th>
<th>Pre-Intervention Performance</th>
<th>Post-Intervention Performance</th>
<th>Parent Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utensil Use</td>
<td>2 out of 10</td>
<td>8 out of 10</td>
<td>Subject was frustrated when feeding.</td>
</tr>
<tr>
<td>Playground Navigation</td>
<td>4 out of 10</td>
<td>10 out of 10</td>
<td>Subject was clumsy.</td>
</tr>
<tr>
<td>Self-Care</td>
<td>5 out of 10</td>
<td>9 out of 10</td>
<td>Subject experienced frustration.</td>
</tr>
<tr>
<td>Arts and Crafts</td>
<td>3 out of 10</td>
<td>9 out of 10</td>
<td>Subject did not like finger paints.</td>
</tr>
<tr>
<td>Performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riding a Tricycle</td>
<td>1 out of 10</td>
<td>10 out of 10</td>
<td>Subject could not ride a tricycle.</td>
</tr>
<tr>
<td>Total Score of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>3 out of 10</td>
<td>9.2 out of 10</td>
<td></td>
</tr>
<tr>
<td>Total Score of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>3 out of 10</td>
<td>10 out of 10</td>
<td></td>
</tr>
</tbody>
</table>
change in performance was 6.2, a 62% improvement from evaluation to study completion. The overall change in the parent’s satisfaction was 7, a 70% improvement from initial evaluation to study completion.

At the close of the intervention period, the subject’s mother provided the treating therapist and principle investigator with a written list of changes and improvements she observed in the subject. The subject was using a fork more without prompting. The subject turned upside down and engaged in rough and tumble play with her father which she had not tolerated prior to treatment. The subject rode on outside toys (scooter, bike, power wheels, and 4-wheeler). The subject was now swinging, going down slides, and crawling in tunnels. At gymnastics, the mother reported that she attempted the high and low bars and walked on a low and high balance beam with help. The subject’s mother noticed that the subject wanted to color and cut more. The subject did not mind playing in sand, paint, and shaving cream. Based on the initial concerns at evaluation and as a result of participation in this study, the subject’s mother identified improvements in the subject’s performance and satisfaction with the subject’s performance relative to those goals. Figure 4 shows the results of the COPM (Law et al., 2005) at initial evaluation and following participation in this study.

Retrospectively, the subject’s parent reported improvements in the subjects’ overall ability to participate and interact with her peers in ways not initially identified as problematic by the COPM (Law et al., 2005). The subject was observed to engage in more role playing games with her sister such as playing “house” or acting like a “doctor.” The subject’s mother went on to say that she felt the subject gained more confidence as a result of occupational therapy intervention, and she said “I can’t” less frequently. She reported that the subject started singing. Prior to the intervention, the subject never sang but following the intervention, the subject was
making up her own songs. Family members noticed the subject was speaking more clearly. The improvements observed relative to the subject’s social and emotional well-being were not initially identified by the COPM but became apparent after participating in this research study.

In conclusion, this subject made progress as a result of her participation in this study. While it cannot be determined whether the sensory-based interventions, behavioral interventions or a combination of both were more effective, it was found that the subject’s overall qualitative performance in the home and community improved. Overall, the parent’s perception of the subject’s occupational performance and the parent’s satisfaction of the subject’s occupational performance were much higher in the last treatment session than at the initial evaluation indicating progress in a short period of time.
Chapter 5: Discussion

Summary of Study

This study was a single subject pilot study to explore the effect of using sensory-based interventions (SB) and sensory-based interventions in combination with behavioral interventions (SBB) during OT treatment with a preschool aged child identified with sensory over-responsivity. It was hypothesized that to improve a child’s play engagement and decrease a child’s nonengagement or escape/avoidance behaviors, a combination of sensory-based interventions and behavioral interventions were more effective than sensory-based interventions in isolation.

During the sensory-based interventions, the subject actually demonstrated an increase in nonengagement behaviors over time. In the sensory-based intervention with behavioral interventions, the frequency of nonengagement behaviors increased as well. The frequency of play engagement behaviors decreased in the sensory-based interventions and in the combination of sensory and behavioral interventions.

Discussion. Interpretation of the results of this study are considered cautious at best because of the single case study design as well as the results obtained from this subject. The subject was initially identified as having a mild vestibular over-responsivity and upon the initial intervention sessions already had high numbers of play engagement behaviors. Over the 6-week intervention period, play engagement decreased, and it is possible that the sensory opportunities became more complex and challenging as treatment progressed.
The first hypothesis stated that children with SOR receiving a combination of sensory-based interventions and behavioral interventions would demonstrate a decrease in nonengagement behaviors during sensory intensive play that is part of sensory-based interventions (within and between conditions). In this study, there was actually an increase in nonengagement behaviors in both the SB and SBB conditions although variability was high and it would be difficult to draw any conclusions. It was possible that because the treatment sessions began to incorporate more challenging sensory opportunities, the number of non-engagement behaviors increased. It is also possible that as the verbalizations increased in the behavioral aspect of the intervention that the subject had more difficulty processing the information requested. The subject may have been overwhelmed by all of the sensory experiences (e.g. movement, vision, auditory, etc.) that were occurring. The subject was already concentrating on trying to meet the movement challenge. Additional verbalizations could have over-stimulated the child’s sensory system and therefore manifested as a nonengagement behavior. The possibility of an extinction burst should be considered. When behavioral modifications are implemented, sometimes, behaviors worsen before they get better. In this study, three weeks did not provide enough time to determine if the increased nonengagement behaviors were a result of the change in conditions resulting in a possible state of disorganization. Often, there is disorganization before organization. There is another possibility that the subject was not as motivated to participate in the sensory intensive play that is part of sensory-based interventions because of the associated negativity. A. Jean Ayres (1972) stated that a child who was internally motivated to participate would not require external reinforcement. With tangible reinforcement, the subject’s nonengagement behaviors increased suggesting that the sensory opportunities presented within the clinic may have limited the child’s ability to participate. The types of
vestibular/movement opportunities presented were more challenging by the end of the interventions such as moving from sitting on a small therapy ball to complete an activity to lying supine, on back, to pick up puzzle pieces off the floor.

To assess if there was a rate of change, hypothesis 2 stated that a child with SOR receiving a combination of sensory-based interventions and behavioral interventions would demonstrate an improvement in play engagement in sensory intensive play that was part of sensory-based interventions (vestibular and/or tactile) within and across conditions. In this case, the number of play engagement behaviors actually decreased from the beginning to the end of each condition (SB and SBB). Again, no assumptions are made due to the variability in the data points, however, it is felt that the number of play engagement behaviors actually decreased because the sensory challenges became more complex. It is possible that the treating therapist did not set the “just right challenge” to foster an adaptive response to support the child’s success within the clinic. So, as the level of challenge increased over time so did the subject’s resistance. It is also possible that the concept of an extinction burst, as mentioned in reference to the increased nonengagement behaviors, also affected the decrease in play engagement behaviors.

While the statistics did not support an increased frequency of play engagement and a decreased frequency of nonengagement, the observed changes in the subject’s performance and the parent’s satisfaction with that performance were extremely positive. This suggests that occupational therapy interventions using sensory-based interventions and sensory-based interventions with a combination of behavioral interventions could bring about positive changes in a parent’s identified functional goals even if change was not observed in the clinic setting. The subject demonstrated many improvements in the motor skills associated with her previously identified vestibular over-responsivity. As a result of improved performance in this area, the
subject’s confidence to engage in previously aversive activities enabled her to meet the demands of the challenge both in familiar and novel presentations. While the results in the clinic setting did not support the first two hypotheses regarding changes during treatment sessions, the third hypothesis with its emphasis on family identified outcomes such as activities of daily living skills, play performance, social interactions and self-confidence were supported. These findings are consistent with those studies found by Case-Smith and Bryan (1999) and Schaaf and Nightlinger (2007). The subject’s occupational performance in the home and community contexts improved as result of her participation in a 6-week course of occupational therapy using sensory-based interventions and sensory-based interventions in combination with behavioral interventions in totality.

This study used a proactive behavioral intervention known as tangible reinforcement. Lavigna and Willis (1992) reported that the use of nonaversive and positive approaches to challenging behaviors were effective for various populations. The subject’s challenging behavior was associated with escape/avoidance, and, in the clinic setting, the use of tangible reinforcement did not decrease the frequency of nonengagement. While the frequency of nonengagement behaviors did not decrease, the overall qualitative improvements were noted in improved activities of daily living skills performance, self-regulation, and improved participation in family routines as identified in a previous study by Powell, Dunlap, and Fox (2006).

In sum, there was little research on using a combination of sensory integration and behavioral interventions and the effectiveness of these approaches on challenging behaviors. The subject’s play engagement behaviors decreased and nonengagement behaviors increased in the presence of sensory-based interventions. While there were some methodological limitations in this study, the subject made significant improvements in most areas of occupational performance.
(play, activities of daily living skills and social interactions). The family observed improvements in the subject’s daily living skills in the home and community. The overall premise that a combination of the two approaches could be effective still remains because of the positive influences in various populations. Stagnitti et al. (1999) found that a combination of sensory and behavioral approaches were helpful to reduce anxiety and touch in a child who was overresponsive to movement and touch. When the child in the previous study was referred back to occupational therapy for problematic behaviors at school, the child completed a two week intervention course using a combination of sensory and behavioral approaches and nine-months post intervention, the child continued to show improvements in all sensory areas.

**Limitations.** This single case study with only one subject and the short duration of intervention used in this study influenced a generalization of results. Future studies should attempt to have a multiple subjects and increase interventions to at least 12 weeks. An A-B-A-B alternating design might also provide pertinent information with regard to actual differences in intervention responses.

**Limitations of the Fidelity Measure.** The Fidelity Measure (Parham, Cohn, et al., 2007) was used to control for and manualize treatment. In this case, the treating therapist had advanced level training in Sensory Integration. There was an attempt to provide interventions in accordance with the Fidelity to Sensory Integration Measure. The observed treatments were slightly shy of the 80% criteria, so the interventions placed more emphasis on sensory-based interventions rather than interventions according to Ayres’ Sensory Integration theory. The Fidelity Measure, while specific in its criteria for sensory integration interventions, provided a level of subjectivity to the coder. And since the measure is still in development, there is no standard error of measurement to control for unreliability in interpretation. There were certain
items on the Fidelity Measure that allowed for this subjectivity as evidenced by the coder’s struggle to score. There was one score under the challenging praxis and organization of behavior criterion that the coder marked through to change her score. The implication here is that it is extremely difficult to attain adherence to Fidelity even for experienced clinicians. It may also be difficult for coders to score in certain instances.

**Implications for OT.** This study found supporting evidence that occupational therapy interventions using a combination of sensory-based interventions and a combination of behavioral interventions to support improvements in occupational performance even in a relatively short amount of time even though changes within sessions were not consistent with the hypotheses. The qualitative outcomes of this study supported improved play skills, activities of daily living skills, social interactions and self-confidence. Occupational therapy practitioners should consider reflection in their own practice regarding the types of interventions they use to facilitate change and attempt to understand the underlying theoretical principles used to guide best practice methods. Sensory integration theory and application into practice is nothing less than challenging. It is important to continue study and mentorship with advanced level practitioners to implement these principles into practice. This recommendation stems from the treating therapist’s intention to implement best practice and interventions that were consistent to sensory integration intervention. With feedback, the treating therapist was able to achieve fidelity to sensory integration in the second intervention session. This improvement from one session to another given the feedback demonstrates the strength of feedback and mentorship in OT practice.

**Directions for Future Research.** Future research studies should incorporate more mentoring opportunities for clinicians attempting to apply interventions based on sensory
integration principles. Even with advanced level training, it is still difficult to apply sensory integration principles in its purest form without mentorship and constant reflection. It was found in the initial training portion of this study with the treating therapist who left the facility that the mentorship received was invaluable to her application of sensory integrative principles in practice. Future studies should continue to use the Fidelity to Sensory Integration Measure to establish credibility and replicability with mentorship as a consideration. Future investigators should also consider using more than one coder for Fidelity to Sensory Integration. Having more than one coder may provide insight to the standard error of measurement of the Fidelity tool. The mentorship and coding outcomes of this study suggest that the occupational therapy profession should continue to sharpen its tools and interventions in order to prove efficacy.

Principles of intervention that are grounded in sensory integration differ from traditional behavioral intervention principles especially with regard to extrinsic reinforcement for participation in an activity. There is an inherent challenge to provide intervention based on the core principles of sensory integration and simultaneously incorporate principles according to operant conditioning and external reinforcement. The challenge to provide interventions based on Ayres’ Sensory Integration© in combination with behavioral interventions would require stringent mentorship. Currently, it is difficult to determine if this would even be a possibility. It may be that the two interventions in the truest sense of application are mutually exclusive and cannot be used simultaneously. More research needs to be done to determine if true behavioral interventions would require an 80% adherence as well. If an 80% adherence would be considered best practice when providing behavioral interventions, it would challenging to integrate and apply the principles of sensory integration and behavior modification.
simultaneously. An inter-rater reliability study may be useful to determine the standard error of measurement to determine a confidence level around 80% adherence.

Future studies should also consider the difficulties associated with recruitment when identifying inclusion and eligibility criteria. Studies using more than one subject will also provide additional data and information to the knowledge base rather than a question of individual differences. Multiple subjects may allow for alternating the sequence of interventions such as using SBB before SB.

The COPM (Law et al., 2005) provided a guideline with regard to the subject’s occupational performance and a family’s satisfaction with that performance. The COPM also facilitated the therapist’s conversations and collaboration with the family to identify goals for the subject. However, the COPM did not provide specificity markers for data obtained in the clinical setting at each intervention. Using a tool such as Goal Attainment Scaling (Kiresuk, Smith, & Cardillo, 1994) might provide more specificity to analyze behaviors between conditions and over time. Goal Attainment Scaling allows for specific goals to have quantitative measures. So a subject’s progress is measured on a numerical scale and the subject’s level of progress or lack of progress is provided with a score.

The subject in this study was identified as having mild vestibular over-responsivity, and the number of play engagement behaviors upon the initial intervention session was high. Future studies could provide more specificity with regard to the level of sensory involvement (mild, moderate or significant). A child with significant over-responsivity may respond much differently to a combination of sensory and behavioral strategies than a child with mild over-responsivity.
This study excluded children with Intellectual Disabilities because of the possible central nervous system impairments. However, it should be considered that some children with Intellectual Disabilities also have sensitivities to movement and touch. Children with Intellectual Disabilities of varying degrees may benefit from a combination of sensory and behavioral interventions that may be unlike a child that has been identified with sensory modulation dysfunction in isolation. It would be interesting to explore the differences in these two populations.

Also, coding procedures and training of coding procedures should be stringent and precise. Having two coders for each condition may provide more reliable information. Keeping coding procedures simplified may have helped capture the changes in nonengagement and play engagement behaviors. For example, it may have been helpful to choose one sensation in which the child was over-responsive as identified in the initial evaluation and code each session with the child’s play engagement or nonengagement with regard to that particular presentation. The coding sessions provided information on the frequency of nonengagement and play engagement behaviors in an interval of 15-seconds. It may be helpful to decrease the coding time because 15-seconds is a long time in the course of a treatment sessions.

The Hawthorne effect, changing behaviors as a result of knowingly being observed, may have occurred in this study. Placing a video camera in an obscure location is optimal. Within an occupational therapy intervention, it is difficult to have a static placement especially when the interventions are sensory-based. It would be optimal to have an obscure location that captures the subject’s responses in all aspects of the intervention session for optimal data collection. In this study, the subject’s mother videotaped the sessions and the subject knew she was being
observed. The subject’s nonengagement and play engagement behaviors may have been different if the subject’s mother was not present for the intervention sessions.

Intervention studies are challenging, to say the least, but the profession of OT needs to support the leaders in our field who continue to work diligently to provide efficacy studies on sensory integration interventions. This study provides some ideas about methodology and potential questions to address in the future.
References


Hobbs, D. (2003, June). Positive approaches to behavior and learning. Symposium conducted at A Southwest Virginia Summer Institute on Special Education in High-Poverty Schools, Radford, VA.


Lane, S. J. (2008, September). Fidelity training session. Symposium conducted at the meeting of the Virginia Occupational Therapy Association, Portsmouth, VA.


## Appendix A

### Parent Interview

1. **Primary Concerns**
   - a. Narrative about primary concerns
   - b. Where
   - c. What
   - d. When
   - e. How Much

2. **Birth History**

3. **Pregnancy** (duration, medications, complications)

4. **Labor and Delivery** (complications, birth weight)

5. **Infancy**
   - a. Feeding
   - b. Crying
   - c. Sleeping

6. **Previous illnesses/injuries**

7. **Current medications/allergies**
8. Developmental History/Milestones achieved
   a. Sitting/crawling
   b. Fine motor skills

9. Activities of Daily Living Skills
   a. Dressing
   b. Feeding
   c. Toileting
   d. Bathing
   e. Grooming and Hygiene
   f. Sleeping

10. Transitions

11. Calming

12. Social Interactions

13. School Experiences

14. List child’s top 5 preferred activities

15. List child’s top 5 preferred toys/objects
Appendix B

Sensory Over-Responsivity Scale: Inventory (SensOR)

SENSORY OVER-RESPONSIVITY SCALE: INVENTORY
ID#____________________________________

Checklist #1  [check each description that applies to your child]

These garments bother my child
1. seams in clothing
2. tags in clothing
3. socks
4. changing from long to short pants
5. accessories (e.g., watch, jewelry, scarf, hats)
6. elastic on clothing
7. fuzzy or furry textured clothes (e.g., sweaters, collars, etc.)
8. wool clothes

These aspects of self care bother my child
9. washing or wiping face
10. cutting toenails or fingernails
11. having haircut or hair clipped
12. hair washing or drying
13. hair brushing or combing
14. getting dressed
15. brushing teeth
16. getting dirty
17. having crumbs around my mouth
18. having messy hands
19. having a messy mouth

Subtotal

These tactile sensations bother my child
20 mud
21 finger paint
22 glue
23 play dough
24 foods
25 hair care products (greasy/sticky)
26 kissing
27 coarse carpet
28 light stroking touch

Subtotal

These visual sensations bother my child
29 brightly colored or patterned materials (e.g. clothes, upholstery, drapes, wallpaper)
30 fluorescent lights
31 fast moving images in the movies or TV
32 visually cluttered environments
33 busy pictures in books or complex and busy images in artwork

Subtotal

These smells bother my child
34 perfume/cologne
35 cleaners/disinfectants
36 bath products
37 soaps
38 air fresheners

Subtotal

These aspects of food and eating bother my child
39 salty foods (e.g., nuts or chips)
40 soft foods
41 lumpy foods
42 slimy foods
43 soup with vegetables or meat pieces
44 spicy foods (e.g., spicy dip, hot sauce)
eating bread crust

food preparation/cooking

new/unfamiliar foods

These sounds bother my child

sound of utensils against each other (e.g., spoon in bowl, knife on plate)

clothing that makes noise (e.g., swishing cloth, accessories)

door bell ringing
dog barking
sirens
alarms
radio or TV in the background
fluorescent lights
someone talking when I am trying to concentrate
clock ticking
construction or landscaping equipment
water running or dripping in the background

Sounds in these places bother my child

toilet flushing in the bathroom

appliances/small motor noises (e.g., blender, vacuum, hair dryer, electric shaver) at home

concerts
large gatherings
restaurants
parades
malls
gymnasium

These aspects related to movement bother my child

climbing activities
walking or climbing up open stairs
experiencing heights
walking or standing on moving surfaces
playing in the playground jungle gym
playing in the playground swings and slides
going on amusement park rides

going up or down escalators

chewing foods
Appendix C

Clinical Observations of Vestibular Processing

<table>
<thead>
<tr>
<th>TASK</th>
<th>YES</th>
<th>NO</th>
<th>OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Jumping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Jumping off of step</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Supine on ball (passive)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sitting and bouncing on ball without trunk support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Stepping on a moving surface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Wheelbarrow walking</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. Crawling over an uneven surface

8. Swinging on a platform swing
   a. Linear
   b. Rotary
   c. Angular

Operational Definitions

<table>
<thead>
<tr>
<th>Task</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumping</td>
<td>Jumps with both feet off of the floor</td>
</tr>
<tr>
<td>Jumping off of step</td>
<td>Child jumps off of step with both feet</td>
</tr>
<tr>
<td>Supine on ball (passive)</td>
<td>Child likes back on ball and therapist rolls it back</td>
</tr>
<tr>
<td>Sitting and bouncing on ball</td>
<td>Child bounces on ball with therapist holding thighs</td>
</tr>
<tr>
<td>Standing on a moving surface</td>
<td>Child steps on tiltboard and steps off backward</td>
</tr>
<tr>
<td>Wheelbarrow walking</td>
<td>Child walks on hands with therapist holding legs for 10 feet</td>
</tr>
<tr>
<td>Crawling over an uneven surface</td>
<td>Child crawls on hands and knees across foam pillow</td>
</tr>
<tr>
<td>Swinging on a platform swing</td>
<td>Child sits on swing; Therapist pushes forward/backward</td>
</tr>
<tr>
<td>a. Linear</td>
<td></td>
</tr>
<tr>
<td>b. Rotary</td>
<td>Child sits on swing; Therapist pushes swing in a circular motion</td>
</tr>
<tr>
<td>c. Angular</td>
<td>Child sits on swing; Therapist pushes swing in a triangular pattern</td>
</tr>
</tbody>
</table>

Criteria for ‘no’ on observations:

Avoidance: hesitation (+6 seconds); refusal or stops task
Emotional behaviors: nervous talk, smile; makes one or more statements of worry, concern, uncomfortability or fear; grimacing; panic
Postural responses: grab or holds for support; mild to high guard responses; awkward or stiff responses
Clinical Observations of Tactile Processing

<table>
<thead>
<tr>
<th>TASK</th>
<th>YES</th>
<th>NO</th>
<th>OBSERVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Light and unexpected touch in high density receptor areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Lips/Mouth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Palmar surface of hands</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Soles of feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Hair/Back of Neck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Rough Textures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Rice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Beans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Messy Textures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Shaving Cream</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Finger Paints</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Operational Definitions

Task Definition

1. Light/Unexpected Touch Therapist uses the back of his/her fingers to touch child
   a. Lips/Mouth Therapist brushes across the lips towards cheeks
   b. Palmar surface of hands Therapist lightly touches the palm of a child’s hand
   c. Back of neck Therapist lightly/unexpectedly brushes back of child’s neck

2. Rough textures
   a. Beans Child finds an object in a bucket of beans
   b. Rice Child finds an object in a bucket of rice

3. Messy textures
   a. Shaving cream Child draws a smiley face in shaving cream
   b. Fingerpaints Child dips finger in fingerpaint to draw a smiley face

Criteria for ‘no’ on observations:

Avoidance: hesitation (+6 seconds); refusal or stops task
Emotional behaviors: nervous talk, smile; makes one or more statements of worry, concern, uncomfortability or fear; grimacing; panic
Appendix E

Fidelity Measure
Sensory Integration Fidelity Measure Training Project 2008

Revised July 2008 for Training in Kuopio, Finland

Diane Parham, PhD, OTR/L, FAOTA
Susanne Smith Roley, MS, OTR/L, FAOTA
Jane Koomar, PhD, OTR/L, FAOTA
Stefanie Bodison, MA, OTR/L, FAOTA
Teresa May Benson, ScD, OTR/L, FAOTA

The purpose of the Sensory Integration Fidelity Measure Training Project 2007-08, is to train several project leaders at various sites across the country to gather data to analyze the inter-rater reliability and inter-site reliability of this measure. This multi-site collaborative project involves occupational therapy and university settings across the country, including Occupational Therapy Associates in Massachusetts, Pediatric Therapy Network in California, Sensory Processing Disorder Foundation in Colorado, Thomas Jefferson University in Philadelphia, University of New Mexico, University of Southern California, and Virginia Commonwealth University.

All material contained in this training packet is copyrighted. Use by permission only. Do not distribute, duplicate, or show for any reason other than its intended purpose, the Fidelity Training Project 2007-08.
Essential Characteristics of Occupational Therapy Using Sensory Integration

Rater: _____________________________  Case: _____________________________  Observation #: _____________________________

**Purpose:** The purpose of this tool is to assure the fidelity of occupational therapy intervention based on the sensory integration theory and principles developed originally by Dr. A. Jean Ayres.

**Key Elements:**
A. Document that intervention accurately represents Occupational Therapy (OT) using Sensory Integration (SI) Intervention methods, the construct being measured.
B. Document that intervention has been carried out in accordance with the essential theoretical and procedural aspects of the intervention.
C. Provide a mechanism to monitor the delivery of intervention in a randomized clinical trial.
D. To differentiate between OT using SI intervention from other types of intervention.

**Use of Measure:**
A. Research assistants will be trained to complete the fidelity measure. Research assistants will be occupational therapists with a background in sensory integration who meet the criteria listed under Therapist Credentials within this measure.
B. There are four parts to the measure that must be completed:
   **Structure**
   Part I. Therapist Qualifications
   Part II. Record Review
   Part III. Preparation for Intervention Process
   Part IV. Observation of Intervention using Sensory Integration Principles
   a) Videotapes will be made of intervention sessions so that rater does not have to watch intervention as it occurs. It is anticipated that ratings will occur on approximately 10 minute segments of an intervention session, most likely session 4 or 5 or late sessions.
   b) Videotapes will be made of the physical environment to record available equipment before therapist and child enter intervention environment if the intervention videotape does not adequately show the setting.
## Part I: Therapist Qualifications

**Please mark yes or no. Include salient comments.**

<table>
<thead>
<tr>
<th>I. (NOTE: ALL areas must be marked as a “yes to be included in study”)</th>
<th>Yes</th>
<th>No</th>
<th>Record Evidence:</th>
</tr>
</thead>
</table>

### Post-graduate Training in Sensory Integration

1. Occupational therapist providing intervention is certified in SI/SIPT (Minimum of 50 education hours in SI theory and practice (e.g., postgraduate SI or SIPT cert., university/college course)

### Supervision

2. Minimum of 1 hour per month by an expert or 5 yrs of experience providing OT using a SI Intervention

**Part I Totals:**

---

### Part II:

**Record Review:**

*(A minimum of 90% of the items listed will be marked as yes):*

<table>
<thead>
<tr>
<th>The following items are included in the Occupational Therapy Assessment Report.:</th>
<th>Yes</th>
<th>No</th>
<th>Note source of information</th>
</tr>
</thead>
</table>

#### Historical Information:

Including medical, educational, and therapeutic, as appropriate

1. Developmental history
2. Occupational profile

#### Current Information:
4. Reason for referral

5. **Performance Patterns**
   a. Activities child currently seeks out and enjoys

**Assessment Results**
Structured evaluations i.e. standardized and norm referenced measures and Unstructured evaluations i.e. clinical observations, parent reports

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Note source of information</th>
</tr>
</thead>
</table>

6. Sensory modulation

7. Sensory discrimination

8. Postural ocular control

9. Visual Perceptual/Fine motor skills

10. Motor Coordination/Gross motor skills

11. Praxis: planning an sequencing the steps of an activity

12. Organization skills

13. Influence of sensory integration, multisensory processing on performance

14. Interpretation on the effects of sensory integration and praxis on referring problems

**Part II Sub-Totals**

---

**Part III. Preparation for Intervention**

*(NOTE: all must be yes to be included in randomized controlled trial study)*

<table>
<thead>
<tr>
<th>A. Physical Environment</th>
<th>Yes</th>
<th>No</th>
<th>Observation Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adequate space to allow for flow of vigorous physical activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Flexible arrangement of equipment and materials to allow for rapid change of the physical and spatial configuration of intervention environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. No less than 3 hooks for hanging suspended equipment, minimal distance between hooks 2 ½ to 3 ft. (enough room to allow for full orbit on suspended equipment)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. One or more rotational devices attached to ceiling support to allow 360 degrees of rotation

5. Quiet space (can be tent, adjacent room or partially enclosed area)

6. One or more set of bungee cords for hanging suspended equipment

<table>
<thead>
<tr>
<th>B. Safe Environment</th>
<th>Yes</th>
<th>No</th>
<th>Observation Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Mats, cushions, pillows are available to be used to pad floor underneath all suspended equipment during intervention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Equipment is adjustable to child’s size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. The equipment that is accessible is monitored for safe use by the therapist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Equipment not being used is stored, anchored, or placed at the side of the room so children cannot fall or trip on it</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Documentation of routine and updated monitoring of equipment safety (e.g. ropes and bungee cords not frayed)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Available Equipment:
(NOTE: one of each item on this list must be present)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Observation Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bouncing equipment (e.g. Trampoline)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Rubber strips or ropes for pulling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Therapy balls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Platform Swing - square</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Platform glider swing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Frog Swing (define)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Scooter/ramp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Flexion disc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Bolster swing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Tire swing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Weighted objects such as balls or bean bags in a variety of sizes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Inner tubes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Spandex fabric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Crash pillow (define)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Ball pit</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Vibrating toys or massagers</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Variety of tactile materials (e.g. brushes, carpet square, beans, rice, etc.)</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Visual targets (e.g. balloons, velcro darts, hanging objects)</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Ramps</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Climbing equipment (e.g. wooden, plastic, steps, ladders or stacking tire tubes)</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Barrel for rolling</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Props to support engagement in play (e.g. dress up clothes, balls/ bats, stuffed animals, dolls, puppets, sports equipment, bikes)</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Materials for practicing daily living skills (e.g. pencils, pens and other school supplies, clothing, grooming and other home-related objects)</td>
<td></td>
</tr>
</tbody>
</table>

**Communication With Parents and Teachers:**

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Note source of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal Setting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Goals and objectives as defined by team including child, family or significant others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>As a result of the evaluation, the therapist defines areas to be addressed that will improve engagement. (therapist can describe the relationship of these goals to desired participation in multiple contexts for child and family)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Family and/or Teacher Education**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ongoing interchange to direct the course of intervention</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Discuss the potential influence of sensory integration and praxis on performance of valued and needed activities.</td>
</tr>
<tr>
<td>2.</td>
<td>Discuss the child’s sensory integration and praxis abilities and its influence on the child’s and family’s participation in the home, school, and the community</td>
</tr>
</tbody>
</table>

Part III Totals
Part IV. Observation of Intervention Using Sensory Integration Principles

Each numbered item on this questionnaire consists of a statement that represents a key therapeutic strategy that a therapist uses when delivering intervention to a child using sensory integration principles.

Following each statement is a series of bullets that clarify and expand on the statement. The first bullet, or first few bullets, identify the key issues that the item targets. These are presented to help the rater focus on what to look for. After the key issues are listed for an item, subsequent bullets provide further elaboration. Bullets provide examples of therapist behaviors or actions that are common expressions of the strategy. Keep in mind that these are only examples, and are not the only ways that the strategy may be demonstrated.

Rate each item, answering the question “Did the therapist do this as a key therapeutic strategy in this intervention session?” Place a check mark under the column that best fits...
your impression of the overall observation: 4, 3, 2, 1, representing 4 different categories (See key below.) View the entire observation at least once before rating any items.

Each rating should represent your **overall impression** of the entire observation. A therapist need not demonstrate any of the example behaviors listed to be rated as certainly or probably using a strategy. Do not count behaviors to obtain ratings. Instead, each rating should reflect your **global impression** of how evident a **particular therapeutic strategy** seemed to be as an **intentional part of what the therapist was doing**.

Remember that you are rating the extent to which this session resembles sensory integration principles applied during intervention. You are not rating whether it is a “good” therapy session. Also, not every sensory integration strategy may be observed in every therapy session.

---

**Key to ratings:**

4  **Certainly, I think the therapist intentionally uses this strategy.**
3  **Probably, I think the therapist intentionally uses this strategy.**
2  **Doubtful, I don’t think the therapist intentionally uses this strategy.**
1  **No, I don’t think the therapist intentionally uses this strategy.**
1. Ensures physical safety

<table>
<thead>
<tr>
<th>The therapist anticipates physical hazards and attempts to ensure that the child is physically safe through manipulation of protective and therapeutic equipment and/or the therapist’s physical proximity and actions. A safe room is important as is the therapist’s attention to the child and his/her potential actions.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comments</strong></td>
</tr>
<tr>
<td><strong>Case 1</strong></td>
</tr>
<tr>
<td><strong>Case 2</strong></td>
</tr>
<tr>
<td><strong>Case 3</strong></td>
</tr>
</tbody>
</table>

**If the therapist attempts to keep the child seated most of the time, score 1.**

2. Presents sensory opportunities

<table>
<thead>
<tr>
<th>The therapist presents the child with at least two of the following three types of sensory opportunities (a, b, &amp;/or c) as therapeutic strategies to support the development of self-regulation, sensory awareness, or movement in space:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. Tactile</strong></td>
</tr>
<tr>
<td>• provides experiences in which touch sensations are the dominant input including: vibration, massage, hugs, pressure touch or light strokes</td>
</tr>
<tr>
<td>• activities may include messy play such as with food, shaving cream or play dough, playing in a bubble ball pit, and sitting in or finding objects in a box of beans, popcorn or rice</td>
</tr>
<tr>
<td>• provides activities that allow deep pressure to body such as jumping into large, squishy and textured pillows, crawling between mats or pillows, wrapping up in spandex fabric or wearing pressure garments</td>
</tr>
<tr>
<td><strong>b. Vestibular</strong></td>
</tr>
<tr>
<td>• provides experiences involving linear, orbital, or rotary head movement</td>
</tr>
<tr>
<td>• may include rocking, rolling, swinging, somersaults, jumping from a height, and whole body movement through space</td>
</tr>
<tr>
<td>• uses suspended or non-suspended moving equipment</td>
</tr>
<tr>
<td><strong>c. Proprioceptive</strong></td>
</tr>
<tr>
<td>• provides experiences in which muscle tension and stretch sensations are the dominant input</td>
</tr>
<tr>
<td>• common examples are pulling, pushing, carrying heavy objects, hanging on to equipment</td>
</tr>
</tbody>
</table>

**If the therapist provides predominately one type of sensory input, and other sensory inputs occur only incidentally (not intentionally), score 1. If in doubt**
about a second sensory system, score 2.
If therapist attempts to keep child seated most of the time, score 1.

Key to ratings:

4  Certainly, I think the therapist intentionally uses this strategy.
3  Probably, I think the therapist intentionally uses this strategy.
2  Doubtful, I don’t think the therapist intentionally uses this strategy.
1  No, I don’t think the therapist intentionally uses this strategy.


The therapist helps the child to attain and maintain appropriate levels of alertness, as well as an affective state that supports engagement in activities.

Key issue: therapist guides session to support functional arousal and affect for optimal task engagement

Key issue: therapist supports and encourages child’s self-regulative strategies for managing arousal, attention, and affect

Key issue: therapist initiates change to the environment, activity, social interaction, or sensory input

• therapist makes adjustments to the activity if child is becoming bored, disengaged, frustrated, anxious, or distressed by the activity, in order to help child attain or maintain optimal state
• may rearrange, remove, or replace equipment or materials, or may verbally suggest such a change
• may change the intensity, duration, frequency, or rhythm of sensory experiences, e.g., increase or decrease speed of swing
• may introduce alternative sensory experiences to calm or organize the child, e.g., deep pressure, heavy muscle work, blowing activity, slow rhythmical rocking, reduce noise or lighting
• allows the child to withdraw from the interaction for short periods as necessary to self-calm
• may support and encourage child’s self-awareness of arousal and emotional state
• may support and encourage child’s knowledge and use of self-regulative strategies for managing arousal, attention, and emotions

Special note for child with autism or other significant developmental disabilities: Therapist may initiate application of passive stimulation to help child modulate arousal and often must provide assistance in finding appropriate strategies for self-regulation such as a cozy corner, chew toy, familiar object or game, or withdrawal from a busy, crowded space. Therapist will shift directives in order to
support and encourage child’s initiative.

Key to ratings:
4  Certainly, I think the therapist intentionally uses this strategy.
3  Probably, I think the therapist intentionally uses this strategy.
2  Doubtful, I don’t think the therapist intentionally uses this strategy.
1  No, I don’t think the therapist intentionally uses this strategy.

<table>
<thead>
<tr>
<th>4. Challenges postural, ocular, oral and/or bilateral motor control</th>
<th>1</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The therapist supports and challenges postural control, ocular control, or bilateral development. At least one of the following types of challenges are intentionally offered:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Postural challenges, e.g., head control, righting, equilibrium reactions, static balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Resistive whole body challenges through working against gravity and/or force to extensor and flexor muscles, e.g., lying prone over a frog swing while swinging, holding tight to a flexion disc while being bounced and swung</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Ocular-motor challenges that require visual localization of objects during body movement, e.g., smoothly using both eyes together to cross midline, eye-hand responses toward a visual target</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Bilateral challenges such as sustained holding a rope at midline with both hands, pumping, pulling or pushing with both arms or legs in a rhythmical sequence, smoothly using both eyes together to cross midline.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Oral challenges e.g., bringing whistles or bubble wands to midline to blow while sustaining postural control to support oral and ocular skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Projected action sequences, e.g., client stationary with target moving</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>If therapist attempts to keep child seated most of the time, score 1.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Key to ratings:
4  Certainly, I think the therapist intentionally uses this strategy.
3  Probably, I think the therapist intentionally uses this strategy.
2  Doubtful, I don’t think the therapist intentionally uses this strategy.
1  No, I don’t think the therapist intentionally uses this strategy.

### 5. Challenges praxis and organization of behavior

<table>
<thead>
<tr>
<th>Case</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td></td>
</tr>
<tr>
<td>Case 2</td>
<td></td>
</tr>
<tr>
<td>Case 3</td>
<td></td>
</tr>
</tbody>
</table>

The therapist supports and presents challenges to the child’s ability to conceptualize and plan novel motor tasks, and to organize his or her own behavior in time and space.

Key issue: therapist challenges child to engage in movement activities that place demands on motor planning, ideation, or planning of actions in future time and space
- challenges may involve initiating, sequencing, and timing of movement tasks, or creating new ideas for movement activities
- challenges may include moving from gross to fine skill development in oral, eye-hand and/or total body movements
- challenges may involve constructional praxis in body-centered space, e.g., building a bridge or house out of blocks large enough so that the child can go under or into it
- amount and type of therapist structuring depends on the extent to which child can successfully execute or create new action ideas
- encourages child to initiate and develop ideas and plans for activities
- encourages child to participate in setting up activities or putting away equipment, to the extent that the child is capable
- may suggest that the child add a new action or new way of performing a familiar activity
- may set up or re-arrange equipment in a way that presents new motor planning challenges to the child
- may direct child to select or make a plan for activities to be done during the session or at a later time.

If therapist attempts to keep child seated most of the time, score 1.
Special note for child with autism, severe dyspraxia, and other developmental disabilities that interfere with ideation, initiation, and planning of movement: Therapist may need to provide a great deal of direction and structuring, as these children typically lack ideation and organization of behavior; however, the therapist continues to be responsive to child’s initiation of goal-oriented behavior and will shift directives in order to support and encourage child’s initiative.
Key to ratings:
4  Certainly, I think the therapist intentionally uses this strategy.
3  Probably, I think the therapist intentionally uses this strategy.
2  Doubtful, I don’t think the therapist intentionally uses this strategy.
1  No, I don’t think the therapist intentionally uses this strategy.

<table>
<thead>
<tr>
<th>6. Collaborates in activity choice</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>The therapist negotiates activity choices with the child, allowing the child to choose equipment, materials, or specific aspects of an activity. Activity choices and sequences are not determined by the therapist.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the therapist appears to have decided on activities prior to the session, or therapist initiates most activity choices for a child who has the capacity to initiate, score 1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Key issue:</strong> therapist provides structuring and support for adaptive responses while allowing child to be actively in control as much as possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• therapist responds to child’s initiative, preferences, and interests in activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• therapist may suggest activities in response to child’s abilities, interests, and initiative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• therapist modifies activities based on child’s acceptance, interest, or abilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• actively encourages child to communicate activity preferences and wishes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• encourages self-direction of child to the extent that the child can generate ideas for activities that present challenges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Special note for child with autism, severe dyspraxia and other developmental disabilities that interfere with self-initiation of plans:** Therapist may provide a great deal of direction and structuring, as these children typically lack ideation and organization of behavior; however, therapist is responsive to child’s initiation of goal-oriented behavior and will shift directives in order to support and encourage child’s initiative.
Key to ratings:
4  Certainly, I think the therapist intentionally uses this strategy.
3  Probably, I think the therapist intentionally uses this strategy.
2  Doubtful, I don’t think the therapist intentionally uses this strategy.
1  No, I don’t think the therapist intentionally uses this strategy.

<table>
<thead>
<tr>
<th>7. Tailors activity to present just-right challenge</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>The therapist suggests or presents a change in activity and challenge that is just beyond what the child can easily accomplish. These challenges primarily target the child’s postural/ocular/oral control, sensory modulation, sensory discrimination or perception, or praxis ability.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Case 1</td>
</tr>
<tr>
<td>Key issue: therapist tailors the activity so that the challenge requires the child to exert some degree of effort but is attainable (not too easy but not too difficult).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Case 2</td>
</tr>
<tr>
<td>• changes can be performed, modeled, or suggested verbally or nonverbally by the therapist</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Case 3</td>
</tr>
<tr>
<td>• may strategically time the challenge so the child can comprehend, attend, and engage optimally</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• may add, remove, rearrange equipment/materials to adjust challenge, e.g., move target closer, change height of equipment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• may make other environmental changes to alter degree of challenge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• may alter activity to be more or less demanding, e.g., alter child’s position, or add a new step to an activity sequence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• When engaging in a game with rules, the therapist may alter the game by changing the rules or modifying the way it is played so that it presents an optimal level of challenge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. Ensures that activities are successful</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>The therapist adapts challenges so that the child experiences some degree of success.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Case 1</td>
</tr>
<tr>
<td>Key issue: Therapist allows child to experience success in doing part or all of a challenging activity.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Case 2</td>
</tr>
<tr>
<td>• may alter the activity at any point in the activity sequence to assure success</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Case 3</td>
</tr>
<tr>
<td>• may assume responsibility for the activity not working out successfully, e.g., “I hung that swing up too high,” to maintain the child’s interest and participation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• may coach child on ways to alter approach to the activity to gain success</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- may ask the child questions to assist the child in arriving at successful strategies

**Key to ratings:**
- 4 Certainly, I think the therapist intentionally uses this strategy.
- 3 Probably, I think the therapist intentionally uses this strategy.
- 2 Doubtful, I don’t think the therapist intentionally uses this strategy.
- 1 No, I don’t think the therapist intentionally uses this strategy.

### 9. Supports child’s intrinsic motivation to play

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

The therapist creates an atmosphere in which child-initiated play is valued as a critical way to fully engage the child in the intervention.

**Key issue:** Therapist attends to and builds upon child’s intrinsic motivation and enjoyment as a primary way to guide activity choice.

**Key issue:** Therapist playfulness is not used mainly to obtain compliance with therapist’s activity plan.

- allows child to explore or experiment with actions or objects
- supports play through nonverbal or verbal messages
- may facilitate reciprocal social, motor, or object play
- may facilitate imaginative play to the extent that the child is able to participate
- may use story lines or fantasy play to engage the child more deeply
- may expand upon or structure activities that the child initiates
- creates a play context regardless of whether therapist’s play style is reserved or exuberant

### 10. Establishes a therapeutic alliance

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

The therapist promotes and establishes a connection with the child that conveys a sense of working together towards one or more goals in a mutually enjoyable partnership.

**Key issue:** Therapist is highly attuned to the child.

**Key issue:** Therapist-child relationship goes beyond pleasantry or evaluation of performance, such as friendliness, praise, or instruction.

- shows respect for the child’s emotions
- conveys positive regard toward the child.
- displays empathy with child’s abilities and struggles i.e. “that is heavy for you” “you worked hard to climb onto that swing”
- creates a climate of trust and emotional safety
- conveys appreciation of child’s capabilities
- may defuse child’s negative emotions by helping child regain
feelings of safety, comfort, and competence through verbal or nonverbal responses
• does not impose sensory stimulation or activity on a child who responds with distress
• does not impose physical closeness or contact on a child who responds with strong distress

**Scoring:**
For each of the 10 items, assign one rating of 4, 3, 2, 1. You will have a total of 10 ratings.

<table>
<thead>
<tr>
<th>Case #:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of (4) Certainly ratings</td>
<td>X 10</td>
</tr>
<tr>
<td>Number of (3) Probably ratings</td>
<td>X 7</td>
</tr>
<tr>
<td>Number of (2) Doubtful ratings</td>
<td>X 3</td>
</tr>
<tr>
<td>Number of (1) No ratings</td>
<td>X 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sum (Total score)</th>
<th></th>
</tr>
</thead>
</table>
Appendix F

Informed Consent
CONSENT TO TAKE PART IN A RESEARCH STUDY

TITLE: Effectiveness of Sensory Integration and Behavioral Interventions on Nonengagement in Preschool Aged Children Identified with Sensory Over-Responsivity

INVESTIGATOR: Tiffany Kuyper, Pediatric Occupational Therapist
Carilion Clinic Pediatric Therapy
101 Elm Avenue
Roanoke, VA 24029
540-985-9813

Marie Anzalone, ScD, OTR/L, FAOTA

VCU IRB#: HM 12950; Version 2; 7-12-10

INFORMED CONSENT:
You and your child are being asked to take part in this research study because your child has sensitivities to movement and/or touch. The person running this study locally is Tiffany Kuyper, Pediatric Occupational Therapist for Carilion Clinic. Before you decide whether to take part in this research, you should be told about the possible risks and benefits with this study. This process is known as informed consent. This consent form will provide information you need to decide whether you would like for your child to take part in this study.

This consent form may have words or information you do not understand. The researcher will explain anything that you do not clearly understand. Please ask as many questions as you need to make sure that you know what will happen to you in this study and why you are being asked to be in it.

WHY IS THIS RESEARCH BEING DONE?
The purpose of this study is to learn more about children who have Sensory Over-Responsivity, or hypersensitivity to sensations. The researchers want to learn if positive interactions with the child during the therapy sessions may influence the child’s behavior and progress. There will be 2-3 subjects taking part. The length of time you can expect to be in this research is 6-8 weeks.

WHAT WILL HAPPEN IN THIS RESEARCH STUDY?
If you decide to take part, you will be asked to bring your child to the clinic for an initial evaluation with the occupational therapist. As part of this evaluation, we will ask you to complete questionnaires about your child’s responses to sensation. In addition, we will ask your child to do some motor tasks and to play in our clinic. This evaluation will take about 2 hours.

Next, you will be asked to bring your child to weekly occupational therapy sessions that will help your child to engage in play, activities of daily living (dressing, toileting, bathing, feeding, grooming and hygiene) and improve social interactions. The sessions involve a standard therapy called sensory integration and another therapy called behavioral modification. Sensory integration is child-directed play with skilled therapist interactions. Therapy provides sensory
enriched opportunities to meet your child’s individualized sensory needs and improve behavior. Behavioral modification is used when a child is not interested in taking part in an activity because of how it makes him or her feel. The child is then encouraged to take part with the use of favorable and appealing objects and activities. These weekly sessions will take place for 6-8 weeks. Each session will take approximately 45 minutes.

During the initial evaluation and weekly sessions, your child will be videotaped. The videotapes will be used by the researcher to measure your child’s behaviors. The videotapes will also be used to determine which intervention strategies better improve your child’s play, ability to interact with others and participate in activities of daily living. At the end of the study, these videotapes will be returned to you.

At the end of the study, your child will continue to receive occupational therapy if needed but not as part of this research study. You will continue to work with your therapist towards your child’s goals.

**WHAT ARE THE RISKS OF BEING IN THIS RESEARCH STUDY?**
The risks of taking part in the therapy part of this study are minimal and no more than what you might encounter in a typical therapy session. The therapist will be focused on safety during every treatment session.

**WHAT ARE THE BENEFITS OF BEING IN THIS STUDY?**
It is not known whether the study may benefit your child. We expect that your child will benefit from being in occupational therapy. In addition, the knowledge gained may benefit others and may provide more understanding to treatments for children with sensitivities to touch and/or movement.

**ARE THERE ANY OPTIONS TO BEING IN THIS STUDY?**
Sensory integration intervention is the “standard treatment” for children with sensitivities to touch and/or movement. If you choose not to take part in this study, your child will also receive standard treatment.

**WILL I RECEIVE NEW INFORMATION ABOUT THIS RESEARCH STUDY?**
During this study, if new information becomes available that could affect your decision to keep your child in this study, you will be told about this information. The researchers will also tell you about other options for your child’s care.

**WHAT ABOUT CONFIDENTIALITY?**
Assessments about your child collected during the evaluations will be included in your child’s medical record at the completion of this study.

During the study, your child’s videotapes and information will be kept in a locked cabinet in the researcher’s office. Your child will be assigned an identification number so that his or her name is not used. The information linking your child’s name to the videos will also be kept in the researcher’s locked cabinet and destroyed at the completion of the study. Videotapes will be viewed by coders and returned to the researcher. When the videotapes are held by the coders,
the tapes will always be kept in a locked cabinet in the office when not being viewed. At the end of the study, the videotapes will be returned to you.

IRB SURVEY: As part of its monitoring of research, the CC (Carilion Clinic) IRB surveys subjects about their experience while taking part in research.

The IRB is a group of people that review research to protect the rights of research subjects. One job of the IRB is to make sure the research is done in a way that is respectful to subjects. To help it do this, the CC IRB would like to send you a survey about your experiences while taking part in research. While your name and address will be given to the IRB in order to mail the survey, the IRB will destroy the list of names and addresses as soon as the survey is mailed. The survey itself will be anonymous. You do not have to allow the IRB to send you this survey. Please check below if you would like the IRB to send you the survey or not:

_____ Yes, I agree to CC IRB sending me a survey about my experiences while taking part in research.
_____ No, I do not want CC IRB to send me such a survey.

WHAT WILL TAKING PART IN THIS RESEARCH STUDY COST OR PAY?
You or your insurance company may be billed for any treatment that your child receives while taking part in this research study. Billing will be in the usual and customary manner. You may wish to talk to your insurance company before agreeing to take part in this study. You will not be paid to take part in this research.

WHAT WILL HAPPEN IF YOUR CHILD HAS COMPLICATIONS OR IS INJURED BY THIS RESEARCH STUDY?
If your child has a medical problem that happens while in this study, your child will be able to get treatment. The treatment will be billed to you or your insurer at the usual charge. The study does not make any provisions for the payment of these costs. You will not receive any other financial compensation. However, you do not give up any legal rights to seek compensation for injury by signing this consent form.

WHAT IF I WANT TO STOP BEING IN THIS STUDY BEFORE IT IS FINISHED?
Being in this research is voluntary. You may refuse to take part or you may withdraw at any time. Your decision not to take part or your decision to withdraw will not affect your child’s ability to get care from the therapist or from Carilion. The researchers may take your child out of the research study for any reason, without your consent, if they feel it is in your child’s best interest. The researchers may also take your child out of the research study if you miss any more than two treatment sessions without making them up. The reason for any exclusion will be explained to you.

ARE RESEARCHERS BEING PAID TO DO THIS STUDY?
This study does not have any sponsors. It does not have any funding. None of the investigators or research staff will receive money or other types of payment from this study.
WHO ARE THE CONTACT PERSONS?
Questions about this study can be asked of the researcher, Tiffany Kuyper, at 540-985-9813 or the principal investigator, Marie Anzalone at 804-828-1575. If you have any questions about your or your child’s rights as a research subject, you may contact staff of the Carilion IRB at (540) 853-0728 or the VCU Office of Research at 804-827-2262.

CONSENT SIGNATURES:

RESEARCH SUBJECT: The research study described in this consent form, including the risks and benefits, has been explained to me and all of my questions have been answered. I consent to take part in this research study. My consent is given willingly and voluntarily. I may withdraw my consent at any time. I will receive a signed copy of this consent form.

____________________________________
Printed Name of Research Subject

____________________________________
Subject’s Signature                               Date

PERSON OBTAINING CONSENT: I certify I was present for the informed consent discussion. The subject or legally authorized representative had an opportunity to ask questions about and appeared to understand the information presented. The subject or legally authorized representative agreed to take part voluntarily in the research and I obtained their signature.

_____________________________________
Printed Name of Person Obtaining Consent

_____________________________________
Signature of Person Obtaining Consent              Date

WITNESS TO SIGNATURE: I certify the subject or legally authorized representative signed or made his or her mark on this consent form.

______________________________________

Printed Name of Witness

__________________________

Witness’ Signature

__________________________

Date
Appendix G

Pre-Research Video Consent
Consent to Release

I give Carilion Clinic permission to use and reproduce: photographs, digital images, videotapes, or other visual and/or auditory recordings of my child under the following conditions:

1. Recordings or images will be used for medical education or training.

2. I understand my name will not be used with these recordings or images unless specifically noted hereon.

3. Further, I release Carilion Clinic from any compensation to me and understand these recordings or images are the sole property of Carilion Clinic.

Signature: _______________________________ Date: __________________
Address: _______________________________ Phone: __________________
Authorization to use name: Yes __________ No __________
Parent or Legal Guardian: ________________________________
Witness: ____________________________________________
Appendix H

Post-Research Video Consent
Consent to Release

I give Carilion Clinic permission to use and reproduce: photographs, digital images, videotapes, or other visual and/or auditory recordings of my child under the following conditions:

1. Recordings or images will be used for medical education or training.
2. Recordings or images will not be used for any future research without further notification.
3. I understand my name will not be used with these recordings or images unless specifically noted hereon.
4. Further, I release Carilion Clinic from any compensation to me and understand these recordings or images are the sole property of Carilion Clinic.

Signature: ___________________________ Date: ___________________________
Address: ___________________________ Phone: ___________________________
Authorization to use name: Yes ______________ No _______________________
Parent or Legal Guardian: ___________________________
Witness: ___________________________
Appendix I

Fidelity of Behavioral Interventions
Fidelity of Behavioral Interventions

Instructions: The coder will complete a Fidelity of Treatment checklist for the first intervention session in each alternating treatment condition to determine the degree to which behavioral interventions were used within the intervention. Enter the date for which the intervention session occurred.

The following scale will be used to rate the degree to which the behavioral interventions were utilized.

0= Strategy was not introduced
1= Strategy was introduced as intended

<table>
<thead>
<tr>
<th>Behavioral Interventions</th>
<th>Rating</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangible Reinforcement</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>/</td>
</tr>
</tbody>
</table>

Total score 7 out of 20 (30%) and higher reflects adequate treatment fidelity

Total Score:_____
Appendix J

Operational Definitions

**Nonengagement**: No occupation of attention or effort to engage (Random House, 1987) in presented activity. Child attempts to escape or avoid engagement when presented with a “do” task or when presented with the opportunity to engage in play with sensory intensive play. The child may present with one or more of the following behaviors:

- Re-direct the therapist’s attention to a different activity
- Say “no,” “I don’t want to,” or anything else that indicates the child does not want to participate
- Child physically moves away from the activity
- Child may say “I can’t”

**Escape**: Child attempts to remove him/herself from a demand (Carr, 1994; Gresham et al., 2001)

**Avoidance**: Child attempts to withdraw when a potential demand is perceived

**Play engagement**: Child initiates play independently or when an activity is presented. Child sustains engagement in play even if for a small period of time. The child terminates play when a product is achieved or an end is determined. For example, he or she makes a smiley face in shaving cream. He or she engages in an activity while swinging on a swing.
Vita

Tiffany Ann Kuyper was born on January 5, 1972, in Roanoke, Virginia, and is an American citizen. She graduated from Patrick Henry High School, Roanoke, Virginia, in 1990. She received her Bachelor of Arts in Biology from Hollins College, Hollins, Virginia, in 1996 and a Bachelor of Science in Occupational Therapy from The College of Health Sciences, Roanoke, Virginia, in 2000. She began her career with Heartland Rehabilitation Services and later moved to Professional Therapies of Roanoke providing services in a private pediatric outpatient clinic and an educationally based setting. In 2006, she obtained a position with Carilion Children’s Clinic and she participates in comprehensive pediatric multidisciplinary evaluations through the Carilion Child Development Clinic and maintains a small caseload of children with Sensory Processing Disorder, Autism, and ADHD.