THE EFFECTS OF SENSORY INTEGRATION INTERVENTION ON THE REDUCTION OF MALADAPTIVE BEHAVIORS IN HIGH SCHOOL STUDENTS WITH AUTISM

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EFFECTS OF SENSORY INTEGRATION INTERVENTION ON THE REDUCTION OF MALADAPTIVE BEHAVIORS ON HIGH SCHOOL STUDENTS WITH AUTISM

The following faculty have examined the final copy of this thesis for form and content, and recommend that it be accepted in partial fulfillment of the requirement for the degree of Master of Education with a major in Special Education.

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ABSTRACT

A single-case experimental design with multiple baseline reversal was conducted to determine the effects of sensory integration intervention on the reduction of maladaptive behaviors in high school students with autism. Four participants with a diagnosis of autism coupled with sensory integration dysfunction ranging in ages from 16 to 17 participated in this study. Individually designed sensory integration intervention (SII) was administered three times per week during the two week intervention phases of the study (B) and (B2). Following administration of individualized SII, participants engaged in an independent pre-vocational task. The use of SII produced improvements in level of engagement for each of the participants with significant decreases in performance upon removal of treatment. A decrease in level of maladaptive behavior occurred during the intervention phases for each participant. The findings of this study may provide support for the use of SII for increasing level of engagement in task work and functional performance while reducing maladaptive behaviors in high school students with autism.
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CHAPTER 1
INTRODUCTION

Autism has become one of the most prevalent developmental disabilities in the United States (CDC) (2007). Generally characterized by deficits in language usage, self-stimulatory behavior and impairments in social reciprocity, autism affects one in every 150 births (Adamson, O’Hare, & Graham, 2006). Perhaps one of the most perplexing issues with autism is the unique manner in which individuals are affected by the disorder. While autism is formally defined by a certain set of behaviors and characteristics, individuals with autism exhibit a myriad of behaviors with varying degrees of severity (Bishop & McArthur, 2005). These varying degrees of severity, coupled with unique combinations of behaviors and characteristics, have made it difficult to provide research-based treatment approaches for individuals with autism. Likewise, the unique manners in which individuals with autism are affected make it extremely difficult to offer streamlined educational practices and research-based approaches for the education of individuals with autism (Baranek, 2002).

Initially identified in the early 1940’s by researcher Leo Kanner (1943), characteristics of autism were documented through the observation of unusual behaviors and reactions to particular stimuli. While research in the field of autism has continued and evolved over the past 60 plus years, autism remains to be a perplexing condition within the general population as little is known regarding the cause of the neurologically-based deficiency (Davis, Bockbrader, Murphy, Hetrick, & O’Donnell, 2006). In 1990, the Individuals with Disabilities Education Act (IDEA, 1990) created a separate category for the diagnosis of autism, defining autism as, “A developmental disability significantly affecting verbal and nonverbal communication and social
interaction, generally evident before age 3, that adversely affects a child's educational performance” (Cohen & Spenciner, 2005).

According to the National Institute of Neurological Disorders and Stroke (NINDS) (Autism, 2006), autism is the most common exceptionality classified in a broader category recognized as autism spectrum disorder (ASD). Other exceptionalities in the category of ASD include Asperger syndrome, Rett syndrome, childhood disintegrative disorder, and pervasive developmental disorder (PDD). Through on-going studies of individuals with autism, researchers have been able to identify three distinctive characteristics of autism. Individuals with autism often display difficulty with social interaction; impairments with communication, both verbal and non-verbal; as well as repetitive behaviors (Atchinson, 2007).

The three distinctive features of autism encompass a multitude of indicators that provide for a definitive diagnosis of autism. The Diagnostic and Statistical Manual (DSM-IV-TR) (American Psychological Association, 2000) identifies behaviors and responses within each category to assist in determining a diagnosis. Specifically, the manifestation of at least two characteristics in the area of qualitative impairment in social interaction, at least one impairment in the areas of communication, and at least one characteristic in the area of restricted repetitive and stereotyped patterns of behavior, interests and activities must be present for a diagnosis.

Within the category of social interactions, the DSM-IV-TR lists impairments such as the inability to use or recognize facial expressions, failure to engage in social interactions with peers, and lack of social or emotional reciprocity. Within the area of communication, impairments may be manifested through a lack of, or delay in, development of spoken language, deficiencies in the area of initiating or sustaining conversations, and stereotyped and repetitive uses of language. The final category for a diagnosis of autism is that of restricted and repetitive behaviors. These behaviors often include a fascination, and sometimes obsession, with one or more items of
interest, a lack of flexibility with non-functional routines, and stereotyped or repetitive motor movements such as flapping, twisting, rocking, or other whole body movements.

While no definitive cause or causes of autism have been identified, the Centers for Disease Control (CDC) (2007) has reported that autism is one of the fastest growing disabilities today, becoming second in terms of prevalence only to mental retardation. The CDC reports that a growing trend has been observed in the number of children identified with autism over recent years. From 1994 to 2006, the number of children with autism receiving public education program services increased from 22,666 in 1994 to 211,610 in 2006. Today, the CDC reports that 1 in every 150 children in the United States is diagnosed with autism. Given the perplexity of such a prevalent disability, coupled with no known cause or cure, research in the field of autism has primarily focused on early identification and identifying the unique features and characteristics of the disability (Cesaroni & Garber, 1991; Grandin, 1992; Kern et al., 2006; Kientz & Dunn, 1997; Ornitz, Guthrie, & Farley, 1977).

Historical Perspective

Historically, autism has been recognized as a neurologically based pervasive developmental disorder (PDD) impacting the sensory processing system. Individuals with autism often experience unusual responses to stimuli. Abnormal responses to sensory input have been identified as a core symptom of autism that result in negative effects on the development of the perceptual system among individuals affected (Hermelin & O’Connor, 1970; Hutt, Hutt, Lee, & Ounsted, 1964; Ornitz, 1974).

In one of the first known clinical accounts of atypical reactions to stimuli, Kanner (1943) studied individuals who focused on unusual attention to parts rather than wholes. He would later describe these individuals as autistic. Kanner’s early findings have served as a foundation for
researching and understanding sensory processing in the exceptionality of autism (Iarocci & McDonald, 2006). His findings have since been corroborated as research in the field of autism has extended (Cesaroni & Garber, 1991; Grandin, 1992; O’Neil & Jones, 1997; Williams, 1994).

Initial theories on the causes of atypical behaviors among individuals with autism were based on observations of hypo- or hyper-arousal and unusual reactions to sensory input (Hutt et al., 1964; Kootz, Marinelli, & Cohen, 1982; Ornitz, 1974; Ornitz et al; 1977). Additionally, researchers found atypical physiological and neurological responses to sensory tasks prevalent among individuals with autism (Heremlin & O’Connor, 1970; Hutt et al., 1964; Ornitz, 1974).

Early theories as well as most current theories of autism share a common foundation of sensory processing in a way that is different from individuals with other exceptionalities and particularly different from those in typically developing peer groups (Iarocci & McDonald, 2006). In particular, deficits in reaction to sensory processing deficits have been found to result in unusually intense attention to, or avoidance of, sensory stimuli from all modalities among individuals with autism.

In a meta-analysis of sensory processing in individuals with autism from 1960 to 2005, Rogers, Hepburn, and Whener (2003) were able to confirm early theories that sensory symptoms were more frequent in individuals with autism than observed in their typically developing peers. In addition to noting significant differences between children with autism and their typically developing peer group, they also found that individuals with autism experience increased levels of hypo-responsiveness to sensory stimuli when compared to the peer group.

Since Kanner’s investigation, research has shown that children with autism manifest sensory integration impairments in multiple areas including: (a) low endurance and tone, (b) poor registration, (c) tactile challenges, (d) fine-motor/perceptual problems, (e) self-regulation, and (f)

In a review of sensory abnormalities among children with autism, O’Neil and Jones (1997) validated previous studies that individuals with autism experience increased abnormalities in each of the five main senses as well as kinesthetic and proprioceptive sensations. In 2004, Smith and colleagues were able to confirm decades of research on sensory processing among individuals with autism, concluding that children and youth with autism manifest sensory integration deficiencies across each sensory modality (Smith, Hagiwara, Dunn, Rinner, Reese, & Huggins, 2004).

Through continued research of sensory processing related to individuals with autism, Smith et al. (2004) determined that sensory processing deficits often have a significantly negative impact on behavior. Additionally, they found that individuals with autism who experience deficits with sensory integration display extreme difficulties adapting and engaging effectively in their environments. Similarly, Watling and Dietz (2007) noted that engagement, an individual’s interaction with the social and non-social environment, is often adversely affected among individuals with autism. Individuals are often non-responsive to their environment, oblivious to people and contexts, and unable to reduce levels of responsiveness to environmental stimuli and cues. As a result, their behaviors are often extreme and frequently maladaptive (Baranek, 2002; Smith et al., 2004; Urwin & Ballinger, 2005).

Definition of Key Terms

Sensory Integration. Sensory integration is the ability to acquire and process information through one or more sources, including tactile, auditory, visual, taste, and smell (Atchinson,
Sensory integration is often elevated or absent in individuals with autism, leading to Sensory integration dysfunction (SID).

*Sensory Integration Dysfunction.* Sensory integration dysfunction (SID) is a congenital neurobiological process, which refers to the integration and interpretation of sensory stimuli from the environment to the brain (Hatch-Rasmussen, 1995).

*Self Injurious Behavior.* Self-injurious behavior is defined as behavior initiated by an individual, which results in physical harm to the individual (Murphy & Wilson, 1985).

*Sensory Integration Intervention.* Sensory integration intervention (SII) is defined as an individualized sensory-based treatment program designed to meet the specific needs of an individual (Schaff & Miller, 2005). Individualized SII may include the use of items to increase, or decrease, stimulation of the senses. Items used in SII for the purposes of this study will include the following: (1) use of deep pressure through brushing, (2) modifications to lighting, (3) modifications to sound, (4) tactile manipulatives, and (5) the use of swings, and balls to address the vestibular sensory system.

*Tactile Processing.* Tactile processing relates to an individuals ability to gain meaningful input from the tactile system, particularly nerves under the surface of the skin that relay information to the brain. Tactile senses include reaction to light touch, pain, temperature, and pressure (SchAAF & Miller, 2005).

*Vestibular Processing.* Vestibular sensory processing relates to an individuals movement and sense of balance (SchAAF & Miller, 2005).

*Proprioceptive Processing.* Proprioceptive processing relates to the senses of joints and muscles (SchAAF & Miller, 2005).
Hyper-responsiveness. Hyper-responsiveness is the result of over-stimulation of the senses (Hatch-Rasmussen, 1995). Individuals who experience hyper-responsiveness typically receive increased levels of sensory input, which often results in individuals who processing sensory input in more extreme manners that other individuals (Dunn, Myles, & Orr, 2002).

Hypo-responsiveness. Hypo-responsiveness is the act of under stimulation of the senses (Hatch & Rasmussen, 1995). Individuals who experience hypo-responsiveness typically receive less sensory input which often results in not being able to hear certain sounds and not feeling pain the same way as other individuals would (Dunn, Myles, & Orr, 2002).

Statement of the Problem

Individuals with autism who experience abnormalities in sensory processing often exhibit maladaptive behaviors making it difficult for them to communicate, interact, and otherwise engage in their own environments (Baranek, 2005; Bundy, Lane & Murry, 2002; Urwin & Ballinger, 2005; Watling & Dietz, 2001). Maladaptive behaviors can range from physical movement and reaction in an attempt to protect themselves from over stimulation, to increased and often unstable physical movement in an attempt to gain sensory input (Duncan, Matson, Bamburg, Cherry, & Buckley, 1999). Similarly, individuals with autism may engage in self-injurious behaviors in an attempt to compensate for such sensory needs. For individuals in an educational setting, this is particularly difficult as these behaviors and reactions to stimuli impede their ability to engage and effectively interact in a learning environment.

A frequently used strategy for addressing the unique sensory processing of individuals with autism has been the use of sensory integration intervention (SII). While there is ample anecdotal and descriptive information in published sources to indicate that many people benefit from the use of various approaches of SII, there is an absence of empirical evidence to validate
the effectiveness of such treatment, particularly with respect to individuals with more severe forms of autism (Baranek, 2002).

A significant amount of existing current research (Kern et al., 2007; Richman, 2008; Urwin & Ballinger, 2005) has focused on identifying discrepancies in sensory processing and integration between children with autism and their typically developing peers rather than focusing on valid treatment options. Likewise, much of the current research (Marler & Champlin, 2005; Smith, Press, Koenig, & Kinnealey, 2005; Urwin & Ballinger, 2005) has been conducted on individuals ranging in age from three to twelve years of age, limiting proposed treatments for individuals as they age. Additionally, existing research on the effects of SII on the reduction of maladaptive behaviors is significantly limited to just two studies (Urwin & Ballinger, 2005; Smith et al., 2005). Consequently, the purpose of this study is to examine the effects of SII on reducing self-stimulating, self-injurious, and stereotypic behaviors in high school students with autism.

As we move to more inclusive educational settings, preparing students with severe exceptionalities to transition to adulthood, it is imperative that students develop the skills and receive the support necessary to allow them to interact and engage in an educational setting designed to meet their needs. Addressing the sensory needs of students with autism is an important first step to defining best practices for serving students with autism.

This study proposes to employ an equivalent time series design to determine the effectiveness of a program specifically designed to meet the individual sensory needs of high school students with autism. The study addresses the following question: What are the effects of individualized sensory integration intervention on the reduction of maladaptive behaviors in high school students with autism?
Purpose of Study

The purpose of this study is to determine what effects an individualized sensory integration intervention (SII) program will have on reducing maladaptive behaviors in high school students with autism.

Research Questions

Three research questions guided this study:

1. Do maladaptive behaviors during an independent pre-vocational task decrease following individualized sensory integration intervention?

2. Does a decrease in maladaptive behavior result in a higher level of goal attainment in task completion?

3. Does level of engagement in pre-vocational task work increase immediately following sensory integration intervention?

Summary

The rationale and background for this study, statement of the problem, and research questions as well as key terms have been identified in chapter 1. Chapter 2 will examine sensory processing from five perspectives: (1) sensory integration; (2) sensory abnormalities; (3) sensory integration dysfunction (SID); (4) maladaptive behaviors; and (5) sensory integration intervention (SII). Further, Chapter 2 will also provide a review of related literature and a synthesis of relevant empirical research.
CHAPTER 2
LITERATURE REVIEW

Chapter 2 is comprised of a review of literature on the unique sensory processing of individuals with autism. This chapter examines historical research on the early findings on sensory processing as it relates to individuals with autism as well as a synthesis of relevant research from five perspectives: (1) sensory integration, (2) sensory abnormalities, (3) sensory integration dysfunction, (4) maladaptive behaviors, and (5) sensory integration intervention as a proposed treatment for addressing the sensory needs of individuals with autism.

Early findings

Historical research on the reactions to sensory stimuli date back to the early 1940’s and the research of Kanner (1943). Kanner noted distinctive social behaviors and differences in sensory processing among individuals with autism compared to those of typically developing peers. From the 1960’s through the early 1980’s researchers theorized that the causes of atypical behaviors experienced by individuals with autism were based on observations of hypo-arousal and unusual reactions to sensory input (Ornitz, Guthrie & Farley, 1977; Hutt et al., 1964; Kootz, Marinelli, & Cohen, 1982; Ornitz, 1974). Early notions regarding the unique manner in which individuals with autism process and react to sensory input continue to be reflected in current psychological theories of autism (Atchinson, 2007).

Following Kanner’s examination of unusual responses to stimuli in individuals with autism, Bergman and Escalona (as cited in Rogers & Ozonoff, 2005) focused on the sensory symptoms of individuals with autism. The researchers developed what is believed to be the first hypothesis in the study of autism, noting that children with autism begin life with a higher degree of sensitivity for which they attempt to compensate for through behavioral responses to stimuli.
In 1949, Bergman and Escalona hypothesized that a child’s need to protect himself or herself from over or under stimulation resulted in developmental distortions that led to the unusual responses Kanner had previously observed (Rogers & Ozonoff, 2005).

By the 1960’s, research in the field of autism, and specifically sensory processing, became more involved as hypotheses on specific sensory dysfunctions and the results on motor, social, and cognitive functioning were developed. As a result, empirical studies in the area of sensory processing in individuals with autism were conducted. The early theories and hypothesis have served as a foundation for scientific research in the area of sensory processing in modern research.

*Sensory Integration: Processing Stimuli Through the Senses*

The concept of sensory integration (SI) was originally introduced in the early 1970’s through the research of Ayres (1972) who defined SI as, “the neurological process that organizes sensations from one’s own body and from the environment and makes it possible to use the body effectively within the environment” (p.11). Ayres found that SI occurs in the cortex of the brain and requires balance between the central and peripheral nervous systems (Bundy, Lane & Murry, 2002; Cook & Dunn, 1998).

The theory of SI continued to be conceptualized through on-going research (Atchinson, 2007). Ayers and subsequent researchers such as Lane (2002) and Baranek (2002) provided concepts of SI as being rooted in well-established scientific models of neurological structure and functioning. For example, they found that research supports the role of the brain in integrating sensory input and the need for balance in the brain.

Ayres’ theory of SI has been recognized as a multifaceted concept difficult to reduce to specific elements or define operationally (Ottenbacher, 1991). Classic SI, as proposed by Ayres,
is based on the understanding that deficiencies in neurological processing of sensory input interfere with the production of structured and meaningful behaviors that serve as a platform for higher-level learning and skill development. Likewise, SI requires enhanced sensory experiences in the context of meaningful, self-directed activity to support an individual’s ability to function adaptively and meet the contextual demands of daily activities (Watling & Dietz, 2007).

While the concept of SI is based on several principles, one of the foremost considerations is the recognition of the importance of tactile, vestibular, and proprioceptive sensory systems (Schaaf & Miller, 2005). Kandel, Schwartz, and Jessell (2000) reported that these three systems play a significant role in the regulatory mechanisms of the nervous system.

*Vestibular processing system.* The vestibular system provides sensory input to the brain and relates to an individual’s body movement through space and sense of balance (Smith et al., 2005). Relaying sensory input from each of the other senses in the body, the vestibular system has been scientifically recognized as one of the most important sensory systems. Consequently, this system directly impacts the ability to function in every day life. Deficiencies in vestibular processing result in a definitive lack of self-control in terms of body movement and reaction and to stimuli (Smith et al.). Impairments within the vestibular system can be seen through poor posture and difficulty planning or sequencing motor activities. Further, impairments are often manifested in two distinct manners. Some individuals may be hypersensitive to vestibular stimulation which results in the fear of seemingly ordinary movement activities such as swings, slides, ramps, and other incline movements. Such hypersensitivity may also result in individuals experiencing difficulty, and intense levels of anxiety, when climbing or descending stairs or other inclines, including walking on uneven surfaces. To an alternate extent, some individuals may experience hypo-responsiveness to vestibular stimulation. Individuals who experience hypo-
responsiveness often seek intense sensory experiences through excessive body movement through jumping, spinning, and rocking which can often result in dangerous behaviors and injury (Iarocci & McDonald, 2006; Schaaf & Miller, 2005).

**Proprioceptive processing system.** The proprioceptive system provides sensory input from the muscles and joints (Smith et al., 2005). This system provides an individual with an awareness of their body positioning. An effectively performing proprioceptive system allows an individual to experience control over body position and movement. For individuals who experience deficiencies in this system, a lack of body control and movement is typical, hindering their ability to function appropriately in common environments and settings (Smith et al.). Deficits in the area proprioceptive processing include the inability to manipulate objects using fine motor skills such as writing, using eating utensils, and dressing one-self (Hatch-Rasmussen, 1995; Iarocci & McDonald, 2006; Schaaf & Miller, 2005).

**Tactile Processing System.** The tactile processing system allows an individual to process and organize input from the tactile system, with particular emphasis on nerves under the surface of the skin that relay information to the brain (Schaaf & Miller, 2005). Impairments of the tactile processing system may be manifested through observable behaviors such as intense physical and verbal reactions to touch and textures as well as the inability or unwillingness to manipulate objects. Schaaf and Miller found that deficiencies within the tactile processing system often lead to poor or absent development of fine motor skills such as the ability to grasp a writing utensil, button a shirt, or manipulate a zipper.

Integration of the vestibular, proprioceptive, and tactile processing systems serves as the foundation of other senses such as hearing and seeing. As a result, these senses are the main focus of sensory integration intervention (SII) (Smith et al., 2005). Additionally, research has
found that the reciprocity of these senses begins to form at birth and continues to develop as an individual matures and interacts with his or her environment. These three systems are necessary for an individual’s basic survival and allow for one to experience, interpret, and respond to different stimuli in their environment (Baranek, Parham, & Bodfish, 2005).

A major concern with the overall theory of SI is the lack of empirical evidence suggesting integration of sensory input is necessary for high level cognitive functioning (Smith et al., 2005). Smith and colleagues argue that there is an absence of sound scientific basis for this claim. A limitation on effectively evaluating the basic premise of the SI theory is that certain constructs, according to the researchers, lack clear definitions.

*Sensory Abnormalities: Deficiencies in Processing Environmental Stimuli*

Deficiencies in sensory processing were first noted through the research of Kanner in the 1940’s. Among the many behaviors noted by Kanner included instances of individuals reacting to stimuli by jumping excitedly, demonstrating through physical movement a fear of loud noises such as machines, fear of movement on items such as tricycles, slides, and swings, the pleasure, and sometimes fear, of spinning objects, as well as fascination with flickering lights. Kanner concluded that these behaviors were linked to the neurological system and an individual’s ability to process sensory information (Rogers & Ozonoff, 2005).

Sensory, attentional, and perceptual difficulties were among the first specific sensory abnormalities identified leading to the generation of theories regarding the underlying causes of autism and interest in research related to autism (Iarocci & McDonald, 2006). Initially, theories of autism hypothesized that sensory abnormalities occurred in response to a chronic state of over-stimulation due to a disturbance in the modulation of arousal level (Hutt et al., 1964). The symptoms of repetitive motor behaviors and restricted focus and interests were thought to serve
as a method of self-regulating arousal levels through external means (Iarocci & McDonald, 2006).

In the late 1960’s and early 1970’s, Ornitz and Rivto (1968) examined the sensory processing of individuals with autism. They focused on repetitive motor behaviors exhibited by children with autism. They determined the repetitive motor behaviors were the result of sensory input and difficulty processing sensory stimuli.

Similarly, in the late 1960’s in a study comparing individuals with autism to clinical controls, Wing (1969) found that children with autism demonstrated significantly more sensory-perceptual abnormalities than typically developing peer groups. Lord, Rutter, and LeCouteur (1995) later confirmed the findings of Wing. Lord et al., through the use of the Autism Diagnostic Interview-Revised, found that children with autism experienced significantly higher levels of sensory dysfunction than clinical control groups with developmental delays.

When considering the early research on sensory processing among individuals with autism, Iarocci and McDonald (2006) cautioned that it is important to consider some of the limitations of early research. They reported that much of the early research in this field was hindered due to poorly defined constraints, small samples, and a lack of sound methodology. As a result, they concluded that such early research lacked validity and reliability. However, they also determined that the findings of early researchers served as a foundation for understanding sensory processing among individuals with autism and provided justification for further research in the area.

Talay-Ongan and Wood (2000) investigated specific sensory sensitivities in children with autism. The researchers confirmed earlier studies finding that significant differences existed between autistic groups and non-autistic groups. Specifically, they found that the group with
autism displayed significantly greater levels of disparity in hyper- and hypo-sensitivities compared to the non-autistic group across all modalities. Results also revealed that sensory sensitivities increased over age. This study, noting the significant differences in sensory processing across all modalities between normally developing and autistic groups, is the first known empirical account of such a discrepancy.

In a similar examination of sensory abnormalities among children with autism, Kern et al. (2001) found that sensory deficiencies were one of the most common clinical features observed in the children studied. Deficits in processing sensory stimuli were later found to result in high levels of anxiety, stress, and maladaptive behaviors, making it difficult for students to actively engage and participate in a classroom setting (Smith et al., 2004; Watling & Dietz, 2007). The researchers concluded that these behaviors not only impede the educational process for students, but they can be physically and emotionally harmful as well.

Further examination of specific abnormal processing of sensory stimuli was conducted by Jones, Quigney, and Huws (2003). Jones et al. conducted a qualitative analysis of sensory disturbances among individuals with autism. Results from this study revealed aversive reactions to sensory input and extreme coping mechanisms. Specifically, they observed intense reactions to participants being touched and to certain sounds as well as aversive reactions to variations in lighting. Additionally, they noted fascinations with certain odors, movements, and engagement in repetitive behaviors. Jones and colleagues determined that observed repetitive behaviors and intense reactions to stimuli were likely coping behaviors used as defense or avoidance mechanism in response to sensory input.

Confirming the findings of Jones et al., Harrison and Hare (2004) observed abnormalities across each of the five main sensory modalities as well as the kinesthetic and proprioceptive
processing systems. Deficiencies noted by Harrison and Hare included hyper- and hypo-
sensitivity to stimulation with a frequent fluctuation between the two; auditory deficiencies; non-
responsiveness to sound, including once familiar voices; sensory overload demonstrated through
extreme and often self-injurious physical responses; and difficulty in processing from more than
on sensory system at a time.

Subsequent research on sensory abnormalities in individuals with autism was further
examined, and researchers continued to confirm the existence of sensory deficiencies across each
of the five main sensory modalities. Kern et al. (2006) found that individuals with autism
experience abnormal processing in each of the five main sensory systems at a level significantly
higher than control groups. Regarding specific sensory deficiencies, they determined that
individuals experienced unusual responses to environmental and sensory stimuli such as light,
noise, touch and odor, and they demonstrated a high threshold for pain. After decades of research
on sensory processing and abnormalities in children with autism, researchers have concluded that
the degree of sensory difficulties can affect functioning in daily life activities in a variety of
activities across a myriad of environments and settings (Baranek, 2002; Harrison & Hare, 2004;
Kern et al., 2006; Kern et al., 2007).

It is important to note that not only do individuals with sensory abnormalities experience
intense, and often painful, responses to stimuli, some individuals also experience sensory seeking
behaviors, known as sensory insensitive (Watling, Dietz, & White, 2001). Individuals classified
as sensory seeking often have a high threshold for responses to stimuli. While they may be
hypersensitive to certain sounds, they may appear to be deaf to other auditory input.
Additionally, they may become fixated on certain stimuli while being oblivious to other stimuli.
Continuing research in the area of sensory abnormalities has not only supported the early findings of Kanner and other pioneer researchers, but has identified additional areas of specific abnormal processing. Rogers and Ozonoff (2005) confirmed the finding of repetitive behavior as an abnormality in sensory processing and found that such behaviors may either have sensory origins or are types of symptoms driven by chronic hyper- or hypo-sensitivities, that is, the over or under stimulation of the senses.

*Sensory Integration Dysfunction*

Sensory integration dysfunction (SID) was first introduced by occupational therapist A. Jean Ayers in 1963 (Miller & Summers, 2001). Ayers examined the relationship between sensory processing and the behavior of children with a myriad of exceptionalities including learning disabilities and emotional disorders. Ayers theorized that there was a connection between impaired sensory processing and functional problems. Through her research, Ayres developed a series of both standardized and non-standardized tests leading to the identification and increased understanding of a myriad of patterns of SID. These tests were later revised, expanded, and published in to what is now the Sensory Integration and Praxis Test (SIGN, 2007). As research in the field of SI expanded, researchers later extended Ayers’ theory, further defining her theory of SI as how the brain processes sensation and the resulting motor, behavior, emotion, and attention responses (Bundy, Lane, & Murry, 2002).

A prominent concern regarding individuals with autism appears in the form of deficits with integration of sensory stimuli. Ayres and Tickle (1980) and subsequent researchers were able to link difficulty with SI to a variety of disorders including physical impairments such as cerebral palsy, learning disabilities, ADHD and developmental disabilities including autism (Linderman & Stewart, 1998; Shellenberger & Williams, 2002; Smith et al., 2005).
Early research (O’Neil & Jones, 1997), found that difficulties with sensory integration lead to what is known as sensory integration dysfunction (SID). The researchers determined that the term dysfunction was synonymous for disorder, defensiveness, or overload when describing difficulties processing sensory input among individuals with autism. They further concluded that difficulties in sensory processing were often more clearly defined as having a low threshold for response to stimuli or being sensory sensitive in areas of tactile, oral, visual, and auditory processing. More recent research further clarified the impact of sensory integration dysfunction (SID) defining it as a congenital neurobiological process, referring to the integration and interpretation of sensory stimulation from the environment that occurs when sensory input fails to be organized effectively in the brain (Kern et al., 2007).

Dysfunction within the sensory processing system often results in varying degrees of difficulty with development, information processing, and behavior (Baranek, 2002). Baranek determined that reactions to sensory processing vary in levels of severity and degree as do the levels of sensory sensitivities among individuals with autism.

As research in the field of SI continued, the area of SID was further examined and a more in-depth definition of the dysfunction was provided (Shellenberger & Williams, 2002). After observing and studying the behaviors and unusual responses to stimuli, these writers defined SID as the inability of the neurological systems to accurately process sensory input.

In 2001, Watling, Deitz, and White conducted a study of children with pervasive developmental disorder (PDD). They identified significant abnormal processing in specific areas such as: (1) sensory seeking, (2) emotional reaction, (3) endurance, (4) oral processing responses, (5) registration, and (6) fine motor perception. This study, however, was limited in
some respects due to the variability among the group of children in the sample population and a lack of mental age matching.

In 2003, Rogers, Hepburn, and Wehner addressed the methodological limitations identified in the Watling et al. study. Rogers and colleagues found significant differences between the control group and experimental group in areas of tactile processing, taste and smell sensitivities, reactions to sensory input, auditory processing and reduced function of the proprioceptive system.

Examining sensory abnormalities among children with autism, Harrison and Hare (2004) determined that unusual responses experienced by individuals with SID often result in a myriad of maladaptive behaviors including but not limited to self-injurious, stereotypic, and physically aggressive behaviors. They concluded that maladaptive behaviors of this nature often result in a negative impact on the students’ ability to interact with peers and perform in an educational setting.

*Maladaptive Behaviors*

The presence of self-injurious, stereotypic, and maladaptive behaviors was first identified in a scientific study in the early 1950’s through the research of Piaget (as cited in Pernon, Pry, & Baghdali, 2007). According to Pernon et al., the earliest empirical research on self-injurious behavior (SIB) focused on the hypothesis that repetitive self-injury and other forms of stereotypic behaviors were used as an attempt to regulate arousal levels for individuals with developmental disabilities and delays. The hypothesis was that individuals with developmental delays experienced difficulty controlling the level of environmental stimulation, leading to contextual situations where individuals experience an aversive situation from being over- or under-stimulated.
Later research extended on the initial hypothesis by conceptualizing over- and under-stimulation as possibly establishing or abolishing operations for SIB (Case-Smith & Miller, 1999). It is now believed that individuals with pervasive developmental disorders such as autism may use repetitive behavior in an effort to compensate for aversive levels of over stimulation or in some cases, increase stimulation via vestibular movements (Richman, 2008).

As the presence of maladaptive behaviors among individuals with autism was explored, researchers validated earlier findings and hypotheses agreeing that the presence of maladaptive behaviors may often serve as an attempt to compensate for deficiencies within the sensory processing system. Additionally, researchers found that the development of self-injurious behavior (SIB) exhibited by children with autism was the result of a complex interaction between neurobiological and environmental variables (Richman, 2008). Studies have also found that these behaviors can be detrimental not only to an individual’s development, but to their daily functioning and quality of life as well (Pernon, et al., 2007; Liss, Sauliner, Fein, & Kinsbourne, 2006; MacDonald, 2000; Richman, 2008; Rosenthal-Malek & Mitchell, 1997).

In an examination of maladaptive behaviors among individuals with pervasive developmental disorder (PDD), MacDonald (2000) identified five types of specific maladaptive behaviors, including stereotypical, self-injurious, ritualistic, tantrum, and aggressive. She determined that each of the five maladaptive behaviors identified could serve as a possible attempt to communicate anxiety, stress, or increased levels of frustration. Noting that individuals with autism often experience difficulty communicating, MacDonald concluded that maladaptive behaviors might also serve as a means of gaining attention to either themselves or something in their environment. While sensory related behaviors demonstrated by individuals with autism are thought to help individuals cope with their sensory environment by either generating or avoiding
sensory stimulation, these behaviors have been found to not only interfere with development and social reciprocity, but to have a negative impact on mainstreaming into general populations as well (Rosenthal-Malek & Mitchell, 1997).

*Self-injurious behavior.* One of the most prominent concerns related to responses to stimuli in individuals with autism is the prevalence of self-injurious behaviors (SIB) (Pernon & Baghdadli, 2007). Self-injurious behavior is defined as an act directed towards oneself resulting in tissue damage, bruises, or open wounds (Richman, 2008). Examples of self-injurious behavior include physical acts such as banging of the head, biting, hair pulling, face or head slapping, skin picking, pinching, scratching, and forceful head shaking or any other behaviors that result in physical injury to a child's own body (Murphy & Wilson, 1985).

Early empirical research on SIB hypothesized that repetitive self-injury and other forms of stereotypic behaviors served to compensate or regulate levels of stimulation for individuals with developmental delays (Richman, 2008). The hypothesis was that individuals may experience difficulty controlling the level of environmental stimulation which leads to contextual situations where the individual experiences an aversive situation from being either over- or under-stimulated (Richman, 2008). As a result, individuals may compensate by using repetitive behaviors to block out aversive levels of over stimulation, or in some cases, increase stimulation via vestibular movements such as jumping excitedly, flapping the hands, or self-injurious behaviors (MacDonald, 2000; Martin, Wolters, & Smith, 2006, Richman, 2008).

In a 1998 study, Oliver, Hall, Hale, Murphy, and Watts, conducted a two-year study documenting naturally occurring antecedents and consequences for emerging SIB with 16 students with developmental disabilities. Results of their study reflected that decreases in SIB over the two-year period positively correlated with social interaction. They concluded that this
empirical data supported a need for further study examining developmental patterns for SIB, along with extended research on proposed treatments to decrease SIB.

In addition to being associated with a lack of effective communication skills, SIB has also been reported to be associated with neurotransmission disturbances (Richman, 2008). Behavioral theories also suggest that SIB is related to external factors such as: (1) social pressures, (2) sleep deprivation, and (3) changes in environment. Likewise, it is believed that many internal factors may also play a role in SIB. Among those internal factors include: (a) emotion, (b) puberty, (c) maturation, (d) ageing, (e) nutritional changes, and (f) overall health (McClintock, Hall, & Oliver, 2007).

Stereotypic behaviors. Other frequent maladaptive behaviors demonstrated by individuals with autism appear in the form of stereotypic behaviors. MacDonald et al. (2007) defined stereotypic behaviors as repetitive movements of the body in the form of hand flapping, tapping ears, scratching, rocking, sniffing, squealing in high-pitched tones, and similar behaviors. These behaviors, while not typically dangerous, often interfere with an individual’s ability to actively engage in their environment and maintain reduced levels of anxiety.

Self-stimulating behaviors. Similar in some respects to stereotypic behaviors, self-stimulating behaviors are often repetitive in nature and include the same body movements as observed in stereotypic behaviors (Martin, Wolters, & Smith, 2006). However, self-stimulating behaviors are distinctive in that they are often more compulsive and physically apparent through body movement. Examples of self-stimulating behaviors include specific adherence to rules and routines and having a sensory need for structure and consistency. They often experience increased levels of anxiety when routines are changed. Similarly, individuals often become fascinated, if not pre-occupied, with unusual objects such as clocks, shapes, and other inordinate
objects or parts of objects, dismissed by typically developing peers (Martin et al., 2006; Richman, 2008).

Such maladaptive behaviors have been determined to pose a detrimental threat in the development of appropriate social and communication skills among individuals with autism (Duncan et al., 1999). Additionally, the presence of maladaptive behaviors may have a significant impact on the quality of an individual’s life, affecting and limiting their ability to interact and engage in their environment. Harrison and Hare (2004) found that individuals with autism who experience SID frequently engage in a myriad of maladaptive behaviors, including but not limited to, self-injurious, stereotypic, and physically aggressive behaviors resulting in a negative impact on the students’ ability to interact with peers and perform in an educational setting.

Sensory Integration Intervention

A form of occupational therapy developed in the 1980’s by occupational therapist A. Jean Ayres (Ayres & Tickle, 1980), sensory integration intervention (SII) continues to be modified as research provides an increased understanding of the complexities related to sensory processing and integration. Lemke (1974) first explored the use of SII as a method of decreasing maladaptive behaviors. He found that systematic application of sensory stimulation was effective in decreasing the self-injurious behaviors of a 19-year-old woman diagnosed with mental retardation. Since Lemke’s early study, researchers have further evaluated the effects of sensory stimulation on self-stimulating and self-injurious behaviors (Baranek, 2002; Bundy et al., 2002; Miller & Summers, 2001).

Although originally designed to treat children with learning disabilities and SID, SII has been applied to other populations including children and adults with autism (Smith-Roley &
Spitzer, 2001). Sensory integration uses planned, controlled sensory input to elicit adaptive responses (somatosensory, vestibular, and proprioceptive) in accordance with an individual’s neurological needs. These needs often elicit a spontaneous adaptive response that integrates the senses (Smith et al., 2005; Urwin & Ballinger, 2005).

Classic SII is based on the understanding that disruptions in neurological processing of sensory input interfere with the production and organization of purposeful behaviors that provide a foundation for learning and skill development (Watling & Dietz, 2007). This original method of intervention uses enhanced sensory experiences in the context of meaningful, self-directed activity to support an individual’s ability to function adaptively and meet the contextual demands of daily activities (Kandel, Schwartz, & Jessell, 2000).

A basic premise of SII is that in order for learning to occur, an individual’s central nervous system must register sensory input accurately and process that input effectively so that he or she may respond to it in an organized and adaptive manner that supports interaction with the environment (Dunn, 1999). Dunn further concluded that when a person cannot habituate to ordinary sensory input, he or she may exhibit agitated and inattentive behavior. The use of SII has often been implemented as a means of decreasing such inattentive, and often aggressive, behaviors.

An equally important factor in the use of SII is the use of controlled sensory inputs to elicit adaptive responses (Urwin & Ballinger, 2005). Since Ayres research, several studies have been conducted using a variety of SII approaches. However, empirical studies related to sensory integration in individuals with autism have remained limited, particularly in comparison to those studies on aspects of development (Baranek, 2002)
Sensory integration intervention is often used in conjunction with a more holistic intervention plan such as interventions designed to improve a child’s occupational performance (e.g., play, academic functional skills, self-care) within an educational context. Additionally, SII is traditionally provided using a one-on-one intervention (Baranek, David, & Poe, 2006). Individualized SII may include the use of items to increase, or decrease, stimulation of the senses. Common methods of SII often include: (1) use of deep pressure through brushing, (2) modifications to lighting, (3) modifications to sound, (4) tactile manipulatives, and (5) the use of swings and balls to address the vestibular sensory system.

While conducting a meta-analysis on the efficacy of 29 approaches of sensory and motor interventions, Baranek, Parnham, and Bodfish (2005) found that some of the treatments examined provided questionable rationale for use among children with autism and lacked empirical evidence to evaluate their effectiveness within the population. They cited limitations such as methodological constraints, weak and uncontrolled designs, and observer bias. Additionally, they were able to determine that the greatest obstacle in many studies was the lack of a direct connection between purported dysfunctional mechanisms (vestibular, auditory sensitivity, visual distortions) to functional changes in behavior. While concluding that several studies in the area of SI provide positive, yet modest results, she acknowledged that they were hindered by methodological constraints. Baranek further concluded that the theoretical strength of many sensory interventions rest on empirical findings that children with autism have measurable deficits in various areas of sensory processing.

Baranek and colleagues’ (2005) detailed meta-analysis emphasized the fact that autistic symptoms are manifested differently across development. Given this consideration, they theorized that it is likely that individualized patterns of reactivity may be associated with
differential treatment outcomes. Further, they determined that it is possible that significant individual differences in subject characteristics may be masking significant group effects in existing studies.

In a 2005 examination on the impact of SII on the reduction of maladaptive behaviors of seven 8-year-old children, Urwin and Ballinger conducted a single-case experimental design. Specific intervention methods utilized in this study included the use of controlled sensory inputs such as deep tactile pressure, active movements, and joint compression in a safe therapeutic environment. After a four-week trial, the researchers found that maladaptive behaviors present prior to treatment decreased significantly. They concluded that this study was perhaps the first to suggest the effectiveness of SII in reducing maladaptive behaviors that impeded those with SID.

A similar study to evaluate the effectiveness of SII on self-stimulating and self-injurious behaviors was conducted by Smith, Press, Koening, and Kinnealey in 2005. The researchers compared the effects of SII with routine tabletop activities such as puzzles, tactile manipulatives, and file folder games in a sample similar to that of Urwin and Ballinger. Studying seven children 8 years of age with pervasive developmental delay, they found that self-stimulating and self-injurious behaviors were significantly reduced within one hour of receiving intervention. In comparison, there was no reduction in self-stimulating behaviors in the control group with tabletop activities. As a result of their study, Smith and colleagues concluded that SII was effective in reducing self-stimulating and self-injurious behaviors.

Additionally, similar to the conclusions drawn by Baranek (2002) and Urwin and Ballinger (2005), the researchers determined that given the unique characteristics and sensory processing deficiencies among individuals with autism, further empirical evidence was necessary to determine the effectiveness of SII across a broader population. They cited that the self-
stimulating and self-injurious behaviors manifested by individuals with autism who experience deficiencies with SI are enough of a threat to the individuals in their daily functioning and quality of life, that further research is warranted to bring relief to these individuals.

Smith and colleagues recommended further need for study in the area of SII as a treatment for maladaptive behaviors in individuals with autism in the following areas: (1) through the use of a large sample size to increase probability of significant results, (2) examination of the results over a longer period of time, and (3) researching the effectiveness of having an appropriate sensory diet implemented within the daily routines to counteract for the tendency of self-stimulatory and self-injurious behavior.

Despite a lack of sound methodology, empirical evidence thus far has confirmed the existence of sensory and motor difficulties for children with autism. Such empirical evidence has provided a foundation of scientific knowledge necessary for understanding children with autism and guidance for intervention planning (Baranek, 2002; Kern et al., 2006; Kern et al., 2007; Kientz & Dunn, 1997; Smith et al., 2005; Urwin & Ballinger, 2005).

*Sensory Diet*

Individualized sensory integration intervention plans are often referred to as a sensory diet. A sensory diet is a comprehensive plan of scheduled activities that includes a combination of a variety of organized activities designed to meet the specific sensory needs of each participant (SIGN, 2007). Sensory diets are generally designed by a participant’s occupational therapist, trained in determining sensory needs and providing sensory integration.

In 2002, researchers in the field of occupational therapy throughout the United States identified and defined the core principles of SII citing the urgent need for an instrument to validate the methods used in sensory integration (Su & Parham, 2002). Among the core
principles of SII identified by the occupational therapy community included a family-centered intervention plan based on a complete assessment regarding the patterns of SID, a safe environment consisting of equipment that provides vestibular, proprioceptive, and tactile sensations, as well as activities that allow participants to make adaptive responses to changing environmental demands (Su & Parham, 2002). The core principles of SII are critical elements to an effective sensory diet. Researchers in the field of occupational therapy elaborated, citing that the use of an individualized sensory diet that incorporates deep pressure, heavy work, and movement allow participants to experience increased focus and adaptive skills in daily activities through reaching a balanced state of arousal.

Chapter summary

This chapter has provided a historical perspective on the study of sensory processing among individuals with autism as well as a synthesis of relevant research on sensory integration, sensory abnormalities, maladaptive behaviors, sensory integration dysfunction, and sensory integration intervention as a proposed treatment for addressing the sensory needs of individuals with autism. The literature has provided scientifically-supported evidence of sensory processing difficulties among individuals with autism. Likewise, the research has shown that individuals who experience significant difficulty processing sensory information also experience sensory integration dysfunction, which can lead to self-stimulating, stereotypic, and self-injurious behaviors. These behaviors have been proven to have a negative impact not only on an individual’s ability to interact and function in their environment, but also pose a serious threat to their quality of life.

Although not all children with autism experience SID, a majority of the population, 95% of children with autism, experience sensory processing deficits and the accompanying
maladaptive behaviors described in research studies (Baker, Lane, Angley, & Young, 2007). Additionally, the ramifications of these impairments have been noted to interfere with the performance in developmental and functional domains.

After decades of research, the area of SII has been evaluated to determine its effectiveness for use among individuals with severe disabilities. However, research on the effectiveness of reducing maladaptive behaviors in individuals who experience SID has been considerably limited. Current research on the effectiveness of SII as it relates to maladaptive behaviors among individuals with autism has been limited to only two studies (Smith et al., 2005; Urwin & Ballinger, 2005). While the use of SII has proven effective in those studies, sound empirical evidence remains limited (Kern et al., 2007; Pernon et al., 2007). Among the most prominent concerns with existing research are limiting key factors such as lack of funding, weak methodological constraints, and the heterogeneity of the population affected by SID (Schaaf & Miller, 2005).

Despite a lack of sound methodology, empirical evidence thus far has confirmed the existence of sensory and motor difficulties among individuals with autism, providing a foundation of scientific knowledge necessary for understanding children with autism and guidance for intervention planning (Baranek, 2002). As a result, Baranek recommends that a best practice, at a minimum, would indicate that educational programs for children with autism need to incorporate appropriately structured physical and sensory environments that accommodate the unique sensory processing patterns of individuals with autism.
CHAPTER 3
PROCEDURES

Chapter 3 provides detailed information on the sample, instruments, procedures for collecting data, as well as data analysis procedures for this study. Additionally, this chapter provides for a detailed description of each participant based on the recommended minimum participation description elements proposed by Rosenberg et al. (1994).

Setting and participants

This study was conducted within a structured learning program (SLP) serving students with severe forms of autism in a rural public high school. The SLP is part of an educational cooperative serving students in nine suburban and rural school districts of a mid-western state.

Sampling

A purposive criterion sampling method was utilized for this study. Purposive criterion sampling was selected as a result of the narrow and specific research question coupled with the unique population being examined (Lodico, Spaulding, & Voegtle, 2006). Participants for this study were selected based on the following inclusion criteria:

1. High school students with a definitive diagnosis of autism as determined using the Childhood Autism Rating Scale (CARS) (Schopler, 1990).
2. Presence of sensory integration dysfunction as determined by the Sensory Integration Inventory-Revised for Individuals with Developmental Disabilities (SII-R) (Reisman & Hanschu, 1992).
3. Referral for occupational therapy services as indicated in the students Individualized Education Plan (IEP).
4. Demonstration of maladaptive behaviors as indicated in student files of school records.

The sample for this study was comprised of four students enrolled in a structured learning program (SLP). Each of the participants are male. Each participant received a definitive dual diagnosis of autism coupled with sensory integration dysfunction (SID). Table 1 provides a descriptive summary of each research participant. Information depicted in Table 1 is based on the recommended minimum participation description elements proposed by Rosenberg et. al. (1994).

**TABLE 1**

**PARTICIPANT DESCRIPTION**

<table>
<thead>
<tr>
<th>Subj.</th>
<th>Sex</th>
<th>Age</th>
<th>SES</th>
<th>IQ</th>
<th>Overall academic (standard score)</th>
<th>Specific academic achievement</th>
<th>Grade level</th>
<th>Level of special education placement</th>
<th>Time in special education placement</th>
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<td>16</td>
<td>M</td>
<td>37</td>
<td>51</td>
<td>53</td>
<td>11</td>
<td>Self-contained</td>
<td>13 years</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>16</td>
<td>M</td>
<td>64</td>
<td>63</td>
<td>62</td>
<td>11</td>
<td>Self-contained</td>
<td>12 years</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>16</td>
<td>M</td>
<td>55</td>
<td>47</td>
<td>47</td>
<td>10</td>
<td>Self-contained</td>
<td>12 years</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>17</td>
<td>M</td>
<td>71</td>
<td>61</td>
<td>60</td>
<td>11</td>
<td>Self-contained</td>
<td>13 years</td>
</tr>
</tbody>
</table>

SES: M = middle socio-economic status, Location: MW = Midwest.

Overall academic achievement scores are the standard scores derived from the *Wide Range Achievement Test-Revision 4* (WRAT-4) (Robertson & Wilkinson, 2004) administered to each participant during their most recent comprehensive evaluation. The grade level score reflects each participant’s overall grade level based on combined scores of each of the following subsets of the WRAT-4: sentence comprehension, word recognition, spelling, and math.
computation. Likewise, specific academic achievement scores are based on standard scores derived from the *Psychoeducational Profile-Revised (PEP-R)* (Schopler, 1990) also administered to each participant during their most recent comprehensive evaluation. The specific academic achievement level reflects each participant’s cognitive development score. The PEP-R is an inventory of behaviors and skills designed to identify idiosyncratic learning disabilities. This instrument provides information on developmental functioning in imitation, perception, fine motor, gross motor, eye-hand coordination, cognitive performance, and cognitive verbal cues. An interpretation guide is provided in Table 2. Interpretative scores are based on a statistical procedure for comparing student’s performance to the performance of some well-defined group. The group used represents a normed sample of students of the same chronological age (Overton, 2003).
TABLE 2
INTERPRETATION GUIDE

<table>
<thead>
<tr>
<th>Classification</th>
<th>Theoretical normal curve</th>
<th>Scaled score</th>
<th>T score</th>
<th>Standard score</th>
<th>Percentile rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very superior</td>
<td>2.2</td>
<td>16+</td>
<td>70+</td>
<td>130+</td>
<td>98+</td>
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<tr>
<td>Superior</td>
<td>6.7</td>
<td>14-15</td>
<td>63-69</td>
<td>120-129</td>
<td>91-97</td>
</tr>
<tr>
<td>High average</td>
<td>16.1</td>
<td>12-13</td>
<td>57-62</td>
<td>110-119</td>
<td>75-90</td>
</tr>
<tr>
<td>Average</td>
<td>50.0</td>
<td>8-11</td>
<td>43-56</td>
<td>90-109</td>
<td>25-74</td>
</tr>
<tr>
<td>Low average</td>
<td>16.1</td>
<td>6-7</td>
<td>37-42</td>
<td>80-89</td>
<td>9-24</td>
</tr>
<tr>
<td>Low/borderline</td>
<td>6.7</td>
<td>4-5</td>
<td>30-36</td>
<td>70-79</td>
<td>2-8</td>
</tr>
<tr>
<td>Very low/Intel Deficient</td>
<td>2.2</td>
<td>3-</td>
<td>29-</td>
<td>69-</td>
<td>2-</td>
</tr>
</tbody>
</table>

This interpretation guide assumes a standard deviation of 15.

Participants

Each participant was also determined to demonstrate a level of maladaptive behavior in an educational setting as reflected through school records and behavior intervention plans. It was anticipated that specific areas of SID for each participant would be identified through the use of the Sensory Integration Inventory-Revised for Individuals with Developmental Disabilities (SII-R) (Reisman & Hanschu, 1992) during pre-assessment testing. Table 3 provides a summary of each participant’s characteristics and identifies the participant’s specific sensory modulation dysfunction as well as reactivity to sensory stimuli as determined using the Sensory Integration Inventory-Revised for Individuals with Developmental Disabilities (Hanschu & Reisman, 1992).
TABLE 3

PARTICIPANT CHARACTERISTICS

<table>
<thead>
<tr>
<th>Subj</th>
<th>Sex</th>
<th>Age</th>
<th>Diagnosis</th>
<th>Sensory Modulation Dysfunction</th>
<th>Tactile Reactivity/Arousal Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>16</td>
<td>Autism</td>
<td>Sensory dormancy</td>
<td>Hypo-reactive over aroused</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>16</td>
<td>Autism</td>
<td>Simultaneous sensory defensiveness/sensory dormancy</td>
<td>Hypo-reactive hyper reactive under aroused</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>16</td>
<td>Autism</td>
<td>Tactile defensive</td>
<td>Hyper-reactive over aroused</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>17</td>
<td>Autism/Epilepsy</td>
<td>Simultaneous sensory defensiveness/sensory dormancy/tactile defensiveness</td>
<td>Hypo-reactive Hyper-reactive under aroused</td>
</tr>
</tbody>
</table>

Participant One

Participant one is a 16-year old male student who was diagnosed with autism at the age of 19 months. He is completely non-verbal and communicates using a picture exchange communication system (PECS) (Bondy & Frost, 1994). Cognitively, he functions at a level of 18 months of age. In terms of academic functioning, he is able to arrange the letters of his name when provided with visual prompts. He is able to match same to same given colors, numbers, and letters; however he is unable to identify a color, letter, or number when questioned. Specific maladaptive behaviors demonstrated by this participant include self-injurious behaviors such as hitting himself in the head, slapping himself, and banging his head. Additionally, he hits and slaps both familiar and unfamiliar adults and will burst into loud sounds and run around and through various settings.
Participant Two

Participant two is a 16-year old male student who was diagnosed with autism at the age of 17 months. He is able to communicate verbally though he often speaks in one-word sentences unless prompted otherwise. He is able to read, write, and compute basic mathematical problems. Cognitively, he is at a developmental age of 6 years 3 months. Until the 10th grade, he had been placed in a functional academic classroom rather than a structured learning program designed to meet the needs of students with severe forms of autism. At the beginning of his tenth grade school year, he was placed in a structured learning program. Among the specific maladaptive behaviors demonstrated by this participant include self-stimulation of the genitalia in inappropriate settings, jumping in place, and flapping his hands. He has also exhibited verbal maladaptive behaviors such as squealing, yelling, and making sounds similar to that of an emergency vehicle siren.

Participant Three

Participant three is a 16-year old male student who was diagnosed with autism at the age of 2 years and 2 months. He is able to communicate verbally, however, his verbal lexicon is limited to profanity and racial slurs and negative comments he has heard outside of the classroom. He uses PECS as a main source of communication in the classroom. Cognitively, he functions at a level of 3 years 7 months. Academically, he is able to match same to same using numbers, colors, and letters. He is able to recognize the letters in his name and rote count to 10. This participant often engages in self-injurious behaviors such as biting his fingers, pinching and grabbing other students and adults, running from familiar adults, elopement, rapid jerking of the body, banging his hands against furniture and walls, and the use of profanity.
Participant Four

Participant four is a 17-year-old male student diagnosed with autism at the age of 21 months. He is able to communicate verbally with prompting and scripts though he relies heavily on the use of visuals coupled with use of PECS. He functions at a cognitive level of 4 years 3 months. However, he is able to read and write at a level commensurate with that of a student in the third month of the first grade. He is able to compute simple addition and subtraction using a calculator, but he is not able to perform the calculations without the use of a calculator. Specific maladaptive behaviors exhibited by this participant include physical aggression toward familiar adults including punching, kicking, and pinning against walls. Additionally, he frequently engages in self-stimulation of the genital area and often manipulates his feces in the toilet.

Informed consent

Consent was obtained from the legal guardians of all participants prior to participation. The parent(s) or guardian(s) of each student was contacted personally, either by phone or in person, to introduce the purpose and procedures of the study. Each parent and or guardian also received a formal written letter describing the study. A signed statement of consent is maintained on file by the researcher. Given the cognitive and developmental level of functioning of the participants, they were not required to complete consent forms. Additionally, the guardians and participants were informed that they, and their child, could withdraw from the study at any time without penalty.
Instruments

Daily collection methods were created to observe and document participant behaviors and reactions to stimuli. Daily collection methods included the use of anecdotal recording and daily written communication with parents through the use of each participant’s notebook.

Anecdotal Recording

Anecdotal recording in the classroom consisted of documentation such as participant reaction to stimuli such as auditory stimulation, tactile stimulation, and visual stimulation as well as aversive reactions to unknown stimuli. Behaviors were recorded and antecedents were identified. Consequences of behavior were documented. Results of anecdotal recording were later compared to the results of additional instruments to determine a possible correlation between sensory input and sensory reactions. Communication with parents included parent’s documentation of the participants at home behaviors and reactions to sensory input.

Sensory Integration Inventory Revised For Individuals with Developmental Disabilities

The Sensory Integration Inventory Revised-For Individuals with Developmental Disabilities (SII-R) (Hanschu & Reisman, 1992) was used to ascertain information regarding the child’s sensory needs; the presence of self-injurious, stereotypic, and or self-stimulating behaviors; and the suitability of sensory integration intervention (SII) given his or her particular profile. Specifically, this instrument was used to identify each participant’s area of sensory deficiency as well as typical reactions to stimuli such as self-injurious, stereotypic, or self-stimulating behavior. This instrument has respectable reliability (r=.87) and construct validity. The results derived via the SII-R were used in the formulation of individualized intervention plans.
Sensory Profile

*The Sensory Profile School Companion* (Dunn, 1999) was used to determine specific sensory needs for each individual student as well as the frequency of over-stimulating and maladaptive behaviors. This instrument is arranged in three sections: environmental sensations, body sensations, and classroom behaviors. Within the environmental sensations section, observations of auditory and visual processing were documented. In the body sensations portion of the profile, observations of movement and touch were recorded. Classroom behaviors were observed in 15 areas. Each observable area was annotated by a frequency rating scale of almost always, frequently, occasionally, seldom, and almost never.

Adolescent Sensory Profile

*The Adult/Adolescent Sensory Profile* (Dunn, 1999) was used to measure sensory responses of each participant. *The Adult/Adolescent Sensory Profile* is a self-reporting questionnaire that measures responses to sensory events in everyday life. Given the exceptionalities and level of functioning of participants in this study, parents and/or caregivers completed this instrument. While having the parents and caregivers complete this self-reporting questionnaire may affect the validity of the results, it was anticipated that the information gained from parent input would prove valuable in assessing the needs and gaining a complete understanding of the participants across all environments for this study. Parents and caregivers completed the questionnaire by reporting how frequently certain responses were given for each item. There are 60 items in the profile. A five point Likert scale was utilized (nearly never, seldom, occasionally, frequently, almost always). This instrument yielded four scores which correspond to the four quadrants of sensory processing proposed in Dunn’s model of sensory processing, i.e., sensation seeking, sensation avoiding, sensory sensitivity and low registration.
School Records

Finally, school records were used to evaluate and determine the presence and frequency of self-stimulating, stereotypic, and self-injurious behaviors as demonstrated in the classroom environment. School records utilized included the use of documented teacher and service provider observations of maladaptive behaviors as well as behavior intervention plans identifying specific behaviors demonstrated by students.

Design

This study employed a single-subject experimental design with multiple baseline measures. An A-B-A-B multiple baseline design with reversal was used, where SII is the independent variable (B) (Figure 1). Using an A-B-A-B design allowed for the study to end on an intervention phase, which allowed for the option of further examination when a positive trend was found during intervention.

<table>
<thead>
<tr>
<th>Phase A1 (Week 2)</th>
<th>Phase B1 (Week 3)</th>
<th>Phase A2 (Week 4)</th>
<th>Phase B2 (Weeks 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Intervention: SII</td>
<td>Remove Intervention</td>
<td>Replace Intervention</td>
</tr>
</tbody>
</table>

Length of trial

Week 1: Week 6

Three observations per week: 9 data points per phase = total of 36 measurement points.

Figure 1. Study design

The use of single-subject methodology permits the objective assessment of behaviors that can be plotted and visually analyzed (Anderson, Domaracki, Vakulick, & Kubina, 2004).

Additionally, single-subject designs allow for experimental control for threats to internal
validity, thus allowing confirmation of a relationship between manipulation of the independent variable and change in the dependent variable. The use of multiple baseline design will allow for the collection of multiple sets of data in a single-case experiment (Neuman & McCormick, 1995). Further, research has shown that in measuring the effectiveness of SII, the use of single-subject experimental designs has been successful among individuals with autism where a small sample size is being examined (Green et al., 2003; Joshi, 2000; Reisman & Hanschu, 1992, Urwin & Ballinger, 2005).

Data Collection Procedures

Measures were developed that recorded changes in the target areas of engagement in task, maladaptive behaviors associated with each participant’s sensory processing disorder, and functional behavior while participating in a specified, daily 10-minute independent pre-vocational task. Maladaptive behaviors were identified for each participant based on their individual and unique responses to sensory stimuli. Specific identifiable maladaptive behaviors such as behaviors resulting in self-injury, physical aggression toward others, and self-stimulating behaviors were determined during pre-assessment. Anecdotal recording was used to identify and document each participant’s maladaptive behavior, frequency and duration of the maladaptive behavior as well as antecedents and consequences of the behavior. Dependent variables were the scores achieved by each participant on three scales measured as: (1) time spent engaged in task; (2) time spent engaged in identified maladaptive behavior; and (3) goal level (support, frequency, and competency) attainment in independent pre-vocational task (Goal Attainment Scale, Carr, 1979; Tobbell & Burns, 1997).

Level of task engagement. The 10-minute time period for the independent pre-vocational task was ranked using a level of task engagement rating scale (Appendix A). Each participants’
level of engagement was ranked into 10 scale levels (1-10); for example, total time of 5 minutes 
31 seconds = level 6. Plotted data for measured time each participant is directly observed 
engaged in independent vocational task provided ordinal data for statistical analysis.

Level of maladaptive behavior. The measured time each participant spent engaged in a 
defined maladaptive behavior during the 10-minute independent pre-vocational task was ranked 
using a level of maladaptive behavior rating scale (Appendix B). The amount of time each 
participant engaged in maladaptive behavior was divided into 10 levels (1-10); for example, a 
total time of 3 minutes and 48 seconds = level 4 while a total time of 8 minutes 57 seconds = 
level 9.

Goal Attainment Scale (GAS). Each participant’s prescribed independent task was 
described as an outcome goal and scaled into five levels from -2 to +2 (Carr, 1979; Tobbell & 
Burns, 1997) with the following rating:

1.  -2 = much less than expected level of outcome, task completion with four or more 
prompts or refusal to complete task.
2.  -1 = less than expected level of outcome, task completion with three or more prompts.
3.  0 = expected level of outcome, task completion with two prompts.
4.  +1 = more than expected level of outcome, task completion with 1 prompt.
5.  +2 = much more than expected level of outcome, task fully completed correctly with 
no prompting.

The primary researcher documented each participant’s level of independent task on the 
GAS recording instrument (Appendix C).
Intervention

Individualized SII designed to achieve a balanced state of arousal was administered for 20 minutes, three times per week during the two-week intervention phase (B) of the study. Sensory integration intervention consisted of a specific sensory diet designed and prescribed by each participant’s occupational therapist. As the designated sensory expert within the participants’ educational cooperative, the occupational therapist maintains the sole authority to prescribe sensory intervention activities for the participants.

The classroom teacher implemented SII for each participant. Each session was guided by the response of the participants and was flexible based on participant responses. Three main sensory systems were targeted: (1) tactile processing system; (2) vestibular processing system; and (3) proprioceptive system. While SII was individualized based on the specific and unique needs of each participant as determined through the use of pre-assessment instruments, common SII methods already used as a part of each participant’s scheduled occupational therapy were continued during this study. Such current interventions included swinging, deep pressure, and engagement in tabletop manipulatives such as sand, water, and modeling clay were also used. Additionally, auditory and visual input was utilized based on the individual needs of each participant. Examples of auditory and visual input included the use of the PECS to engage in communication with participants unable to communicate verbally as well as verbal and visual prompting to assist in effective communication with each participant. The participants completed their independent pre-vocational task immediately following intervention activities. A description of the scope and sequence of individualized SII for each participant is provided in Table 4.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Individualized SII</th>
</tr>
</thead>
</table>
| 1           | Provide a small, quite, enclosed work environment.  
Provide deep pressure over large body surface for 5 minutes.  
Provided low frequency auditory vibration for 5 minutes.  
Provide pressure through palms of hands and soles of feet for 5 minutes each. |
| 2           | Provide cold tactile manipulative in the form of ice pack for 5 minutes.  
Provide headphones and CD player to listen to loud music for a period of 5 minutes.  
Allow swinging on indoor classroom swing for 5 minutes.  
Allow jumping on mini trampoline for 5 minutes. |
| 3           | Provide a small, quiet, enclosed environment.  
Use of PEC cards to communicate transition between phases of intervention.  
Provide deep pressure touch from shoulders down arms to palm of hands for 3 minutes each side.  
Provide deep pressure from mid thigh down legs to soles of feet for 3 minutes each side.  
Provide slow linear movement in net swing for 14 minutes. |
| 4           | Provide a small, quiet, enclosed environment.  
Use of PEC cards and verbal prompt to communicate transition between phases of intervention.  
Provide low frequency vibration through the use of massaging pillow for 3 minutes.  
Provide deep pressure from shoulders down arms to palm of hands for 3 minutes each side.  
Provide deep pressure from mid thigh down legs to soles of feet for 3 minutes each side.  
Provide slow linear movement in net swing for 5 minutes. |
Materials

Specific materials utilized in this study included items specific to each student’s level of sensory processing and specific area of sensory need. Materials included in this study consisted of items such as: (a) indoor and outdoor swing, (b) water table, (c) sand table, (d) deep pressure touch, (e) weighted vests, (f) weighted backpack, (g) mini-trampoline, (h) exercise ball, and (i) play-dough.

Data Analysis

In order to test the effectiveness of SII in the reduction of self-injurious, self-stimulating, and stereotypic behaviors, several analyses were conducted. Through a typical time series analysis, the frequency of student’s maladaptive behaviors was charted for each week of the four-week period. The principal investigator measured behavior 15 minutes prior to intervention, and at 15 and 60 minutes following the intervention. Frequency of behaviors were charted using an A-B-A-B design. These assessments were correlated with data obtained through use of the GAS on functional behavior in independent pre-vocational tasks by the classroom teacher.

Through an examination of the data, it was anticipated that there would be evidence to support or refute the effectiveness of SII on the reduction of maladaptive behaviors in high school students with autism. With the added elucidation of different degrees of severity, it was anticipated that a relationship between efficacy of sensory integration intervention and the level of sensory integration dysfunction could be determined.

Chapter Summary

A single-subject design with multiple baseline measures was utilized to determine the effects of sensory integration intervention on the reduction of maladaptive behaviors in high school students with autism. Four students with a definitive dual diagnosis of autism and sensory
integration dysfunction selected to participate in this study. Data collection was conducted by developing measures that would record changes in target areas defined in this study. Specific methods of gathering data included the use of anecdotal recording, level of engagement rating scale, level of maladaptive behavior rating scale, and a goal attainment scale. Data were analyzed through a typical time series analysis to chart frequency of participant behavior as well as triangulation between three measures using an A-B-A-B design. Chapter four will present the results and findings of this study.
CHAPTER 4

RESULTS

Chapter 4 presents the results from the findings of this study. This chapter also includes
brief review of the purpose of the study, summary of participant characteristics to include results
of pre-assessment testing, as well as a review of the methodology of this study. This chapter will
conclude with the individual results of each participant.

Purpose of Study

This study investigated the effectiveness of sensory integration intervention (SII) on the
reduction of maladaptive behaviors in high school students with autism. In addition to having a
definitive diagnosis of autism, as determined by administration of the Childhood Autism Rating
Scale (CARS) (Schopler, 1990) each participant in this study has also been diagnosed with
sensory integration dysfunction (SID). This study also examined the effect of SII on level of
three target behaviors. The target behaviors were identified as level of task engagement in
prevocational task work, level of engagement in maladaptive behavior, and functional behavior
in an independent pre-vocational task. With respect to specific maladaptive behaviors, the
behaviors were defined as repetitive, frequent, non-functional actions, which sometimes resulted
in bodily harm or impeded the student’s ability to perform in an educational setting. Maladaptive
behaviors for each participant were determined based on results of testing using The Sensory
Integration Inventory Revised-For Individuals with Developmental Disabilities (SII-R) (Hanschu
& Reisman, 1992). Table 5 provides a description of the maladaptive behaviors for each
participant in this study.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Sex</th>
<th>Age</th>
<th>Specific Maladaptive Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>16</td>
<td>Biting, rocking, hitting, kicking</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>16</td>
<td>Head banging, hitting, elopement</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>16</td>
<td>Rocking, elopement, hand-flapping</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>17</td>
<td>Hand flapping, elopement, hitting</td>
</tr>
</tbody>
</table>

For the purposes of this study, a single maladaptive behavior was identified for each participant as a measure of engagement in maladaptive behavior. The specific behavior for each participant was based on observations conducted through the use of a functional behavior assessment recording form to record each participant’s behavior. The behavior which was demonstrated the most frequent in levels of intensity, duration, and self-injurious to the participant was selected as the maladaptive behavior for measure in this study. Table 6 identifies the specific maladaptive behavior used for measurement of level of engagement in maladaptive behavior for each participant in this study.
TABLE 6
SPECIFIC MALADAPTIVE BEHAVIOR FOR MEASURE

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Sex</th>
<th>Measurable Maladaptive Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>16</td>
<td>Biting</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>16</td>
<td>Head banging</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>16</td>
<td>Elopement</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>17</td>
<td>Hitting</td>
</tr>
</tbody>
</table>

Study Design

This study employed a single-subject design with multiple baseline measures (Figure 1). Data were collected through the use of multiple measures including the use of measures to record changes in the target areas of level of task engagement in prevocational task work, level of engagement in maladaptive behavior, and functional behavior in an independent prevocational task. Data were analyzed initially through a typical time series analysis (A-B-A-B) (Figure 2) to chart frequency of participant behavior.

Figure 2. Study design
FINDINGS

Data collection

Measures were developed to record changes in three target behaviors, level of engagement in independent prevocational task work, level of engagement in maladaptive behavior, and functional behavior in a pre-vocational task. To ensure against bias, a double blind procedure was implemented during the observation phase of data collection. Participants were unaware of their participation in the study. Simultaneous and independent anecdotal recordings by the occupational therapist and primary researcher were conducted 15 minutes prior to intervention and at 15 and 60 minutes following intervention. One maladaptive behavior associated with each participant’s sensory processing disorder previously identified using the SII-R was used to create a scale for measuring the time engaged in the identified maladaptive behavior. Both the researcher and occupational therapist utilized the behavior observation recording form (Appendix B) to document the occurrence and frequency of participant behaviors. The percentage of agreement between the occupational therapist and researcher was relatively high at a level of 97%, which is considered reliable and confirms the presence of inter-observer agreement. The recordings of the occupational therapist as an observer and the researcher were used as a method of documenting self-stimulating and self-injurious behaviors of the participants. The measured time each participant spent engaged in maladaptive behavior throughout the school day was divided into 10 ranks (see Appendix C). Similarly, level of task engagement was measured using a ranked scale with 10 scale levels (see Appendix D). A Goal Attainment Scale (GAS) was used to rate each participant’s independent task work (Appendix E). Independent task work was described as an outcome goal and scaled into five levels from -2
and -1 (much less or less than expected level of outcome), 0 (expected level of outcome) to +1 and +2 (more or much more than expected level of outcome).

**Intervention**

Individualized SII, as described in Table 7, designed to provide participants with a balanced state of arousal, was administered for 20 minutes, three times a week, during the treatment phase (B) and (B2) of the study. Following SII, participants then completed a 10-minute, independent, pre-vocational task.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Typical behaviors</th>
<th>Individualized SII</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preoccupied in ritualistic tactile obsessive-compulsive behaviors; difficulty transitioning from one activity to another, remaining distracted by rituals; comfortable with sensory experiences he controls; inappropriately touching clothing on others; physical assaults staff who attempt to intervene; biting fingers, hands, and staff who attempt to calm him.</td>
<td>Provided a small, quite, enclosed work environment. Received deep pressure over large body surface for 5 minutes. Provided low frequency vibration for 5 minutes. Received maintained pressure through palms of hands and soles of feet for 5 minutes each.</td>
</tr>
<tr>
<td>2</td>
<td>Controlling of environment; preoccupied in ritualistic behaviors that appear to be proprioceptive self-stimulating; able to achieve balanced state of arousal if allowed to control own sensory experiences.</td>
<td>Provided cold tactile manipulative in the form of ice pack for 5 minutes. Provided headphones and CD player to listen to loud music for a period of 5 minutes. Swinging on indoor classroom swing for 5 minutes. Jumping on mini trampoline for 5 minutes.</td>
</tr>
<tr>
<td>3</td>
<td>Demonstrates tactile defensiveness; auditory hypersensitivity and fight/flight behaviors when threat is perceived (noise, rain, other people); limited attention to task.</td>
<td>Provided small, quiet, enclosed environment. Use of PEC cards to communicate transition between intervention sessions. Received deep pressure touch from shoulders down arms to palm of hands 3 minutes each side. Received deep pressure from mid thigh down legs to soles of feet for 3 minutes each side. Provided slow linear movement in net swing for 8 minutes.</td>
</tr>
<tr>
<td>4</td>
<td>Demonstrates tactile defensiveness and self-stimulating behaviors such as hand-flapping and variable pitch voice; fluctuates between dominate state, minimal attention span to over arousal; when hears particular words such as no or don’t, strips off clothing and emits high-pitched shriek.</td>
<td>Provided small, quiet, enclosed environment. Received low frequency vibration through the use of massaging pillow for 3 minutes. Received deep pressure from shoulders down arms to palm of hands for 3 minutes each side. Received deep pressure from mid thigh down legs to soles of feet for 3 minutes each side. Provided slow linear movement in net swing for 5 minutes.</td>
</tr>
</tbody>
</table>
**Results**

The visual analyses presented in figures 3, 4, 5, and 6 plot the changes for level of engagement and maladaptive behavior for each participant. Figures 3.1, 4.1, 5.1, and 6.1, depict the rate of behavior change for each participant’s GAS score. The GAS expected level of outcome is shown as a solid line at 0. The phases of the trial are labeled for initial baseline (A, followed by observation number) intervention (B plus observation number), return to baseline (A plus observation number), and reintroduction of intervention (A plus observation number).

**Participant One**

Participant one demonstrated a significant reduction in maladaptive behavior at the introduction of SII (see Figure 3). The level of engagement did not improve significantly during the initial intervention phase. However, upon removal of SII, there was a significant decrease in level of engagement. Similarly, during the return to intervention, a significant increase in level of engagement occurred. With respect to maladaptive behavior, the variability in baseline shows a clear and significant decrease followed by stabilization during both intervention phases.

![Figure 3. Participant one: levels of engagement and maladaptive behavior.](image)

Participant one’s GAS scores reflect a slight improved performance during the initial intervention phase both (see Figure 3.1). A significant decrease in level of goal attainment occurred upon removal of intervention. There may have been an initial carryover effect upon
during the removal phase. An increase in functional performance of goal attainment occurred during the final intervention phase with performance reaching or exceeding the expected level of outcome.

Figure 3.1: Participant One Goal Attainment Score

*Participant Two*

The introduction of SII for participant two led to an increase in level of engagement in pre-vocational task work as well as a reduction in maladaptive behavior (see Figure 4). Upon withdrawal of SII, there was a significant reversal in the direction and change in level across all three measures. An increase in level of engagement was demonstrated upon return to intervention in the final phase of the study. Likewise, a decrease in maladaptive behavior was observed upon reintroducing the intervention.
Figure 4. Participant two: levels of engagement and maladaptive behavior.

Participant two’s GAS scores improved during intervention and approached much better than expected levels of performance (+2), with a significant reversal upon withdrawal (see Figure 4.1). Once the intervention was replaced, participant two’s GAS score began to increase and stabilize at a level of better than expected (+1).

Figure 4.1. Participant two: Goal attainment score

Participant Three

Although not as noticeable as for participants one and two, a trend and level change between the baseline and treatment phase suggests that, despite variability, participant three may have gained some benefit from the introduction of SII (Figure 5). A slight decrease in
maladaptive behavior can be observed during the intervention phase. Likewise, a significant decrease in level of engagement can be observed when the intervention was removed, while level of maladaptive behavior remained somewhat stable. Upon reintroducing the intervention, participant three experienced an increased level of engagement as well as a decrease, though not stable, level of maladaptive behavior. This suggests the possibility of a carryover effect with respect to maladaptive behavior. The decrease in maladaptive behavior between the baseline and intervention phase may be indicative of a delayed impact of SII. The continued decrease level was significant into the withdrawal phase, suggesting that participant three may have slowed habituation.

![Graph](image)

Figure 5. Participant three: Level of engagement and maladaptive behavior

With respect to participant three’s goal attainment score, no clear change in GAS score was evident during introduction of the intervention. However, functional performance began to stabilize near the end of the removal phase and continue throughout the final intervention phase (Figure 5.1).
Participant Four

Participant four’s baseline performance showed the least variability and, despite little obvious change in performance, some small but evident changes occurred during the study (Figure 6). Level of maladaptive behavior decreased significantly and began to show signs of stabilization during the first intervention phase. This trend continued into the removal phase suggesting a carryover effect prior to a return in maladaptive behaviors. Upon reintroducing the intervention, participant four began to experience an increase in level of engagement as well as a trend toward stabilization of maladaptive behaviors.
Participant four’s functional performance on GAS indicated significant impact resulting from SII. During baseline, participant four experienced unstable levels of goal attainment (Figure 6.1). Upon introduction of the intervention, his level of functional performance exceeded the expected level of outcome throughout the phase. Upon removal, he demonstrated a decrease in level of goal attainment. However, upon return to intervention, participant four reached higher than the expected level of outcome.

Figure 6.1 Participant Four goal attainment scale
CHAPTER 5
DISCUSSION

Visual analysis of each participant’s performance illustrates the changes taking place with the introduction and withdrawal of SII. The improvement in level of engagement for each of the participants during SII occurred when there was a reduction in maladaptive behavior. This suggests a positive relationship between the use of SII on increasing level of engagement and reducing maladaptive behavior. Additionally, this may provide positive evidence to confirm the findings of previous studies where a reduction in maladaptive behavior was theorized to be sensory based (Reisman, 1993; Smith, 2005). In a 1993 examination of adults with profound mental retardation, Reisman reported that a sensory integrative approach, when broadened to include responding to activities with communication, resulted in a decrease in self-injurious behaviors. Similarly, in a study of children with pervasive developmental disorder, Smith reported a reduction in both self-stimulating and self-injurious behaviors following implementation of a sensory integrative approach (2005). Additionally, Smith found an overall downward trend of behaviors over time.

The subsequent return toward baseline for each of the participants following the withdrawal of SII suggests that the intervention may have had a positive influence on the reduction of maladaptive behaviors. Likewise, the reduction and stabilization of maladaptive behaviors following introduction of the intervention provides a basis for confirming the efficacy of SII on reducing maladaptive behaviors. SII appeared to have a positive impact on each participant’s maladaptive behaviors resulting in a decrease in duration, suggesting that SII facilitated a more balanced state of arousal for each of the participants.
The falling trend and pattern of responses for participants three and four who experience tactile defensiveness coupled with hyper-reactivity, indicates that they may have benefited from a longer period to habituate. Additionally, participants three and four appeared to have less marked response to SII. The trends in their intervention phases indicate some positive responses to SII however, they may have benefited from a longer intervention period to accommodate slower habituation. This may provide evidence to support McIntosh, Miller, Shyu, and Hagerman (1999) who found atypical responses to sensation in children with sensory modulation disorders who were slower to habituate. McIntosh and colleagues suggested that such differences might have ramifications for functional behavior, providing a possible explanation for the slower rate of change in behavior for participants three and four. While SII appeared to have a positive impact on each of the participants’ maladaptive behaviors, it is important to note limitations of the study.

**Limitations**

The findings of this study should be carefully interpreted given the limitations of the study. One of the foremost considerations is that this study was limited to four participants in a single classroom. As a result, the findings of this study can certainly not be generalized to confirm the efficacy of SII across a larger population of individuals with autism. As the classroom teacher and researcher in this study, I found that administration of treatment was often influenced by interpretation of participant’s responses. Additionally, given that each participant responds to sensory input and stimuli in varying degrees, it was difficult to describe a single consistent independent variable for the group as a whole. While each participant received the intervention, intervention was individualized, which varied depending on the sensory needs of each participant.
Use of more detailed records might have contributed to a deeper understanding of how SII is delivered to individual participants with unique and individual deficiencies, specifically noting immediate reactions. The positive gains during the intervention phases indicate that the frequency of SII was effective but that the duration, two weeks, was not sufficient to demonstrate the long-term maintenance of any goals achieved. Another consideration was the difficulty encountered in attempting to observe, measure, and analyze level of engagement. Attempting to determine the effectiveness of SII on two separate behaviors may have distracted from the focus of evaluating the effectiveness of SII as a method of reducing maladaptive behaviors. In essence, it may be that the attempt to investigate broader and multiple concepts in one study rather than focusing on a single possible relationship between sensory needs and maladaptive behavior increased a threat to internal validity. Perhaps future research could be conducted to more carefully study the administration, response, and effectiveness of individualized SII and the direct impact on maladaptive behaviors.

Additional limitations, or considerations, relate to the research design of this study. The use of single-case experimental design allowed for detailed analysis of each participant’s behavioral responses. Interpretation of the results however, should be approached carefully allowing for the variability in initial baseline data. While this study found that SII appeared to have reduced and stabilized variability during the intervention phases, the ideal is a stable baseline. The A-B-A-B design provided important information into the withdrawal phase, suggesting more frequent data collection may provide information on the effects of SII on each individual. For example, an A-B-A-B design over several hours, or days, rather than weeks, may elicit more definitive and individualized results. Similarly, longer phases could have enabled the baseline data to stabilize.
Implications for Future Research

This study provides evidence that participants who received SII were not only observed to process and integrate sensory information more effectively, but were also able to form appropriate behavior responses. Additionally, participants were able to experience an increase in functional task performance. This study supports previous studies of individuals with sensory impairments, which indicate the use of SII can be an effective method of reducing maladaptive behavior while improving adaptive behaviors. The impact on the level of functioning and performance in adaptive behaviors may enable individuals to experience greater positive interactions within their environment (Reisman & Hanschu, 1993, Smith et al., 2005).

Although practical questions remain regarding optimal frequency, duration, and implementation of SII for this population, having an understanding coupled with accommodating an individual’s sensory needs may promote adaptive behavior. Findings from this study might prove beneficial not only for classroom teachers of students with sensory impairments, but related service providers, home care givers, and family members as well. The use of SII, in conjunction with a regular, individualized, sensory diet, would likely improve opportunities for functional and adaptive behavior, fostering an individuals ability to engage and interact in their environment. Through understanding sensory accommodations that help an individual reach a balanced state of arousal, providers and caregivers can use SII to meet an individuals sensory needs prior to the onset of maladaptive behavior. Additionally, having an understanding of the effects of SII as it relates to specific individuals can allow a teacher, provider, or care-giver to respond to maladaptive behaviors in a much more expedient and effective manner, thus minimizing the extent and duration of maladaptive behaviors.
List of References


APPENDICES
Appendix A

ABC Observation Form
Antecedent-Behavior-Consequence

Student:_____________________________  Observer:_____________________________
Date:_______________  Time:___________  Activity:______________________

Context of Incident:

Antecedent:

Behavior:

Consequence:

Comments/Other Observations:
APPENDIX B

Behavior Observation Recording Form

Identified Maladaptive Behavior: ___________________________  Date: _________

<table>
<thead>
<tr>
<th>Time Period</th>
<th>15 Minutes Prior to Intervention</th>
<th>15 Minutes Following Intervention</th>
<th>60 Minutes Following Intervention</th>
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</thead>
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<td></td>
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</tr>
<tr>
<td>Total # Behaviors</td>
<td>Total # Behaviors</td>
<td>Total # Behaviors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix C

Maladaptive Behavior Rating Scale

Document the level of maladaptive behavior in 10-minute independent task according the scale level below. Indicate start time of engagement in maladaptive behavior on the line provided and end time of maladaptive behavior on the indicated line. Calculate the elapsed time to indicate the level of maladaptive behavior participant.

Start time: ___________  End time: ___________  Elapsed time: ________

<table>
<thead>
<tr>
<th>Level</th>
<th>Duration</th>
<th>Participant Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>0:01 – 1:00</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>1:01 – 2:00</td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td>2:01 – 3:00</td>
<td></td>
</tr>
<tr>
<td>Level 4</td>
<td>3:01 – 4:00</td>
<td></td>
</tr>
<tr>
<td>Level 5</td>
<td>4:01 – 5:00</td>
<td></td>
</tr>
<tr>
<td>Level 6</td>
<td>5:01 – 6:00</td>
<td></td>
</tr>
<tr>
<td>Level 7</td>
<td>6:01 – 7:00</td>
<td></td>
</tr>
<tr>
<td>Level 8</td>
<td>7:01 – 8:00</td>
<td></td>
</tr>
<tr>
<td>Level 9</td>
<td>8:01 – 9:00</td>
<td></td>
</tr>
<tr>
<td>Level 10</td>
<td>9:01 – 10:00</td>
<td></td>
</tr>
</tbody>
</table>
Appendix D

Level of Engagement Rating Scale

Document the level of engagement during 10-minute independent task according the scale level below. Indicate start time of level of engagement on the line provided and end time of level of engagement on the indicated line. Calculate the elapsed time to indicate the level of engagement for the participant.

Start time: ___________  End time: ___________  Elapsed time: ________

<table>
<thead>
<tr>
<th>Level</th>
<th>Duration</th>
<th>Participant Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>0:01 – 1:00</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>1:01 – 2:00</td>
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<tr>
<td>Level 3</td>
<td>2:01 – 3:00</td>
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<tr>
<td>Level 4</td>
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<tr>
<td>Level 5</td>
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<tr>
<td>Level 6</td>
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<tr>
<td>Level 7</td>
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<tr>
<td>Level 8</td>
<td>7:01 – 8:00</td>
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<tr>
<td>Level 9</td>
<td>8:01 – 9:00</td>
<td></td>
</tr>
<tr>
<td>Level 10</td>
<td>9:01 – 10:00</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E

Goal Attainment Scale (GAS) Recording Instrument

Indicate the participant’s level of goal attainment in the box provided based on the provided indicator.

<table>
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<th>Level</th>
<th>Indicator</th>
<th>Participant Level</th>
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</thead>
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<td>-2</td>
<td>much less than expected level of outcome.</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>less than expected level of outcome.</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>expected level of outcome.</td>
<td></td>
</tr>
<tr>
<td>+1</td>
<td>more than expected level of outcome.</td>
<td></td>
</tr>
<tr>
<td>+2</td>
<td>much more than expected level of outcome.</td>
<td></td>
</tr>
</tbody>
</table>