THE IMPACT SENSORY STIMULATION INTERVENTIONS HAVE ON TRANSITIONS FOR CHILDREN WITH DISABILITIES IN AQUATIC THERAPY

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THE IMPACT SENSORY STIMULATION

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Title of Study: THE IMPACT SENSORY STIMULATION INTERVENTIONS HAVE ON TRANSITIONS FOR CHILDREN WITH DISABILITIES IN AQUATIC THERAPY

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Abstract: This study examines children with ASD, and the impact sensory stimulation techniques have in an aquatic therapy setting on transitional behaviors. The purpose of this study was to determine the efficacy of sensory stimulation interventions on transition difficulty between tasks in children with ASD. The main focus was to observe behavioral outcomes and the impact agitator jets have on transitions in a child with ASD. This study provided valuable information to both aquatic therapy settings and individuals with ASD. The design for this case report was quantitative, as it assessed observational behaviors based on the assessment for data collection. Data collection conducted by multiple researchers through observations. The data was analyzed using descriptive statistics and Inter-Rater Reliability of Cohen's Kappa utilizing SPSS. This single-subject case design involved one individual diagnosed with ASD, who utilized RT treatment in an aquatic setting. The significance of this study provided insight into transition difficulties for individuals with ASD and a way to decrease negative behaviors seen when transitioning from task to task.

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CHAPTER I

INTRODUCTION

Rationale for the Study

This study examines children with ASD and the impact sensory stimulation techniques have in an aquatic therapy setting on transitional behaviors. Issues transitioning from one task to the next is a common problem in many individuals with ASD, especially children. The challenges of change affect the behavior of a child with ASD. While research reveals sensory stimulation techniques and transition planning on land, it lacks insight into the setting of aquatic therapy and the therapeutic benefits provided by sensory stimulation in transition planning. Research is limited on the use of sensory stimulation in the water and the role it plays in this population (Murphy & Hennebach, 2020). Understanding the impact sensory stimulation interventions have on transitions for children with disabilities is a topic not common among research studies. Those who have conducted research have utilized the WOTA (Water Orientation Test of Alyn) and the Aquatics skills checklist, which assess individuals with disabilities functional swimming ability (Tirosh, Katz-Leurer & Getz, 2008; Alaniz et al., 2017). While these provide knowledge of aquatic based skills, the demand for behavioral assessments measuring transitions is needed. This understanding will produce new valuable research to the population for children with disabilities in an aquatic therapy setting.

Statement of the Problem

The Aquatic Therapy (AT) field continues to grow as research is conducted and increased populations are immersed into this setting. Additional research and assessments are needed in studying behavioral outcomes in children with disabilities and AT. Sensory stimulation interventions are limited in an AT setting, thus further research may aid in providing useful interventions to serve individuals with disabilities in the water. This research study may add to the growing knowledge of AT and the therapeutic benefits it offers to children with disabilities.

Purpose and Significance of the Study

The purpose of this study was to gain a better understanding of sensory stimulation interventions in an aquatic therapy setting. The main focus was to observe behavioral outcomes and the impact "agitator jets" have on transitions in a child with ASD. This will provide valuable information to both aquatic therapy settings and individuals with ASD.

Hypothesis

The purpose of this study was to understand the impact sensory stimulation interventions have on transitions for children with disabilities in aquatic therapy. This quantitative study collected data to analyze behavioral outcomes, as shown in the hypothesis.

H_a: The child will show decreased negative behaviors when transitioning after the sensory stimulation intervention in the pool.

H_o: The child will show no change in behaviors in transitioning after the sensory stimulation intervention in the pool.

Definition of Terms

The following terms have been included for a better understanding throughout the study:

- **Autism (ASD)-** This is a neurodevelopmental and developmental disorder that is often diagnosed based on behavioral and developmental characteristics. Individuals diagnosed with ASD show impairments in behavioral, social, and communication aspects (Firth, 2008; Coco-Ripp & Smith, 2015).
- **Recreational Therapy (RT)-** The use of planned recreational activities and interventions in an environment to support a client's attitudes, beliefs, and behaviors necessary for psychosocial adaptation, health, and well-being (Austin et al., 2020).
- **Aquatic Therapy (AT)-** The use of passive and active techniques for methods of rehabilitation and habilitation through the use of water as a therapeutic condition (Broach & Datillo, 2011).
- **Sensory Stimulation-** An intervention that utilizes the therapeutic process in stimulating one or more of the senses (Porter, 2016).
- **Horizontal Transition-** This is the movement from one situation/setting to another and usually occur on a daily basis. This includes transitions from home to school or in-between activities (Stoner et al., 2007).
- **Vertical Transition-** These are predictable and developmental changes, such as the shift in school grades or from school to adult life (Stoner et al., 2007).
- **Agitator Jets-** The pressure vents which lie under the water and produce bubbles.

Limitations

Limitations of this study include the lack of research involving the pediatric population and sensory stimulation interventions in an aquatic therapy setting. Partial assessments create another barrier when assessing behavioral outcomes of children (Wilke et al., 2012; National Institute of Mental Health, 2011). These limitations combined with the lack of research provide an avenue to be explored and further studied in the AT field.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The purpose of this study is to gain understanding on the impact that sensory stimulation interventions can have on transitions in children with disabilities in an aquatic therapy environment.

Recreational Therapy

Recreational Therapy (RT) can be defined as "planned uses of recreation and other activity interventions and a helping relationship in an environment of support with the intent of effecting change in a client's attitudes, beliefs, behaviors, and skills necessary for psychosocial adaptation, health, and well-being" (Austin et al., 2020, p. 2). RT techniques are designed to be goal oriented and purposeful to benefit clients in producing positive experiences to promote healthy lifestyles. These leisure experiences lead to optimal levels of functioning and involve clients in activities promoting recreation and health. Interventions include recreation and leisure activities and experiences to enhance one's health and well-being. Some main goals of RT are restoring health, assisting chronic conditions and disabilities, and helping clients use their leisure interests to achieve a high level of wellness. Using leisure and recreational interests enables personal growth and aids individuals to restore healthy and positive lifestyles (Austin et al., 2020).

Recreational Therapy is used in a variety of settings as well as interdisciplinary teams across healthcare settings (Austin et al., 2020).

RT's work with an assortment of individuals including medical doctors, nurses, psychologists, social workers, physical therapists, occupational therapists, music therapists, art therapists, and dance therapists. RT is commonly found in general and psychiatric hospital and in school-based programs for students with disabilities. Other settings for RT are skilled nursing facilities, assisted living facilities, home health care, correctional facilities, outdoor recreation, rehabilitation centers, community mental health centers, and various other human service agencies. Clients receiving RT treatment are most likely individuals with intellectual disabilities, behavioral health, physical disabilities, children that have been hospitalized or geriatric populations in long term care facilities. Additional individuals who have benefited from RT interventions include those with ASD, substance use disorders, cognitive impairments, military veterans, and those incarcerated. A range of RT interventions can be provided through several formats such as classes, clubs, special interest groups, counseling sessions, therapy groups, recreation programs, special events, and contests (Austin et al., 2020). Overall, RT can be used in a variety of professions with other interdisciplinary teams, settings, and structures used to benefit and serve clients (Austin et al., 2020).

Aquatic Therapy

Aquatic Therapy (AT) includes both passive and active techniques for methods of rehabilitation and habilitation through the use of water as a therapeutic condition (Broach & Datillo, 2011). AT is a specialized area in which skilled practices and interventions are used to implement and improve or maintain functioning. The AT environment offers a vast number of unique properties such as: buoyancy, support, and resistance. These properties enhance the AT interventions for clients across the lifespan with musculoskeletal, neuromuscular, cardiopulmonary, and psychological diseases, disorders, or conditions. Interventions using AT are

designed to improve balance, motor coordination, oral-facial control, postural stabilization, respiration and vital capacity, muscle strength, endurance, range of motion, gait, weight bearing, proprioception, circulation, edema reduction, relaxation, self-esteem, mood, skill, and life activity level (Broach & Datillo, 2011; Vargas, 2004).

Clients with deficit areas utilized by AT include reduction in pain, muscle fatigue, spasticity, depression, and anxiety (Broach & Datillo, 2011; Vargas, 2004). AT interventions use the properties of water to provide an environment in which there are many benefits, compared to those of land-based interventions. These benefits include decreased blood pressure, increased blood flow, improved oxygen in the muscles, and improved renal and relaxation effects. The temperature of the water has a positive effect on the body in an AT setting, as well as the physiological and psychological aspects (Broach & Datillo, 1996).

A RT applies the principles of AT to meet treatment goals. A RT utilizes AT as an evidence-based intervention to promote functional improvements, while also fostering independence in water-based activities. Studies have shown physical and psychological water interventions to be effective in many ways (Becker, 2011; Broach and Datillo, 2011). Physical outcomes have shown a decrease in pain and fatigue (Cantarero-Villanueva et al., 2012; Guillemin et al., 1994; Hauser et al., 2010; Langridge & Phillips, 1988; Templeton, Booth, & O'Kelly, 1996; Woods, 1989; Broach et al., 1998; Hauser et al., 2010). AT techniques support these outcomes in increasing joint and functional ability, while reducing pain to perform daily tasks (Templeton et al., 1996).

An increase in motor performance, strength, endurance, and fitness were shown to improve physical functioning (Broach & Datillo; 2001; Broach et al., 1998; Broach & Datillo, 2003; Gehlsen, Grigsby, & Walnut, 1984; Broach, Groff, & Datillo, 1997; Burke & Keenan, 1984; Edlund et al., 1986; Routi, Troup, & Berger, 1994; Wright & Cowden, 1986; Wang et al.,

2007). AT interventions promote positive effects on changes in muscular strength, fitness, and motor performance in upper and lower extremities (Gehlsen & Winant, 1984). Psychological outcomes indicate improved body image (Benedict & Freeman, 1993; Smith & Michel, 2006), enhanced mood (Berger & Owen, 1992; Berger, Owen, & Man, 1993; Hauser et al., 2010), and a decrease in anxiety (Parker & Smith, 2003).

Sensory Stimulation

Sensory Stimulation is an intervention that utilizes a therapeutic process in stimulating one or more of the senses (Porter, 2016). This therapeutic process is most often utilized in individuals who have deficits in sensory deprivation. The purpose of this intervention is to restore functioning, improve sensory deprivation, and reduce negative behaviors such as outbursts and agitation. Sensory stimulation techniques activate sensory receptors in response to motor reactions in the body. Spinal reflexes are located in short nerve pathways used in sensory stimulation therapy. This reflex system is linked to the spinal cord and controls all incoming and outgoing impulses of the body (Elizabeth, 1966). A stimulus must have three characteristics in order to activate a response from the body including: sufficient intensity, speed, and a repetitive action in order to illicit an adaptation of the stimulus. The location of a sensory reflex, techniques used, and patients' reactions are all factors that affect sensory reflex for treatment. One of these locations used in sensory reflex is the use of a receptor on the body called an exteroceptors. This kind of receptor is located on the outer surface of the body and is used in arousing the nervous system to environmental stimuli. This receptor is used to access stimuli from outside the body (Porter, 2016). Exteroceptors relay special senses such as vision, hearing, balance, taste, smell, and pain. This receptor needs proper context when acquiring new access to a stimulus, which can be supplied from proprioception and the vestibular sense (Porter, 2016). This receptor reacts to stimulation and produces a quick response by the body. "Therapeutic goals can be achieved and

maintained through repeated use of the reflex neural pathways to facilitate and condition this sensory-response behavior" (Elizabeth, 1966, p. 281).

These techniques provide patients with a greater sense of personal and physical control. The use of sensory stimulation techniques provides therapeutic outcomes to facilitate and condition the sensory response behavior (Elizabeth, 1966). Exteroception senses include tactile or cutaneous receptors of the body, which is known as the somatosensory system. This system is made up of receptors that respond to touch, pressure, temperature, and pain stimuli. The three types of touch are passive, active, and functional (Porter, 2016). Passive touch is desensitized, a sensation such as wearing clothes. Active touch is the integration of somatic senses in combination with motor and sensorimotor functions to recognize objects. The functional touch utilizes components that contribute to our enjoyment, experience, and learning. The sensation of touching objects provides a learning atmosphere to discriminate among textures, density, size, shape, vibration, and temperature. The ability to touch objects in the environment provides an experience to learn and explore the world around us (Porter, 2016).

Activities are chosen specifically to stimulate certain senses, depending on the desired outcomes of the patient. Some outcomes that are assessed are alertness, behavior change, verbalizations, and relaxation. These activities are chosen based off each individual's needs and reactions to stimuli (Porter, 2016). Sensory experiences must be able to pass through the sensory threshold in order to provide recognition to the individual. A stimulus must be meaningful in order to engage and capture the attention of the patient, while also offering pleasure during the intervention. When engagement with the stimuli increases, the neural connections strengthen, and functional changes improve (Porter, 2016).

Sensory stimulation has been shown to be effective when using interventions that stimulate multiple senses at once instead of a single sense. Research has shown that multi-sensory

stimulation increase speech, peer relations, initiation in activities, and positive emotion and activity levels while reducing boredom (Baker et al., 2001; Baker et al., 2003). Multi-sensory stimulation provides individuals with dementia various visual, auditory, olfactory, and tactile stimuli (Tortosa-Martinez & Yoder, 2015). Multi-sensory stimulation provides a wider network of brain regions to be activated. For children, this broad range provides an advantage to engage different learning styles, such as visual or auditory. Research shows that multiple processing channels that are utilized in multi-sensory stimulation promote a greater processing spread between multiple senses. Increased long term memory and processing can be shown from multi-sensory stimulation learning environments (Shams & Seitz, 2008).

Children

Piaget developed a theory based on cognitive development throughout the stages of life (Huitt & Hummel, 2003). Each stage offers a structure of development that builds on the one before. With time, the foundation grows more complex and cognitive processes develop (Bashrin, 2015). These stages are sensorimotor, pre-operational, concrete, and formal. The pre-operational stage includes the toddler (18-24 months) and early childhood age (7 years old) (Huitt & Hummel, 2003; Orey, 2010). In this period of life, an individual demonstrates intelligence through the use of symbols, language, memory, and imagination (Huitt & Hummel, 2003).

Interventions such as aquatic therapy and sensory stimulation are utilized in all populations and various ages. Activities are chosen depending on the client, diagnosis, and treatment goals. AT and sensory stimulation interventions can be beneficial to children with disabilities in restoring function in those with sensory deprivation (Porter, 2016).

Children with Disabilities

A disability is defined as an environmental limitation to a child's capacity to perform appropriate activities with others and in the community (Piatt & Dawson, 2015). Research has

shown that children with disabilities often need more support in order to participate in recreation or school activities. The constant battle of access to recreational activities, negative attitudes and support from staff members, and concerns of safety by parents are evident as barriers to children with disabilities. Recreation is a vital aspect of a child's quality of life, as it promotes physical and social engagement (Schleien et al., 2014). Children with disabilities display a lower participation in activities, few friends, and a diminished sense of autonomy. Children with disabilities have environmental barriers which limit their active participation in community day to day activities. Barriers are also evident in aspects of participation, engagement, school, inclusion, comparison, disability, and support for children with disabilities (Eriksson et al., 2007). These barriers are evident through routine patterns in activities and social isolation from peers from those without disabilities (Law & Dunn, 1994).

Participation in activities is defined when "people form friendships, develop skills and competencies, express creativity, achieve mental and physical health, and determine meaning and purpose in life" (Law et al., 2006, p. 1). Participation and social engagement skills provide opportunities for children to learn and grow in their environment. Research has shown that children with disabilities are at a greater risk for less participation in social activities with peers, in the home, and the community. Factors such as participation in physical activity and exercise, risk and resilience of children facing adversity, and support through leisure and recreational activities all influence a child's opportunities (King et al., 2003). Other barriers children with disabilities encounter are a lack of opportunities, decreased engagement in social activities and social isolation. Individuals with disabilities are limited in multiple ways that impact their ability to interact with the environment and those around them, due to the nature of their disabilities and the barriers associated with social engagement. This creates a learning, social, and emotional obstacle when engaging individuals in recreational activities (Law et al., 2006).

Children with Specific Disabilities

Children with disabilities is a broad topic, which includes many diagnoses and populations. Some diagnoses emphasized throughout will be: Cerebral Palsy (CP), ASD, and Attention-Deficit/Hyperactivity Disorder (ADHD).

Cerebral Palsy is one of the most common motor disabilities in children (CDC, 2012b; Davis et al., 2009; Geytenbeek, 2011; Groff, Lundberg, & Zabriskie, 2009; Ketelaar et al., 2008; Longo, Badia and Orgaz, 2013; Vargus-Adams & Martin, 2011; von der Luft at al., 2008). It is a neurological disorder that appears in early childhood and is diagnosed in the early developmental years (DeVries, 2015). These neurological problems are due to damaged areas in the brain, such as the basal ganglia and cerebellum, which control movement and coordination. Cerebral Palsy means affected areas of the brain impact muscle problems and weakness throughout the body (National Dissemination Center for Children with Disabilities (NICHCY), 2010; Reaching for the Stars 2013; CDC 2012b; NINDS, 2012). The section of the brain impacted are the result of non-progressive damage to areas that impact and control movement and coordination (Griffin, Fitch, & Griffin, 2002; NICHCY, 2010; NINDS, 2012; Odding, Roebroeck, & Stam, 2006; Reaching for the Stars, 2013). These affected areas also influence muscle tone, endurance, strength, and speech (DeVries, 2015). CP can have a range of physical and cognitive effects depending on the individual and severity of the diagnosis.

Children diagnosed with CP show primary signs and symptoms of ataxia, spasticity, poor muscle control, atypical gait, fine motor impairments, drooling, toe walking, and tremors (Mayo, 2010; McRae et al., 2009; NINDS, 2009, 2012; NICHCY, 2010; Reaching for the Stars, 2013). Other than the primary signs and symptoms of CP, this neurological disorder affects many systems in the body (DeVries, 2015). The digestive, respiratory, and urinary systems are all secondary systems affected by CP. A key domain highlighted in the nervous system is difficulty processing sensory stimuli including tactile, auditory, or visual stimuli (Clayton et al, 2003;

NICHCY, 2010; NINDS, 2012; Mayo 2010; March of Dimes, 2007; Reach for the Stars, 2013). This hyper- or hypo- responsiveness to stimuli impacts a child's ability to manipulate objects during task activities. These sensory interventions have been shown to improve functioning and attention in children with CP (Pavão & Rocha, 2017).

Autism Spectrum Disorder (ASD) is a neurodevelopmental and developmental disorder that is often diagnosed based on behavioral and developmental characteristics (Firth, 2008). The age of onset to diagnose children with ASD is difficult to identify, but many children are diagnosed between 18-36 months (APA, 2000). Individuals diagnosed with ASD show impairments in behavioral, social, and communication aspects. Some deficits shown in ASD individuals include social communication, understanding and maintaining relationships, emotional reciprocity, repetitive patterns of behavior and movements, and fixated interests or focus to stimuli (Coco-Ripp & Smith, 2015). Cognitive and behavioral impairments common in ASD include attention problems, intellectual delays, anxiety, depression, aggression, temper-tantrums, and self-injurious behavior. Children with ASD may also have sensory impairments such as tactile, auditory, visual, and vestibular deficits, depending on the hyper- or hypo-responsiveness to stimuli (Srinivasan, Pescatello & Bhat, 2014).

These impairments can be represented in a range of symptoms and severity depending on each individual and the level of impairment. Children diagnosed with ASD often have difficulty processing sensory stimuli. This may be shown as a sensory over responsivity, sensory under responsivity, or sensory seeking (Volkmar & Wiesner, 2009). Sensory over responsivity is an exaggerated negative behavior in response to a stimulus, which is shown as "melt downs" because the brain cannot control the reaction to stimuli (Kranowitz, 2005). Sensory under responsivity is when an individual "reacts less intensely to sensory information" (Kranowitz, 2005, p. 41). This is due to the amount of neural activity it takes to reach the responsive threshold needed to react to a stimulus. Sensory seeking is the need for heightened sensory input such as self-stimulation, which can be shown in individuals as: spinning and jumping (Kranowitz, 2005).

Attention-Deficit/Hyperactivity disorder (ADHD) is a neurodevelopmental disorder that affects social and academic functioning (Porter, 2015). Children with ADHD are often diagnosed by the age of seven and common signs of ADHD are recognized more commonly in school settings. Heredity and environmental factors play a strong role in underlying causes of ADHD (CDC, 2013). Primary signs and symptoms of ADHD are difficulty staying on task, excessive motor activity, and impulsive decisions and behavior. Executive functioning is a core deficit in ADHD, which results in a range of dysfunctional behavior. Cognitive processing and functioning impairments are common in children with ADHD. The ability to respond to detection, motor control, target detection, and executive decision making are impairments children with ADHD struggle with cognitively (Porter, 2015).

Children with disabilities often experience more intense transition challenges. These experiences impact children and the ways in which they process new tasks and settings. Transitions for children with disabilities often require specialized services and support to meet the needs of the individual (Gooden & Rous, 2018).

Individuals with ASD and Transitions

Individuals with ASD commonly have difficulty with transitions. These transitions are usually unpredictable, which cause confusion and anxiety for children with ASD. Transition strategies for individuals with special needs has been widely researched, especially the emphasis on the need for transition planning for children with ASD. There are two types of transitions individuals experience in life, including vertical and horizontal transitions. Vertical transitions are those that are predictable and developmental and usually experienced by all individuals. This includes transitions in school grades and the shift from school to adult life. Horizontal transitions include the movement from one situation to another, or those that occur on a daily basis. Examples of horizontal transitions include those from home to school, in between activities, or

unfamiliar settings. These transitions are not as predictable as vertical transitions. "For children with ASD, horizontal transitions can be especially challenging and stressful, resulting in stereotypical or aggressive behaviors, therefore, planning and devising strategies for horizontal transitions is critical" (Stoner et al., 2007, p. 24). Understanding the different transition types provides improved planning strategies for professionals working with individuals with ASD. Research findings indicate the need for children to be at the center of all transition concerns. A child's strengths, weakness, and tolerance play a role in implementing a useful transition plan unique to each child. Understanding and identifying a child's needs provided successful outcomes in overcoming barriers (Stoner et al., 2007).

Individuals with ASD often have more trouble shifting from tasks or routine changes. This may be caused due to the need for predictability in routines, understanding upcoming tasks, or difficulty adjusting when a pattern of behavior is disrupted. Transition strategies are implemented to support individuals with ASD during transition points in activities or routines. These techniques are often utilized before a transition occurs, during a transition, or after a transition and are presented verbally, auditorily, or visually. Transition strategies offer predictability for individuals with ASD and promote positive routines around transitions. A vital component of transition strategies is the use of "cueing" before a transition is going to take place. The use of a cue provides an individual with ASD enough time to shift from one task to the next (Hume, 2008).

Common characteristics in individuals with ASD include repetitive and restricted behaviors and interests. The reliance on routines and resistance to change can impact an individual's ability to transition, while decreasing progress from one task to the next (Sevin, Rieske & Matson, 2015). Children with ASD often struggle with transitions which can lead to behavioral problems. Unexpected routine and schedule changes can commonly lead to verbal and physical aggression, tantrums, non-compliance, or self-injury. "The many different activities

schedules in a typical day are problematic for a child whose resistance to change is an inherent component of his or her autism" (Banda, Grimmett & Hart, 2009, p. 17). Reducing transition difficulties can include a variety of strategies such as: choice making, activities preferred by the individual, behavioral motivation, and reinforcement of positive behavior (Banda, Grimmett& Hart, 2009).

Individuals with ASD often engage in negative behavior to avoid or escape their anxiety provoking environment or situation. These situations cause individuals to seek reassurance or comfort to self-soothing stimuli. Research is limited on the functional assessment and treatment of anxiety and behavioral problems in children with ASD (Moskowitz et al., 2017).

Children with disabilities & Sensory Stimulation

Children with disabilities may have sensory issues, which makes them abnormally sensitive or insensitive to certain stimuli in the environment (Lee et al., 2017). Sensory issues can provoke a strong response to sounds with particular frequencies, certain colors, or even types of materials. These responses elicit unexpected movements or behaviors often seen in children with disabilities. Children with disabilities are limited in engaging in activities due to the lack of participation and opportunities available. Sensory stimulation interventions for children are important in creating an environment in which they can respond to stimuli affecting behavioral and social domains. Sensory stimulation interventions highlight the existence of positive disturbances in implementing sensory stimuli into the child's environment (Schleien et al., 2014).

Stimuli interventions in children with disabilities have focused on behavioral consequences (Zentall, 1979). Environmental stimulation highlights the importance of understanding a child's disordered behavior patterns and biological differences. A direct control of a stimuli input can moderate effectiveness in behavior and can facilitate the development of different motor skills.

Interventions

Hydrotherapy

The use of water is one of the basic methods of treatment and is referred to as water therapy, aquatic therapy, pool therapy, and balneotherapy (bath therapy). Using water in various forms and temperatures can produce a range of effects on the body. Hydrotherapy is defined as the "external or internal use of water in any of its forms (water, ice, steam) for health promotion or treatment with various temperatures, pressure, duration, and site" (Mooventhan & Nivethitha, 2014, p. 199). Hydrotherapy is the therapeutic use of non-weight bearing exercises and activities in a warm water setting. This type of intervention is useful in treating a range of conditions for various populations. The therapeutic concepts of hydrotherapy include relative density, buoyancy, hydrostatic pressure, and viscosity (Ion, 2007). Aquatic exercise or hydrotherapy interventions are utilized to improve strength and muscle endurance, while also reducing joint pain. This method is used to facilitate and assist therapeutic swimming exercises for individuals, depending on the patient and diagnosis present (Ion, 2007). Benefits of hydrotherapy include improved cardiovascular and respiratory function, mobility, muscle strength, gait, and decreased levels of pain (Skinner & Thomson, 2008).

The main properties that make up hydrotherapy include buoyancy, hydrostatic pressure, and resistance (Brody & Geigle, 2009). These properties provide an exercise experience of weightlessness and ease of movement, resulting in buoyancy and the feeling of support and force from hydrostatic pressure. "The influence of buoyancy on a person creates an ideal environment for both rehabilitation and conditioning" (Brody & Geigle, 2009, p. 196).

Buoyancy is "when an object is immersed in water, it experiences an upward thrust that is equal to its weight resulting in less gravitational pull on the body" (Broach, 2016, p. 186). This is due to the properties of density and the displacement of an individual in water. The relative density of water is 1.0, while the density of a human body is slightly above or below 1.0 (Koury,

1996). Individuals with a percentage higher than 1.0 have a hard time floating due to the lack of body fat, while those with a percentage lower than 1.0 are more able to float because of body mass. The warm water paired with buoyancy reduce the effect of gravity on the body, which reduces tone and spasticity (Dellaratta, 2002).

Table 1: *Defining Density*

Density	**Meaning**
Less than 1.0	Objects/body floats
Relative Density= 1.0	The density of water is 1g/cm^3, neither sinking nor floating
Greater than 1.0	Objects/body sinks

Rushall, E. B. S. (2007, February 15).

This principle of buoyancy results in decreased weight bearing and off-loading when standing in water (Bloomfield, Fricker, & Fitch, 1992). Buoyancy allows improved movement in the water with less pain and joint compression (Broach, 2016). Hydrostatic pressure is "when a body is immersed in the water there is pressure exerted by the fluid that varies with depth of immersion and density of fluid" (Becker, 2009, p. 186).

The hydrostatic pressure is equal to that around a body at a given depth, while increasing with the depth of the water. Benefits of hydrostatic pressure in the water include improved circulation, oxygen delivery to the muscles, muscle relaxation, lung capacity, and decreased heart rate during exercise (Broach, 2016). Viscosity is "the resistance that occurs between molecules of a liquid" (Broach, 2016, p. 187). This has an effect on how the body moves through the water. Movement in the water results in resistance produced by friction in the water. As a body moves faster in the water, the resistance increases. This resistance felt in the water allows for a greater response time in maintaining balance (Broach, 2016). The warmth and pressure of the water helps

to reduce swelling and joint load, while promoting muscle relaxation (Mooventhan & Nivethitha, 2014).

Another property of water which makes up the setting of hydrotherapy is the use of warm water temperatures. Hydrotherapy exercises keep water temperatures between a range of 33.5 and 35.5 degrees Celsius, or 90 to 94 degrees Fahrenheit (Carere & Orr, 2016; Broach, 2016).

The temperature of water can affect treatment outcomes of an individual. Settings with warm water pools impact circulation in blood vessels, improved skin condition, relaxation, and decreased pain (Becker, 2011; Vargas, 2004). In this setting when warm blood reaches the muscles it causes an increase in muscle temperature, which causes less stress on the muscles. The water temperature should be modified depending on the diagnosis of each individual (Broach, 2016). The properties of water provide increased motor skills and strengthening of tight or spastic muscles (Mortimer, Privopoulos & Kumar, 2014).

Benefits of Hydrotherapy

Aquatic therapy exercises provide physical and motor fitness, social skills, and self-esteem in individuals with disabilities. This intervention provides an outlet for individuals to enjoy exercise without putting decreased pressure on the joints. Aquatic interventions have been shown to increase muscle tone through proprioception and sensory stimulation (Conatser, 2007). Aquatic therapy provides a variety of sensory stimuli with the properties of water present in this environment (Dumas & Francesconi, 2001). Hydrotherapy promotes positive impacts in individuals with musculoskeletal conditions in decreasing pain and increasing quality of life and functional exercise capacity (Carere & Orr, 2016). The effectiveness of a hydrotherapy program has shown improvements in social, psychological and emotional wellbeing of children with ASD. More specifically, the use of adapted aquatic interventions is shown to improve social skills in individuals with ASD (Conatser, 2007). This therapy intervention is considered to be a beneficial

option, either alone or in combination with other treatment interventions (Mills et al., 2017). AT interventions have been shown to positively affect patterns of behavior, changes in activity, social communication, and social interaction in individuals with ASD. Improvements were also seen in school functioning and aquatic skills (Güeita-Rodríguez et al., 2021). An increase in swim skills, attention, muscle strength, balance, tolerating touch, maintaining eye contact, and water safety were results from aquatic therapy (Vonder Hulls, Walker & Powell, 2006).

Aquatic exercise programs for children with ASD focused on swimming skills, endurance, mobility, and patient/parent satisfaction. These outcomes were measured before and after the aquatic exercise intervention. Results from the program revealed improvements in swimming skills and satisfaction among parents and children during the intervention. This program showed progress in swimming abilities in children with ASD, while a lack of fitness outcomes produced low exercise intensity during the program (Fragala-Pinkham, Haley & O'neil, 2011). Exercise interventions to improve physical activity in children with ASD is limited. Literature is provided on other pediatric developmental disabilities, while further research and assessments are needed to accommodate children with ASD. Research emphasizes a clear need in developing a sensitive assessment tool in providing interventions for children with ASD with social communication problems, motor, and behavioral impairments (Srinivasan, Pescatello & Bhat, 2014).

Relaxation Methods

Watsu

The method of Watsu is commonly used in aquatic therapy as a relaxation intervention (Stan, 2013). The word Watsu means "water" and "shiatsu" and is a common form of passive hydrotherapy. Elements of joint mobilization, stretching, massage, and shiatsu are used during this intervention (Schitter et al., 2020). This type of therapeutic treatment is often used in 35-degree Celsius warm water (Schitter et al., 2015). Watsu impacts the neuromuscular and

musculoskeletal systems of the body by promoting movements with less pain and greater mobility (Broach, 2016). Watsu applies breathing techniques and assisted moves by the therapist to provide mental and physical benefits to the individual. This intervention "incorporates static pressure stretches and a structured sequence of passive limb, head, and neck motions or models executed at water surface" (Stan, 2013, p. 56-62). These movements promote relaxation and allow the release of weight from the body resulting in flexibility of the spine. Movements are performed more easily when in a state of relaxation and controlled breathing. Tandem motions between client and therapist result in coordination (Stan, 2013).

During this intervention the client is cradled by the therapist at the surface of the water, while various movements are practiced. Each movement utilized during therapy sessions are specific to the diagnosis of the client. Watsu consists of an optimal environment in order to achieve positive outcomes. These outcomes include depth of the water, body position, pool environment, and proper explanation of techniques during intervention (Broach, 2016). Benefits of the Watsu method include decreased stress and pain and overall improved mood and quality of life (Schitter et al., 2015). Research shows positive rehabilitation and functioning of individuals for hemiparetic stroke. Watsu movements control spasticity and improved functioning of individuals with paralysis (Chon et al., 2009). Additional benefits of Watsu include improved circulation, flexibility, postural alignment and sleep patterns, with a decrease in spasticity, edema, fatigue, and tension (Broach, 2016).

Halliwick model

Another intervention commonly used as a relaxation tool in aquatic therapy is the Halliwick method. This concept "places a strong emphasis on ability rather than disability and on the application of the effects of water on the human body" (Skinner & Thomson, 2008, p. 76-77). This model illustrates a 10-point program consisting of: mental adjustment, disengagement, transversal rotational control, sagittal rotational control, longitudinal rotational control, combined

rotational control, up thrust, balance in stillness, turbulent gliding, and simple regression.

Table 2: *Halliwick Method*

10-Point Halliwick Movement	**Definition**
1. Mental Adjustment	Learning to react appropriately to water. The adjustment of fluid (buoyancy, flow conditions, waves).
2. Disengagement	Therapist withdraws manual and visual support, challenging the client's independence and skills/
3. Transversal rotational control	The ability to control movements around a transverse axis of the body (flexion/extension).
4. Sagittal rotational control	The ability to control movement, left & right around the axis of the body, especially in upright positions.
5. Longitudinal rotational control	The control of movements around the axis of the body. Including rolling over from supine.
6. Combined rotational control	The ability to control movements around a combination of previous axes.
7. Up thrust	The understanding of water and support provided in not to sink.
8. Balance in Stillness	Maintaining a stable and relaxed position without compensatory movements of the arms or legs. Focus on effective postural control.
9. Turbulent Gliding	Client is guided in the wake of the instructor, who walks backward. Client has control of head and trunk movements.
10. Simple Regression	A small swimming movement with hands prepared for activity, important in maintaining trunk control.

Grosse, S. J. (1986).

The properties of water combined with the application of the Halliwick concept result in improved functioning of various systems, muscle strength, stretching, gait, and pain relief (Skinner & Thomson, 2008).

The Halliwick model was originally created to help teach individuals with a physical disability learn how to swim independently in the water. Since then, this model has expanded to aquatic therapy and the focus on treating impairments of the body. This method is dynamic in facilitating movement and sensory input, while activating muscles and creating stabilization of specific joints. The Halliwick concept is used in treating musculoskeletal, neurological and pediatric populations in aquatic therapy (Lambeck & Gamper, 2011).

This intervention provides individuals an understanding of how their body works in the water, resulting in increased independence and achieved treatment goals (Broach, 2016). Research has shown the Halliwick method affected motor abilities in children with ASD. Further technical effects of therapy are needed in order to properly understand the implications (Mohamed, 2017). The Halliwick method has shown improvements in hand skills, balance and gait, while reducing hyperactive behavior and anxiety in children with ASD (Mortimer, Privopoulos & Kumar, 2014).

Sensory Stimulation Intervention

Sensory stimulation "is an intervention to improve the quality of life of persons through gradual introduction to pleasurable sensory experiences within an atmosphere of trust and relaxation" (du Plessis, 2011, p. 1). Senses such as seeing, hearing, smelling, feeling, and tasting are commonly used sensory techniques (du Plessis, 2011). This therapeutic process is most commonly used in individuals who have sensory deprivation to either restore functioning or to improve negative behaviors (outbursts, agitation, aggression) (Porter, 2016). Most sensory stimulation techniques are considered either single stimulation or multi-sensory stimulation. Single stimulation requires one sensory used in stimulation, while multi-sensory uses two or more of the senses during intervention (Strøm et al., 2016). These senses are gently stimulated without intellectual activity in a non-directive and supportive approach. Sensory stimulation therapy aims to improve happiness and wellbeing in a meaningful therapeutic approach (du Plessis, 2011).

Sensory stimulation therapy promotes engagement in structured session activities, while also motivating the individual to continue the activity engagement in setting outside of therapy. Sensory stimulation therapy sessions are most commonly used in individual sessions or small groups, depending on the need or abilities of the client (Porter, 2016). This repetitive engagement offers additional therapeutic stimulation to be used and carried over to strengthen skills in other settings (Porter, 2016). This intervention emphasizes stimulating a particular sense that increases the likelihood of a desired outcome, such as alertness, behavior change, verbalizations, or relaxation. The approach when applying sensory stimulation allows each individual "to be in control of the stimuli with no intellectual or intentional demands" (Porter, 2016, p. 431). This allows the individual to control the interaction with the stimuli (Porter, 2016).

Pressure/Agitator Jets

In a hydrotherapy environment, the use of "agitator jets" is a common method used for sensory stimulation. The warm water paired with the use of jets in the pool provides a sensory experience (Ion, 2007). The touch sensory receptors on the body respond to the constant hydrostatic pressure, jets, and turbulence (Brody & Geigle, 2009). The hydrostatic pressure and flow provide various sensory stimuli through water temperature, weight loss, and balance (Mohamed, 2017). Research has shown AT interventions provide strong sensory stimulation for children with ASD. The movement of water, water pressure, and sensory stimulation result in a calming effect that improves interaction (Güeita-Rodríguez et al., 2021). The turbulence caused by moving water around the body provides therapeutic benefits in challenging movement and strengthening muscle groups. The drag of the water, hydrostatic pressure, and turbulence all act in reducing pain (Kinnaird & Becker, 2008). These properties of water provide a unique experience in stimulating the exteroceptors on the outside of the body while in the pool. This promotes a more relaxed and interactive environment for the individual, while stimulating various muscle groups.

The effect of turbulence in the water provides sensory stimulation to help "increase body awareness or desensitize hypersensitive body parts" (Dellaratta, 2002, p. 2). When immersed in water, the pressure and temperature decrease pain due to stimulation the body is receiving (Norton & Jamison, 2000). The sensory cortex is activated due to water pressure, flow, and temperature (Lambeck & Lambeck, 2020). The use of jets in sensory stimulation provide therapeutic outcomes in facilitating and conditioning a sensory response behavior. This type of pressure provides sensory feedback which increases coordination in extremities (Sullivan, 1992). The sensory receptors in response to the water activate a response to motor reactions in the body. Further research has shown how sensory stimulation of the water may help to normalize sensory deficits, while the warm water provides therapeutic benefits in relaxing and strengthening muscles (Dumas & Francesconi, 2001).

Assessment

The assessment is a vital component and should be chosen based on the needs and diagnosis of the client. The instrument used will evaluate the field of study being analyzed and offer assistance when researching. This will provide a foundation for learning and development. Further assessments and instruments will be discussed, evaluating population, style, and diagnosis.

The Functional Disability Inventory (FDI) measures the child's status of health. A specific emphasis is placed on activity limitations in children and adolescents in the pediatric population. This includes the functional assessment of pediatric pain, which includes acute and chronic pain. The FDI has been devalued due to validity techniques in comparing pain levels to children that are well. Further research is needed to examine the properties of pain, sample size, age of the child, and gender (Claar & Walker, 2006). This instrument is useful in assessing pain levels in children with disabilities but is not useful in properly understanding behavioral outcomes with transitions in children with ASD.

The Pediatric Evaluation of Disability inventory (PEDI) is a functional assessment used in groups of children who are living with and without a disability. Children ages 6 months to 7 years are evaluated using this instrument. This assessment is administered as a parent report questionnaire. The PEDI displays functional status and change over functional skill level, caregiver assistance, and the use of adaptive equipment (Feldman, Haley & Coryell, 1990). While this study provides an evaluation of children with disabilities, it does not reveal the specific behavioral outcomes associated with ASD.

The Autism Diagnostic Observation Schedule (ADOS-G) is an observational tool. This assessment measures the socio-communicative behaviors that are delayed or absent in a child with ASD (National Institute of Mental Health, 2011). This standardized assessment contains aspects of social interaction, communication, and play. The observational assessment contains four, 30-minute modules measuring the child's level of expressive language at each stage (Lord et al., 2000). All four modules contain a set of scheduled activities that allow observations of the child to be examined on both a developmental and language level (Gotham et al., 2007). This instrument is widely accepted but is restricted when using it with very young children (Luyster et al., 2009). This tool reveals the language skills present at each stage, while behaviors are not documented and assessed during transition periods.

The Childhood Autism Rating Scale is another common assessment used by professionals in evaluating a child's body movements, adaptation to change, listening response, verbal communication, and relationship to others. This assessment can be used in children two years and older and focuses on observations of the child, while obtaining information from the parent. During the assessment, observations are taken on the child's behavior and compared to that of typical behavior of a child the same age. The main focus of this assessment emphasizes behavior (National Institute of Mental Health, 2011). While this assessment is common in this

population and based on observations of the child, the parental information and interview portion is not needed for this particular study.

A functional assessment such as the Questions about Behavioral Function (QABF) highlight children and adolescents with ASD focusing on repetitive and challenging behaviors. This study included a small sample size of individuals with stereotypical patterns and behaviors of ASD, using automatic reinforcement to maintain behaviors. Results of the study revealed the high percentage of individuals with stereotypical behavior positively adapting to the methods of automatic reinforcement. This study provided mixed results on the ideas of "stereotypical behavior" and only included small sample sizes of children with ASD (Wilke et al., 2012). This provides the need for further research in this area surrounding the idea of "behaviors" and reinforcement for children with ASD. This study highlights the repetitive and challenging behaviors seen in children with ASD but lacks a proper definition of "stereotypical behaviors" and the use of automatic reinforcement.

The Autism Diagnosis Interview-Revised (ADI-R) consists of a structured interview with 100 items and conducted with a caregiver. Four main components presented are: child's communication, social interaction, repetitive behaviors, and the age-of-onset (National Institute of Mental Health, 2011). This instrument assesses an individual's level of autism at 2 years of age and above. This ADI-R has been proven very useful in diagnosing individuals with ASD, as well as treatment and planning strategies. Questions containing a child's background, behavior, social and language acquisition are assessed by the parent or caregiver (Rutter, Le Couteur & Lord, 2003). This instrument emphasizes components of ASD but lacks the needed understanding of transitions and behavioral outcomes. The purpose of the Water Orientation Test of Alyn (WOTA) is to evaluate the adjustment and functional ability of an individual in an aquatic environment, based on the Halliwick method. Research shows that children with disabilities were assessed on water orientation skills compared to motor performance on land. The assessment proved reliable

and valid in assessing mental adjustment and aquatic functioning in children with disabilities (Tirosh, Katz-Leurer & Getz, 2008).

The Aquatics Skills Checklist and the Social Skills Improvement Scale examine the effectiveness of swim instruction in an aquatic therapy program on water safety skills in children with moderate to severe ASD. Water safety skills were measured using the Aquatics Skills Checklist, while social skills were measured using the Social Skills Improvement Scale. This assessment emphasizes the prevention of drowning in children with ASD. The draw to swimming and aquatic activities has proven to be very popular for children with disabilities. This need to explore the water unfortunately leads to accidental drownings and deaths among children between the ages of one and fifteen years old. Research shows that 91% of total deaths in the US in children with ASD under the age of 14 were a result of accidental drowning, making it the number one cause of death in children with ASD. These findings aid in measuring the effectiveness of improving water safety skills in children with ASD. Improvements were shown in improving water safety skills in individuals with ASD, while social skills revealed no significant difference (Alaniz et al., 2017). While this instrument provides safety skills in an aquatic therapy environment for children with ASD, it does not provide the behavioral outcomes seen in children with ASD.

An assessment useful and unique to the individual in the case study, is an observational instrument focused on transitions and behavior outcomes. The "sensory stimulation and transitions in pediatric populations with disabilities transitions observations" measures the behaviors before, during, and after the sensory stimulation intervention. Frequency and duration of negative behaviors are also assessed during transition periods. Negative behaviors are defined in this instrument as outbursts, crying, screaming, resisting exiting the pool, irritability and oppositional behavior. These behaviors are assessed, and the duration of each behavior is documented. This tool emphasizes observations made in a single child diagnosed with ASD and

the affect sensory stimulation (agitator jets) has on the transition periods in an aquatic therapy environment.

This study involves analyzing behaviors recorded through observations of behaviors of the client with sensory stimulation to assist with transitioning from one behavior to another. An observational assessment provides an assumption that a problem, generally personality or behavior, involve the environmental interaction of a setting. This focuses on the individual setting interaction. The psychometric properties of observational assessments involve direct measurement of behaviors in a setting. This highlights a more direct and close relationship between assessment and intervention being used (Keller, 1980).

CHAPTER III

METHODOLOGY

Introduction

This section will include research design, participant, data collection, instrument utilized, and data analysis.

Research Design

The design for this case report is quantitative, as it assesses observational behaviors based on the assessment for data collection. Data collection conducted by multiple researchers through observations. Intervention and analysis of data was directed by lead researcher. A case report was used to highlight the in-depth investigation style utilized in presenting the findings (Tellis, 1997). The design of a case report is to bring out the details of a study by using multiple sources of data (Gerring, 2004). A case report was used to provide an intensive investigation into the transitional behaviors of the subject and the potential impact sensory stimulation may have related to the disruptive behaviors of the subject during transitions. This design style is useful in providing an understanding of a problem or situation in-depth, while identifying specific information or behaviors related to the participant (Noor, 2008).

The characteristics of a case report meets the needs of the study being conducted. The use of a case report has been used throughout various clinical practices and research (Crowe et al., 2011).

The use of a case report for this study was necessary in providing insight into specific behaviors associated with a child diagnosed with ASD and the affects AT has on behavioral outcomes. It was important to examine the detailed behaviors associated after the sensory stimulation intervention, and the impact on transitions. As previously stated, limited research is available on the effects sensory stimulation has on behavior in transitions in an AT setting for children with disabilities (Wilke et al., 2012; National Institute of Mental Health, 2011).

Participant

This case report included one participant in the study. The participant is a 6-year-old male in Pre-Kindergarten. The individual was diagnosed with ASD, along with developmental and neurological deficits and hydrocephalus. The child was selected based on the struggle to transition from task to task. The assessment being used in the case report was created to measure specific behavioral outcomes seen from this child.

Data Collection

The participant arrived at Total Health Fitness Aquatics for 30-minute RT session in pool with therapist. Participant completed activities and tasks instructed by therapist during RT treatment time. The last 5 minutes of the session, the therapist prompted to begin the sensory stimulation intervention with the child. The therapist took the child to the location in the pool where the "agitator jets" are and began the sensory stimulation intervention. The intervention included placing the child in front of the agitator jets on his stomach, hands, arms, legs, feet, etc. This sensory stimulation intervention lasted as long as the child is calm or expresses that he is ready to get out of the pool. The child's behaviors will be assessed before, during, and after transitions. The frequency and duration of the behaviors are documented during each session.

Data collection will end when the participant exits the pool area. The data being collected is across a 16-week timeline. This case report is already a part of IRB-21-78 and will be a continuation of that study.

Instrument

The instrument being used in this study is the "Sensory Stimulation and Transitions in Pediatric Populations with Disabilities Transition Observation Measures". This observational assessment focused on transitions and behavioral outcomes in the participant before, during, and after transitions. Frequency and duration of negative behaviors were documented and assessed during transitional periods. Negative behaviors were identified and defined in this instrument as crying, outbursts, screaming, resisting exiting the pool, irritability, and oppositional behavior. This assessment was used each RT session during the last 5 minutes involving the sensory stimulation intervention.

- Behavior **before** transition:
    - Note behavior before transition- i.e. compliant, non-compliant, calm, upset, etc.
- Behavior **during** transition:
    - Note behavior during transition- i.e. compliant, non-compliant, calm, upset, etc.
    - Duration of Sensory Stimulation Intervention
- Behavior **after** transition:
    - Note behavior after transition- i.e. compliant, non-compliant, calm, upset, etc.
- Frequency (#) of negative behaviors **during** and **after** transition:

- Behaviors such as outbursts, crying, screaming, resisting exiting the pool, irritability, oppositional behaviors, etc.
- A tally is placed for each separate incident of negative behavior

- Durations of negative behaviors **during** and **after** transition
  - The time (minutes and seconds) are documented based on the duration of negative behaviors.

Data Analysis

The data collected during this study will utilize a single subject case design. This design will be beneficial to this study in providing an understanding of behavioral change in an individual, while using an observational format. The analysis style highlights the change over time in an individual, while the participant serves as both the control and treatment for the study. Single subject research utilizes one variable changed during the study, emphasizing the effects of the intervention. While single subject research studies are weak in producing validity, the design highlights the use of replication across an individual over time. The use of a single subject design and case report format provide this study with an in-depth look at a specific individual and the affects an intervention have on behavioral outcomes when utilizing an observational format to demonstrate change over time (Fragala-Pinkham et al., 2011).

This study will utilize descriptive statistics using the Inter-Rater Reliability Cohen's Kappa test in excel using SPSS. This type of research design highlights the importance of two raters used in the study when analyzing and evaluating the same sample (Glen, 2014). The use of Cohen's Kappa test will use a 95% confidence interval and will provide an increased precision on interobserver agreement on a specific sample (Landis & Koch, 1977; Altman, 1999). All data from the study will be documented in an excel document, which will be used to run Cohen's Kappa using SPSS. A coding chart (represented in table 3) will be used when running data

through SPSS. This coding system will follow a set duration of timed intervals shown in seconds. The duration code in the following chart illustrates 15 second intervals. This time span was chosen based on observations of changed behavior.

Table 3: *Coded Duration (seconds)*

Coded Duration (Seconds)	
0 seconds=	0
1-15 seconds=	1
16-30 seconds=	2
31-45 seconds=	3
46-60 seconds=	4
61-75 seconds=	5
76-90 seconds=	6
91-105 seconds=	7
106-120 seconds=	8
121-135 seconds=	9
136-150 seconds=	10
151-165 seconds=	11
166-180 seconds=	12
181-195 seconds=	13
196-210 seconds=	14
211-225 seconds=	15
226-240 seconds=	16
241-255 seconds=	17
256-270 seconds=	18

CHAPTER IV

FINDINGS

Introduction

The purpose of this study was to gain understanding on the impact that sensory stimulation interventions can have on transitions in children with disabilities in an aquatic therapy environment. The data was analyzed using descriptive statistics using the Inter-Rater Reliability of Cohen's Kappa in excel using SPSS. This single-subject case design involved one individual diagnosed with ASD, who utilized RT treatment in the water.

Demographics

This case report included one participant in the study. The participant is a 6-year-old male in Pre-Kindergarten. The individual was diagnosed with ASD, along with developmental and neurological deficits and hydrocephalus. The child was selected based on the struggle to transition from task to task. This child participated in RT treatment at the pool for 25 minutes plus 5 minutes of sensory stimulation intervention at the end of each treatment session in the pool.

Findings

Interrater Reliability: Cohen's Kappa

This study utilized Cohen's Kappa of Interrater reliability to analyze the interobserver agreement in this data. This means that multiple raters (observers) were used in this study to provide precision and reliability when observing the duration and frequency of negative behaviors of the participant in the study (Glen, 2014). The data was split into two sections of raters 1 and 2 frequency and duration and raters 3 and 4 frequency and duration. Raters 1 and 2 highlighted the first half of the data (sessions 1-8), while raters 3 and 4 focused on the second half of the data (sessions 9-16). The study included 16 weeks of data collection, with the first two weeks being baseline weeks (with no agitator jets), and the other 14 weeks as actual treatment collection (with the agitator jets). This Interrater reliability test of Cohen's Kappa applied a confidence interval of 95% in order to determine the overall agreement between raters of duration and frequency of negative behaviors seen in the participant.

The use of Cohen's Kappa highlighted the strength of agreement between raters in this study and the amount of times raters agreed on frequency and duration of negative behaviors. This overall rater agreement provides precision when the data raters give the same score to the same data item, also called interobserver agreement (Glen, 2014). Overall, the interobserver agreement was stronger in frequency and duration for raters 3 and 4, than raters 1 and 2. This means that there was an increased agreement, or more substantial agreement in raters 3 and 4 on duration and frequency.

The crosstabulation of raters 1 and 2 had less agreement on duration. Cohen's Kappa (k) reported k as 0.357 (35%) or as fair agreement, while $p < 0.5$ showed significant agreement between raters 1 and 2 for duration. The frequency between raters 1 and 2 indicated k as 0.186 (18%), or as poor agreement, while $p < 0.5$ indicated significant agreement between raters 1 and

2 in frequency of negative behaviors. The duration and frequency of Raters 1 and 2 are reported below in tables 4 and 5.

Table 4: *Duration of Raters 1 and Rater 2*

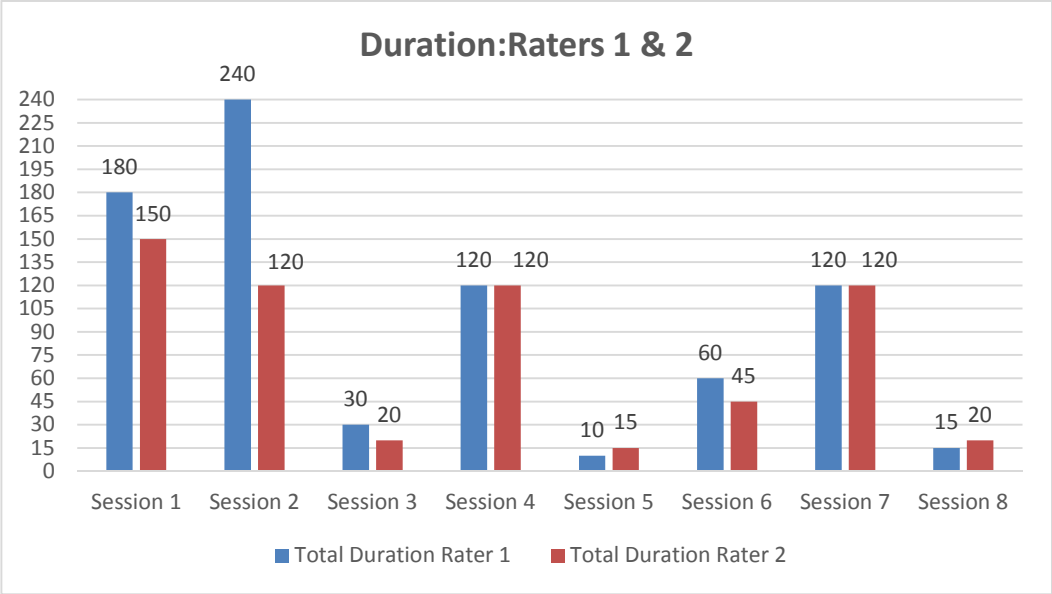
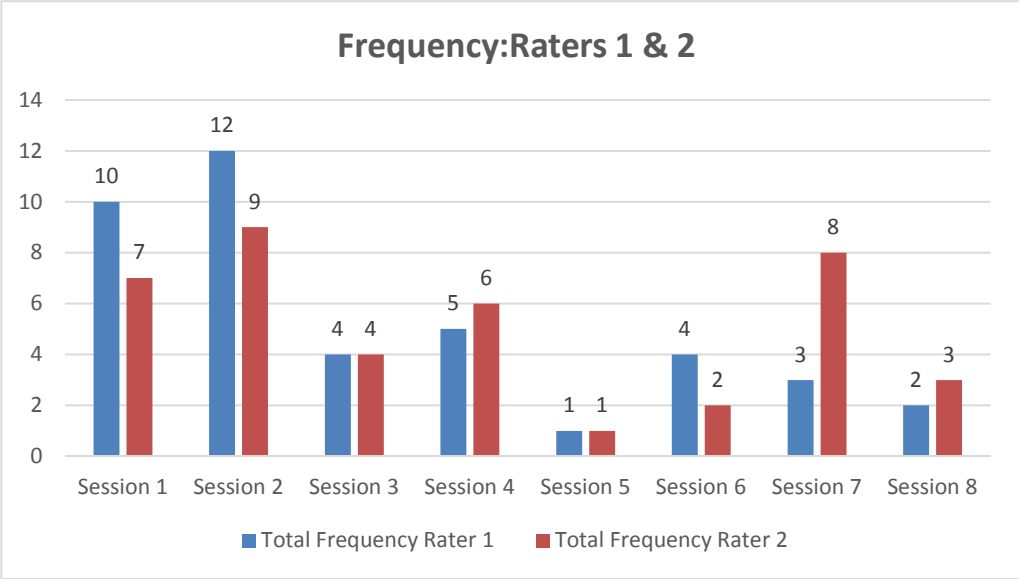


Table 5: *Frequency of Rater 1 and Rater 2*



The crosstabulation of raters 3 and 4 for duration indicate Cohen's Kappa *k* as 0.692 (69%), or as substantial agreement, while $p < 0.5$ highlights the significant agreement between raters 3 and 4 for duration of negative behaviors. The frequency between raters 3 and 4 represent *k* as 0.704 (70%), or as substantial agreement, while $p < 0.5$ reports the significant agreement between raters 3 and 4 in frequency of negative behaviors. The duration and frequency of Raters 3 and 4 are reported below in tables 6 and 7.

Table 6: *Duration of Rater 3 and Rater 4*

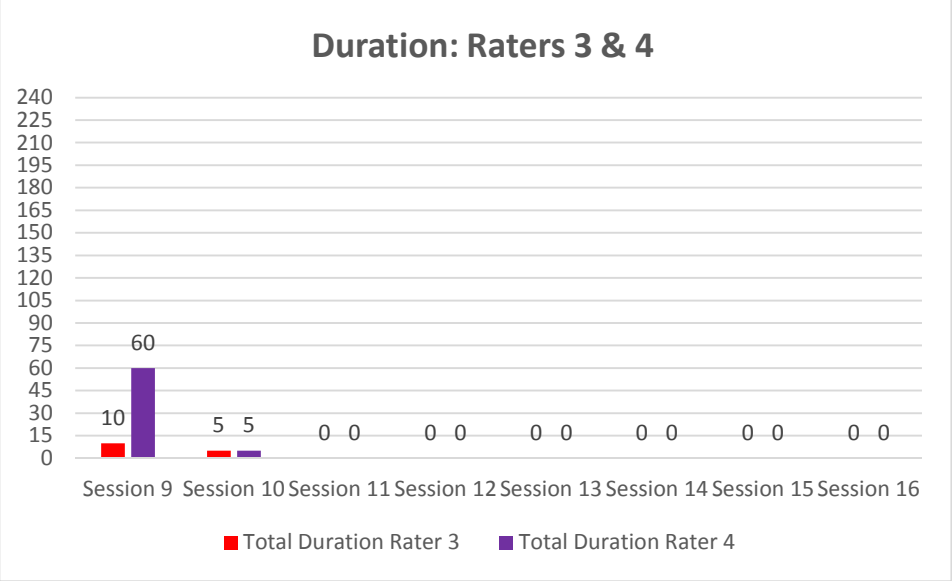
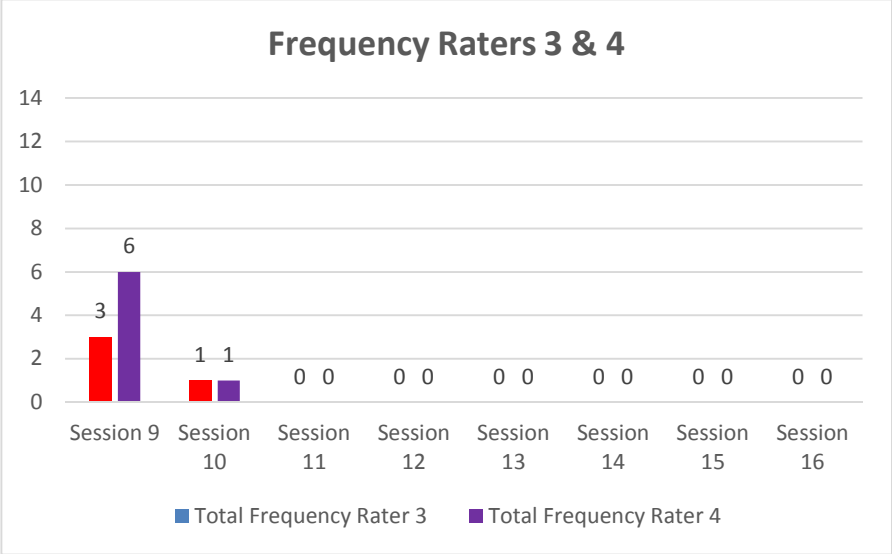


Table 7: *Frequency of Rater 3 and Rater 4*



Overall, raters 3 and 4 reported Kappa *(k)* a stronger agreement in both frequency and duration compared to raters 1 and 2. However, $p < 0.5$ provided significant agreement in raters 1 and 2, and also in raters 3 and 4. Even though the agreement was stronger in raters 3 and 4 in duration (k=0.692) and frequency (k=0.704), than in raters 1 and 2 in duration (k=0.357) and frequency (k=0.186), the *p-value* reported significant agreement in all raters in duration and frequency across the study. The p-value reported $p < 0.5$ in raters 1 and 2, and also raters 3 and 4 indicating the significant agreement in duration and frequency of negative behaviors in each data set. The table below (table 8) reports the overall findings between raters 1 and 2 and raters 3 and 4 in duration and frequency indicated in k and p values.

Table 8: *Inter-rater Reliability-Cohen's Kappa (k)*

Interrater-Reliability-Cohen's Kappa *(k)*		
	Cohen's Kappa *(k)*	**P- value *(p)***
Rater 1 & 2 Duration	0.357	$p < 0.5$
Raters 3 & 4 Duration	0.692	$p < 0.5$
Rater 1 & 2 Frequency	0.186	$p < 0.5$
Rater 3 & 4 Frequency	0.704	$p < 0.5$

Hypotheses

The purpose of this study was to understand the impact sensory stimulation interventions have on transitions for children with disabilities in aquatic therapy. This quantitative study collected data to analyze behavioral outcomes.

Hypotheses I

The alternative hypothesis stated the child will show decreased negative behaviors when transitioning after the sensory stimulation intervention in the pool, while the null hypothesis stated the child will show no change in behaviors in transitioning after the sensory stimulation intervention in the pool. Tables 5 and 7 indicate a decrease in frequency of negative behaviors observed during this study. The frequency of raters 1 and 2 (table 5) and the frequency of raters 3 and 4 (table 7) indicate a decrease of negative behaviors during transitions after sensory stimulation in the water. This data reports the findings of rejecting the null hypothesis.

Table 5: *Frequency of Raters 1 and 2*

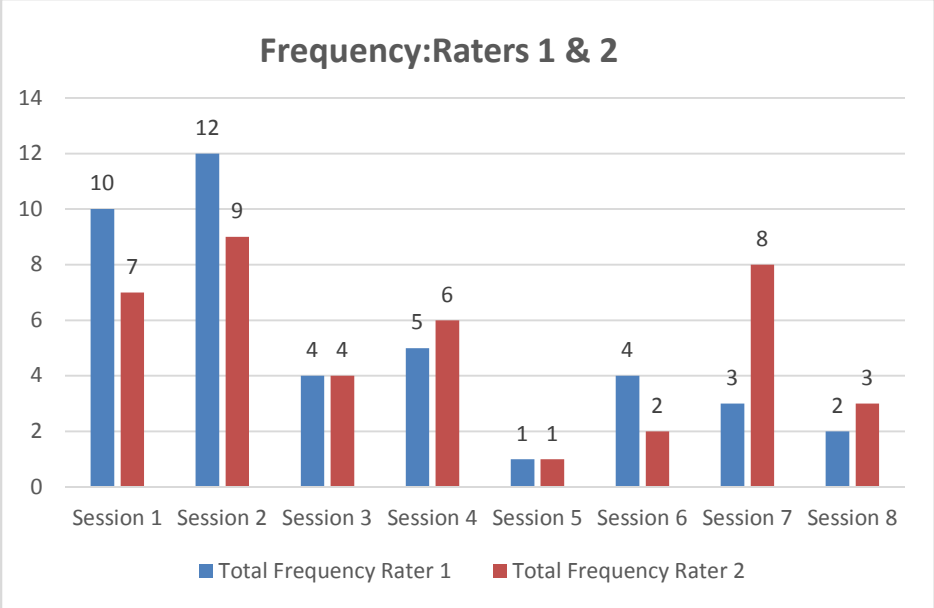
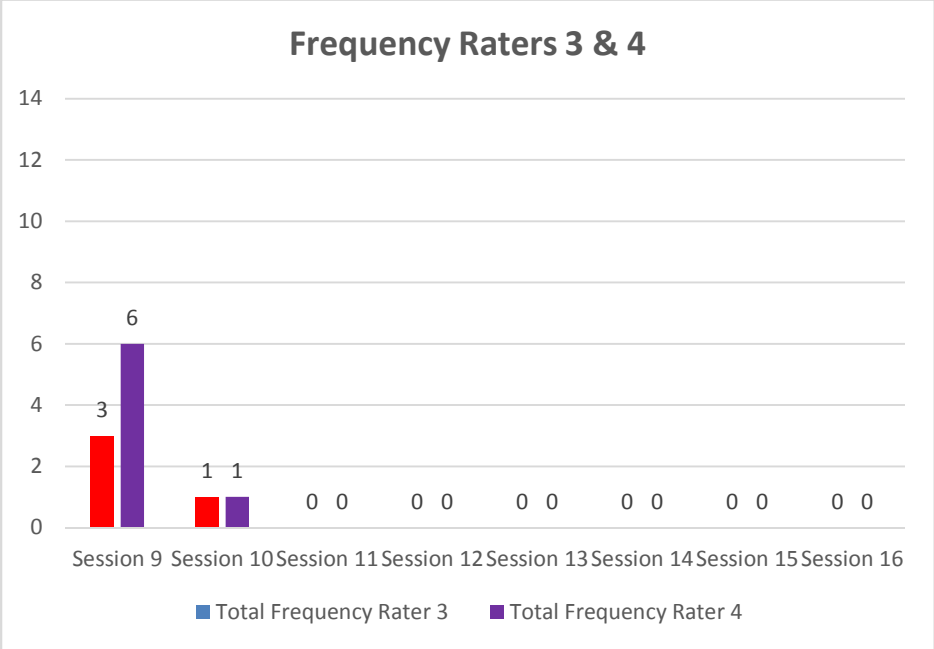


Table 7: *Frequency of Raters 3 and 4*



CHAPTER V

DISCUSSION

Introduction

The purpose of this study was to gain a better understanding of sensory stimulation interventions in an aquatic therapy setting. The main focus was to observe behavioral outcomes and the impact "agitator jets" have on transitions in a child with ASD. This will provide valuable information to both aquatic therapy settings and individuals with ASD.

Significance of the Study and Practical Implications

The significance of this study provides insight into transition difficulties for individuals with ASD and a way to decrease negative behaviors seen when transitioning from task to task. The horizontal transitions are shifts that usually occur on a daily basis. Individuals with ASD commonly have difficulty with these types of transitions. This type of transition is usually unpredictable, which may cause confusion and anxiety for children with ASD (Stoner et al., 2007). Individuals with ASD often have more trouble shifting from tasks or routine changes. This may be caused due to the need for predictability in routines, understanding upcoming tasks, or difficulty adjusting when a pattern of behavior is disrupted.

Transition strategies are implemented to support individuals with ASD during transition points in activities or routines. These techniques are often utilized before a transition occurs, during a transition, or after a transition and are presented verbally, auditorily, or visually. Transition strategies offer predictability for individuals with ASD and promote positive routines around transitions (Hume, 2008).

If individuals working with children with ASD in therapy, schools, classrooms, etc. can find ways to provide a transition period for individuals with ASD then there may be a positive impact in decreasing negative behaviors often seen when transitioning to tasks throughout the day. Understanding the need for transition time provides improved planning strategies for professionals working with individuals with ASD. A child's strengths, weakness, and tolerance play a role in implementing a useful transition plan unique to each child. Understanding and identifying a child's needs provided successful outcomes in overcoming barriers (Stoner et al., 2007).

The use of Sensory Stimulation in an aquatic environment provides the use of "agitator jets" to be utilized to gently stimulate the senses before a transition occurs, as shown in this study. This intervention emphasizes stimulating a particular sense that increases the likelihood of a desired outcome, such as alertness, behavior change, verbalizations, or relaxation (Porter, 2016). While this study was conducted in an aquatic setting with "agitator jets", the use of transitions and sensory stimulation could be carried over into a variety of land-based settings. The use of Sensory Stimulation therapy promotes engagement in structured session activities, while also motivating the individual to continue the activity engagement in settings outside of therapy. This repetitive engagement offers additional therapeutic stimulation to be used and carried over to strengthen skills in other settings (Porter, 2016).

Future Directions

This study highlighted one participant's behavior in an aquatic environment and the behavioral outcomes in transitions using agitator jets in the pool. This case study focused on one individual who was diagnosed with ASD and the trouble he had transitioning from one task to the next. Future studies may include more individuals who share a similar diagnosis of ASD and the trouble transitioning throughout the day. This increase of participants may provide a broader range of behavioral outcomes seen, transition difficulties, and other adverse signs and symptoms of those with ASD when transitioning. This increased scope of individuals with ASD may provide future knowledge into new ways and techniques to improve behavioral outcomes of individuals with ASD that may have trouble transitioning.

This study may also provide a new avenue of future research in utilizing sensory stimulation techniques used in the pool with the "agitator jets" to then be carried over outside the pool, such as the classroom or other settings. The use of "agitator jets" in this study is limited to an aquatic setting, therefore this type of sensory stimulation can only be replicated in the pool. However, sensory stimulation techniques may be adapted and utilized in a variety of ways to incorporate and activate the sensory receptors in the body in response to transition times. Future research may provide new sensory techniques that can be utilized outside of the pool and still be beneficial in decreasing negative behaviors seen in individuals with ASD when transitioning. One method of sensory stimulation that may be utilized outside the pool is the use of sensory stimulation rooms, often called multi-sensory stimulation rooms. These classrooms provide a variety of stimulating interactions and objects for individuals to interact, look at, and play with. This type of sensory stimulation room may be an avenue for future research when understanding transitions and behavioral outcomes in individuals with ASD (Lorusso & Bosch, 2018). These future directions will increase the knowledge and research-base on individuals with ASD and

transition difficulty. It may provide further insight into new ways in which to adapt sensory stimulation techniques in a variety of settings.

Conclusion

Individuals with ASD show impairments in behavioral, social and communication domains**.** The purpose of this study was to gain a better understanding of how this behavioral domain affects individuals with ASD and the ways in which they transition. Sensory stimulation interventions in an aquatic therapy setting were utilized to observe those behavioral outcomes and the impact "agitator jets" have on transitions. This study adds to the limited research on transition difficulties and those diagnosed with Autism Spectrum Disorder (ASD). Transitions are a daily part of the day and used in every setting and should be prioritized to improve functioning and decrease negative behaviors seen in individuals with ASD. Future research should add to the need of transition planning and sensory techniques used to better assist behavioral outcomes in individuals with ASD in various settings.

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APPENDICES

Oklahoma State University Institutional Review Board

Application Number:	IRB-21-78
Proposal Title:	Sensory Stimulation and Transitions in Pediatric Populations with Disabilities
Principal Investigator:	Brittany Dao
Co-Investigator(s):	Carlie Morris, Tim Passmore
Faculty Adviser:	Tim Passmore
Project Coordinator:	
Research Assistant(s):	

Status Recommended by Reviewer(s): Approved

Study Review Level:	Expedited
Modification Approval Date:	12/01/2021

The modification of the IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46. The original expiration date of the protocol has not changed.

Modifications Approved:
Modifications Approved: extend the intervention to 30 weeks of sensory stimulation interventions

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are available for download from IRBManager. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved.
2. Submit a status report to the IRB when requested
3. Promptly report to the IRB any harm experienced by a participant that is both unanticipated and related per IRB policy.
4. Maintain accurate and complete study records for evaluation by the OSU IRB and, if applicable, inspection by regulatory agencies and/or the study sponsor.
5. Notify the IRB office when your research project is complete or when you are no longer affiliated with Oklahoma State University.

Sincerely,

Oklahoma State University IRB
223 Scott Hall, Stillwater, OK 74078
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VITA

CARLIE RENEE MORRIS

Candidate for the Degree of

Master of Science

Thesis: THE IMPACT SENSORY STIMULATION INTERVENTIONS HAVE ON TRANSITIONS FOR CHILDREN WITH DISABILITIES IN AQUATIC THERAPY

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Completed the requirements for the Master of Science at Oklahoma State University, Stillwater, Oklahoma in December, 2022.

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