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Abstract

Objective: This study examined the effect of reducing sensory stimulation in the external environment alone and in the presence of higher functioning peers on play behaviors of children who have a neurodevelopmental disability.

Method: A Multi-Sensory Environment (MSE) was used to manipulate the intensity of sensory stimulation in the external environment during playgroup sessions. In cohorts of children with developmental disabilities, the intensity of sensory stimulation was reduced after baseline sessions. In separate cohorts, intensity was reduced in sessions after higher functioning peers had been introduced. The occurrence of desired and undesired behaviors was utilized to quantify engagement. Participants' sensory processing patterns were described using The Sensory Profile (Dunn, 1999).

Results: Reducing the intensity of sensory stimulation did not influence engagement in play, whether introduced alone or in combination with higher functioning peers. The average number of desired and undesired behaviors did not differ when the Reduced Sensory Stimulation condition was introduced following the Baseline condition. Similarly, the average number of desired and undesired behaviors did not differ when the Reduced Sensory Stimulation was introduced subsequently to the Higher Functioning Playmates condition.

Conclusion: Although the results of this study do not suggest that the reduction of sensory stimulation in the external environment does not enhance play behaviors in children with developmental disabilities, it also did not seem to interfere with play. Therefore, occupational therapy clinicians can utilize the strategy for individual clients according to their own clinical judgment. In this study, no other therapeutic strategies were employed. Future research is needed to establish whether reduction of sensory stimulation may be an effective therapeutic

strategy when used in combination with other interventions, in different settings, or with different populations.

Introduction

A developmental disability is one that is manifested before the age of 22 and affects normal development. This can include intellectual disabilities, neurodevelopmental disorders (formally pervasive developmental disorders), learning disabilities, hearing and visual impairments, and other neurological disorders (Center for Disease Control, 2012b). The prevalence of these disorders is rising and has become a major health concern. The Center for Disease Control (2012a) reports that over the last twelve years developmental disabilities have increased by approximately 17%, which represents about 18.1 million more children than the decade prior. Occupational therapy is commonly involved in the care of children with developmental disabilities. Occupational therapy services can be provided to children and their caregivers to maximize occupational performance in schools, outpatient settings, and within the home. This study seeks to contribute to guidelines occupational therapists may provide for the modification of children's play environments.

The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM), (American Psychiatric Association, 2013) provides the most recent detailed criteria for the different types of neurodevelopmental disorders (previously pervasive developmental disorders). Intellectual/cognitive disability (formerly mental retardation) is the term used when there are limits to a person's ability to learn at an expected level and function in daily life (Center for Disease Control, 2012c). There are two basic criteria for diagnosis: the intellectual level based on standardized testing and the ability to adapt to the demands of normal life must be impaired (Morrison, 2006). A diagnosis of intellectual disability must be given before the age of 18. The primary causes for an intellectual disability include genetic abnormalities, chemical effects, structural brain damage, inborn errors of metabolism, and childhood disease (Morrison, 2006).

There can be a large difference in severity between individuals. The level of intellectual disability can range from mild to profound or be unspecified. An intellectual disability could cause a child to learn and develop more slowly than other children of the same age. It could take longer for a child with an intellectual disability to learn to speak, walk, dress, or eat without help, and he/she could have trouble learning in school (Center for Disease Control, 2012c). The ability to perform daily occupations is affected in many ways.

Neurodevelopmental Disorders (previously referred to as Pervasive Developmental Disorders) is a term that describes multiple diagnoses that are characterized by global developmental delays, particularly in communication and social interaction (Smith-Case, 1999). Children previously diagnosed with Autistic Disorder, Childhood Disintegrative Disorder, Asperger's Disorder, and Pervasive Developmental Disorder Not Otherwise Specified, will now have a diagnosis of Autism Spectrum Disorder (ASD) within the Neurodevelopmental Disorders diagnostic category of the DSM-V (American Psychiatric Association, 2013). The term spectrum is used to describe the wide range of symptoms that are involved (National Institute of Mental Health, 2011). According to the DSM-V, Autism Spectrum Disorder is characterized as persistent deficits in social communication and social interaction across multiple contexts, restricted and repetitive patterns of behavior, and has symptoms that cause clinically significant impairment in social, occupational, and other important areas of functioning (American Psychiatric Association, 2013).

Autism spectrum disorder is increasing faster than any other developmental disorder, and it is currently estimated that 1 in 88 children in the United States have been diagnosed as having autism spectrum disorder (Center for Disease Control, 2012a). In 2010, the Center for Disease Control reported that the median age of receiving the diagnostic label of autism is between 4.5

and 5.5 years, but more than fifty percent of individuals had developmental concerns prior to that age. Improved accuracy in defining the diagnosis, and improved awareness of the signs and symptoms among physicians and parents, has led to autism being diagnosed at a younger age (Atchison & Dirette, 2012).

Research is currently being done to find the cause of autism spectrum disorder. The primary cause is thought to be genetics. Schaefer and Mendelsohn (2008) concluded that results of population studies are consistent with inheritance of autism. A family that already has a child with an autism spectrum disorder diagnosis is 2-18% more likely to have a second child with autism spectrum disorder, and the percentage is even higher for a diagnosis of a third child once two children are diagnosed (Center for Disease Control, 2013). Yet, no single gene has been specifically linked to autism with reliability, rather the disorder is believed to be polygenic (Hertz-Picciotta, Croen, Jones, Van de Water, & Pessah, 2006). Along with genetics, there has also been research done on the environmental contribution to autism. There is less known about this aspect, because of the varying types of factors that could potentially contribute (Hertz-Picciotta, et al., 2006).

Miller-Kuhaneck (2004) suggested that the range of play preferences for children with autism might be restricted, and they may demonstrate unusual ways of occupying their time. There are several ways in which the play of children with autism differs from the play of typically developing children. It is common for children with autism to be completely immersed in play with one toy or object for an extended amount of time. They will frequently play alone; however, they may want to engage in play with other children, yet may have difficulty managing the social complexity required to do so (Miller-Kuhaneck, 2004).

Researchers have reported that children and adolescents with autism spectrum disorders respond to sensory experiences differently from peers without disabilities (Tomchek & Dunn, 2007). In their study of children with and without autism, Tomchek and Dunn (2007) reported there were consistent patterns of inattention/distractibility, sensory seeking, auditory sensitivity, and tactile sensitivity in children with ASD. These findings imply that children with ASD process external stimuli differently than normally developing children. Due to this, individuals with ASD may seek sensory stimulation from the environment in order to calm themselves (Stadele & Malaney, 2001). This may present as self-injury or repetitive movements. Self-injurious behavior can include hitting themselves, biting their fingers or lips, and hitting their head against something within their surrounding environment (Miller-Kuhaneck, 2004). Repetitive movements can include echolalia (repetitive speech with meaningless or irrelevant content), hand movements, body rocking, and unusual object manipulation (Linderman & Stewart, 1998). These behaviors can impact occupations of daily living and social development.

Duker and Rasing (1989) suggest that when children receive too much or too little sensory stimulation, according to their own sensory tolerances, inappropriate behaviors can result. They asserted that behavior change could be achieved by modifying sensory stimulation through redesigning the physical environment. In their study of children with autism, Baker and colleagues (2008) demonstrated associations between atypical sensory processing and behavioral/emotional problems. Results of their study indicated the presence of specific sensory processing impairments in the children with autistic disorder. Further, there were significant relationships found between sensory processing and social, emotional and behavioral function (Baker, Lane, Angley, & Young, 2008). Kahle (2011) hypothesized that when children were placed into an environment that met their sensory needs they would have more desired social

behaviors and decreased stereotypical autistic behaviors. These would lead to children being more observant and involved in peer play.

Changing sensory qualities of the environment can be achieved by using a Multi-Sensory Environment (MSE). An MSE can have visual, tactile, and auditory equipment. It is a designated space where stimulation can be controlled, manipulated, intensified, or reduced (Stadele & Malaney, 2001). In recent years Multi-Sensory Environments have been used with a variety of populations such as children with traumatic brain injuries (Hotz et al., 2006), individuals in mental health facilities (Teitelbaum et al., 2007), and individuals with dementia (Staal, 2012). Therapists can use a MSE to deliver sensory stimuli that are either relaxing or stimulating, making assessment and treatment of individuals with disabilities more successful (Stadele & Malaney, 2001). Influencing arousal level and behavior through the use of an MSE may be a tool to improve occupational performance. We hypothesize that in children with developmental disabilities, modifying the environment using a MSE will increase appropriate behaviors and decrease inappropriate behaviors.

Another technique for improving social and play behaviors which has preliminary evidence is the introduction of higher functioning playmates. Tanta and colleagues (2005) suggest that success in play enhances learning through the development of higher-order skills such as initiative. Both initiation and response to initiations made by a peer are important and desirable elements of interactive play. Unfortunately, not all children experience the positive play interactions that provide a foundation for social success. Play with peers has a long term impact on occupational performance. A parallel project to this study will test whether higher functioning peers introduced into a play situation will enhance social initiations and appropriate behaviors by children with developmental delays.

Because of the importance of play, it is critical that research explore the optimal combination of treatments. Therefore, the hypothesis of this study is that reduced sensory stimulation enhances play in children with developmental disabilities both on its own and when added to a peer model situation.

Methods

Study Design

This study used a counterbalanced experimental design reduced sensory stimulation alone and in combination with higher functioning playmates. There were two possible orders of session conditions (conditions are described below). Three sessions were held at each stage. Both sequences began with a baseline condition. In one sequence, reduced sensory stimulation was introduced in sessions following baseline and then subsequent sessions included incremental introduction of higher functioning playmates. In the other sequence, higher functioning peers were introduced in sessions following baseline and then subsequent sessions included incremental reduction of sensory stimulation. Participants were assigned to playgroups of three to four members.

Participants

For this study we recruited preschool-aged participants with a diagnosis of a developmental disability. Participants were recruited from the community. Participants were at least three years old and as old as six years of age, providing they had not yet begun kindergarten. Children with Trisomy 21 (Down Syndrome) and Cerebral Palsy were excluded from this study. Demographic information was gathered about the participants, including diagnosis, age, gender, age and gender of siblings, race and origin, and socioeconomic status.

MSE

The research playgroup sessions took place within a planned Multi-Sensory Environment (MSE). The MSE included equipment that could be manipulated by the researchers (Refer to Appendix B for pictures). The equipment was created to stimulate all of the primary sensory systems when turned on. The equipment is specifically designed to meet the needs of the users. Visual, auditory, tactile, olfactory, and proprioception are the primary sensory stimuli that this equipment was designed to deliver. Equipment included bubble tubes with lights that changed color, fiber optic light strands which also changed color, vibrating chair synced to music playing, kaleidoscope lights on the ceiling, ball pit, lighted marble wall, and a wall of toys for tactile stimulation. Olfactory stimulating equipment was not used for the sessions. Also, a climbing wall was built in the room, however was not used for safety reasons. Within the MSE there were also preschool toys for the participants to play with, including storybooks, building blocks, and toys for pretend play. Pretend play toys included plastic food, plastic silverware, musical instruments, and action figures. An example of pretend play may include preparing a meal with the plastic food to cook and then using the plastic silverware to eat the pretend meal.

Conditions

Baseline. In the Baseline condition, all of the sensory equipment was turned on and all of the toys were visibly displayed.

Reduced Sensory Stimulation (RSS). In this condition, the same equipment was present in the room; however, upon the entry of the participants, the equipment was turned off and toys were stored in bins with picture labels. The participants (and playmates, when relevant) were able to activate equipment (or request that it be activated) and remove toys from bins for playing as they desired.

Higher Functioning Playmates (HFP). In addition to the participants, we recruited typically developed peers aged four to five years. In advance of study sessions, the peers attended an orientation session in which they were provided with hands-on instruction and practice in initiating play and responding to initiations to play with others (see below). During sessions in the *higher functioning playmates* condition, at least one of these peers attended. They were cued to initiate play with participants and reminded to respond to attempts to initiate play made by participants through the use of a nonverbal signal. Higher functioning peers were cued to initiate play with participants who have not been engaged in play with others for at least five minutes.

Measures

Sensory Profile. The Sensory Profile (Dunn, 1999) was designed to assess a child's sensory processing It is a questionnaire that is filled out by the parent or legal guardian. The questionnaire describes a child's multiple responses in various sensory experiences. The Sensory Profile is scored and gives the professional information about the child's performance strengths and barriers in sensory processing (Dunn, 1999). Cronbach's alpha was calculated to examine the internal consistency for each section, resulting in a range from .47 to .91 (Dunn, 1999). For the construct validity and convergent validity for the Sensory Profile, scores compared well to the School Function Assessment (Dunn, 1999).

Playgroup behavior observation sheet. To capture a description of participants' play and social behaviors during playgroups, we compiled a set of dependent variables with operational definitions (See Appendix A). Compilation of this set of behaviors was influenced by a review of the literature (Cohen & Pressman, 2006; Charlop, 1983; Atchinson, & Dirette, 2012; Weiss-Roberts, Hoop, & Heinrich, 2010; Miller-Kuhaneck,2004). To allow a range of

outcomes, we have included both desirable and undesirable behaviors. The first draft of these behaviors was critiqued by 10 specialists (occupational therapists, a physical therapist, a special education professor, and an early childhood education professor). After reviewing the feedback from the specialists, the behaviors and definitions were adjusted accordingly. We then assessed the utility of the set of behaviors by using it to assess play and social interaction in a videotaped playgroup session. As finalized, this measurement tool was used to quantify occurrence of desired and undesired social behaviors during sessions.

We assessed the inter-rater reliability of the behavior observations. Inter-raters were instructed in the definition of behaviors and shown examples from video. Researchers then rated videos until they demonstrated 90% agreement. Finally, both researchers independently rated a random 10% of the research video. Inter-rater reliability is reported as the linearly weighted Cohen's Kappa statistic. For the desired behaviors, the linearly weighted Cohen's Kappa statistic was 0.88 (excellent agreement), and 0.99 for the undesired behaviors.

Procedures

Participants. Prior to the playgroup sessions the participants and parents came to the facility for a pre-visit. During this visit the informed consent was reviewed and signed by the parent or legal guardian. Participants were asked for verbal assent at the beginning of each session, and this was documented by a researcher. The history and demographic information about the participant was also obtained. The Sensory Profile was reviewed and filled out in its entirety by the parent or legal guardian. All information taken about the children was kept confidential. Following the paperwork the participants and family members were given a tour of the facility.

Higher functioning playmates. Parents/legal guardians were asked to provide informed consent for each playmate. Playmates were asked for verbal assent at the beginning of each session, and this was documented by a researcher. Playmates attended a training session. In this session, their caregivers were oriented to the study facility and the higher functioning playmate protocol. The playmates were allowed to explore the play environment in free play for 20-30 minutes while their caregivers reviewed paperwork with the researchers. Then the playmates were gathered for hands-on instruction. This instruction was led by a researcher and included reading a storybook about children who are differently abled, discussing the importance of making friends and "being nice", along with practicing their ability to invite others to play and responding to invitations from others to play.

Playgroup sessions. When a playgroup was full, researchers worked with families of participants and playmates to schedule sessions. Two researchers were present for each session. There were nine sessions for each group, three in each condition. Caregivers were asked not to bring their children to playgroup feeling hungry. Each session began with a 10-minute portion in which the participants (and playmates, when relevant) arrive, drop off personal belongings (such as coats), use the restroom under their caregivers guidance as needed, enter the play room, and separate from their caregivers. Subsequently, the participants (and playmates, when relevant) engaged in free play for a period of 35 minutes. Participants were allowed to engage as they wished within the environment, provided they maintain their safety and the integrity of materials in the environment. Researchers provided redirection and suggested alternative play opportunities when children engaged in behaviors that could result in injury to themselves or others. Researchers responded to any initiation attempts on the part of the participants and attempted to invite playmates into the interaction. Five minutes before the end of the free play

portion, one researcher announced that the session would end in five minutes. Children were then released to their caregivers. In total, sessions lasted 45-50 minutes. Caregivers were able to observe playgroup sessions through closed-circuit television. Playgroup sessions were videotaped from multiple locations in the room to allow for subsequent offline data analysis.

Data Analysis

In order to be included in data analysis, the participants would miss not more than three playgroup sessions. Social and play behaviors during playgroups were quantified for each participant using the observation sheet in Appendix A. The first five minutes of the free play periods were not used for data collection, but rather as acclimation time for the participants. Each participant's behavior was observed for each of the remaining minutes of the 30-minute playgroup session. For each minute, raters marked any behavior observed from the set of behaviors defined on the observation sheet. The number of marked instances of desired and undesired play behaviors was totaled. As there are ten desired behaviors, the maximum score could have been 300; and with six undesired behaviors, the maximum score could have been 180.

The dependent variables used for this section of the research were referred to as play behaviors. The desired play behaviors included purposeful vocalization or verbalizations, social communications, positive affect, exploring environment, observing, solitary play with toy or object, sharing objects or experiences. The negative play behaviors include echolalia/ self-stimulation, negative affect, avoidance, and purposeful destruction of materials.

Scores for the first session in each condition were considered acclimation scores and were not entered into data analysis. Scores for the second and third session in each condition were

averaged to represent participants' social and play behavior in that condition. This allowed for individual variability in children's behavior from day to day.

The data was assessed for normalcy and parametric analysis was utilized. The first hypothesis, the difference in behaviors between the Baseline and the Reduced Sensory Stimulation sessions, and the second hypothesis, testing the incremental benefit of reducing sensory stimulation after introduction of higher functioning playmates, were both tested using paired t-tests to compare mean scores for desired and undesired behaviors. Significance was determined with an alpha of 0.05 adjusted to 0.0125 to account for performing four t-tests between this study and the parallel study.

Results

A total of 16 participants were consented to participate in this study. Of those 16, 14 participants attended sufficient sessions to be included in data analysis. Of the 14 participants, three were female and 11 were male ranging in ages of three to six years old. In regards to ethnicity, 11 of the participants were Caucasian, one African American, and three participants were of mixed race. The diagnoses of the participants varied. Primary diagnoses included Sensory Processing Disorders, Developmental Delay, Autism Spectrum Disorder, Goldenhar's Syndrome, and speech / communication delays due to cleft lip / lip pit. Secondary diagnoses included apraxia, anxiety, Obsessive Compulsive Disorder, Attention Deficit Hyperactivity Disorder (ADHD), and sensorineural hearing loss.

The parent/legal guardian completed a Sensory Profile, which was scored by the researcher. The sensory profile was scored in four quadrants; low registration (behaviors such as missing stimuli or slowed responses), sensation seeking (identifies responses and characteristics such as pursuit of sensory stimuli), sensory sensitivity (identifies responses such as distractibility

and discomfort with sensory stimulation), and sensation avoiding (identifies responses and behaviors such as deliberate acts to reduce or prevent exposure to stimuli and make exposure more predictable) (Adolescent/Adult Sensory Profile,2008). By comparing their scores against the normative distribution, the participants were classified as either typical, probable difference/more than others, or definite difference/more than others within each of those four quadrants which were described above. Refer to Table 1 for quadrant results.

To test the hypothesis that reduced sensory stimulation enhances play in children with developmental disabilities, we compared the occurrence of desired and undesired behaviors in the baseline sessions to those in sessions where sensory stimulation was reduced for participants in the two groups of children who were randomized to this order of conditions. The average number of desired behaviors did not differ when the Reduced Sensory Stimulation was introduced following the Baseline condition (69.0±6.2 Baseline, 71.7±12.1RSS, n=14, p=0.5, see α in Figure 1). Similarly, the number of undesired behaviors did not differ when the Reduced Sensory Stimulation was introduced following the Baseline condition (2.4±2.8Baseline, 2.0±1.6 RSS, n=14, p=0.7, see α in Figure 2).

To test whether reducing sensory stimulation is effective after higher functioning peers have been introduced to the group, we compared occurrences of desired and undesired behaviors in sessions with peers to subsequent sessions where sensory stimulation was reduced. The average number of desired behaviors did not differ when the Reduced Sensory Stimulation was introduced subsequently to the Higher Functioning Playmates condition (55.1±14.0 HFP, 54.9±9.8 HFP/RSS, n=14, p=1.0), see β in Figure 1), nor was there a decrease in undesired behaviors subsequent to the Higher Functioning Peers condition (7.6±8.2 HFP, 9.1±8.2 HFP/RSS, n=14, p=0.7, see β in Figure 2).

Discussion

This research study assessed whether reduced sensory stimulation enhances play in children with developmental disabilities and whether reducing sensory stimulation is effective after higher functioning peers have been introduced to children's playgroups. The hypotheses were not supported by data analysis. As can be seen in the analysis of the data, reducing stimulation did not have a significant effect on the play behaviors of the children involved in the study. The average number of desired behaviors did not increase when stimulation was reduced. There was also not an increase in desired play behaviors when stimulation was reduced after higher functioning peers were introduced into the play sessions.

The participants had a range of sensory processing patterns, as evidenced by their Sensory Profile scores (Table 1). The researchers observed that some children displayed changes in behaviors when stimulation was decreased, while some children seemed to prefer the baseline condition. For some of the children who regularly displayed repetitive behaviors in a reduced stimulation environment, it was observed that those behaviors were not as frequent when the equipment was on. However, they were also less likely to participate in group play due to their attention being placed on the equipment. For the children who had sensory sensitivity, the reduced stimulation resulted in less negative play behaviors. However, statistically these observed changes were not found to be significant. This implies the need for future research and that the sensory needs of children with neurodevelopmental disabilities are very specific.

Also, this specific research project was based on the concept of free play, rather than structured playgroups. The children were not directed by the researchers, unless intervention was required for safety concerns. There may have been a difference in behaviors if the researches provided more structure and modeling for the children. The higher functioning peers did provide

some modeling during play sessions when they were present, but there was not a difference in behaviors found when higher functioning peers were introduced. These should be considered for future research.

Throughout the completion of this research project, there were no negative effects noted when sensory stimulation was reduced. Occupational therapists are trained to make changes based on the needs of the child being treated. Reducing sensory stimulation is appropriate if it fits the need for the child. Changes in behavior were observed during play session, but there were no lingering effects for the children involved.

Limitations

A possible limitation for this study may have been human error. Videos were analyzed by researchers, so there is the possibility of errors being made during this process. Two researchers collected data and there may have been subtle differences in procedures when data collection was being done (camera positioning, equipment and toy placement, verbal cues to participants).

This research study could be prone to a Type II error, due to individual differences and small sample size of 14 participants. Additionally, there may have been other contributing factors that could have led to a Type II error. Due to unforeseen changes at the facility in which these sessions took place, data was unfortunately lost. The footage from the internal cameras within the multi-sensory environment was only accessible by staff of the facility. It became unavailable to us, due to changes in staffing at the facility. The internal cameras supplied a primary view of the multisensory room. Some children involved in the study would spend a majority of time outside of the views that were available to us with our own removable video cameras. This resulted in the researchers being unable to document what behaviors the children were engaging in at that time.

Another possible contributing factor may be the comfort levels of the children within the groups. The groups were randomized and given specific conditions for the sessions. However, the overall comfort level of the children with the researchers and other children may have affected later sessions. It was observed that the children were more likely to leave their parents and engage in play with others as time passed.

Also, in order to meet the time frame for data collection, group sessions were not always done on the same day of the week. If not enough participants were available, another group was called and asked to complete a session. At times, groups completed multiple sessions within a week. Along with differing nights of the week, the groups were also joined by different higher functioning peers. Some peers were only able to join the participants on certain days of the week, so the peers varied. Also, some of the peers were siblings which may contribute to the participants behaving differently or being more apt to join in play with their sibling there. All of these circumstances may have contributed to the data results.

Future Research

Future research on this topic would be beneficial for occupational therapy practice. It may benefit future studies to concentrate on a sample of participants who have the same diagnosis and are similar in regards to sensory processing patterns. In future research it may also be beneficial to incorporate more structured play. In this research project the children participated in free play. It may be beneficial to incorporate therapeutic interactions with the children including, instruction, modeling, and positive reinforcement to enhance play behaviors.

Implications for Occupational Therapy

This study does suggest implications for the field of occupational therapy. The environment may have an impact on a child's play behaviors and social interactions with others.

Once children begin school, their response to the environment may have an impact on learning and participation. Specifically, children with autism spectrum disorder are all very different and have very specific needs, and it is important that those needs are met individually. An MSE can be used in various situations, based on what an individual child requires. An MSE can be used as a quiet and safe environment when the child is overstimulated. If a child is sensory seeking the MSE at the baseline condition could have an impact on meeting those sensory needs, and may decrease the occurrence of negative behaviors. Occupational therapists are trained to recognize what a child's sensory needs are and the use of the MSE can be beneficial in making the treatment session more successful.

Conclusion

Although results were not statistically significant, we can speculate that the environment and the presence of peers can have an impact on behaviors based on observation in the different environments. When children with disabilities, primarily autism, are placed in an environment that meets their sensory needs, it could result in decreased stereotypical behaviors and increased social interactions with peers. Placing children in an environment that fits their needs can ultimately have a positive impact on their lives and allow for them to engage in occupations in a positive way.

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Table 1 Sensory Profile Quadrant Results

N=14

	Registration	Seeking	Sensitivity	Avoiding
Typical	5	2	2	2
Probable Difference	3	1	4	4
Definite Difference	6	11	8	8

Figure 1

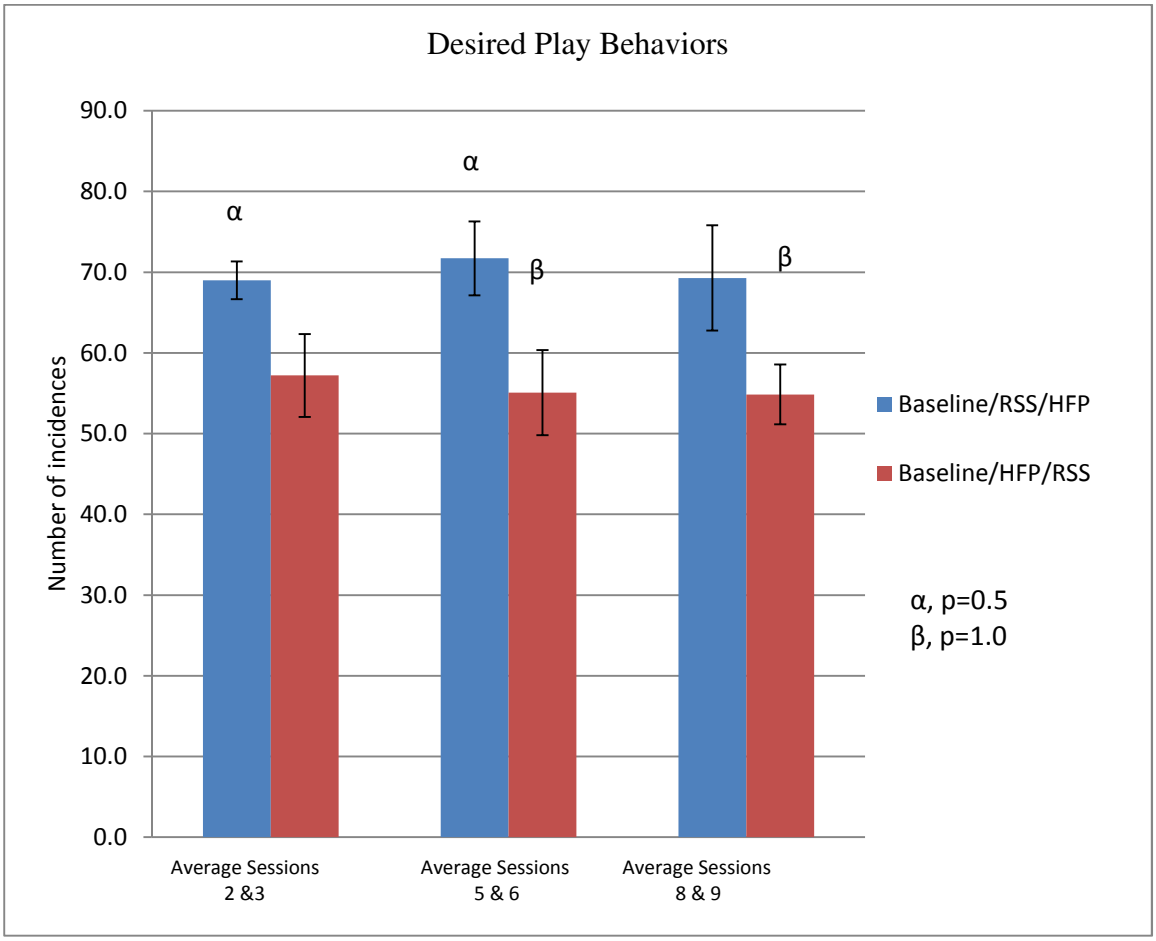

Figure 1 shows that the average number of desired behaviors did not differ when the Reduced Sensory Stimulation was introduced following the Baseline condition (α). Similarly, the average number of desired behaviors did not differ when the Reduced Sensory Stimulation was introduced subsequently to the Higher Functioning Playmates condition (β). The bar graph shows the mean and standard error across participants (n=14) after the number of behaviors from the second two sessions in each condition were averaged for each participant. The first session in each condition was not included in analysis. Differences were tested using a paired student's t-test.

Figure 2

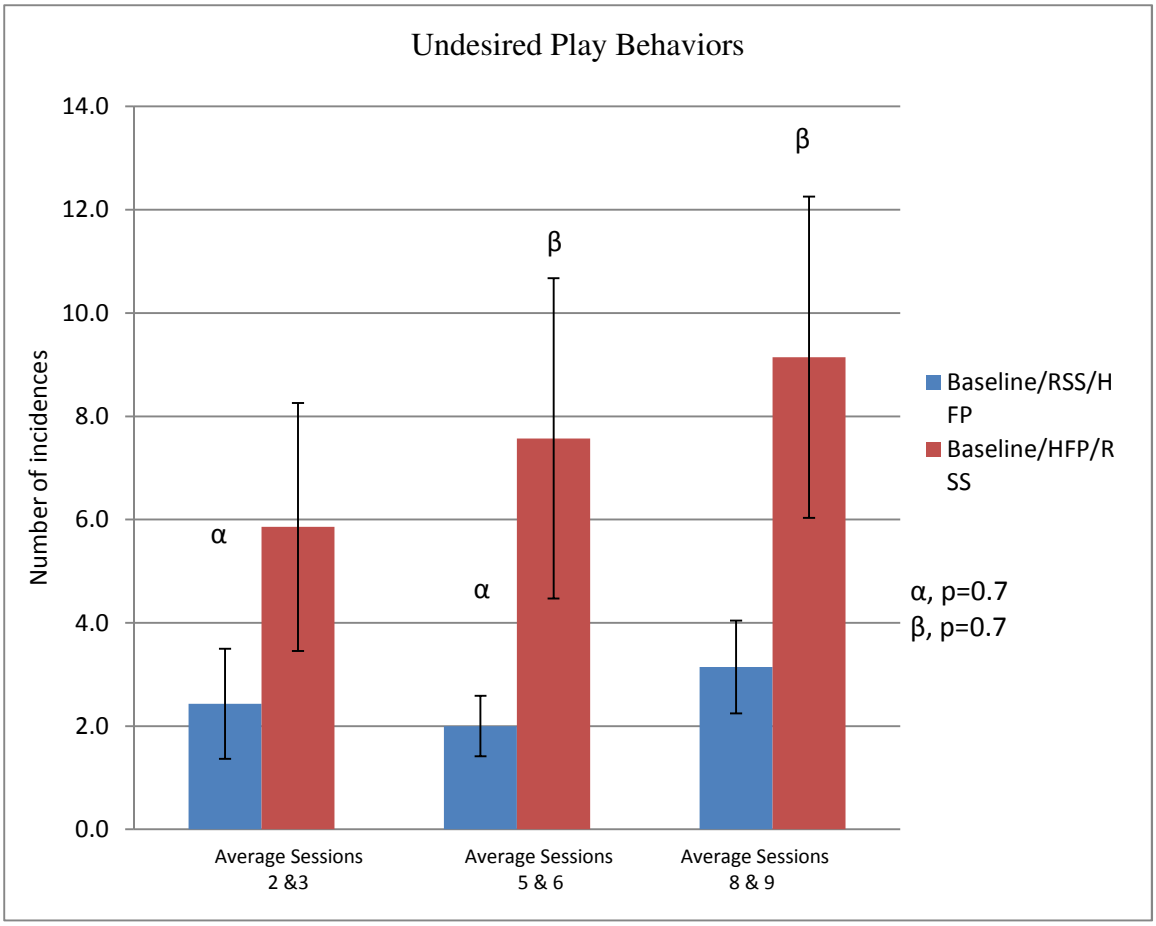

Figure 2 shows that the number of undesired behaviors did not differ when the Reduced Sensory Stimulation was introduced following the Baseline condition (α). Similarly, there was not a decrease in undesired behaviors subsequent to the Higher Functioning Peers condition (β). The bar graph shows the mean and standard error across participants (n=14) after the number of behaviors from the second two sessions in each condition were averaged for each participant. The first session in each condition was not included in analysis. Differences were tested using a paired student's t-test.

Appendix A

Definitions of behaviors

Purposeful vocalizations or verbalizations: The child makes sounds or speech that directly relates to the task the child is engaged in (examples include making engine sounds when playing with a car, talking to a stuffed animal, reading a book aloud)

Echolalia/self-stimulation: The child produces echoed speech or vocalizations that are not relevant to the context, the child engages in repetitive, apparently non purposeful delivery of sensory experiences to self for example, hand flapping, spinning, stimulate peripheral visual field, etc.

Positive Affect: The facial expression of the child reflects feelings that reflect a level of pleasure, such as happiness, joy, excitement, enthusiasm, and contentment.

Negative Affect: The facial expression of the child reflects emotions such as anger, anxiety, and sadness.

Exploring the environment- The child moves about the environment in an attempt to become familiar with it (is not focused on one specific task, but appears to be taking note of environmental elements, i.e. studying or observing them, is not engaged in repetitious movement, i.e. pacing, rocking, perseverating)

Observing The child watches activity in the environment including action of objects and peers (can include apparent use of peripheral vision).

On-task play: The child is actively engaged and focused on an activity

Solitary play with a toy or object: The child interacts alone with objects in the environment, includes activating toys, receiving stimulation from toys, holding a book & turning pages, playing with toys or game parts (excludes destruction).

Sharing objects or experiences: The child actively engages in or tolerates ongoing, simultaneous engagement in play or communication by **peer(s)**, this can include joint, cooperative play with a toy, turn taking games, singing songs together, listening to a story together, engaging in conversation together, or helping one another.

Avoidance: The child tries to keep away from someone or something in the environment. This can include walking away, turning away, closing eyes, or covering ears.

Destruction of materials: The child breaks or destroys materials in environment, or attempts to, excludes playful purposes. This includes knocking over towers uninvited, tearing papers or books, trying to unplug devices, etc.

Social Initiation: The child makes an observable effort **to start** a friendly or neutral interaction with a peer (does not include interactions that are already ongoing). This can include verbal statements (“let’s play”), r gestures like throwing a ball for someone to catch, reaching for or toward a peer, appropriate vocalizations, or inviting eye contact and/or facial expressions (excludes aggression).

Social Response: The child’s behavior is complementary to a peer’s initiation of interaction. The child can respond verbally or nonverbally to social stimuli directed toward him/her by peers (excludes aggression)

Imitating: The child does what others are doing, or attempts to.

Cooperation: The child follows instructions, agrees to the direction or suggestion of peers, or compromises with peers during decision making within shared experiences.

Uncooperative: The child does not follow instructions, agree to the direction or suggestion of peers, does not compromise with peers during decision-making within shared experiences, includes domineering of play.

Aggression: The child acts inappropriately toward other children, including kicking, yelling, hitting, forcefully taking materials from others, throwing objects at others, etc.

Appendix B

MSE Equipment