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Does vestibular sensory stimulation, in the form of slow, linear swinging, change the modes of communication among children with autism?

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Does vestibular sensory stimulation, in the form of slow, linear swinging change, the modes of communication among children with autism?

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Dedication Page

To my parents, these past two years could not have been possible without your love, support, and encouragement. I am deeply grateful for everything you have done for me. I would not be where I am today without you.

To my friends Megan, Darielle, and Kody, thank you for joining me on this journey and for always being there for me! I'm going to miss our long hours in the library (or HHS) discussing "thesis stuff."

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1.0 Abstract

The purpose of this study was to determine if children with autism receiving vestibular sensory stimulation (VSS) in the form of slow, linear swinging, had any change or progression in their modes of communication when compared to children with autism who received a free-play period (nVSS) during speech-language (SL) therapy. Over the course of therapy, each child's response mode was recorded as a gesture, vocalization, gesture + vocalization, or an utterance, and each mode was a dependent variable (DV) in this study. Participants who received VSS treatment were expected to have a greater improvement on the progression of modes, such as using fewer gestures and more vocalizations and/or utterances throughout therapy. There were 18 participants who had a medical diagnosis of autism and each participant was administered the VBMAPP to determine four goals to target during therapy. Participants were randomly assigned to the VSS or nVSS group and received four days of SL therapy for five weeks that consisted of four treatment work periods per session. Trained graduate clinicians counted the number of each communication mode per participant. The results indicated that there was no evidence to suggest that VSS or therapy had an effect on the modes of communication among children with autism. The findings suggested that there was no relationship that the therapy target of requesting incidentally affected communication modes among the participants in either group.

2.0 Introduction

Autism and Autism Spectrum Disorder (ASD) are described as a group of complex disorders of the brain development ("What is Autism," 2014). Individuals with ASD have social, cognitive, and communication impairments and the majority have stereotyped patterns of behavior (Watson, Crais, Baranek, Dykstra, & Wilson, 2013). Current research shows that the prevalence of ASD is significantly higher in boys, with boys having a 4-5 times greater chance of being diagnosed with ASD (Baio, 2014). Children are usually not diagnosed with autism until around age two or three because this is time when the symptoms tend to emerge. According to the Diagnostic and Statistical Manual of Mental Disorders-V, (DSM-V), persistent deficits in social communication and social interaction across multiple contexts are characteristics that are common for individuals with autism (*American Psychiatric Association,* 2013). The spectrum covers children with a range of severity from high functioning to children who require very little support to those who have severe challenges who require very substantial support.

Other hallmarks of ASD include lacking joint attention (JA), poor eye contact, and usually difficulty understanding facial expressions, intonation in people's voices, among other social cues. They also demonstrate deficits in verbal and nonverbal communication. Their speech and gesture use develops later than typically developing children and they use fewer gestures in the early months (Tager-Flusberg, Paul, & Lord, 2005). There is a lot of variability among children with ASD in regards to verbal versus nonverbal communication (Schoen et al., 2011). In the toddler years children may be nonverbal or verbal, with their degree of vocalizations varying. Some may have limited vocabulary and/or phoneme inventory, whereas others may have complex, multisyllabic

utterances (Wetherby, Prizant, & Hutchinson, 1998) that may or may not include nonverbal communication such as changes in facial expression (Schoen et al., 2011).

With proper treatment, a child with autism may be able to increase their language skills. However, many times multiple therapies are needed to help a child with autism make the most progress. A child may receive speech therapy, occupational therapy, and/or physical therapy. Speech therapy helps to increase their nonverbal and verbal skills so a child can communicate in more functional ways. Children with autism may be non-verbal or may be verbal but have problems with discourse, but speech-language therapy is designed to coordinate the mechanics of speech with the meaning and social use of language ("What Treatments are Available," 2014). Children with autism may also receive physical therapy to help them improve their gross motor skills, such as walking, so they can lead more fulfilling lives. Occupational therapy (OT) focuses on building fine motor movements as well as cognitive and physical skills so a child can experience more freedom and independence ("What Treatments are Available," 2014).

Speech-language therapy that may improve a child's language development can be critical since children with autism usually demonstrate developmental delays in communication. Therapy can help these children from falling further behind their typically developing peers. Children may begin to show developmental delays within the first year, such as lack of JA (Watson et al., 2013) which is defined as acts used to direct another's attention for purposes of sharing the focus on an entity or event (Bruner, 1981). Speech therapy focuses on many aspects of language which include producing gestures, sounds, and words, helping children understand nonverbal communication during conversations with others, and turn taking and interacting with others (Vann, 2010).

According to the DSM-V children with autism are usually hyper- or hyporeactive (over or under responsive respectively) to sensory input or unusual interests in sensory aspects of the environment. OT focuses on sensory integration (SI), since a child may struggle with processing sensory input, such as touch, movement, vision, smell, taste, or hearing. For example, they may have an adverse response to specific sounds or textures or excessive touching of objects (American Psychiatric Association, 2013). A. Jean Ayers researched the effect SI can have on a child's learning and behavior. Since children with autism or other developmental disorders such as cerebral palsy usually have trouble with SI (Bundy, Lane, & Murray, 2002), SI is believed to stem from a problem in the neurological processing of sensory stimulation from the environment (Hatch-Rasmussen, para. 2). This trouble of properly processing and interpreting sensations in the brain from stimulation to the body and the environment (Ayers, 1972a) can lead to problems with learning, development, and behavior (Kranowitz, 1998). Some children may have anxiety or have problems focusing since they are uncomfortable from being over or under stimulated. SI usually has an effect on the vestibular, tactile, and proprioceptive sensory systems. Movement through gravity – head tilts, posture, muscle tone, perception of motion, and head and eye movements – is included in the vestibular system (Bundy et al., 2002). A child with ASD may be hyper- or hyposensitive to vestibular stimulation. Some children that are hypersensitive may feel uncomfortable climbing stairs or on unstable surfaces, meanwhile others who are hyposensitive may seek intense sensory experiences such as swinging and spinning (Hatch-Rasmussen, para. 7). The tactile system includes input from touch, vibration, and pressure. Children with ASD that are sensitive to touch have excessive brain activity that makes it hard for the child to concentrate and it can lead

to negative emotions from touch sensations (Hatch-Rasmussen, para. 6). The proprioceptive system includes recognition of the body and its relation to space, such as perception of joint and body movements. If a child is not fully aware of his body positions, that child will most likely have problems with fine motor movements such as holding a pencil, which will have an effect on everyday life (Hatch-Rasmussen, para. 8).

In order to help children with problems processing sensory input, Ayers (1972a) proposed sensory intervention therapy (SIT), which is now considered sensory-based intervention (SBI). "Enhancing effective neurological processing and building a foundation for improved learning and function by developing the various underlying sensory systems are the primary goals of SIT" (Schooling, Coleman, & Cannon, 2012, p. 2-3). SBI can help control a child's response to sensory input and some studies have shown that it could have a positive effect on communication (Ayers, 1981). Physical activities such as swinging, jumping, playing with toys and sand, or pushing a heavy load can help to stimulate the sensory systems. Vestibular stimulation is usually used to modulate arousal, increase vocalizations, or facilitate postural tone (Baranek, 2002), since children with ASD have difficulty maintaining positions against gravity due to low muscle tone (*Postural Muscle Tone*, 2012). While there is still some controversy over SI and SBI, more research is being conducted to determine whether SBI yields any evidence base to produce effects on language development and behavior.

Children with autism usually have delayed communication, which includes gestures, when compared to a TD child. Children with ASD generally use more gestures to request wants, such as instances when the child directs an adult's hand to obtain an object or action. In general, children with ASD use fewer gestures than TD children

(Sowden, Perkins, & Clegg, 2007) and their babbling is delayed, which is a good predictor that their future language skills will be delayed as well (Tager-Flusberg, Paul, Lord, 2005). Factors such as JA and gesture use are good indicators of speech-language development, especially since there are so many word-learning opportunities, since children are starting to associate names to objects others are pointing to or looking at (Tager-Flusberg, Paul, Lord, 2005; Justice & Turnbull, 2008). While most TD children say their first word at 12 months, some children's first words do not emerge until later and they may be considered late talkers. However, they still may be able to achieve normal language levels around 4 years old (Singleton & Shulman, 2010, p. 52; Turnbull & Justice, 2008).

For TD children, a pattern usually exists for their language development, starting with the prelingual stages of their lives. TD children are able to engage in JA and respond to different facial expressions (Turnbull & Justice, 2008). They are able to begin understanding the difference between expressions and the meaning their caregiver is trying to convey. Infants also begin cooing and babbling, in addition to other early vocalizations around two to six months (Singleton & Shulman, 2010), which leads to more adult-like vowels and consonants around eight months. While a child is exploring his or her vocal cords, he or she is also communicating by gestures. Children use gestures in the first year, usually starting around seven months (Watson, et. al., 2013) to gain and maintain an adult's attention. Before a child reaches ten months, their behavior reflects social goals, which can include smiling, JA, or object-related goals, which may include gestures like reaching for an object. However, these two goals are not combined until later (Tomasello, 1988). Children may also start using gestures plus a vocalization, such

as a grunt, to signal what they want. Early gesture use is a good predictor of future vocabulary and language skill (Rowe & Goldin Meadow, 2009). After TD children say their first word, usually around age one, children start using gestures and vocalizations to communicate. A child is able to expand his or her language repertoire when he or she uses a vocal and a gesture since it usually elicits a response from an adult. At first, children are vocal about what they want and may point to it as well, which is characterized as a combination of a vocalization and a gesture. Differences usually exist between the gestures and utterance patterns of TD children and children with ASD of the same age. While TD children are able to point to an object they want, such as juice, and say "Mommy" at the same time, children with autism are more likely to engage in gestures that complement their vocalization. They will point to the juice and, if verbal, will say "juice" as well. This gestural use is a good indicator of a child's cognitive state (Capone & McGregor, 2004; Singleton & Shulman, 2010).

As children's gestural use is increasing and they begin to use more advanced gestures, they slowly begin to replace their gestures with utterances (Capone & McGregor, 2004). In addition, studies have shown that gesture and speech combinations are good indicators of sentence complexity in the future (Rowe & Goldin-Meadow, 2009). There is a strong correlation between the beginning of gesture-vocal use and the emergence of two-word combinations, which occurs around 18 months (Iverson & Goldin-Meadow, 2005). For children with ASD who are nonverbal, some may look for an increase in their gestures and vocals or vocals when compared to their amount of gestures to mark progress.

On the other hand, children diagnosed on the autism spectrum do not always follow a pattern for language development since individuals display varying symptoms of autism to different degrees (Watson et al., 2013). In addition, autism is not usually diagnosed until around two-three years old because each child develops language differently and sometimes at a different pace. This is the age where it is easier to classify the delays as a disorder. With that said, there are children with autism who are high functioning and others that may be low functioning, with many other children between the two extremes. Even though some children may be able to talk in complex sentences, others may be nonverbal but still be high functioning. There is no specific description as to what defines high or low functioning, especially since there are so many varying factors. Children with lower-function autism usually need support, like that mentioned in the DSM-V (2013). The DSM-V (2013) has three different levels to categorize a child: level 3, requiring very substantial support, level 2: requiring substantial support, and level 1: requiring support. Children who are high functioning, or "requiring support" based on the DSM-V usually can complete more independent actions in everyday life. Children in levels 1 or 2 can range from requiring assistance for feeding to trying to manage behaviors that result in tantrums. Children who require this extra support may be nonverbal or verbal as well, but their utterances may only be directed towards their daily needs (*American Psychiatric Association*, 2013).

The research question that is guiding this study is "Does vestibular sensory stimulation, in the form of slow, linear swinging change, the modes of communication among children with autism?" Over the course of two consecutive summer clinics, eighteen children (10 one summer and 8 the next summer) with autism were chosen from

a pool of applicants to participate in the original study that focused on whether vestibular sensory stimulation (VSS) improved communicative responding in young children with autism. The main objective of this current study is to determine whether the children's modes of communication incidentally changed over the course of therapy and see if VSS had an effect compared to the group of children who did not receive VSS (nVSS). Both groups received speech-language (SL) therapy but the nVSS group received 20 minutes of free play while the VSS group received 20 minutes of slow, linear swinging during a break. Over the course of therapy, each child's response mode was recorded as a gesture, vocalization, gesture + vocalization, or an utterance. These modes of communication were studied to see if VSS had an impact on the progression of responses used, where the target therapy was responding.

3.0 Methodology

The study was conducted over the course of two consecutive summers at the Summer Autism Clinic (SAC) at James Madison University Speech/Language/Hearing Applied Lab (JMUSLHAL). Each summer, ten children received Speech-Language (SL) treatment four days a week, three hours per day for five weeks. Half of the participants received vestibular sensory stimulation (VSS) in the form of slow, vestibular swinging for 4 of the 5 weeks. This created two groups that were randomly selected: an experimental VSS group and a control nVSS group. Each group received SL treatment that targeted responding behavior by trained first year SLP graduate clinicians.

3.1 Participants

The participants for the study were chosen from a pool of applicants to the SAC at JMUSLHAL. A general announcement to the local community about the availability of the SAC resulted in this sample of participants. All participants were required to have a medical diagnosis of autism, meet the age range criterion (3 years to 6 years), and have no diagnosed co-morbid conditions. The participants were then chosen on a first come, first serve basis from the pool of eligible applicants. Each participant was randomly assigned to a first-year SLP graduate clinician and was administered the Verbal Behavior Milestones Assessment and Placement Program (Sundberg, 2008) (VBMAPP).

3.2 VBMAPP

The VBMAPP (Sundberg, 2008) is a criterion-referenced assessment tool that is designed for children with autism and other developmental delays. The VBMAPP (Sundberg, 2008) contains five components which includes: VBMAPP Milestones assessment, Barriers Assessment, Transition Assessment, Task Analysis and Skills

Tracking, and Placement of IEP Goals. This test is used in public and private schools and in clinics all over the United States and Canada.

3.3 Goal Development

The clinicians used their participant's VBMAPP (Sundberg, 2008) individual results to create four goals that were created to target each participant's developmental level mode of communication, i.e. nonverbal or verbal. Each participant had a requesting and a responding goal that was targeted during therapy as well as two others that were specific to their individual needs.

3.4 SL Treatment Structure

Each participant received five weeks of SL treatment. Each day of SL treatment (20 days) consisted of four SL treatment work sessions. During the first week, that was a baseline, there was a 20-minute free play session after Work 1. For the remaining four weeks, the participants randomly assigned to the VSS group received VSS treatment instead of free play. The other participants (nVSS group) continued to have free play. The random assignment of the participants to receive VSS and those not to receive VSS was made *a priori* during the week preceding the beginning of the summer program. The standardized treatment materials included ball poppers, squishy balls, rapper snappers, and KaleidoGears. Each week the treatment materials were randomly assigned to work sessions 1 and 2.

During Work 1 clinicians focused on requesting behaviors and it provided a standard treatment focus that helped the participants adjust to the daily routine. During Work 2, SL treatment was provided based on the client's individual responding goal. Standardized treatment materials were presented in a specific order and used to elicit

responses, either verbal or nonverbal, from the participants. During Work 3 and Work 4 each clinician was required to provide SL treatment to the participant based on the goals created to work on the weaknesses based off of the results of the VBMAPP (Sundberg, 2008). Examples of goal skill areas were: motor initiation, visual perceptual, and play skills. Work 3 and Work 4 were not standardized sessions regarding materials and there was no strict adherence to a materials presentation schedule, but these sessions were standardized in terms of adherence to time.

3.5 VSS Treatment

Each participant randomly assigned to the vestibular SS group was required to sit on an unenclosed therapy swing and swing in a slow, linear direction at the end of Work 1 but prior to Work 2 The swing was suspended approximately six inches above a foam mat. While the participant was on the swing, the participant's clinician ensured safety, used minimum verbal interaction in order keep the dose of SL treatment to a minimum during this time, and redirected the participant to stay engaged in the VSS treatment if necessary.

3.6 Dependent Variable (DV)

The DV for the original study was responding behavior, however in this study, the interest was the modes of communication and whether they were vocal, gesture, vocal + gesture, or an utterance. The number of occurrences of each communicative mode was recorded. A gesture is operationally defined as a nonvocal behavior directed to another person that serves a communication function (Wetherby & Prizant, 1998). A vocalization was recorded if a participant used transcribable vowels that were used as a communicative act (Longerbeam, 2013). A response was marked as a gesture +

vocalization when a child used a verbalization in coordination with a gesture to communicate. In order for a response to be recorded as an utterance, the child may use a vocalization in which transcribable vowels were used as a communicative act, but it could not be used in conjunction with a gesture (Longerbeam, 2013).

3.7 Clinical Training

The first-year graduate students received training in the administration and scoring of the VBMAPP (Sundberg, 2008) in addition to the use of data sheets and specific goal writing. During the training the clinicians were observed by the researchers in order to make sure that test procedures were being followed accurately.

3.7.1 SL Treatment Training

The clinicians were trained to adhere to the standardized procedures of daily schedules and administration of treatment. In addition, each clinician participated in SL treatment training. This was done during a daylong training session that included a PowerPoint lecture and demonstrations from the researcher on different requirements, goal development, materials, schedules, and treatment strategies. The graduate clinicians were required to provide accurate feedback on the use of each document after the researcher demonstrated the use and development of weekly lesson plans. Goal development was also a main topic that was discussed using a PowerPoint demonstration and the VBMAPP Task Analysis and Skills Training components. Each clinician needed to analyze the child's VBMAPP Milestones assessment results and create goals that would be targeted in the lesson plans. The researcher reviewed the lesson plans.

Each clinician was also given proper instruction on the use of the standardized materials that would be used in Work 1 and Work 2. Each clinician had to demonstrate

that he/she understood how to present the materials to the clients, how to appropriately respond to the client, and reinforcement strategies. The clinicians were also trained how to appropriately elicit responses, how to collect therapy data, and different behavior management strategies.

3.7.2 VSS Training

The clinicians were properly trained on how to set up the swing as well as different swinging procedures to ensure that the client was safe but engaging in the VSS treatment appropriately. The clinicians were instructed not to give an SL treatment during this time, and talking was to be kept to a minimum – mainly to redirect the client to stay on the swing or to maintain safety. The clinician could not force the participant to stay on the swing.

3.7.3 Free Play Training

Free play was provided to all of the participants during the first week, but afterwards to participants who received VSS treatment did not continue with the free play period. The other participants were given the two toys that were used during Work 1. There was no SL treatment during this twenty-minute period and the only interaction allowed from the clinician was instruction to maintain the participant's safety.

3.7.4 Equipment Training

The clinicians were properly trained how to use the timer used for each Work and Play/VSS treatment period. Video recording also took place during the therapy sessions and the clinicians were properly trained how to use the Sony and Samsung video recorders.

3.8 Reliability

The Graduate Assistants (GAs) were properly trained for reliability coding. This included general orientation of the study, learning the time sampling procedure, practicing with and without the researcher, and recoding each other's segments at an agreement of 80% or more with each other and to the researcher. The GAs did not see each other's coding and coded 62 randomly selected segments, which were then compared to the gold standard and each GA and observer had a level of agreement over 80%. Intra-rater reliability and inter-rater reliability were examined and the researcher's initial ratings could be deemed trustworthy.

3.9 Validity

There are different types of factors that can affect validity, which would affect how the results can be relevant to the population and in real life settings. Subject bias, pretest sensitization, sample restrictions, measurement restrictions, and treatment restrictions can all restrict the generalizability of treatment research results.

3.10 Fidelity

For the original study, the researcher coded SL and VSS treatment using different scales to access fidelity. The different SL treatment elements evaluated were: duration, procedures, treatment, environment, and free play delivery. There were four elements coded for the VSS treatment fidelity: equipment, delivery, method, and duration. The results indicated good treatment fidelity overall.

3.11 Data Collection and Analysis

DVDs were labeled by date and given the participant code. The researcher reviewed the DVDs and counted the number of occurrences of each DV during two, 4 –

minute time segments during the first 20-minute work period and another two, 4 – minute time periods during work session 2. The data was collected in a table.

4.0 Results

The aim of this research was to investigate if sensory stimulation, in the form of slow, linear vestibular swinging would change the modes of communication among children with autism. In order to attempt to answer this main question, each participant's communication modes were analyzed by video review and counting the number of each communication mode per participant. The two groups, VSS and nVSS, were divided and each client's (a) gestures, (b) vocals, (c) gestures + vocals, and (d) utterances were organized in four different charts. When analyzing the data, it was expected that the each client would progress to using more vocals and utterances than gestures throughout the therapy and preliminary paired, two-tailed TTESTs were created to determine if any progression of mode could be considered significant. The data was analyzed and organized per participant as well as analyzed based on the two groups (VSS and nVSS).

The variance between the four different modes, VSS treatment versus nVSS treatment, and the relationship between therapy and time was analyzed using a repeated measures ANOVA test. The only significance among the data occurred between the types of communication modes since the resulting F value of 52.262 was significant at the $p=.005$ level. The results are shown in Figure 1. Figure 1 shows the total amount of responses for each mode of communication and compares pre VSS/nVSS to the total responses of each mode post VSS/nVSS. This figure is showing if therapy over the course of five weeks had any significant impact on responses for each mode of communication. According to the figure, gestures, vocals, and G + V, did not change after post VSS/nVSS over the course of therapy. The figure also shows that the total

amount of utterances during the course of therapy decreased from pre VSS/nVSS to post VSS/nVSS.

Using MATLAB, the change scores comparing the increase or decrease in gestures, vocals, G + V, and utterances after VSS/nVSS for each participant were calculated and graphed as a 3D stem plot, and the results are shown in Figure 2. The plot shows that there was not any significant change between the number of gestures, vocalizations, or G + Vs used before and after VSS/nVSS treatment. The outcome of the messy data can be seen from this plot. The plot does not show any significant change among the modes and no evident pattern.

Figure 3 is a MATLAB 3D stem plot that displays the change scores comparing vocals, G + V, and utterances. The plot does not show any significant change in communication modes before and after VSS/nVSS treatment. There were six children who were nonverbal, which is why there are multiple points in the same area in the plot. The messy data does not show any significance and it is evident by the lack of variance in the plot.

5.0 Discussion

5.1 Findings

Participants who had VSS treatment instead of free play were expected to have a greater improvement from using gestures to more utterances over the course of therapy. Contrary to the hypothesis, there were no significant data results that suggested that VSS treatment enhanced a child's progression of modes of communication. While some clients showed significant improvement in one mode of communication or responses overall, the data did not show any progression to the higher-level communication modes. The results from the ANOVA and MATLAB figures showed that there was no significant data that suggested gestures decreased over therapy in either group. There was no data that suggested a relationship that SL therapy that targeted requesting goals resulted in an increase in vocals and/or utterances among the children in either group either. The results indicated that there was no evidence to suggest that vestibular sensory stimulation had an effect on the change of communicative modes. In many instances, the number of utterances before VSS treatment/nVSS was higher than the number of utterances after VSS/nVSS treatment. In addition, the results did not show an improvement among responding behavior in the different modes in the children with nVSS treatment either. While some participants showed an improvement in a specific mode over the course of therapy, the results do not support that SL therapy that targeted requesting incidentally impacted the progression of communicative modes. The statistical analyses in the figures do not show any evidence that any participant used fewer gestures and more vocals/utterances at the end of therapy when compared to the beginning sessions.

However, there is evidence that SL treatment improved the participants' responding behavior, disregarding the type of communicative mode. The evidence is shown in the original data and noted in Dr. Longerbeam's dissertation "Contribution of sensory stimulation to the effectiveness of speech-language intervention for young children with autism." Even though the data showed that the addition of VSS treatment did not increase the effectiveness of SL treatment, there was significant evidence that SL treatment in general increased the responding among the participants from the beginning of treatment to the end of the treatment sessions. The effect size of SL treatment was medium to large.

Since this current study used the same data from Dr. Longerbeam's study, the therapy targeted responding and requesting goals, therefore the different modes of communication were not a focus of therapy. There is some debate over incidental treatment and the effects of teaching language. "Incidental teaching refers to the interactions between an adult and a child that arise naturally in an unstructured situation, such as free play, and that are used systematically by the adult to transmit new information or give the child practice in developing a communication skill" (Hart & Risley, 1975; Warren & Kaiser, 1986). Some studies suggest that incidental training is more effective than traditional training, where the teacher controls the opportunities during intervals (McGee, Krantz, & McClannahan, 1985). However, in the study by McGee et. al., the results suggested that incidental teaching was mostly ineffective for children with autism who were verbal, mostly because these children required more prompting (simulating a more traditional therapy approach) and the children chose items in a ritualistic sequence (McGee, Krantz, & McClannahan, 1985). Autistic children can

acquire functional language through structured therapy that emulates normal language production (McGee, Krantz, & McClannahan, 1985). If this study was to be repeated, the modes of communication should be targeted during therapy in order to have the greatest chance for progress in mode change. In order to have more accurate results and see progress, one should use evidence-based practices that focus on the target goals.

In addition, there is evidence that children with autism learn communicative behaviors at a slower rate than TD children. At around 4-5 years old, TD children are usually saying sentences that contain 4-5 words and have a vocabulary around 1500 words (Boyse, 2012). Even though the number of words in the participants' utterances was not recorded in this study, most of the participants, if not all, can be categorized as having a language delay. Furthermore, since children with autism learn communicative behaviors at a slower rate, the time of the sessions and duration of therapy during this study may not have been an adequate amount of time to see an improvement or impact on the modes of communication for the participants.

In addition, the severity of autism may have impacted the results. Higher functioning participants with autism are more likely to use utterances and may respond to therapy at a faster rate than participants with lower functioning autism. The participants with lower functioning autism may require more time in therapy to have the same results as children with higher functioning autism. This is a factor that was not considered in this study. Even though each child in the study was diagnosed with autism, some children were more advanced based on their degree of autism, which could have had an impact on the results. For example, some children were non-verbal while others were verbal and had many utterances, which leads to another possible factor.

In each group, VSS and nVSS, there were children who did not produce any utterances during the course of therapy. Each participant could have responded differently to the therapy based on his or her verbal status at the beginning of therapy. Some participants may have been more advanced than others, like 2 of the participants who were already producing around 200 utterances per day at the beginning of therapy. The therapy for these clients was different than the therapy for participants who did not have any vocals or utterances during therapy. Even though the therapy was geared for each participant based on the results from the VBMAPP, there was less room for communicative improvement for the participants who started therapy already using utterances. In order to have more accurate results and see progress, one should use evidence-based practices that focuses on target goals.

On the other hand, gesture use has been studied multiple times due to its impact to predict later linguistic skills (Rowe & Goldin Meadow, 2009). Furthermore, gestures can be categorized as either simple or complex. Simple gestures could be a simple shake of the head indicating "no" or pointing while complex gestures can be shaking the head "no" while pointing to an object at the same time (Tager-Flusberg, Paul, Lord, 2005) or a representational gesture such as flapping the arms and/or hands for a bird (Capirci, Iverson, Pizzuto, Volterra, 1996). This study did not categorize the type of gesture, so it is unknown if participants, specifically the non-verbal participants, progressed from using simple to complex gestures, indicating an improvement in communicative responding. In addition, participants using complex gestures at the beginning of therapy were more likely to progress to using vocals and/or gestures + vocals based on previous studies (Capirci, Iverson, Pizzuto, Volterra, 1996). This relationship was not analyzed or noted in

this study, but if it was, there could have been evidence to suggest a progression in the modes of communication, especially vocals and G + V.

The VSS treatment administered for this study could have affected the results as well. There are no specific guidelines on VSS dose and how the dose should be determined. The VSS treatment was very controlled and each participant in the VSS group received the same kind of treatment for the same amount of time. For some participants, additional time may have been necessary to have an impact, or reducing the time for some participants, especially the noncompliant ones, may have resulted in a different effect on therapy (Longerbeam, 2013). The intensity of swinging was another controlled aspect that could have affected the therapy results. In the study, slow, linear swinging was administered. However, this type of swinging may not have had an effect on the participant based on his or her particular sensory needs. The VSS treatment may need to be individually tailored to each client based on his or her sensory needs (Longerbeam, 2013).

VSS treatment is also a subjective measure and its effects lack evidence (Van Rie & Heflin, 2009). Studies that test the results of VSS treatment both support and question whether it is beneficial when doing therapy with a child with autism (Lang et al., 2012; Mauer, 1999). It is difficult to measure the amount of VSS treatment a child needs in order to possibly have an impact during therapy. Each child is different and there is no way of knowing if it has an impact on therapy or if the child considers it as a pleasurable activity. In addition, since children with ASD require reinforcement in order to learn the targeted skills, VSS treatment may serve as a positive reinforcement for the children (Longerbeam, 2013).

5.2 Conclusion

Overall, the findings from this study indicate that VSS treatment during speech-language therapy sessions for children with autism is ineffective. However, there are many factors that could have influenced the obtained results. In further studies, the different types of communication modes should be the targets of therapy and the communication level (nonverbal vs. nonverbal) of the participants should be considered.

Figure 1

Repeated measures ANOVA graph test result showing the change of the different modes of communication from pre to post VSS/nVSS treatment.

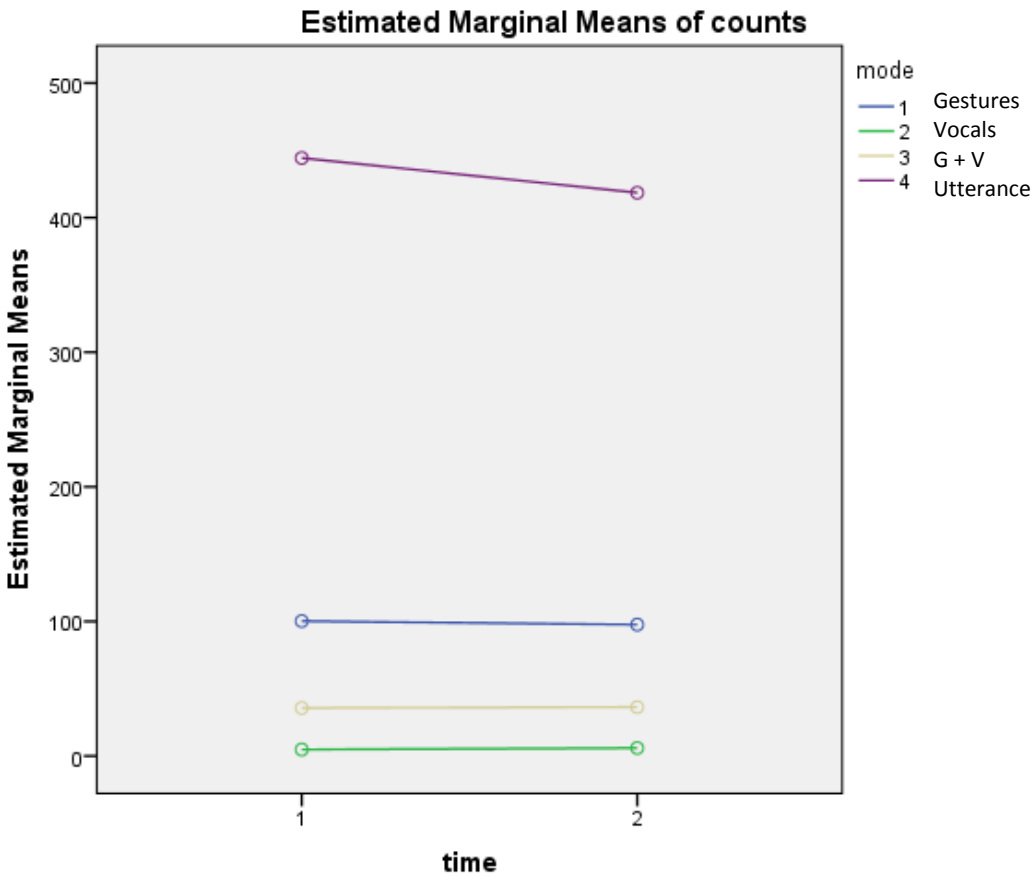


Figure 2

MATLAB 3D stem plot comparing change scores between gestures, vocalizations, and G + Vs.

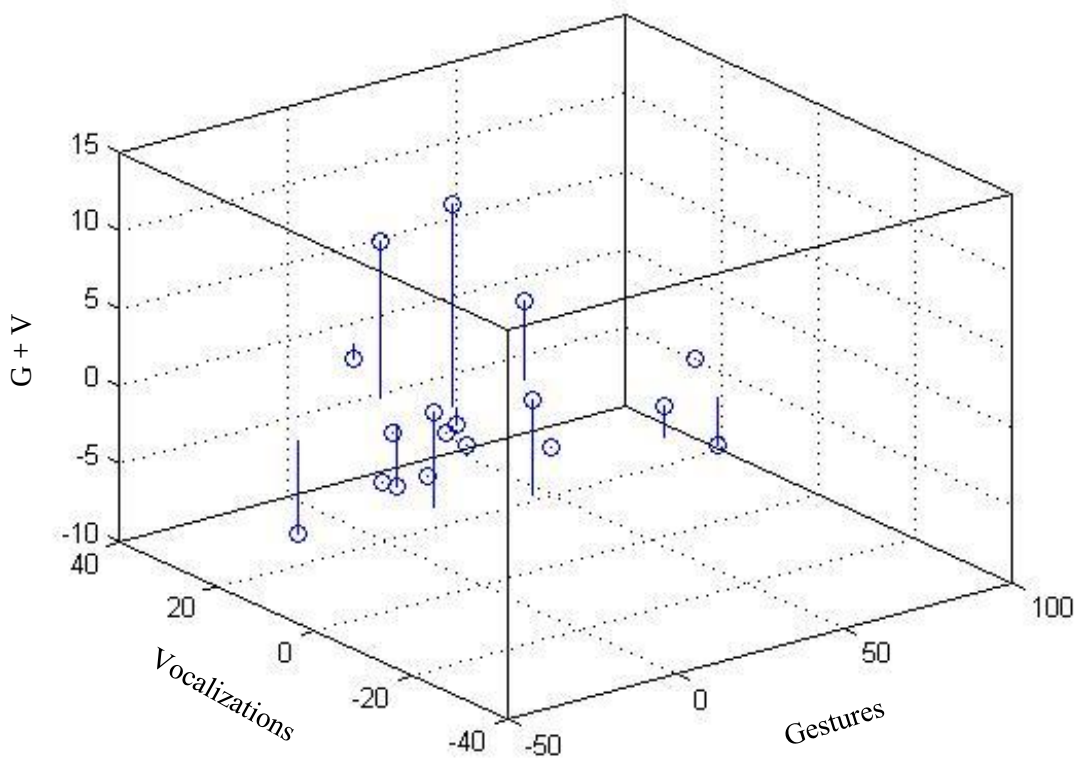
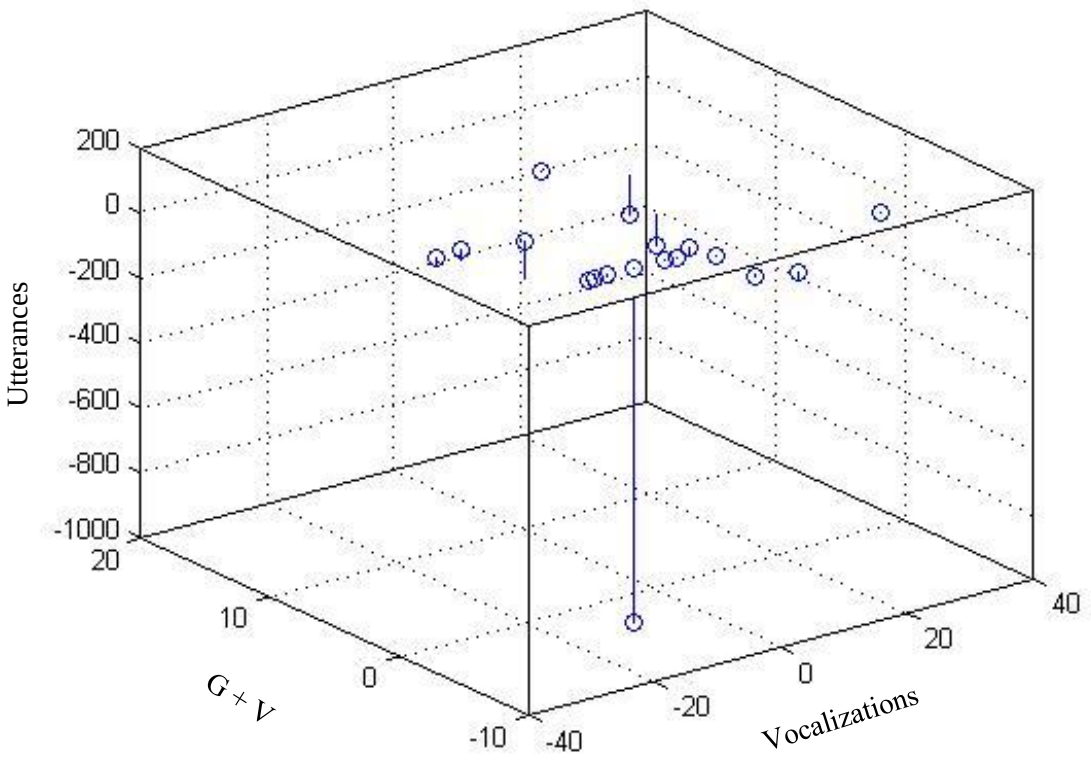


Figure 3

MATLAB 3D stem plot comparing change scores for before and after VSS/nVSS treatment between vocalizations, G + Vs, and utterances.



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