The Immediate Effects of Vestibular Stimulation on the Language Performance of a Child with Autism

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Western Michigan University

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THE IMMEDIATE EFFECTS OF VESTIBULAR STIMULATION ON THE
LANGUAGE PERFORMANCE OF A CHILD WITH AUTISM

by

Jennifer L. Sova

A Thesis
Submitted to the
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Jennifer L. Sova
THE IMMEDIATE EFFECTS OF VESTIBULAR STIMULATION ON THE LANGUAGE PERFORMANCE OF A CHILD WITH AUTISM

Jennifer L. Sova, M. A.
Western Michigan University, 2003

There is a proposed link between sensory processing abilities and language performance in children with autism. Research evaluating such a relationship is limited. This study sought to evaluate the hypothesis that language expression is facilitated by the application of vestibular stimulation in a child with autism. The purpose of the present study was to implement language interaction techniques and measure the outcome of language performance in a 4-year-old child with autism and sensory integration dysfunction. The child was evaluated in regards to vestibular stimulation and its facilitative effect on language production for social communicative purposes. Direct observation was used to measure language production prior to and immediately following vestibular stimulation and a control condition. Treatment was employed within a randomly alternating treatment design over six weeks. Daily increases were noted in each of the seven target areas. Results were discussed in terms of within session changes as well as broader trends over the experimental period. Findings indicated that nonlinguistic vocal production increased consistently immediately following vestibular stimulation. Spoken word production also exhibited an increase in most of the sessions, both experimental and control, indicating the possibility that this variable was facilitated by language interaction without specific sensory stimulation techniques. Limitations are discussed and directions for future research is provided.
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Autism as a Language Disorder

Autism is a developmental disorder that is characterized by a wide array of behavioral deficits. One of the most prominent features of autism is a limited development of age appropriate communication abilities (Mundy & Markus, 1997). Spoken language is often delayed and children with autism will often use repetitive or idiosyncratic language (American Psychiatric Association, 1994). Even if children with autism maintain functional, or only mildly weakened phonological, syntactic, and semantic skills, they will usually exhibit abnormal social communicative/pragmatic abilities. These include difficulties incorporating behaviors such as initiating and sustaining conversation, appropriately turn-taking during conversation, maintaining eye contact, and using voice inflection for communicative purposes (Mundy & Markus). Additionally, there may be impairments in the ability to use nonverbal behavior (e.g., gestures) to facilitate social interaction and communication. Also, shared attention or emotional reciprocity is not consistently present and there is preference to solitary routines and activities. Individuals with autism do not develop age-appropriate peer relationships and do not spontaneously share activities with others (e.g., by joint attention).
Sensory Deficits Associated with Autism

In addition to communication deficits, children with autism have an array of other behavioral symptoms (American Psychiatric Association, 1994). For example, individuals with autism commonly react abnormally to sensory stimuli associated with touch, movement, body awareness, sound, and gravity (Klecan-Aker, Green, Flahive, 1995). Reactions can be inappropriately exaggerated or understated. Both over-sensitivity and under-sensitivity to sensory stimulation can impact overall sensory motor function (Cook, 1991) and may contribute to mood alterations, emotional lability, and problems eating and sleeping (American Psychiatric Association).

Ayres (1972) hypothesized a theoretical link between the individual’s ability to process or “integrate” sensory information and the ability to perform “complex” activities such as language processing and formulation. The term “sensory integration” (SI) refers to the organization of sensory stimuli to aid in the interpretation of incoming information from the environment and from actions of the body (Fisher & Murray, 1991). Ayres suggested that directly addressing sensory integration deficits in individuals with disorders such as autism would have a facilitating effect on higher-level activities such as language.

Ayres (1972) hypothesized that SI therapy facilitates speech-language acquisition by enhancing efficiency of sensory processing at the brainstem level, which then provides the foundation for more complex, higher level cortical processing, particularly central auditory processing, which is necessary for language development (Griffer, p. 394).

Many speech-language pathologists and occupational therapists have since adopted this position and frequently use therapies based on SI theory in their practices.
involving children with autism. There are only a limited number of studies that have evaluated the relationship between SI therapy and language expression in the autistic population. Most published studies have used an SI therapy that is directed toward activating the vestibular system through swinging and other movement activities. The results of these studies are suggestive of a facilitative relationship between SI therapy and communication in individuals with autism (Ayres, and Tickle, 1980; Ray, King and Grandin, 1988). However, treatment-related increases in verbal communication do not appear to persist beyond the vestibular stimulation task itself. Ayres and Tickle found that children with autism who are most likely to exhibit facilitated language expression tend to be hypersensitive to environmental stimuli.

More research is needed to clarify the relationship between vestibular-based sensory processing therapy and language expression. At least two issues need to be addressed. First, it is uncertain if increased language expression that is coincident with SI therapy is due specifically to the therapy activities, or if the therapy simply serves as a common referent for communication with partners. Controlling for this alternative explanation would require comparing the SI therapy with an activity that does not carry SI therapy’s theoretical underpinnings but can serve as a common referent for the child and his/her communication partners. Second, the environment and manner in which language has been sampled is often poorly described (Ray et al., 1988; Ayres & Tickle, 1980). Sampling language expression using a standard, language interaction model (Greenspan, 1992) before and after SI therapy would enhance the interpretive value of the experiment. For example, if a facilitative relationship between vestibular stimulation therapy and language interaction exists, speech-language pathologists and occupational
therapists may be in a better position to optimize the coordination of therapies with this population. If the design facilitates improved communication, future interventions may consider the impact of providing speech-language treatment and sensory processing treatment within the same session to maximize the child’s performance in language production.

**Research Questions**

This project was designed to expand upon previous research by using a single subject research design (ABACA) to test the hypothesis that exposing a hyper-sensitive child with autism to vestibular-based stimuli through SI training will provide short-term facilitation of expressive communication in a language interaction environment.

Measures of expressive language were compared across language interaction sessions before and after a vestibular stimulation task and a task requiring fine motor skill activity. Specifically, the following research questions were addressed.

1. Does vestibular stimulation therapy provide short term increases in amount of joint attention exhibited by a hyper-sensitive child with autism?

2. Does vestibular stimulation therapy provide short term increases in the amount of non-linguistic and linguistic vocal expression in a hyper-sensitive child with autism?

3. Does vestibular stimulation therapy facilitate the number of self-initiated communicative attempts in a hyper-sensitive child with autism?
Communication Deficits and Autism

Autism is a developmental neurobiological disorder occurring in approximately 1 per 1,000 children (Bristol et al., 1996). Deficits in autism have been characterized as a “triad of impairments” in the areas of socialization, imagination, and communication ability (Keen, Sigafoos, & Woodyatt, 2000). Impairment in socialization is revealed by the difficulty children with autism have developing human attachments, particularly with adults (Prizant & Wetherby, 1998). When attachments exist, they are often directed toward a few, select adults familiar to the child (Walters, Barrett, & Feinstein, 1990). Children with autism are more likely to develop attachments to objects than to people, and research suggests that this difficulty forming attachments with humans stems from a lack of social interest (Olney, 2000), although there are many plausible alternative explanations. Limited imaginative abilities are suggested by a lack of observed spontaneous make-believe play and social imitative play in children with autism. Abnormal levels of intensity or focus, the need for structured routines, stereotyped and repetitive motor behaviors, and/or persistent preoccupation with parts of objects are commonly observed with this population. Third, and particularly significant to the speech-language pathologist, is the child’s reduced capacity to engage in age-appropriate communication (American Psychiatric Association, 1994).
All individuals with autism exhibit abnormal development of spoken language. However, the heterogeneity of the population precludes a description of language impairment that generalizes to all individuals with autism (Rollins, Wambacq, Dowell, Matthews, & Reese, 1998). Signs of communication deficits are observed at a prelinguistic level of development and take the form of a limited repertoire of communicative intentions and the absence of initiating and sharing attention (Rollins et al., 1998). Phonologic and syntactic abilities have a delayed rate of development but eventually reach levels comparable to that of normally developing peers (Rollins et al., 1998). Verbal expression is often stereotyped and repetitive. Perseverations, neologisms (i.e., jargon) and echolalia are typical language features in individuals with autism (American Psychiatric Association, 1994).

The language of autism is most clearly deviant from normal language in the area of pragmatics (i.e. the use of language for social purposes). The use of language to communicate specific intentions such as requesting, protesting, commenting, and greeting do not appear, or are relatively rare in conversation (Nelson, 1998; Keen et al., 2000). Greetings may be present in the child’s repertoire, but usually appear as a routine behavior instead of purposeful recognition of a person’s presence. Children with autism often acquire intentions expressing direct needs or wants prior to intentions used for socialization. Additionally, individuals with autism have difficulty focusing attention on a communication partner, or sharing attention with that partner on a common referent (i.e. joint attention) (Mundy & Stella, 2000). Nonverbal communicative behaviors such as gestures and facial expression are often impaired. Children with autism seldom use eye
contact for social purposes, but are more likely to display the behavior if eliciting someone’s attention to meet his/her needs (Mundy & Markus, 1997).

Rollins (1999) examined pragmatic behavior and vocabulary development among children with autism participating in a language interaction program and found a correlation between increased vocabulary and amount of joint attention during communication. The authors suggested that joint attention must reach a peak before any evidence of significant vocabulary growth can be observed.

It has been proposed that individuals with autism have a limited capacity to understand the perspective or point of view of their communication partners, resulting in frequent breakdowns in communication (Olney, 2000). Further, it has been posited that a limited ability for self expression through language is a source of frustration and is in part responsible for the aggressive actions, emotional fits, and self injurious behavior that is commonly observed with this population (Rollins, 1999).

To summarize, children with autism experience deficits in language comprehension and expression abilities that inhibit their ability to interact successfully with their environments. Identifying these deficits and facilitating the ability to communicate for social purposes, not only to meet basic wants and needs is the goal of many language interventionists (Keen et al., 2000). Providing a child with the opportunity to engage in an increased number of social interactions may impact willingness to participate over time.
Language Assessment and Intervention Approaches for Individuals with Autism

Designing assessment and treatment approaches for the autistic population often centers on communication skills (Keen et al., 2000). As outlined earlier, pragmatic language deficits, a limited range of communication intentions, and difficulty directing and maintaining shared attention are frequently observed among this population (Rollins et al., 1998). Assessment and intervention approaches must be sensitive to the kinds of communication deficits in individuals with autism. Deficits associated with pragmatics may only be revealed in relatively natural communication contexts. For example, individuals with autism often are described as self-absorbed and do not consistently interact with communication partners or share a common referent (Klinger & Dawson, 1992). Evaluating the child’s ability to direct or share joint attention necessitates an assessment context that allows the evaluator to follow a child’s lead (Greenspan, 1992). Highly structured assessments are unlikely to expose those features of communication that are likely to be most impaired.

Evaluating and treating those with autism is also challenging because many of the communication deficits are not easily quantified. For example, communicative intent, considered an important emerging component to communicative development, is difficult to measure and is often based on subjective findings during social interaction (Keen et al., 2000). Wetherby and Prizant (1989) have defined specific indicators of intentional communication, including eye gaze with an object and with a communication partner, along with exhibiting pleasure when a goal is met and disappointment when it is not. However, numerous authors dispute the criteria implemented to define intentionality, and
believe that the age a child acquires intentional communication is dependent upon the flexibility of the measures (Wetherby & Prizant, 1989).

Similar challenges are faced when developing intervention programs to address language deficits in individuals with autism. One approach is to build treatment programs around the principles of applied behavior analysis (ABA). Briefly, ABA facilitates language through repeat trial teachings, which focus on isolated skills rather than the social components of communication. Specifically, the sessions are designed to train children with autism to use eye contact, act on command (e.g., sit), and increase receptive and expressive language in a one-on-one setting (Lovaas, 1981). In this treatment approach child-initiated communication is not emphasized until the child has met the criteria for readiness skills in discrete trial training. Advocates of the discrete trial traditional behavioral approach believe the methods are beneficial to children with autism because they break activities down into small steps, are extremely structured, and emphasize the role of the teacher (Prizant & Wetherby, 1998). However, the use of discrete trial training as an approach to language intervention has been under debate for the past two decades.

More recently, the growing interest in social communication has given way for more natural intervention approaches in which a communication style was adapted to meet the needs and abilities of individual children (Prizant & Wetherby, 1998). This style incorporates modeling, scaffolding, and following the child’s lead to expand attempts at communication. This approach emphasizes meaningful language and functional communication abilities rather than highly structured intervention activities that serve to build an inventory of speech sounds, words, and sentences without reference to a social
context. This “child-centered” approach has since been developed to incorporate social-pragmatic ideas and eliminating the structured behavioral ideas. The emphasis is on initiative and spontaneous language production within a naturalistic context.

One example of the child-centered social pragmatic developmental approach is “Floor Time” (Greenspan, 1992). Floor Time is a language tool used for early identification and intervention in children up to 5 years of age. Unlike a discrete trial traditional behavioral approach, Floor Time exploits social and communication opportunities for purposes of facilitating communication skills. Opportunities for interaction are provided using a broad range of activities designed to stimulate communication attempts. The primary goal is for children to successfully achieve increased levels of socioemotional growth, which Greenspan argued was the core for communication and language development. Social development is achieved by increasing the overall amount of communication, the length of communicative turns, and the child’s awareness of the environment (http://www.coping.org/earlyin/floortm.htm). Greenspan defined a successful social interaction as a completed circle of communication with one partner “opening” the circle (initiating) and the other “closing” the circle by commenting or gesturing in response to the initiation.

Floor Time (Greenspan, 1992) is a 5-step approach used to determine the child’s developmental level and expand upon it. Step one includes observation of the child within the context of his/her environment to gauge the best approach for the individual. Step two involves opening circles of communication (i.e. initiating communication). Step three involves following the child’s lead when a circle of communication is opened. Greenspan posited that this step is pivotal to the intervention process since the clinician is
offering support to ideas/themes important to the child. Step four entails the clinician extending and expanding play by asking questions and offering supportive comments. Finally, step five occurs when the child closes the circle of communication, which signifies that the child is engaged in a two-way social interaction or exchange. During Floor Time, the clinician should follow the child’s lead, avoid changing the subject during an interaction, be positioned in front of the child, and work to increase the child’s responsiveness. Finally, a Floor Time session should be designed using items grouped by themes that will foster dramatic play (e.g., kitchen and play food, animal figures, and blocks) and allow the child to develop imaginative schemas.

Currently, naturalistic interventions, like Floor Time, are commonly used with children with autism (Kohler, Anthony, Steighner, & Hayson, 2001). Kohler et al. suggest that “Tactics that rely on environmental structuring and following the child’s lead seem ideally suited to young children with autism, who do not only exhibit significant delays but also limited interest in interacting with others” (p. 94). There is some research support for using naturalistic interventions with children with autism. Klinger and Dawson (1992) used an intervention technique in a group of children with autism with the goal of increasing joint attention and eye gaze that focused on following the child’s lead, conditional imitation, and providing materials preferred by the child. After training, both verbal and nonverbal children with autism were found to have increased social communication skills, including eye contact. It was concluded that social interactive tactics might enhance early social communication abilities within this population.

Rollins et al. (1998) provided more recent evidence that the use of specific communicative acts (e.g., pointing and eye gaze) to draw a partner’s attention is an
indicator of increased shared attention and vocabulary development (Rollins et al.). Their work indicated that joint or shared attention is a pivotal marker for social interactive behavior in children with autism. This increased evidence of joint attention may suggest increased potential for language development and use. These results are consistent of Greenspan’s (1992) contention that following a child’s lead may encourage shared attention, and that in turn, social interaction and communication will increase. Rollins et al. noted a caveat, however, that increasing joint attention in individuals with autism may be accompanied by the use of nonfunctional language such as echolalia or continuously repeating questions, suggesting that increased opportunities for communication does not always translate into functional language use.

Sensory Integration Dysfunction and Autism

A behavioral characteristic that is common in children with autism is hyper- or hypo-reactivity to stimulation of any or all sensory modalities (Ritvo & Freeman, 1978). For example, in a study that compared sensory reactivity in children with and without autism, Watling, Deitz, and White (2001) found the two groups differed in areas of sensory registration, oral sensitivity, emotional reactivity, and distractibility. The children with autism displayed more extreme sensitivities (i.e. both hypo-sensitive and hyper-sensitive) and demonstrated greater inconsistencies in behaviors. As a result, group-based scores made it difficult to discriminate children with and without autism based solely on behaviors reflecting sensory reactivity and processing.
Ayres (1972) introduced the term “sensory integration dysfunction”, now broadly used to characterize the heightened or diminished reactivity to sensory stimulation commonly observed in individuals with autism, when she postulated sensory integration (SI) theory over 30 years ago. According to the theory, to successfully navigate the immediate environment, the developing child must assimilate and interpret a wide array of sensory information. This includes sensory experiences that are mediated externally (e.g., sight, sound, and tactile information) and internally (e.g., balance, kinesthesia, proprioception). Successful interactions rely on distinguishing between relevant and irrelevant/redundant sensory information. This organization and interpretation of sensory stimuli from the environment and from actions of the body is defined as sensory integration (SI) (Fisher & Murray, 1991).

Without the ability to process incoming sensory stimuli a child has a difficult time understanding the systems of the body and how his/her own body functions. SI necessarily involves coordinated activity from various nervous system structures to allow the individual to successfully interact with the environment in a satisfactory way (Ayres, 1979). The theory itself was developed to “describe and predict the specific relationships among neural functioning, sensorimotor behavior, and early academic learning” (Fisher & Murray, 1991, p. 3). According to the theory, individuals who recognize and interpret sensory information effectively are more likely to adjust their motor and behavioral responses to environmental stimuli (Linderman & Stewart, 1999). Further, basic sensory alertness, recognition and discrimination are the foundation on which concise motor abilities can develop (Fisher, Murray, & Bundy, 1991). Relevant to communication is the
proposition that SI is a necessary antecedent to the development of complex behaviors such as language and cognition.

SI theory predicts two things. First, individuals or populations may exhibit a dysfunction in the ability to effectively achieve sensory integration. Second, SI abilities may be improved using treatment approaches that expose the individual to a variety of sensory stimulation. One of Ayres’ goals in developing SI theory was to develop a theory-based approach to treating populations with presumed sensory dysfunction (Ayres, 1972).

A crucial component to SI theory is the manner in which an individual modulates sensory information. The constant flow of sensory information from the periphery may alternatively be suppressed or potentiated by neural pathways, depending on its relative importance to the behavioral context (Ayres, 1979). The limbic system has been implicated as a possible site of sensory modulation, which is thought to occur along a continuum from suppression to facilitation (Spitzer, Roley, Clark, & Parham, 1996). Sensory integration dysfunction, which can vary in level of impairment, is characterized by an inability to appropriately modulate the range of sensory information (e.g., tactile, auditory, olfactory, visual, oral, and/or spatial input) that floods the nervous system on a moment-to-moment basis. The dysfunction can be over or under-reactivity to stimulation (Ayres & Tickle, 1980). Spitzer et al. explained that insufficient sensory modulation (hyper-sensitivity) can completely overwhelm an individual and suggested it as a source of problems with orientation, regulating information, sensory defensiveness, abnormal arousal levels, difficulty managing stress, and lack of attention. The opposite condition, excess modulation of sensory information (hypo-sensitivity), can lead to
ignoring relevant sensory information. Anzalone & Williamson (2000) suggested that some behaviors characteristic of hyposensitivity are an overshoot in adaptation to insufficient modulation of sensory information in an effort to maintain a comfortable environment. The result of sensory integration dysfunction is that the individual is unable to process or organize the flow of sensory input in a way that provides accurate information about the environment or the individual's body state, leading to deficits in motor behavior, concept formulation, language use, the ability to make appropriate behavior changes, and academic progress (Ayres, 1972).

Severe sensory integration dysfunction is commonly associated with autism spectrum disorders (Case-Smith & Bryan, 1999). In fact, some have suggested that sensory integration dysfunction is the primary symptom of autism, and that SI deficits are the source of social and communication disturbances (Ornitz, 1974; Greenspan & Wieder, 1997; Case-Smith & Bryan). Children with autism are known to participate in perseverative and stereotypic behavior (e.g., rocking), and this is presumed to be an attempt to regulate their sensory systems (Case-Smith & Bryan). Some hypothesize that these behaviors appear as a way for the child to self-stimulate himself in the absence of social interaction (Dawson & Watling, 2000; Case-Smith & Bryan).

SI theory has led to the development of treatment approaches for SI dysfunction. The aim of SI treatment is to systematically expose an individual with SI dysfunction to sensory stimulation with the expectation that this exposure will engage SI processes in the individual. These sensory activities include vestibular stimulation (e.g., swinging), tactile stimulation (e.g., brushing the skin), and auditory stimulation (e.g., listening to music). Sensory integration treatment was originally designed by Ayres (1972) to be used...
with school-aged children who had learning disabilities. It has been suggested that SI
treatment might be effective in improving motor skills, sensory processing, academic
performance, and other complex tasks, including language (Ayres, 1972; Griffer, 1999).

Of the range of specific SI procedures, vestibular stimulation has received
prominent attention, at least in the research literature. The vestibular system is an
important sensorimotor system that assists the individual in establishing an awareness of
the body position and body movement in space, development of muscle tone, and
stabilization of the eyes during head movements (Fisher & Murray, 1991). Vestibular
stimulation tasks include those that provide vertical, horizontal, or angular/rotary
movement. Ottenbacher (1982) argued that the vestibular system serves as the main
modulator and coordinator of all sensory input. Supportive of SI theory, DeGangi, Berk,
& Larsen (1980) suggested that vestibular system disorders are associated with learning
disabilities in motor behavior and language acquisition.

Stillwell, Crowe, & McCallum (1978) found that children with speech and/or
language impairments also possess impairments in vestibular capabilities. They proposed
that the vestibular system may not be operating sufficiently in these children causing
disturbances in lateralization, or the internal awareness of the two sides of the body and
the differentiation between the two. If lateralization is not attained, the left hemisphere,
generally considered the site of the major language center, may not sufficiently
communicate with the right hemisphere. This would result in significant motor deficits as
well as language difficulties. Ayres (1972) proposed that vestibular (and tactile)
stimulation could increase an individual’s ability to register sensory information and
execute the motor tasks essential for speech production. Vestibular system dysfunction

16
also may be associated with problems in orientation and attention to relevant visual stimuli (Case-Smith & Bryan, 1999).

Ayres (1979) proposed a direct link between SI-based treatment and speech and language production. This prompted Griffer (1999) to suggest that SI-based therapy effects on language ability need to be evaluated through experimentally designed research studies. He pointed out that evidence is limited on the effectiveness of sensory integration therapy, especially with language-disordered children.

In spite of limited evidence of its effectiveness, SI-based treatment is used routinely with individuals with autism (Ayres & Tickle, 1980). Watling, Dietz, Kanny, and McLaughlin (1999) designed and distributed a questionnaire for occupational therapists working for children with autism. The purpose of the research was to identify the most commonly used therapeutic activities and diagnostic tools for children with autism. The researchers determined that common assessment methods for children with autism included measurements of fine motor ability, attention, behavior, coordination, and sensory processing.

Need for Evidence of Treatment Effectiveness Using Vestibular Stimulation

Ayres (1979) stated that the primary objective of SI-based therapy in children with autism is to help them organize reactions to sensory stimuli and develop adaptive strategies. Based on the extreme level variations in the sensitivity (i.e. hypo- and hyper-), the therapist must find a balance between excitation and reservation (Cook, 1991). Specifically, children with autism tend to seek out movement or completely reject it
Clinicians have reported that SI dysfunction may be correlated with rigid and stereotyped behaviors typical in children with autism. Therefore, when targeting the deficits, clinicians should be observing for reduced rigidity and stereotypic behaviors that may result from them (Dawson & Watling, 2000). Sensory processing also plays a significant role in the level of arousal and attention in a child; therefore, using vestibular stimulation during intervention may create affect in a child with autism (who is often emotionally detached) and possibly enhance his/her desire to communicate and display purposeful behavior (Ayres, 1972).

Empirical studies evaluating the relationship between vestibular-based sensory processing training and language use in children with autism are limited. Ayres and Tickle (1980) administered sensory processing treatment to children with autism who were hypo and hyper-reactive to sensory stimuli. The authors analyzed results according to participants’ response to each treatment (tactile and vestibular). The participants labeled by the authors as the “good response group” showed increased language expression, increased awareness of their environment, produced increased verbalizations, and were able to attend to more complex activities following treatment. It was determined that participants who ranged from normal to hypersensitive in their reaction to vestibular stimuli also were members of the good response group. The authors concluded that the children’s hyper-reactivity to sensory stimuli is a predictor of positive outcomes with sensory processing training, and suggested that those children who are easily over stimulated will develop adaptive strategies as a result of sensory processing therapy. This is consistent with the view that children who are hypersensitive will achieve more
appropriate levels of arousal and attention and become less threatened or anxious in their environment as a result of treatment (Anzalone & Williamson, 2000).

Ray, King and Grandin (1988) evaluated vocal expression in a child with autism before, during, and after vestibular stimulation therapy. The participant’s level of sensory reactivity was not reported. The authors measured the child’s vocal behavior by averaging the number of vocalizations (making a sound with the voice) and verbalizations (expressing in words) produced within each phase of the experiment. They found that the frequency of vocal behavior was limited in the pre-treatment phase, dramatically increased during vestibular stimulation, and dropped in the post-treatment phase to a similar frequency as in the pre-treatment phase. During the experiment the investigator’s only interaction with the child was to give him permission to use the swing. These results suggest that changes in language use may be limited to the SI-based activity.

Linderman and Stewart (1999) examined the effects of sensory integrative treatment on social interaction and approach to new activities. Several sensory-based activities, including vestibular stimulation using a platform swing were administered to children with autism within the context of their own homes. Their findings supported Ayres’ (1972) theory that when children can process sensory input they can more efficiently reach a satisfactory state that enhances engagement in social interaction as well as participation in age-appropriate activities. These results suggest that applying SI-based treatment to children with autism may enhance functional behaviors in a naturalistic setting.
Summary of the Literature

In summary, autism is associated with extensive language deficits, specifically those in the area of pragmatics or social communication. Additionally, individuals with autism may also exhibit abnormal levels of sensitivity to environmental and proprioceptive sensory stimuli. A link between sensory processing dysfunction and language abilities has been proposed. A limited amount of research is available to support such a proposal. The current investigation is designed to add to the small body of evidence regarding intervention approaches for individuals with autism.
CHAPTER 3

METHODS

Subject Selection

Introduction

The participant was selected from a list of referrals for language interaction at Western Michigan University’s Charles Van Riper Unified Clinics. The clinic coordinator, Adelia Van Meter, M.S., CCC-SLP, personally distributed a flyer to parents of the participant, which introduced and explained the project. A copy of the flyer is in Appendix A. The parents expressed interest by returning the postcard to the student investigator. Once initial contact was made between the student investigator and the participant’s parents, a consent form and a Sensory Profile Caregiver Questionnaire (Dunn, 1999) was mailed to the parents. The student investigator availed herself to the parents of the participant to address any questions or concerns related to the consent form or questionnaire. The Sensory Profile Caregiver Questionnaire served as the main factor in determining inclusion and exclusion criteria for the study.

Consistent with the inclusion criteria for the study, the participant was ambulatory, possessed verbal language capabilities, and based on the Sensory Profile Caregiver Questionnaire (Dunn, 1999) and clinical assessment exhibited a profile of being hypersensitive to sensory stimulation. Consistent with exclusion criteria for the study, the participant had no history of a seizure disorder, was not currently on medications with known side effects of nausea or headaches, did not exhibit motion
sickness when swinging, and was not enrolled in a therapy program that combined
vestibular-based sensory processing therapy and language interaction. These exclusion
criteria were established to reduce the risk of adverse reactions to vestibular stimulation.

Participant

A single subject design was used in this research. The participant was a 4 year, six
month old male who received a formal diagnosis of autism by an educational team using
the criteria of the American Psychiatric Association (1994) prior to his participation in
the study. Concurrent with study participation, the participant attended a local preschool
program for preprimary impaired students, received weekly individual occupational
therapy at the Western Michigan University clinic, and was participating in biweekly
individual language intervention sessions from an area licensed educational psychologist.

Consent and Assent Process

All assent and consent forms were in compliance with the standards set forth by
the Human Subjects Institutional Review Board of Western Michigan University. One
document was used to obtain consent of parents to complete the Sensory Profile
Caregiver Questionnaire (Dunn, 1999). A protocol clearance document is found in
Appendix C. Three consent forms were personally distributed by the student investigator
to the families after the parents returned the mailing indicating an interest in the project.
The document was explained to the parents by the student investigator during telephone contacts.

Three potential participants were identified. Two potential participants were excluded based upon criteria obtained from the Sensory Profile Caregiver Questionnaire and the conclusions made by the collaboration of Dr. Ben Atchison and the student investigator. The student investigator informed two sets of parents of the reasons why their children could not be included in the project, based on the same criteria. The student investigator generated a report based on the collected information on sensory processing and distributed it to parents as a courtesy for their time and inconvenience. The report provided additional insight into the reasons why the child did not fit the necessary criteria.

The second consent form and letter were used to obtain the consent of the parent whose child was the participant in the project. The consent form was distributed and explained to the parent by the student investigator at the first session, prior to any intervention.

The student investigator informed the parent that due to her child's language impairment, his participation was primarily dependent on her oral assent on his behalf. Before each session, the student investigator asked the parent if her child seemed willing to participate in the intervention procedures.

The parent could withdraw her child from this study at any time without any negative effect on services to the child. The parent could have stopped intervention procedures (withdraw oral assent) at any time if she felt that her child was no longer willing to participate. The child could have withdrawn from this study of his own free
will at any time without any negative effect on services he received. The student investigator also reserved the right to discontinue treatment at any time if the child did not cooperate with the procedures or did not interact with the student investigator beyond the initial baseline sessions.

Pretesting to Identify Pattern of Sensitivity to Sensory Stimulation

The participant’s sensitivity to sensory stimulation was determined by a combination of questionnaire results and clinical evaluation by a certified occupational therapist. The parents of the participant completed the Sensory Profile Caregiver Questionnaire (Dunn, 1999). A completed copy of the questionnaire is in Appendix B. This questionnaire requests information about behavioral responses to various forms of sensory stimulation and allows a determination to be made of the participant’s level of tolerance (under-responsiveness or over-reactivity) to experiences in the environment. As stated in the inclusion criteria, the participant had to exhibit a profile, which classified him as hyper-sensitive to sensory stimulation, specifically in the area of vestibular information. This was based on prior research by Ayres and Tickle (1980) that showed that individuals who exhibit over-reactive sensory profiles are more likely to produce vocal behavior as a result of vestibular stimulation. This information was collected in the Sensory Profile Caregiver Questionnaire and was verified by committee member and occupational therapist, Ben Atchison, Ph. D. There were some areas of under-reactivity reported in the questionnaire; however, using additional information provided by the
participant’s mother and after clinical evaluation, the certified occupational therapist identified the participant as hypersensitive to environmental stimuli.

**Determination of Vestibular Stimulation Procedure**

Dr. Atchison, certified occupational therapist, was also present to determine the details about the vestibular stimulation procedure. One session was dedicated during the baseline/screening phase to determining the tolerance level for the participant. The participant was observed in vertical, linear movement and horizontal, linear movement to assess gravitational security during activities that involved a trampoline, scooter boards, and the platform swing. Judgments of tolerance of movement were based on the amount, the direction (vertical, linear), and the presence of adverse reactions associated with the procedure including pupil dilation, sweaty palms, increased respiration, flushing, pallor, and sensory disorientation (dizziness). The occupational therapist provided a gradual increase in the speed and excursion of the movement to assess the child’s threshold. The participant tolerated each type of movement and exhibited no signs of adverse reaction to the linear or rotary activities during the baseline phase. Overall, he was able to tolerate 10-15 minutes of vestibular stimulation, which met the desired quantity for the project.

Once the student investigator and occupational therapist determined the participant’s tolerance for vestibular stimulation, the platform swing was selected, suspended from the ceiling, as the best means for providing optimal stimulation to the child.
Experimental Procedures

Brief Overview

The participant attended 1-2, 45-minute sessions per week over a six-week period (see Table 1). The schedule varied depending on the availability of the participant and student investigator.

Table 1

<table>
<thead>
<tr>
<th>Time Frame</th>
<th>Wednesday (5:30 p.m.)</th>
<th>Friday (3:00 p.m.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Vestibular Stimulation</td>
<td></td>
</tr>
<tr>
<td>Week 2</td>
<td>Fine Motor (Control)</td>
<td></td>
</tr>
<tr>
<td>Week 3</td>
<td></td>
<td>Vestibular Stimulation</td>
</tr>
<tr>
<td>Week 4</td>
<td>Fine Motor (Control)</td>
<td>Vestibular Stimulation</td>
</tr>
<tr>
<td>Week 5</td>
<td>Fine Motor (Control)</td>
<td>Vestibular Stimulation</td>
</tr>
<tr>
<td>Week 6</td>
<td>Fine Motor (Control)</td>
<td></td>
</tr>
</tbody>
</table>

Activity Sequence for Treatment Session

The participant attended a total of eight sessions. Four sessions were devoted to each treatment (i.e., vestibular stimulation and fine motor activity). Sessions were
alternated between the two treatments (i.e., vestibular vs. fine motor). Each of the eight sessions was divided into three phases, each lasting approximately 10-15 minutes. Table 2 outlines the sequence of the two possible treatment sessions. The initial language interaction phase of the session, or Phase I, served as a baseline for dependent measures. A baseline was taken each session due to the variability exhibited in behaviors inherent in those with autism. Phase II of each session contained one of two treatment types (vestibular stimulation or fine motor). Phase III, which immediately followed Phase II, was identical in structure to Phase I and served as the language interaction phase for the purposes of measuring the dependent variables immediately following treatment.

Table 2

Event Sequence for the Two Possible Experimental Sessions

<table>
<thead>
<tr>
<th>Phase I Baseline (10-15 min)</th>
<th>Language Interaction (language sample collected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase II Treatment (10-15 min)</td>
<td>Vestibular OR Fine Motor (Control)</td>
</tr>
<tr>
<td>Phase III Post-Treatment (10-15 min)</td>
<td>Language Interaction (language sample collected)</td>
</tr>
</tbody>
</table>
Language Interaction (Phase I and III)

The language interaction components involved language intervention techniques based on the developmental, individual-difference, relationship-based model (DIR) approach, which was described in chapter two. This approach, also known as *Floor Time* (Greenspan & Wieder, 1997) is child-centered and requires the adult (student investigator) to follow the child’s lead during play activities. The focus of *Floor Time* is dependent upon on the individual child’s development level, differences in language, motor, sensory, and cognitive abilities. The program was developed to incorporate speech/language therapy, occupational therapy, and parent interactions (Greenspan, 1992). Objects available during this interaction include several pretend food items, dishes, and a table. The participant also had access to blocks made of plastic, a toy barn with animals inside of it, a ball, bubbles, and trains and cars. The student investigator initiated communication with the participant and attempted to scaffold communication attempts by the participant. Scaffolding occurred when an adult prompted or aided the child in his ability to communicate to encourage him to be more competent in his interactions (Nelson, 1998). The language interaction task took place in a therapy room of the Charles Van Riper Unified Clinics.

Vestibular Stimulation Treatment (Phase II)

Vestibular stimulation was provided to the participant using linear and rotary movement on a platform swing during the experimental phase of the intervention over
four sessions. This activity took place in a therapy room in the Charles Van Riper Unified Clinics. The participant sat on the platform swing and the student investigator and Dr. Atchison regulated the speed and direction of movement, to observe the child for adverse reactions to the vertical, linear movement. Each session was individualized and approaches were varied depending upon the child’s behavior that day. Increased speed and the participant’s enjoyment of the stimulation were beneficial to achieve the desired results, but this was based only on his tolerance level and threshold each session. If the participant was visibly enjoying the movement, the student investigator increased the speed and circular movement of the swing. However, when the child made attempts to remove himself from the swing the student investigator immediately stopped the swing in order to reduce the amount of over-stimulation and reduce anxiety expressed by the participant regarding vestibular stimulation.

The participant’s tolerance level was recognized by his performance during the baseline phase. He demonstrated gravitational security or the ability to modulate sensory input produced by movements of the body (specifically when the feet leave the ground) during initial activity (Fisher, 1991). The sessions utilized the participant’s tolerance to create guidelines for the session, establishing a graded approach (mentioned previously).

The success of the session was dependent upon his participation in the activities. If the participant had not received the five minute minimum amount of vestibular stimulation (or the fine motor activity) the session would not have be analyzed to determine dependent measures.
The second intervention phase (Phase II) served as a control condition. The participant moved to another therapy room to engage in a 10-15 minute fine motor activity, separating those activities from the language interaction. The participant was given choices for this activity including crayons and paper to color, a puzzle, books, a bus that locks, and beads and string. Favored activities included books and working with a manipulative bus that had many locks to open and close. Book reading was very interactive with the clinician narrating pages/reading and the participant pointing to pictures and turning pages. The student investigator and the participant sat on the floor as other furniture was removed from room. This was done to reduce temptation for gross motor activity (e.g., climbing on chairs). The student investigator attempted to be a passive participant and only interact with the participant to encourage his participation in the activity; however, the participant needed frequent redirection to stay on track. The clinician behavior was similar to that in the vestibular stimulation activity.

All intervention procedures were administered by the student investigator under the direct supervision of certified speech-language pathologist, co-investigator, and Western Michigan University faculty member, Adelia Van Meter. The parent was also available to join the sessions if the child had needed support at any time throughout the activities.

Analysis
Data Collection

All sessions (baseline/screening and intervention phases) were video recorded. These records were used to evaluate whether the session met the minimum criteria for inclusion in the study and to extract dependent measures.

To minimize experimenter bias, the student investigator was not aware of the identity of the language interaction sessions (i.e. baseline, post-vestibular treatment or post-control treatment) during analysis.

Data Extraction

The student investigator created operational definitions for each of the dependent variables to keep coding consistent throughout the analyses. Once the definitions were implemented, one randomly selected session was chosen as the training session to verify the manner in which each variable was measured. After the session was transcribed and coded (see Appendix D), the session was transferred to systematic analysis of language transcripts or SALT computer program (Miller & Chapman, 2000) to examine in depth. Sample SALT transcripts and also appear spreadsheets in Appendix D.

Dependent Variables

All dependent measures were made during review and transcription of the videotapes. They were defined operationally as follows:
1. **Number of times the participant uses joint attention.** This was defined as shared eye contact and attention on a specific object or activity that the child and adult use to guide an interaction (Bruner, 1974, 1975). These were independently measured of one another in the study.

   Joint attention was defined according to two conditions: eye contact and eye gaze. Eye contact occurred only with documented eye contact with the clinician. In many instances the clinician coded the behavior to the camera at the moment it occurred as it was unable to capture the facial expressions of the participant. Eye gaze with an object occurred when the participant clearly engaged in an activity, looking at a shared object and/or using acts or gestures to gain the clinician’s attention to an object. It was also coded during activities in which the investigator and the participant were interacting with a common object or the participant was engaged with the activities of the investigator (e.g., the investigator blowing bubbles and the participant watching and popping them).

2. **The number of times the participant opens or closes communication circles.**

   This included both opening a circle of communication (i.e., initiating communication) and closing a circle of communication (i.e., responding to a communicative attempt by the communication partner). Opening and closing acts were separately counted in the data collection.

   Opening a circle of communication was defined as the initiation of a topic or activity that may be immediately contingent on the investigator’s previous communication, but
acts to start a new circle rather than complete the previous turn (e.g., participant guides investigator’s hand to broken train so she will fix it). This initiation may be verbal/nonverbal communication, including a gesture, eye gaze, speech/speech approximation, facial expression, head nod, or change in proximity, possibly initiating new idea. As long as this did not close the attempt by the investigator it begins new idea. Closing a circle of communication was coded during each verbal/nonverbal communicative act that was a response to the investigator’s action and could include an answer to a question. It was also coded when the participant built on the investigator’s idea or responded to speech (e.g., the investigator asked the participant, “More bubbles?” and the participant responded “More,” effectively closing the circle). If there was no response to initiation of the investigator, the child was not actively involved in the interaction, the circle has not been closed, and the circle was broken.

3. **Speech, speech approximations (part spoken words,) and nonlinguistic productions used during language interaction.** The measures were derived following transcription of the language sample using the Systematic Analysis of Language Transcription (SALT) computer program (Miller & Chapman, 2000).

A nonlinguistic production was defined as unintelligible speech production that may be sound effects (e.g., “Ah!”), mumbling or singing nonwords, and was also coded as one event when an utterance was acoustically unintelligible (unless the investigator interpreted for the camera). **Speech approximation** was defined as any part word
(syllable, or partially unintelligible utterance) generally interpreted verbally by the investigator to the video camera during sessions. For example, “li” was interpreted as an approximation for “light” as the participant was saying, “Buzz Lightyear.” The utterance may or may not have been appropriate or fit within the context of the interaction. Speech was classified as any English word, intelligible on recording (e.g., “goat”). If the word was mumbled and not interpreted by the investigator to the camera it was considered an instance of jargon/nonlinguistic production. If the utterance appeared to be echolalia it was still coded, but if spoken more than once during an utterance, each instance was coded (e.g., monster, monster). One exception was “choo-choo” as it is an expression and was coded once.

Reliability

Following this trial coding, the student investigator trained a second graduate student to transcribe and code the sessions using the operational definitions for each variable and the instructions to document each utterance including accompanying nonverbal behavior by the participant. The second graduate student was given three randomly chosen ten-minute sections of three sessions to transcribe and code to serve as the inter-rater reliability measure.

In addition, the student investigator judged a portion (15%, 45 minutes) of the samples again by transcribing them a second time to assess intra-rater reliability. The reliability measures were calculated by taking the student investigator’s original total for each individual variable and dividing it by the original total plus the number of disagreements.
for both inter-rater and intra-rater totals. The total agreements were then combined to
determine the average reliability for each dependent variable. The measure used to
determine reliability is problematic when there are only a few observations. For example,
the sessions with one to two occurrences limits the configuration of reliability to 100%,
50%, or 0%. Overall, results indicate variable inter-rater as well as intra-rater reliability,
which is strongly dependent upon the fluctuation in values.

Table 3

Inter-rater Reliability (% agreement)

<table>
<thead>
<tr>
<th>Eye Gaze</th>
<th>Contact</th>
<th>Nonlinguistic</th>
<th>Speech</th>
<th>Speech Approx</th>
<th>Opening</th>
<th>Closing</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>75% (8)</td>
<td>100% (3)</td>
<td>80% (5)</td>
<td>33% (1)</td>
<td>25% (4)</td>
<td>67% (3)</td>
<td>75% (8)</td>
<td>3</td>
</tr>
</tbody>
</table>

| 100% (4) | 100% (0)| 57% (14)      | 83% (6)| 50% (4)       | 50% (1) | 44% (4) | 7       |

| 83% (12) | 0% (0)  | 95% (19)      | 0% (9) | 0% (3)        | 0% (6)  | 76% (17)| 8       |

| 83%      | 60%     | 79%           | 33%    | 27%           | 20%     | 68%     | Average |

The number of original observations are in parenthesis.

The bottom row is an average for reliability for each variable.
### Table 4

**Intra-rater Reliability (% agreement)**

<table>
<thead>
<tr>
<th>Eye Gaze</th>
<th>Contact</th>
<th>Nonlinguistic</th>
<th>Speech</th>
<th>Speech Approx.</th>
<th>Opening</th>
<th>Closing</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>60%</td>
<td>82%</td>
<td>100%</td>
<td>50%</td>
<td>100%</td>
<td>92%</td>
<td>2</td>
</tr>
<tr>
<td>80%</td>
<td>100%</td>
<td>80%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
<td>56%</td>
<td>4</td>
</tr>
<tr>
<td>67%</td>
<td>100%</td>
<td>89%</td>
<td>100%</td>
<td>86%</td>
<td>78%</td>
<td>71%</td>
<td>8</td>
</tr>
<tr>
<td>43%</td>
<td>67%</td>
<td>86%</td>
<td>100%</td>
<td>70%</td>
<td>88%</td>
<td>74%</td>
<td>Average</td>
</tr>
</tbody>
</table>

The number of original observations are in parenthesis.
CHAPTER 4

RESULTS

Findings

Overall Participant Compliance

The participant displayed limited attention throughout all phases of the study. The student investigator was unable to be a passive participant during control (fine motor task) and experimental (vestibular stimulation) procedures as the participant frequently attempted to vacate the treatment area, turn overhead lights off, and bite the student investigator. These unpredictable behaviors significantly reduced the student investigator’s ability to follow the child’s lead and increased the amount of redirecting statements (e.g. “No,” “come over here,” and “lights on”). One session had to be terminated early due to the participant’s frequent attempts to bite the student investigator. The participant’s variable level of compliance tended to interfere with the potential for communication interactions as the student investigator had to intermittently focus on behavior management.

Vestibular Stimulation Task

To evaluate the consistency of vestibular stimulation across experimental sessions, the total time the participant took part in the task was measured. Each experimental session included several intervals of vestibular stimulation. An interval was defined as the time from when the participant positioned himself on the swing and began...
to move until the moment he physically vacated the swing. Total Vestibular stimulation time was the sum duration of all intervals. Table 5 illustrates the sessions' overall length of stimulation as well as the longest interval for each session. All sessions met the minimum period of five minutes total of vestibular stimulation. Session 1 contained the shortest amount of vestibular stimulation. This may have been due to poor positioning of the swing, which was not adjusted for the participant's height.

Table 5

<table>
<thead>
<tr>
<th>Session</th>
<th>Amount of Vestibular Stimulation</th>
<th>Longest single interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Activity (Fine motor task)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session</th>
<th>5 minutes</th>
<th>8.5 minutes</th>
<th>8.25 minutes</th>
<th>5.5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 1</td>
<td></td>
<td>2 minutes</td>
<td>1 minute</td>
<td></td>
</tr>
<tr>
<td>Session 3</td>
<td></td>
<td>1 minute</td>
<td>3 minutes</td>
<td>1 minute</td>
</tr>
<tr>
<td>Session 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Session 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Control Activity (Fine motor task)

During the initial control activity session (Session 2), the participant consistently climbed on the furniture. This behavior was both dangerous to the participant and served to potentially provide the participant with some vestibular stimulation. As a result, furniture was removed for all subsequent control activity sessions. This significantly decreased the inappropriate climbing, but affected the quality of the fine motor activities originally planned.
Language Interaction

The language interaction phases were intended to last between 10 and 15 minutes. Table 6 illustrates the length of each session, both pre- (baseline) phase and post-treatment phase. On average all phases of each session were within two minutes of each other with the exception of post-treatment phases for session two and four, which were significantly shorter in length. Due to unforeseen issues such as toileting accidents, behavioral problems, and scheduling conflicts these two session lengths could not be controlled.

Table 6

Duration of Language Interaction Sessions (Minutes)

<table>
<thead>
<tr>
<th>Session #</th>
<th>Baseline (Pre-Treatment) Language Interaction</th>
<th>Post Treatment Language Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (experimental)</td>
<td>12.97</td>
<td>14.33</td>
</tr>
<tr>
<td>2 (control)</td>
<td>11.65</td>
<td>6.87</td>
</tr>
<tr>
<td>3 (experimental)</td>
<td>11.78</td>
<td>15.60</td>
</tr>
<tr>
<td>4 (control)</td>
<td>10.72</td>
<td>6.03</td>
</tr>
<tr>
<td>5 (control)</td>
<td>12.75</td>
<td>15.58</td>
</tr>
<tr>
<td>6 (experimental)</td>
<td>14.87</td>
<td>11.95</td>
</tr>
<tr>
<td>7 (experimental)</td>
<td>15.42</td>
<td>12.50</td>
</tr>
<tr>
<td>8 (control)</td>
<td>16.25</td>
<td>16.30</td>
</tr>
</tbody>
</table>
**Dependent Variables**

Given the unequal duration of each language interaction phase, the frequency of occurrence of each dependent measure was normalized to a common duration (10 minutes). Figures 1 through 7 plot the normalized frequency of each dependent measure as a function of therapeutic session. Within each session, measures based on a baseline language interaction phase (BA) and post-treatment language interaction phase (TX) are plotted. Data pairs represented as filled squares and connected by a broken line represent the vestibular stimulation treatment session (EXP). Data pairs represented as filled circles and connected by an unbroken line represent the control activity treatment session (CON). The plots were designed to allow within session comparisons as well as broader behavioral trends over the experimental period. A positive, negative and zero slope in the line connecting the BA and TX phases indicates a increase, a decrease or no change in treatment-related frequency of behavior.

**Joint Attention**

Figures 1 and 2 respectively plot results for frequency of eye gaze on objects and frequency of eye contact with experimenter. Results indicate that for each variable, both the experimental and control sessions exhibit inconsistent slopes from baseline to post-treatment phases over the eight sessions. No clear trend was observed for either the experimental or control conditions.
Spoken Communication Modes

Figures 3-5 respectively plot results for frequency of nonlinguistic vocal productions, spoken words and spoken word approximations. Results for the spoken modes of communication illustrate variable findings. Figure 3 reveals that the participant exhibited an increased frequency of nonlinguistic vocal productions across all four experimental sessions. Control sessions display inconsistent results (i.e. two sessions showed positive slopes and two showed negative slopes) for this variable. These trends suggest that combining language interaction and experimental procedures has a facilitating effect on nonlinguistic vocal productions.

For the variable, frequency of spoken words (Figure 4), 7/8 sessions display positive slopes indicating increased spoken word frequency from the baseline to post-treatment phases. Interestingly, the one session that demonstrated a reduction in spoken word frequency was the experimental condition. While these findings do not conclusively support one treatment condition over another, they do suggest that language interaction procedures have a facilitating effect on this variable.

The frequency of spoken word approximations (Figure 5) shows variable slopes between pre- and post-treatment phases during control and experimental procedures. No clear trends were observed.

Discourse Functions

Figures 6 and 7 plot results for frequency of discourse initiation and frequency of discourse termination. For both measures, no clear trends are observed for either the
These findings suggest that procedures implemented in this project did not influence discourse functions in a consistent manner.

Figure 1

Frequency of Eye Gaze on an Object

This figure plots the frequency of eye gazes on an object/10 minutes as a function of therapeutic session. Within each session, measures based on a baseline language interaction period (BA) and post-treatment language interaction period (TX) are plotted. Data pairs represented as filled squares and connected by a broken line represent the vestibular stimulation treatment session (EXP). Data pairs represented as filled circles and connected by an unbroken line represent the control activity treatment session (CON).
This figure plots the frequency of eye contact with the examiner/10 minutes as a function of therapeutic session. Refer to Figure 1 legend for details regarding the organization of the data.
Figure 3

Frequency of Nonlinguistic Vocal Production

This figure plots the frequency of nonlinguistic vocal productions/10 minutes as a function of therapeutic session. Refer to Figure 1 legend for details regarding the organization of the data.
This figure plots the frequency of spoken words/10 minutes as a function of therapeutic session. Refer to Figure 1 legend for details regarding the organization of the data.
Figure 5

Frequency of Spoken Word Approximation

This figure plots the frequency of spoken word approximations/10 minutes as a function of therapeutic session. Refer to Figure 1 legend for details regarding the organization of the data.
Figure 6

Frequency of Discourse Initiation

This figure plots the frequency of discourse initiations/10 minutes as a function of therapeutic session. Refer to Figure 1 legend for details regarding the organization of the data.
Figure 7

Frequency of Discourse Terminations

This figure plots the frequency of discourse terminations/10 minutes as a function of therapeutic session. Refer to Figure 1 legend for details regarding the organization of the data.
CHAPTER 5

DISCUSSION

Effects of Vestibular Stimulation on Measures Reflecting Communicative Behavior

Previous studies suggest that during and/or immediately following vestibular stimulation activities, individuals with autism exhibit increased vocal behavior (Ayres & Tickle, 1980; Ray, et al., 1988). The present study was designed to replicate and expand upon earlier studies. Vocal behavior was measured in this study. However, unlike previous studies, vocal behavior was further classified as one of three possible behaviors: nonlinguistic vocal productions, intelligible spoken words, and spoken word approximations.

In addition to vocal behavior, measures reflecting joint attention and discourse function (opening and closing circles of communication) were included in the present study. Such measures were not evaluated in previous studies (Ayres & Tickle, 1980; Ray, et al., 1988) even though individuals with autism routinely exhibit problems using social communication skills. Therefore, the present study has the potential to provide a more complete picture of potential communication change as a result of vestibular stimulation for sensory integration (SI) therapy. Another unique feature of this study was that it incorporated a standard language interaction procedure (Greenspan, 1992) during each baseline and post-treatment phase of data collection. This was done to add ecological validity to the procedure and increase the probability of social communication. Finally, this study included a control task ("fine motor activity"). With such a design, changes in
dependent measures following SI therapy can be directly compared to a task that lacks
the theoretical underpinning of SI therapy.

Spoken Communication Modes (Vocal Behavior)

Classifying vocal behaviors into the categories of nonlinguistic vocal productions,
spoken words and word approximations was highly informative. Of these three variables,
the frequency of nonlinguistic vocal productions was consistently higher after vestibular
stimulation treatment. Increases were observed for all four sessions. This result is even
more compelling as suggesting a relationship because a similar trend was not observed
following the control task. In the control task, the participant was equally likely to
increase or decrease his frequency of nonlinguistic vocal productions. Vocalizations
included undistinguishable sounds (e.g., humming, screaming, laughing, etc.) and
occasional context appropriate sound effects (e.g., sound of fire truck, sound an animal
makes- “baa”). While it was encouraging that the vestibular stimulation task facilitated
these vocalizations, it is difficult to conclude that such behaviors serve a clear
communicative purpose. Such increases may reasonably be considered the result of
heightened stimulation after receiving vestibular stimulation (Fisher, Murray, & Bundy,
1991). Alternatively, the participant could be using these vocalizations as a means to self­
stimulate his regulatory system. Third, they may simply be failed attempts at echolalic
behavior. Regardless of cause, this trend for an increase in the frequency of nonlinguistic
vocalizations following vestibular stimulation is consistent with earlier studies (Ayres &
There was a trend toward an increase in the frequency of spoken word production following both the vestibular stimulation task and the control task. A post-treatment increase in spoken word frequency was observed for three of four vestibular stimulation sessions and four of four control sessions. Therefore, the vestibular stimulation condition failed to outperform the control task. These results appear to suggest that some form of continued stimulation (vestibular stimulation or otherwise) in the context of a language interaction session facilitated spoken word frequency.

There did not appear to be a consistent trend toward increased frequency of word approximations following either the vestibular stimulation or control conditions. Evaluation of the results indicate that, in general, spoken word approximations were a low-frequency event for this participant. Therefore, the limited variation in this measure would decrease the probability of observing a consistent change.

**Joint Attention and Discourse Function**

Frequency of shared attention on an object and with the examiner was highly variable both for the vestibular stimulation and control conditions. Similar variability was observed for measures reflecting discourse function (i.e., frequency of discourse initiations and terminations). No clear trends emerged for any of these variables. As with the frequency of word approximations, the frequency of many of these behaviors was very low, and in some cases, zero. Therefore, systematic differences might not be clearly revealed for behaviors that occur so infrequently. On several occasions, the behavior frequency actually decreased following treatment. This may be due to participant fatigue
over the 45-minute session. If fatigued or frustrated a child with autism may be unresponsive or may exhibit limited interest in social contact.

To summarize, these results do not support a conclusion that joint attention and discourse functions were facilitated by vestibular stimulation. This result has not been previously reported, and is not consistent with suggested links between sensory integration dysfunction and social communication skills (Ornitz, 1974; Greenspan & Wieder, 1997; Case-Smith & Bryan, 1999).

Summary

The results of this study support previous conclusions that vestibular stimulation provided to a hypersensitive child with autism may enhance aspects of vocal behavior (Ayres & Tickle, 1980; Ray, et al., 1988). However, the kinds of vocal behaviors that consistently increase in frequency are not necessarily communicative in nature. There is a modest trend toward increased spoken word use following vestibular stimulation. However, this finding must be qualified. The control condition (fine motor activity), which did not involve vestibular stimulation, if anything, was associated with a more consistent trend toward facilitating spoken word frequency. Measures of social communication failed to demonstrate any facilitating effect for vestibular stimulation. Therefore, while measures of vocal behavior may exhibit change, these changes do not appear to translate into improvements in some of the communicative behaviors that most commonly affect individuals with autism.
Experimental Design and Participant Selection

A single-subject treatment design was selected for this study. Therefore, one should be cautious about generalizing these results to the population. This is particularly true for individuals with autism, who exhibit wide behavioral variability. The present study clearly demonstrates the variability possible within a single participant. It is recommended that future studies use a larger number of participants, employing either single subject or group designs. It is impossible to determine whether other children with autism would experience the same kinds of results. Ideally, future studies would include prospective randomized clinical trials where a vestibular stimulation treatment group could be compared to groups undergoing other intervention techniques including standard language interaction. However, the behavioral variability observed in this study would also plague group studies that rely on random treatment group assignments. In the present study, the participant used limited spoken communication (generally in the form of self-talk or babble) and required frequent behavior management input from the investigator to stay on task and avoid safety hazards. As a result, there were very low frequency counts for many of the dependent measures.

The schedule of the experimental sessions was aimed to avoid times of the day that the participant would likely experience fatigue. The participant was in school until after 2:30 p.m., however, which limited his availability for the project. Therefore.
sessions were held at 3:00 p.m. and at 5:30 p.m. The available times for treatment
sessions varied from week to week based on the participant’s schedule with other
activities and absences due to illness. As a result, it was impossible to equalize the
different treatment sessions across the different session times. As a result, fatigue has the
potential to confound the results.

Another limitation of the study’s design was the relatively small number of total
sessions for which the participant was available. Increasing the number of sessions in the
experimental and control groups would enhance the validity of the study and possibly
allow more formal statistical analysis to be employed.

Investigators designing future research studies should attempt to employ longer,
more frequent sessions. An increased number of occurrences for each dependent variable
may have been more likely to show consistent change with longer language interaction
phases. Due to the small number of observations for each variable and the constraint of
only eight total sessions (i.e. four experimental and four control conditions), treatment
effect would have to be very pronounced to be observed. The small number of
observations also contributes to the highly variable inter-rater and intra-rater agreement.
For example, if only two instances are coded the percentage agreement can be 100%,
50% or 0%. A single disagreement has a profound effect on the overall agreement.
Clearly longer language interaction phases (or higher level participants) would increase
the frequency of the behaviors of interest.
Issues Related to Identifying Sensory Integration Deficits and Establishing Appropriate Intervention

The Sensory Profile Caregiver Questionnaire (Dunn, 1999) provides a broad overview of all the child’s sensory system reactions but does not examine reactions to vestibular input in depth. During this project the student investigator interviewed parents to verify the information provided on the questionnaires and investigate the consistency of the associated behaviors. Allowing one session for a certified occupational therapist to evaluate the child in person would provide a truer picture of the child’s sensory profile. This observational period could have been the final inclusion criteria in the project’s preliminary procedures. Finally, expanding the exclusion criteria may increase the probability of task cooperation. For example, in this study, the participant sought oral stimulation throughout all sessions, which limited his desire to interact socially as he searched for objects to put in his mouth.

Data Extraction and Analysis

Due to spatial constraints of the treatment room, and to reduce the potential for distraction, sessions were video-recorded using a single camera behind a two-way mirror. This recording method resulted in poor sound quality and limited visual information. Sound reverberation and limited volume control resulted in great difficulty during coding procedures. The participant spoke softly and it is possible that intelligible words were recognized as strictly nonlinguistic productions because upon viewing, sounds could not
be definitely distinguishable. It is likely these limitations compromised the validity and reliability of the data extraction process. Future research should consider employ high quality microphones and multiple video cameras to aid in capturing all relevant information.

**Dependent Measures**

More extensive analyses could be utilized in future research to determine the occurrence of potential dependent variables. For example, coding all opportunities for closing circles of communication would allow analysts to determine the discrepancy between the amount of circles closed by the participant and the number of opportunities he was given to close circles opened by the student investigator. This count could potentially provide more conclusive evidence on the amount of social interaction in a given time period given the amount of opportunity. Also, further breakdown of nonlinguistic vocal behavior into potentially meaningful or context-related utterances (e.g., sound affects for police car) and those that are unrelated to the communication event (e.g., screaming) might offer more conclusive evidence into the meaningfulness of increased vocal behavior.

Future studies also need a more concise method for measuring joint attention, or eye gaze on a common object, during experimental procedures. During the viewing of sessions it was extremely difficult to confidently determine whether the participant used eye gaze to engage in a common activity with the student investigator. Installing more than one camera within the treatment area would provide views from multiple angles, increasing the probability for capturing all events.
Conclusion

In summary, the results of the current study suggest the need for further experimentation in this area. Though the findings provide valuable information to the field of occupational therapy and speech-language pathology regarding vocal production following vestibular stimulation, it is uncertain whether generalizations can be made across the population. It is certain that the need for more research-based findings is crucial for determining the efficacy of such treatment techniques. It would have been beneficial to the design of this study to incorporate the direct observations of occupational therapists throughout the experimental procedures to expand upon the meaningfulness of the findings from each discipline’s perspective.

It would be interesting to replicate the study, using a child who is hypo-reactive to sensory stimulation to compare and contrast to the findings of the current project. Future research may also consider applying various forms sensory stimulation to participants to examine effects on language performance.
Appendix A

Flyer Indicating Interest in the Project
Children with Autism

We are looking for children with autism to participate in a study of sensory processing training and its effect on language production. If your child has been formally diagnosed with autism, is oversensitive to the environment, and is 4-6 years of age, he or she may be suitable for the study. If selected each participant will attend 1-2, 45-minute sessions per week over an 8-10 week period. Participants will receive formal language therapy at no cost to you, and the results of the study are likely to contribute to improved methods of language treatment for children with autism. Parents must be present with their children for all sessions. If you are interested in learning more about the project please contact Jennifer Sova by returning the bottom of this sheet in the envelope provided to the Department of Speech Pathology and Audiology, Western Michigan University, 1903 W. Michigan University, Kalamazoo, MI 49008-3825. If you have questions or concerns please contact Jennifer Sova by telephone at 616-656-2780 or email at j7burt@wmich.edu or call Adelia Van Meter at 616-387-7007.

____ Yes, I would like to learn more about the project. Please contact me.

Contact Information: Name ________________________________

Phone # ________________________________

Child’s Name and Age ________________________________
Appendix B

Protocol Clearance from the Human Subjects
Institutional Review Board
Date: August 13, 2002

To: Stephen Tasko, Principal Investigator  
    Jan Bedrosian, Co-Principal Investigator  
    Jennifer Sova, Student Investigator for dissertation

From: Mary Lagerwey, Chair

Re: HSIRB Project Number 02-06-05

This letter will serve as confirmation that your research project entitled “The Immediate Effects of Vestibular Stimulation on the Language Performance in Children with Autism” has been approved under the full category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: July 17, 2003
Appendix C

SALT Transcripts and Corresponding Coding Spreadsheets
<table>
<thead>
<tr>
<th>Joint Attention</th>
<th>Spoken Modes of Communication</th>
<th>Discourse Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye Gaze</strong></td>
<td><strong>Eye Contact</strong></td>
<td><strong>Nonlinguistic Productions</strong></td>
</tr>
<tr>
<td>Object</td>
<td>Person</td>
<td></td>
</tr>
<tr>
<td>5. Engaged with feet game (examining his own feet as C plays)</td>
<td>5. do-do-do</td>
<td>5. do-do-do</td>
</tr>
<tr>
<td></td>
<td>8. Ooh!</td>
<td>8. Ooh!</td>
</tr>
<tr>
<td></td>
<td>9. Yea-yea-yea (not said to indicate yes/agreement)</td>
<td>9. Yea-yea-yea (not said to indicate yes/agreement)</td>
</tr>
<tr>
<td></td>
<td>10. Ah (chewing sounds)</td>
<td>10. Ah (chewing sounds)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
$ CHILD, EXAMINER
+ Name: Participant
+ Gender: M
+ CA: 4;6
+ ParentEduc: 16
+ Context: CON
+ Examiner: Jennifer Sova
+ Transcriber: Jennifer Sova

[CONT] eye contact
+ [GAZE] eye gaze on object
+ [NONLIN] nonlinguistic spoken production
+ [SPEECH] intelligible spoken words
+ [APPROX] speech approximations
+ [OPEN] opening circle
+ [CLOSE] closing circle

0:00
C {walks in and grabs bubbles} [OPEN].
E Do you want to blow bubble/s with me?
= C follows bubbles can with his eyes [GAZE].
E I'll blow them for you.
C {Staring at bubbles} [GAZE].
E {Blows bubbles}.
C {Reaches out for bubbles} [CLOSE].
* C Pop[SPEECH].
E {Holds wand up to C's mouth}.
C {Pushes wand away} [CLOSE].
E {Blows more}.
= C sticks hand out to pop them [GAZE] [CLOSE].
E {Models how to pop bubbles}.
E Ready {holds up wand to him}?
C {Pushes it away again} [CLOSE].
E No?
* C Ah [NONLIN], pop [SPEECH] [CLOSE].
E Oh, pop, pop, pop!
E Are you ready?
= C engaged looking at bubble wand [GAZE].
E {Blows more}.
= C keeps hand on wand and stares at E [CONT].
E You're look/ing right at me.
E Pop, pop on your shoe!
E More bubbles.
* C More [SPEECH] please [SPEECH] bubble/s [SPEECH] [CLOSE].
E Oh that was so nice, I will blow more.
* C Ooh [NONLIN] bam [NONLIN] [OPEN].
E Bam, you got it!
* C Bubble/s [SPEECH] bam [NONLIN].
E Bubble/s go bam {holds wand to C's mouth}.
C {Backs away} [CLOSE].
E No {continues to blow}?
E I got your nose that time.
C {Touches his nose} [CLOSE].
E You have to chase them and pop them {shows how to stomp bubbles}.
C {Goes down to floor to pop bubbles} [GAZE] [CLOSE].
E Are you ready?
* C Bubble/s [SPEECH] [CLOSE].
E Bubbles. ok here we go.
E You're look/ing right at me [CONT].
C {Popping bubbles}.
E You pop/ed all my bubble/s.
E Can I put bubble/s away?
* C Eeeh[NONLIN]!
  = C goes for new toy.
  E Do Ernie and Elmo want to blow bubble/s?
  E Should I blow bubble/s on the train?
  E Here we go!
* C Candy[SPEECH] {looking at block}.
  E What, that tastes gross!
  E Does someone want candy?
  E Are you put/ing block/s in your mouth?
  E No mouth!
  C {Chewing block but gets up when E takes it away}.
  E Do you want to be an airplane?
* C Eeeh[NONLIN] {running around room} [CLOSE].
  E Are you an airplane?
  C {Walks away with back to E}.
  E Those are my bubble/s.
  E Do you want more bubble/s?
  C {Puts down can and opens door} [CLOSE].
  E Not time to go yet.
  E Uh=oh, do you want more?
  C {Grabs squeaky toy}.
  E Few more minute/s and you get a big surprise.
* C {Chewing rubber chicken} aah[NONLIN].
  E Is that a chicken?
  E Yuck, that/'s not a real chicken.
  E Does it taste good?
  = C is unresponsive so E moves on.
  E [Blowing bubbles].
  = C watching bubbles and popping them while chewing chicken [GAZE].
  E I got your jeans with my bubble/s {tickling C'S legs}.
  = C watching C's hand [GAZE].
  E Ouch my bubble/s hurt.
  C {Grabs bubbles}.
  E Pop, they/'re slimy.
  C {Walks away while mouthing object}.
  E I guess I'ill just blow bubble/s over here.
  C {Turns to examine E's actions} [CLOSE].
  E I got someone/'s shoe, should I blow bubble/s in it?
  C {Climbs on chair}.
  E We sit on our chair/s.
  E Sit on your chair please.
  C {Sits on table}.
  E {Moves toward C}.
  C {Scoots away}.
  = C makes faces in mirror.
  E You can make silly face/s.
  E Can you stick your tongue out {gives visual prompt}? 
  C {Sticks out tongue to lick blinds} [CLOSE].
  E Please don/'t put that in your mouth.
* C Ah[NONLIN].
  E Yeah, it/'s yucky.
  C {Trying to pull down blinds}.
  E Can/'t pull down my blind/s, nope, nope.
* C Dayadayaya[NONLIN].
  E No, no, no.
  E Can/'t pull it down.
  C {Trying to pull it down} [GAZE].
  E I see you in the mirror, you are/n't look/ing.
  C {Trying to chew cord}.
  E Keep the blind/s out of your mouth.
* C Snowman[SPEECH] [OPEN].
  E I don/'t think we can make a snowman out of this.
  C {Tries to eat it}.
E No, yuck, not candy.
C {Kicks off his shoe}.
E {Grabs C's foot} Where did your shoe go?
= C smiles and looks at foot [GAZE][CLOSE].
E I see the other one over there.
E Stinky toe/s {tickling C's feet}.
= C smiles and looks at E [CONT].
E You're making face/s at me, you lost your shoe.
E It's over there, stinky toe/s.
C {Chewing on object}.
E I don't like you chewing on my rope.
E Can you put it down for me?
C {Ignores and continues to chew}.
E Let's put it away.
C {Climbs away from E}.
E {Bangs rhythm on table for C to imitate}.
C {Turns to see noise}.
E Can you do that?
C {Looks at ceiling and sticks out tongue}.
E I see someone's tongue.
= C looks E and smiles [CONT][CLOSE].
E You're looking at me making 'cuz I stuck my tongue out at you.
* C Ah[NONLIN] {runs across table}!
E No we don't stand on table.
C {Grabs E for support}.
E Do you want to come down?
C {Laughs}.
E You're laughing at me.
C {Climbs down and mouths E's arm}.
E No we don't bite, no biting.
E We can play but I don't want you to bite me.
* C {Goes to bite E again} Ah[NONLIN]!
E No biting.
* C Ah-uh[NONLIN].
E No biting.
E I think we should find you a toy to chew on.
* C Ah-ee[NONLIN].
E I don't think it tastes like candy.
* C Orange[SPEECH][OPEN].
E It is orange, you are right.
C {Reaches into E's pocket}.
E Those are my secret treat/s.
E You can have them in a minute.
E Let's go in the other room.
* C Ah[NONLIN].
E Let's go.
E Hold my hand please.
C {Holds E's hand upon request} [CLOSE].

* = C&I Verbal Utts
<table>
<thead>
<tr>
<th>Joint Attention</th>
<th>Eye Gaze Object</th>
<th>Eye Contact Person</th>
<th>Nonlinguistic Production</th>
<th>Speech</th>
<th>Speech Approx.</th>
<th>Discourse Functions</th>
</tr>
</thead>
</table>
| 1. Trying to fit different objects into bus door  
2. Watches C. spin wheels on a truck  
3. P. reaches into bus to pull out cupcake, C talks about chocolate cupcake  
4. Toes game ("Whose feet are these"), looking at feet  
5. Game of catch (C- "Can you kick it?", P laughs and throws it but won’t retrieve it) | 1. Talking about ball | 1. ba-ba-ba-ba  
2. XXX XX  
3. ba-ba...  
4. Mmm-hmm (humming)  
5. Ah! (scream) | 1. help (echolalia)  
2. Potty  
3. Potty  
4. Go potty please | 1. pease (please) | 1. Opens door of bus to grab cupcake (and try to eat it)  
2. Trying to prevent C. from opening bus (C- "Hey you’re in my way!") | 1. C- “Do you want help?”  
P- Grabs C’s hand and pulls it to lock.  
2. C- “Do you have to go potty?”  
P- “Potty”  
3. C- “Do you have to go?”  
P- “Go potty please”  
4. C- “Do you have to go?”  
P- “Ah!”  
5. C- “I bet our car will fit in bus”  
P- Grabs it from C.  
6. Stinky toes exchange  
7. C- “Do you want to play catch?”  
P- Grabs ball  
8. C- “Can you kick it?”  
P- throws it and laughs |
Session 4 SLT
March 17, 2003

$ CHILD, EXAMINER
+ Name: Participant
+ Gender: M
+ DOE: 3/7/2003
+ CA: 4;6
+ ParentEduc: 16
+ Context: CON
+ Examiner: Jennifer Sova
+ Transcriber: Jennifer Sova
+ [CONT] contact
+ [GAZE] eye gaze on object
+ [NONLIN] vocalization
+ [SPEECH] intelligible spoken words
+ [APPROX] speech approximations
+ [OPEN] opening circle
+ [CLOSE] closing of circles
- 0:00
E Oh no train won't fit.
  = try to fit objects in bus [GAZE]
E I think the truck will fit.
C {Grabs trucks, shuts bus, and rolls it on top}.
E Oh the truck wants to ride on top of the bus.
E It has wheels and so does my car.
E See how fast they go.
  = C stares at the spinning wheels of bus [GAZE]
C {Try/ing to unlock bus}.
C {Turns away when unsuccessful}.
E I'll help you.
* C {Looks at open door of bus} E Open shut, open shut.
* C {Locks bus but can't unlock it} E Need help?
* C {Looking away from lock he grabs E's hand and moves it to lock} [CLOSE] E Beep, beep, bus is leaving.
* C {Tries to prevent E from getting by and opening the bus} [OPEN] E Hey you're in my way.
* C {Takes off shoe} E Oh, stinky toe/s {grabs foot and tickles} = C watches feet as E tickles [GAZE]
* C {Goes and stands on chair} C {Wathes his feet} E We don't stand on chair/s.
E Can you throw the ball?
* C {Grabs ball and throws it across the room} [CLOSE] E Can you go get it?
  = C makes eye contact [CONT]
E Can you kick the ball?
* C {throws it and laughs} [CLOSE] E Do you have to go potty?
* C Potty please. [CLOSE]
E Do you have to?
* C Potty please, potty. [CLOSE]
E Do you have to?
* C Go potty [CLOSE] [SPEECH] C {has accident ending the session early}.

* = C&I Verbal Utts
**Joint Attention**

1. C. is showing P toys and he is watching
2. C and P are examining broken car
3. Play/share fire truck
4. Look at horse (C names it Pokey)
5. P tries to get bubbles, C takes out wand but the bottle is out of soap
6. P wants to catch ball (then chews it, not interested in playing)

**Spoken Modes of Communication**

1. Eeh!
2. ding-ding-sing (sounds of fire truck)
3. Ding-ding-ding-ding...
4. Ding-ding-ding
5. Humming/singing with dinging of fire truck
6. Eeh!
7. Aah! (peek-a-boo with C)
8. Self talk (a-ma-wa...)
9. Ah!
10. Ba-ma-ba-ma

1. Gone (all gone)
2. Pop
3. Goat
4. Goat say baa
5. Pokey (echo)
6. Here comes the goat (echo)
7. Goat- baa
8. Giraffe
9. Hippo (echo)
10. Dinosaur
11. Doggie
12. Hippo, hippo, hippo
13. Go home!

1. Ah (all)
2. No (XXX)
3. Fa (farm)
4. Gira (giraffe)
5. Shu da do (shut the door0 echo)

1. P- reaches for more M & Ms (C-all gone)
2. P- “Pop”, C- “We can’t pop bubbles, all gone”
3. Plays with ball
4. P.- “Goat” C.- “Yeah”
5. P.- “Goat say…”
6. P.- “Goat, baa” C.- “Yeah”
7. P.- “Giraffe” (holding animal)
8. Exploring farm (looks through window at C)
9. P.- peeks at C, C.- “Hi”
10. P. shuts all windows C.- “Oh you want them shut”

1. C.- “Is that doggie/goat?” P.- “Doggie”
2. C.- “Can I show you something?” P.- “Go home”
3. C.- “Do you want to try?” P.- squeals, grabs truck, drives it
4. Share fire truck (Responding to C’s attempt to play)
5. C.- “Look this is Pokey” P.- grabs horse and examines it
6. C.- “Ready, catch” P.- catches it
7. C.- “Can you throw it?” P.- drops ball and laughs
8. C.- “Can you get it?” P.- picks ball off floor and throws it

**Discourse Functions**

1. P- reaches for more M & Ms (C-all gone)
2. P- “Pop”, C- “We can’t pop bubbles, all gone”
3. Play/share fire truck
4. Explore farm (looks through window at C)
5. C- “Look this is Pokey” P- grabs horse and examines it
6. C- “Ready, catch” P- catches it
7. C- “Can you throw it?” P- drops ball and laughs
8. C- “Can you get it?” P- picks ball off floor and throws it
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<td>7. C- “Does goat say baa?” P- picks up goat and “baa”</td>
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<td>9. Exchange with chicken, C- “Open the farm door and let it in”</td>
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<td>11. Peek-a-boo (P peeks through to see what C is doing)</td>
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<td>12. Play with animals (C- “Is that a doggie?”)</td>
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<td>10. P- grabs animals from C</td>
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<td>14. Echo C’s “Woof! Woof!”</td>
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<td>16. C- “open up barn” P- grabs it away, leaves it shut</td>
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EI brought you a farm today.

C watches E play with toy fire truck [GAZE].

E That's a fireman.

* C Eeeh! [NONLIN]

E You can try it.

* C Eeeh {grabs truck and drives it}[NONLIN][CLOSE].

E What does fire truck do?

E {Makes siren noises}.

C {Imitates siren noises}. [CLOSE][NONLIN]

E Can you find the ladder?

* C Ding-ding-ding [NONLIN].

E I need a car too, this one doesn't have wheel/s.

= C examines broken car and shoves in his mouth [GAZE].

* C {Goes back to fire truck} ding-ding-ding [NONLIN].

E I'll save you, I need my hose.

= C takes car away from E and more sound effects [GAZE][NONLIN].

C {Responding to E's attempt to play}[CLOSE].

C {Walks over to barn}.

E I have a horse name/d Pokey.

= C takes and looks at horse [GAZE][CLOSE].

* C Ding-ding-ding [NONLIN].

C {goes over to get more M&Ms}[OPEN].

E All gone.

* C Ah(all)[APPROX] gone[SPEECH].

* C {walks over to bubbles} pop[SPEECH][OPEN].

E We can't pop bubbles.

= C looks at can [GAZE].

E They don't work because we dump/ed them out {talking about soap solution}.

C {Grabs ball}[OPEN].

E Can you throw the ball to me?

C {runs across room and sits down}.

E Ready, catch!

= C watches ball [GAZE].

C {Grabs ball and mouths it}[CLOSE].

E Can you play catch?

C {Thaws ball on floor and laughs}[CLOSE].

E I see it under the table.

C {Retrieves ball and gives to E}[CLOSE].

E Good job!

* C {Babble}[NONLIN] E Ready, catch!

E You don't want to eat it you want to throw it.

* C Ah[NONLIN]!

* C {runs over to barn} C Goat[SPEECH].

E it is a goat.
* C Goat[SPEECH] say[SPEECH].
    C {Puts goat in mouth}.
    E What do/3s a goat say?
    E Does a goat say baa?
* C Ba-ba-ba-ba[NONLIN][CLOSE][GAZE].
    E Uh oh there go/3s your ball.
* C Ma-ma-ma-ma[NONLIN][GAZE].
    C {Puts goat in mouth}.
    E Here is another goat.
* C Go[APPROX] ba[NONLIN].
    E they do say ba.
    C {Opens barn door}.
* C Giraffe[APPROX][OPEN].
* C Giraffe[SPEECH].
    E Yeah, a giraffe does/n't go on farm.
    C {Singing}[NONLIN].
    E I see a cow, moo.
* C Moo[NONLIN][CLOSE].
    E I see horsies.
* C Hippo/s[SPEECH].
* C Hippo/s[SPEECH].
    E Yeah and dinosaurs.
* C Dinosaur/s[SPEECH].
* C Rar[NONLIN][CLOSE].
    E They don/'t go on a farm.
* C Rhino[SPEECH].
    E Yeah, that/s a rhinosaurus.
    E Goat say/3s ba.
* C Pew[NONLIN].
    E Cockle-doodle-do!
    E Time to get up.
    = C peeks through barn window at E [GAZE][OPEN].
    E I see you through there, hi.
* C Arf[NONLIN].
    E He sound/3s like a doggie.
    C {Puts animal in mouth}.
    E Yuck, that does/n't taste like candy.
    E Woof, woof!
* C Woof[NONLIN] woof[NONLIN] [CLOSE].
    E Shut the door.
* C Shu[APPROX] da[APPROX] do[APPROX].
* C Goat[SPEECH].
    E Yeah that is a goat.
    E Here come/3s a cow, moo.
* C Moo[NONLIN][CLOSE].
    E They are on the farm.
    C {singing, babbling}[NONLIN].
    E Is that a doggie or a goat?
* C Doggie[SPEECH][CLOSE][GAZE].
    E It is a doggie.
    E There he is by the rhino.
    C {Babble}[NONLIN].
    E Time to go to bed, shut the door.
    C {No response keeps playing}.
    E It/3s morning, time to get up.
    C {Tries to pull barn doors shut against actions of E}[CLOSE].
    E You want them closed, shut please.
    E Doors shut {helps C shut doors}.
    E Can I show you something?
* C NoXXX[APPROX][CLOSE].
    E I/3m go/ing to the other room.
    C {No response}.
    C {Picks up fire truck}.
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