Effect of Therapist-Initiated Versus Self-Initiated Vestibular Stimulation on Vocalization in Children with Autism

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EFFECT OF THERAPIST-INITIATED VERSUS SELF-INITIATED VESTIBULAR STIMULATION ON VOCALIZATION IN CHILDREN WITH AUTISM

by

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EFFECT OF THERAPIST-INITIATED VERSUS SELF-INITIATED VESTIBULAR STIMULATION ON VOCALIZATION IN CHILDREN WITH AUTISM

Carol L. Maddox, M.S.
Western Michigan University, 1990

Therapist-initiated vestibular stimulation was compared to self-initiated stimulation to determine their relative effects on vocalization in children with autism. Vocalizations produced during table-top activities were also compared to those produced during vestibular stimulation. Two children with autism participated in the study. Vestibular stimulation was provided by a hammock swing. All vocalizations were recorded during a total of thirteen 15-minute test sessions.

Results indicated that in this study: (a) There was no significant difference in quantity of vocalizations produced during self-initiated versus therapist-initiated vestibular stimulation, and (b) there was a significant increase in vocalizations during vestibular stimulation as compared to during table-top activities.
ACKNOWLEDGEMENTS

I wish to express my appreciation to my advisor, Doris Smith, for her unending encouragement, support, and patience throughout the process of this study; and to my committee members, Sandra Edwards and Cindee Peterson, for their guidance and assistance. Thanks are also due to the staff and students of the Doris Klaussen Developmental Center, in Battle Creek, Michigan, for their participation in the research.

Carol L. Maddox
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Effect of therapist-initiated versus self-initiated vestibular stimulation on vocalization in children with autism

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INTRODUCTION

Increased vocalization is frequently observed in correlation with vestibular stimulation. The latter is commonly provided as part of sensory integrative treatment in clients with autism and many other diagnoses. As Ayres remarked: "Vestibular stimulation usually elicits vocalization" (1972b, p. 243).

A number of researchers have hypothesized a connection between the vestibular and auditory-language systems although limited clinical research has been performed to support this hypothesis. Ayres (1972a) stated that auditory-language dysfunction is one of the syndromes which is most responsive to sensory integrative treatment, while DeQuirós (1967) identified syndromes of vestibular dysreflexia which involved abnormalities of language.

It has been noted that, phylogenetically, the auditory system evolved out of the vestibular system, therefore, a close connection has been assumed (Ayres, 1972b). In support of this connection, Moore (1973) reports that hearing deficits may interfere with equilibrium reactions.

Decreased post-rotary nystagmus, considered to be one of several indications of vestibular dysfunction, has been documented in children with a variety of language disorders, including autism (Ayres, 1979; Ayres & Mailloux,
Wing (1976) mentioned a lack of dizziness—another indication of depressed vestibular functioning—following spinning as characteristic of children with autism.

Studies of abnormal reflexes in children with language disorders provide additional evidence linking the vestibular system with language. Rider (1974) documented a significantly increased number of abnormal reflexes in children with dysphasia. Stilwell et al. (1978) hypothesized that if speech/language development is indeed related to vestibular functioning, the child with disabilities in this area would exhibit deviations in vestibular functioning. In fact, they did find "decreased postural stability" (p. 226) to be characteristic of their subjects with speech/language disabilities. Studies have documented improvement in reflex integration utilizing vestibular stimulation (Chee, Kreutzberg & Clark, 1978; Montgomery & Richter, 1977; Ottenbacher, 1983; Ottenbacher, Short & Watson, 1981).

Language has been noted to be an essential prerequisite for verbal instruction (Clark & Steingold, 1982) as hearing is for the development of language (Ayres, 1972b). In other words, one must be able to understand language in order to comprehend verbal commands; similarly, one should be able to hear in order to develop adequate spoken
Condon (1975), in his work with autistic children, speculated that infants with defects in auditory processing might encounter difficulties learning speech as well as in developing human relationships.

DeQuirós and Schrager (1978) believe that vestibular stimulation is necessary for development of the ability to exclude excess information about posture, movement and equilibrium from consciousness in order that learning may occur. DeQuirós (1976) postulates that language development progresses as the child gains the ability to close out much of the sensory input which is received. Conversely, inability to modulate this incoming information would interfere with the development of language.

Autism is a condition characterized by disturbances of language, perceptual integration, motility, relationships with others, and development. It is felt that the pathology may be present at birth in most cases, rendering the individual virtually incapable of effectively utilizing incoming stimuli (Ornitz & Ritvo, 1968).

Ornitz (1970) suggests that autism is primarily a disorder of faulty sensorimotor integration. He states that, under normal conditions, the vestibular system suppresses sensory input during motor discharge, while vestibular influence on motor output may in turn be suppressed during excessive sensory input. However, in children with autism, qualitative observations reveal a number of
anomalous sensorimotor reactions, such as abnormal motor output in reaction to sensation, or motor inhibition which may be sought in order to reduce sensory input.

In the auditory area, autistic children have been noted to be overreactive or abnormally attentive to certain specific auditory stimuli, such as self-produced sounds, while at the same time failing to react visibly to other stimuli, such as very loud noises. In fact, very often infants with autism may at first be thought to be deaf, an assumption which is reinforced by the fact that they frequently lack the "babbling" behavior typical of this developmental stage, which is the normal precursor to speech. Rutter (1968) hypothesizes that this lack of response to certain sounds may indicate an inability to understand them, which could indicate a dysfunction in auditory processing. Yet another characteristic is the apparent inability to accommodate to continuous sound (Ayres, 1979) or an exaggerated lack of tolerance to common sounds.

A number of language anomalies are typically observed in autistic children and delayed development of speech is common in this population. According to Wing (1976) half of all children with autism never develop speech at all. Also common is echolalia, which for 75% of all autistic children is the first language to develop (Wing, 1976). Other limitations include failure to use gestures (such as
signed language) as a substitute for spoken language, and spontaneous speech which is produced only with great effort and marked by immaturity and/or abnormalities of grammar. Frequently, the speech which is produced resembles that seen in individuals with receptive disorders; indeed, the comprehension problems found in autism are similar to those characteristic of receptive aphasia. However, aphasic children are generally able to understand gestures, an ability which autistic children seem to lack (Ornitz & Ritvo, 1968; Wing, 1976). Though articulation disorders may be present in autism, probably more significant is the apparent lack of an inner language. In addition, children with autism seem to experience a great deal of difficulty in dealing with symbols and symbolic thought. The latter would seem to cause the most severe disability (Savage, 1970).

The speech which is produced by autistic children is often "stereotypical and parrotlike, with much echolalia" (Bloom & Lahey, 1978, p. 516). The voice tends to be high-pitched—often hoarse or very nasal; there is poor control of volume and speech tends to be monotonous (Fay & Schuler, 1980). Wing (1976) described it as resembling the speech of the congenitally deaf, citing deficient control of pitch and volume, atypical intonations and uneven delivery. Koupernik (1970) observed that autistic children seem incapable of monitoring their own voices, an
ability which most children acquire by the age of six months. Although memory and the ability to memorize and repeat phrases (demonstrated by echolalia) are areas of relative strength in many autistic children, these children, in addition to exhibiting a delay in the development of speech, often fail to develop communicative speech or to use the words already learned (Ornitz & Ritvo, 1968).

According to Rutter (1968), Kanner, who first described the syndrome of autism in 1943, considered failure to relate to others, or social withdrawal, to be its most important characteristic. Rutter presents a number of pieces of evidence to refute this view, including the following: (a) that social withdrawal tends to decrease with age, although the individual remains autistic; (b) that it is impossible to explain the characteristic intelligence test scores or the specific language defects encountered in terms of social withdrawal; (c) that other conditions which involve social withdrawal do not show a similar pattern of intelligence test scores; (d) that some autistic children may never develop language and yet, as they mature, they become less socially withdrawn; and (e) that the most important predictors of eventual prognosis include IQ and degree of language improvement, while social withdrawal has only a weak correlation with prognosis.

Rutter (1968) proposes the theory that speech is the primary defect in autism. His evidence for this point of
view includes the following points: (a) that retarded speech is inevitably associated with autism, indeed, in many cases, it is the first sign to be noticed in the autistic infant; (b) that scores tend to be poor on all tests which involve verbal concepts, abstract and/or symbolic processes, whether or not those tests actually require speech; and (c) that studies have suggested deficits in verbal coding and patterning.

Other researchers concur with Rutter's theory, including Schopler and Reichler (1970) who believe that the primary defect in autism is impaired communication and comprehension. Wing (1970) reports that disorders in perception, understanding and language (both verbal and non-verbal) are basic, with behavior playing a secondary role. In addition, Wing (1976) states that most of the observed behavior problems may be blamed on the child's problems with symbolic function and non-verbal communication.

Vestibular system dysfunction is a characteristic of autism (Ayres & Hesket, 1972; Wing, 1976). Autistic children frequently engage in self-stimulatory behavior such as rocking, whirling, head banging and spinning of objects, all of which stimulate the vestibular system either through direct input, optokinetic effects, or both (Ayres, 1979; Kinnealy, 1973; Knickerbocker, 1980; Ornitz, 1970, 1974; Ornitz & Ritvo, 1968). Knickerbocker (1980) believes that this behavior represents an excessive need for
vestibular stimulation as well as a means of facilitating sensory integration. Ornitz, Atwell, Kaplan and Westlake (1985) suggest that the abnormalities in nystagmus which they observed indicated brain stem dysfunction, which could be sufficient to explain many of the symptoms and behaviors of autism.

Ayres and colleagues (Ayres, 1979; Ayres & Hesket, 1972; Ayres & Mailloux, 1981) have noted that their autistic clients tend to either strenuously avoid or excessively seek vestibular stimulation, both of which may indicate defective processing. Some degree of gravitational insecurity is also commonly observed (Ayres, 1979; Kinnealy, 1973; Ornitz, 1969; Ornitz & Ritvo, 1968). Ayres (1979) describes two categories of faulty sensory processing which are relevant here. First, she discusses the failure of the nervous system to properly register sensory input which leads to hypo- or hyper-reactions to sensation; second she explains gravitational insecurity and tactile defensiveness as due to a lack of modulation of input.

Observation suggests that varying states of arousal may exist in the same individual at different times (Ornitz & Ritvo, 1968). Another characteristic is the inability of autistic children to modulate perceptual input and thereby maintain constancy. Ornitz and Ritvo state that "identical percepts from the environment are not experienced as the same each time" (p. 88) a fact which they
attribute to a failure of the homeostatic regulation mechanism of the central nervous system. Similarly, Bergman and Escalona, as cited by Ornitz and Ritvo (1968), postulated that there are low neurological thresholds to external stimulation, which could lead to either too much or too little input being received into the system. In 1974, Ornitz postulated that a vestibular defect might, by removing the vestibular system's normal modulating influence on sensory input, cause the sensorimotor dysfunctions commonly observed. These dysfunctions could in turn lead to language dysfunction.

It seems clear that some degree of vestibular malfunction is involved in autism and is responsible, at least in part, for the language deficits experienced by individuals with the disorder. Much research has documented the utility of vestibular stimulation in increasing verbal output in individuals with a variety of conditions which limit their language ability. A number of these studies are described below.

Kawar (1973), studying children with learning disabilities, found that sensory integrative therapy which included vestibular stimulation, produced improvement in right ear scores on tests of dichotic listening in a group of 18 subjects. This indicated improved lateral specialization for language functions.

Brody, Thomas, Brody, and Kucherawy (1977) reported in
their study of 27 profoundly retarded, marginally vocal adults, that sensory integrative treatment, which incorporated vestibular stimulation, produced a significant increase in rate of vocalizations. They felt that sensory integrative methods might be an appropriate means of eliciting vocalizations in clients whose rate of vocalization is too low to employ behavioral methods. Similarly, Clark, Miller, Thomas, Kucherawy, and Azen (1978) reported significant increases in frequency of vocalization following sensory integrative treatment incorporating vestibular stimulation in their study of 27 profoundly retarded, minimally vocal, institutionalized adults.

King (1974) employed vestibular stimulation to produce increased verbalizations in adult chronic, non-paranoid schizophrenics. She hypothesized that an underreactive vestibular system might be an etiological factor in this type of schizophrenia. In 1973, King (Henderson & Coryell, 1973) reported that she had found that gains achieved through the application of vestibular stimulation were generally retained as opposed to the regression which may occur with other treatment modalities. In 1978, Bailey, also working with chronic schizophrenics, reported an increase in quality of language in her group of seven subjects, though no difference was noted in either quantity or rate.

Magrun, Ottenbacher, McCue, and Keefe (1981) reported increases in spontaneous verbalizations in five trainable
mentally impaired and five developmentally delayed children as a result of self-initiated, active vestibular stimulation, along with a decrease in verbal responses following withdrawal of the stimulation. They also noted that the strongest effect was found in the youngest subjects with more severe delays, a group which is typically least responsive to traditional therapy. Kantner, Kantner, and Clark (1982) provided controlled, passive, semi-circular canal stimulation to ten mentally retarded children. Some improvement in language was noted, although the results were not statistically significant.

Morrison and Pothier (1972) reported that nine mentally retarded pre-schoolers who participated in sensorimotor training incorporating vestibular stimulation demonstrated significant improvement in their language as measured by the Denver Developmental Screening Test (DDST) language subscale (Frankenburg & Dodds, 1967). It is important to recognize that the DDST is a screening test which is not considered to be an optimal tool for the measurement of language. In addition, the reliability and validity of the DDST are considered to be low.

Researchers specifically studying children with autism have also reported significant results. Ayres and Heskett (1972) provided a course of sensory integrative therapy to a seven-year-old girl with autism and reported an increase in auditory-language ability. In 1977,
Wolkowicz, Fish, and Schaffer used sensory integrative treatment incorporating vestibular stimulation with four autistic children and documented an increase in spontaneous vocalizations.

Karsteadt (1983), in a single-case design with a child with autism, compared vestibular stimulation with table-top activities and reported a marked increase in verbalizations during vestibular stimulation as opposed to table-top activities. The subject worked one-on-one with a tutor both prior to and following each of twelve activity sessions.

In a follow-up study, Reilly, Nelson, and Bundy (1983) studied 18 children with autism in a counterbalanced/crossover design. They compared vestibular stimulation and fine-motor/table-top activities and failed to replicate Karsteadt's success, reporting instead no significant differences in most areas measured, and in fact significantly more variety and greater average length of utterances in the fine-motor group.

Reilly et al. (1983), in discussing their findings, mention several possible reasons for the difference in results. Most relevant here is the fact that the children in their study had had previous experience with the specific table-top activities used, in which their teachers had encouraged verbal interaction related to some of the specific objects employed in the study. They suggest that
these experiences might have biased the subjects in some way toward increased verbalization during these activities as opposed to the activities involving vestibular stimulation. They also cited the short time frame of their study. Essentially only four sessions were conducted for each child, amounting to a total of one hour of vestibular stimulation per subject, which may not have been sufficient to produce results.

Ray, King, and Grandin (1988) reported a significant increase in vocalizations in a nine-year-old child with autism, with the application of self-initiated vestibular stimulation which was administered by spinning in a rotary fashion on a platform swing with a bouncer attachment for a five-minute period once daily for 17 days over a period of four weeks.

In a related study, Kreutzberg (1976) performed vestibular stimulation with normal, unimpaired infants and reported subjective observations of increased vocalizations in many of the subjects.

A significant characteristic of autism is a strong resistance to change and the related lack of self-direction which is so pervasive. Ayres (1979) states that the therapist may not be able to rely on the autistic child to self-direct his or her activity, as is generally recommended in sensory integrative therapy, but instead, may have to encourage the child to participate. Pettit (1980)
stresses the importance of recognizing when the child is in need of encouragement or is able to direct her/his own activity. Keeping this fact in mind, along with the principles of sensory integrative therapy as promoted by Ayres, it seems that the method of administration remains an important factor to consider when examining the impact of vestibular stimulation on language. It is worth noting that whereas Magrun et al. (1981) reported statistically significant increases in verbalizations in mentally retarded children as a result of self-initiated, active stimulation, Kantner, Kantner, and Clark (1982) reported less than significant results in a similar population, where passive, controlled stimulation was employed. Also relevant is the Ray et al. (1988) study, which produced increased vocalizations during self initiated stimulation, as well as an increase in vocabulary of 13 words over the term of the study. Cermak and Henderson (1989) state that one of the variables which may affect sensory integration is whether stimulation is self- or therapist-initiated.

Stimulation may be provided to the vestibular system in many ways and positions. Ottenbacher and Peterson (1984) reviewed 14 studies of the effects of controlled vestibular stimulation, defined for their purposes as "procedures designed to stimulate vestibular receptors... rotatory stimulation combined with impulsive starts and stops and/or linear or vertical accelerations or some
combination of rotatory, linear, or vertical acceleration or movement" (p. 429), on a total of 533 subjects, ranging in age from infancy to adolescence. Sixty-five percent of the subjects were "normal" without any "identified handi­capping condition" (p. 430), 15% were preterm infants classified as "at risk," and the remaining 20% were children with developmental delays such as cerebral palsy and mental retardation. The investigators reported that "the mean effect size for rotatory vestibular stimulation was approximately twice that of linear/vertical vestibular stimulation" (p. 431). Kantner, Clark, Allen, and Chase (1976) suggested that not all accelerations in linear and angular directions create vestibular stimulation. In practice, many of the purposeful activities which provide vestibular stimulation, such as riding a scooter board down a ramp or swinging on a swing set, provide it in a linear fashion. However, in addition, these activities typically incorporate other types of sensory stimulation such as proprioceptive or tactile input. For the purposes of sensory integrative therapy, such a combination of stimulation to more than one system with the purposeful aspect of the activity would be ideal; however, to insure experimental control, it is necessary first to isolate the form of stimulation, and second to assure that the stimulation received is equivalent across conditions.

In order to satisfy the first condition, swinging in
a hammock swing was selected for this study as the means of providing vestibular stimulation. With reference to the second condition, although it would have been preferable to limit the stimulation to rotary spinning, it was not possible to maintain control over the subject during the self-initiated condition. Therefore, an alternating pattern was utilized, which incorporated both linear and rotary movement.

One consideration in using vestibular stimulation is the "concern that vestibular stimulation may induce seizures in seizure-prone children" (Kantner, Clark, Atkinsons & Paulson, 1982, p. 16) which may include children with autism, according to Rutter (1968). A search of the literature failed to produce documentation of any instance in which seizures could be directly attributed to vestibular stimulation. This issue has been addressed by Ayres (Henderson & Coryell, 1973). Ayres (Henderson & Coryell, 1973) stated that, although she felt "a great deal of concern and responsibility over the possibility that certain types of vestibular stimulation will possibly precipitate seizures...this has never happened to any of the children that I have worked with" (p. 122). According to Kantner, Clark, et al. (1982) this concern "has been based on hearsay and unconfirmed clinical impressions of practicing therapists" (p. 16).

Kantner, Clark, Atkinsons, and Paulson (1982) looked
at the effects of vestibular stimulation on EEG readings in children prone to seizures. They reported that the stimulation did not exacerbate abnormal brain-wave patterns; in fact they observed a significant decrease in paroxysmal activity in six of their ten subjects. The authors concluded "available literature, supported by our findings, indicates that a seizure directly induced by semicircular canal stimulation is an extremely rare event" (p. 20).

Kantner, Clark, Atkinsons, and Paulson (1982) proposed a number of possible explanations for the assumption that vestibular stimulation might promote seizure activity, among them (a) the possibility that inexperienced observers might mistake the manifestation of spinal level reflexes, which may be evoked by spinning, for seizure activity; (b) that seizures may be caused by fatigue, excitement or hyperventilation; or (c) that they might be a result of the stroboscopic visual effect created by spinning in a lighted room. For the latter reason, as well as in the interest of more specifically isolating the effects of vestibular stimulation, Kantner, Clark, Atkinsons, and Paulson (1982), along with several other researchers, suggest keeping eyes closed and/or spinning in darkness (Kantner, Clark, Atkinsons & Paulson, 1982; Montgomery, 1985; Palmer 1980; Reilly et al., 1983; Stilwell et al., 1978).
This recommendation was not considered to be a viable option for the purposes of this study for two reasons. First, the basic principle of sensory integration, indeed of occupational therapy itself, centers on the concept of purposeful activity. It is questionable whether it would ever be possible to incorporate vestibular stimulation performed in a completely darkened room or with the client's eyes closed into a purposeful activity or one requiring an adaptive response. Second, as Montgomery (1985) acknowledges, a child may resist being blindfolded, especially a child who has gravitational insecurity, as so many children with autism do.

Two hypotheses were tested in this study. It was hypothesized that vocalizations would increase during vestibular stimulation compared to table top activities and that the number of vocalizations produced would be greater in response to self-initiated stimulation than when the stimulation was initiated by the therapist.
METHOD

Subjects

Two subjects were selected from volunteers in the Autistic Impaired classrooms at the Doris Klaussen Developmental Center in Battle Creek, Michigan. Selection criteria were that subjects: (a) be between the ages of five and fifteen years; (b) have a primary diagnosis of autism; (c) be essentially non-verbal, that is have a delayed development of language; and (d) have no history of seizure disorders, no EEG abnormalities, and no inner ear dysfunction.

Subject A was a nine-year, nine-month old male who had no spoken language (non-verbal). The subject was responsive to verbal commands and there was no reason to suspect hearing impairment. The classroom teacher reported that the subject had at one time had tubes surgically implanted to relieve a fluid build-up in the inner ear. An audiological screening was unsuccessfully attempted by the school nurse shortly after the initiation of this study.

Subject B was a 15-year old male, also non-verbal. Subject B would not remain seated in the swing long enough to participate in the study after the second session.
Apparatus

Equipment included a post-rotary nystagmus testing board, a mat, a hammock swing, a stopwatch, and a handheld cassette recorder.

Procedure

The experimental design employed was a single-subject, alternating treatment design (Ottenbacher, 1986a). A total of 13 experimental sessions were conducted two times per week over a nine-week period, with a two-week break imposed by the school holidays. During a third week, school conferences necessitated an alteration in the schedule and only one session was completed. The initial session was eliminated from data analysis due to adjustments in the procedure which were made following this session. The two conditions—therapist-initiated versus self-initiated—were alternated every third session (i.e., two sessions of one condition, followed by two sessions of the second condition), beginning with the therapist-initiated condition.

Each subject initially received an assessment of vestibular system integrity. The Southern California Post-Rotary Nystagmus Test (SCPNT) (Ayres, 1975) was administered. Integration of the asymmetric (ATNR) and symmetric tonic neck reflexes (STNR), and the tonic labyrinthine reflex (TLR) in prone and supine were assessed.
addition, the subjects were observed for the presence of equilibrium reactions in quadruped, kneel-standing, and seated positions. Ottenbacher (1978) believes that post-rotary nystagmus is easily influenced by other factors, most notably visual fixation; therefore, he investigated other means of identifying vestibular dysfunction. The inability to assume the prone extension posture (essentially, the test for TLR, prone) was found to be an effective indicator of "vestibulo-proprioceptive dysfunction" (p. 221). Montgomery (1985) cited correlations between hypo-reactive nystagmus and poor postural mechanisms and recommended assessing prone extension, righting and equilibrium responses, and the tonic neck reflexes.

Results of the SCPNT test on Subject A were equivocal. The subject appeared to receive definite pleasure from the rotation, and was cooperative in assuming and maintaining the testing posture; however, it was not possible to prevent visual fixation while attempting to measure nystagmus, and no nystagmus could be observed. The SCPNT had previously been administered by the school occupational therapist on three occasions when the subject was between six-years, five-months and six-years, ten-months of age, at which time combined scores of 13, 40 and 5 seconds were obtained. Notwithstanding the high score of 40 seconds, the reliability of which was questioned by the
administering therapist due to the subject's behavior during administration, the remaining scores obtained at that time were indicative of significantly depressed nystagmus as the mean total score for six year old males is 20.1 seconds while the subject's mean score, excluding the anomalous score of 40, was 9. The combined SD for the scores of 13 and 5 were calculated at 1.0 and 2.1 respectively, again significantly different from the norm of 8.7.

Subject A was resistant to assuming the posture for testing of the ATNR and STNR; therefore it could not be determined that these were present. The subject was apparently unable to assume or maintain either the prone or supine postures for observation of the TLR, indicating a possible unintegrated reflex, although this may have simply resulted from lack of compliance.

Vestibular stimulation was provided by swinging for five minutes in a suspended hammock swing. During the therapist-initiated stimulation the subject sat passively while the examiner moved the swing. For the self-initiated condition, the subject propelled himself by pushing with his feet against the floor. The subject tended to alternate between rotary and linear swinging in a fairly even pattern. As there was no way to control this self-initiated condition, the therapist attempted to imitate this pattern as closely as possible during the therapist-initiated stimulation; therefore, the pattern was as
follows. For 30 seconds, the swing was propelled in a linear fashion, i.e., forward and back. During the next 30 seconds, the swing was rotated to the left, followed by another 30 seconds of linear motion. Finally, the swing was rotated to the right for 30 seconds.

Each experimental session consisted of a five-minute pre-intervention stage during which the subject engaged in his usual classroom activities, which generally consisted of assembling an assortment of puzzles or completing a coloring project; a five-minute intervention session during which vestibular stimulation was provided by the subject or therapist; and a five-minute post-intervention stage during which the subject returned to the table-top activities. The experimenter was present in the room at all times, without speaking, except to indicate to the client when it was time to change activities. During the table-top activities the investigator sat at the table with the client; during the self-initiated swinging sessions, the therapist stood within view of the client, again without speaking; and during the therapist-initiated sessions, the therapist stood in front of the client to propel the hammock. In this way an effort was made to keep the therapist's presence as constant as possible.

Data Analysis

During the entire 15-minute session, all sounds the
child produced were audio-recorded. The tapes were then analyzed by a graduate student in Speech/Language Pathology, Western Michigan University, Kalamazoo, MI, who counted the number of vocalizations produced. Vocalizations were defined as intentional phonations produced from the larynx. Excluded from the count were sounds such as tongue clicks, "whimpers" and inhalatory stridors. In order to maintain a single blind control of the data and avoid any effect of experimenter bias on the results, this assistant was not aware of the purposes of the study, the experimental conditions, or the hypotheses. The number of vocalizations produced during each phase of each session were tallied and graphed to compare the effect of therapist-initiated versus self-initiated vestibular stimulation as well as any differences between the three phases.
RESULTS

Variability in the subject's responses was observed throughout the study, with marked fluctuation from session to session. However, plotting on a graph (see Figure 1) indicated a large difference between the mean number of vocalizations produced during the table-top activities [pre- and post-intervention phases ($\bar{x} = 10.5$)] and that produced during vestibular stimulation ($\bar{x} = 29$).

On the second graph the quantity of vocalizations during the therapist-initiated sessions was compared to the quantity produced during self-initiated sessions. As may be observed in Figure 2, the mean number of vocalizations during the self-initiated phase was marginally higher than during therapist-initiated sessions ($\bar{x} = 31$ as compared to $\bar{x} = 27$), but, due to the high degree of variability within the sessions, the difference cannot be considered significant.
Figure 1. Number of Vocalizations Produced During Vestibular Stimulation in Therapist-Initiated vs. Self-Initiated Conditions.

Legend: ○ = Self-Initiated, △ = Therapist Initiated
Phase II: Vestibular Stimulation

Phase I: Table-top Activities

Phase III: Table-top Activities

Legend: S = Self-Initiated, T = Therapist Initiated

Figure 2. Number of Vocalizations Produced During Table-top Activities vs. During Vestibular Stimulation.
DISCUSSION

The high level of variability observed in the subject's responses contributed to difficulty in drawing conclusions with regard to either hypothesis. The results appear to support the hypothesis that vocalizations would increase during vestibular stimulation as compared to table-top activities. However, the second hypothesis that the number of vocalizations would be greater in response to self-initiated stimulation than to stimulation initiated by the therapist could not be supported.

Several factors may have contributed to the variability of the data. The classroom teacher noted that the subject had been experiencing difficulties in the home environment. On several occasions, the subject appeared distressed when the experimenter arrived to begin the session. This was indicated by either depressed or agitated affect. On those days when the subject appeared depressed, vocalizations were increased as can be noted on Figure 1 (see days 2 and 7). On days when the subject was visibly agitated, indicated by vigorous head shaking, hitting self lightly on the forehead, or resisting table-top activities, vocalizations were decreased (see Figure 1, days 3, 5, and 12). In each of these instances, the subject's affect had visibly improved by the end of the
intervention, suggesting a positive effect of the vestibular stimulation. In general, the subject evidenced enjoyment of the stimulation through smiles and laughter. During one of the sessions, the vestibular stimulation seemed to have a calming effect on the subject. This effect was indicated by a relaxed posture and drooping eyelids and resulted in fewer vocalizations (see Figure 1, day 12).

Another confounding factor was related to the difficulty encountered in controlling the testing environment due to the fact that the research was conducted in a busy school building. The swing which was available and appropriate for use in this study was located in a classroom which was generally vacant during the experimental sessions. However, on three occasions, a schedule change resulted in unavailability of this room, necessitating a change in location and on two of these location changes, a different swing was used. There were also frequent interruptions caused by other students entering the room or by announcements being made over the public address system. Any of these phenomena could have affected the subject's responses. The changes in schedule due to school holidays and the subject's absence from school may also have affected the subject's performance.

In reference to the lack of a measurable difference in response between the therapist-initiated and self-initiated stimulation, several possible explanations may be
projected. It is conceivable that any effect may have been mitigated by the fact that when the therapist was providing vestibular stimulation, there was necessarily more interaction between the subject and the examiner than during the self-initiated phases. Such interaction, although non-verbal on the part of the examiner, may have induced more vocalizations by the subject.

A second possibility is that the slight degree of gravitational insecurity which was initially observed in the client may have created an increased number of vocalizations during the therapist-initiated session, since, in order for the examiner to control the swing, it was necessary for the subject to lift his feet off the floor. It was also noted that the swing was slightly less stable under this condition which may have resulted in increased vestibular input.

It is also possible that the frequent alteration between conditions prevented an effect from developing or becoming measurable. It may have been more effective to employ each condition for six sessions in sequence, rather than alternating every third session.

No qualitative differences were apparent in the subject's vocalizations recorded on the tape; however, the classroom teachers reported that the subject had been increasingly vocal in the classroom over the course of the study. They also voluntarily reported a significant
improvement in his affect. Finally, just prior to termination of the study, they reported that the subject had begun to produce some babbling sounds, i.e., sounds such as "ba-ba-be."
SUMMARY

In considering these results, there seems to have been some sign of increase in the number of vocalizations which the subject produced during the vestibular stimulation as compared to table-top activity sessions. The high degree of variability in the subject's responses from session to session interfered with establishment of a consistent trend. While it would be impossible to control all of the factors such as those related to the subject's home life, illnesses, or affective changes, which may have contributed to this variability, a future study might maintain better control of environmental factors such as interruptions and changes of site if a more adequate facility were available.

More frequent sessions could also be employed on a more regular schedule. Due to a combination of factors, the sessions in the present study were conducted each Thursday and Friday, at different times of the day. Daily, or at least thrice weekly, sessions conducted at the same hour each day would have been preferable. Such a schedule might have produced a more consistent pattern of responses. In addition, an increased amount of data could allow for more in-depth analysis of the subject's vocal productions. In this study, anecdotal reports indicated
that a possible improvement was occurring in the quality of the subject's vocalization; however, given the limited time frame and number of sessions, no evidence of this was noted in the tape recordings.

With reference to the lack of difference in vocalizations during self-initiated versus therapist-initiated stimulation, a future study might employ a means of providing vestibular stimulation which requires less direct contact by the experimenter for operation in order to mitigate possible effects of the increased interaction during this condition. It would also be advisable to control the means of vestibular stimulation such that the stimulation provided is equal during both conditions.
Appendix A

Research Protocol Clearance
Human Subjects Institutional Review Board
Date: January 24, 1990

To: Carol L. Maddox

From: Mary Anne Bunda, Chair

This letter will serve as confirmation that your research protocol, "Therapist-Imposed Versus Self-Imposed Vestibular Stimulation in Terms of Their Effects on Verbalization in Children with Autism", has been approved as full by the HSIRB. 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 approval application. You must seek reapproval for any change in this design.

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

xc: D. Smith, Occupational Therapy

HSIRB Project Number 90-01-07

End Date of Approval January 24, 1991
BIBLIOGRAPHY


