Effects of Vestibular Stimulation on Spontaneous Use of Verbal Language in Developmentally Delayed Children

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The relationship of speech and language deficits to motor disorders has been repeatedly documented. For example, Perozzi (4) considers language as an adaptive response primarily dependent on maturational forces within the child and thus correlated to the development of motor skills. Bilto (5) found that children with speech deficits had less adequate large muscle coordination than children who evidenced no speech problems. Snyder (6) suggests language as a generative, rather than an imitative, process with auditory perception dependent in part on intact tactile and kinesthetic systems. Kahn (7) stated that appropriate sensory stimulation may be necessary to raise the cognitive level of a retarded child's functioning to stage six of Piaget's sensorimotor period, before language training can be effective. King (King, L; Discussion presented at workshop on Sensory Integration for the Schizophrenic, Buffalo, N.Y., September 1974), in her model of personality development, theorizes that integration of the tactile and vestibular systems are essential before any perceptual constancy or learning can take place. Bloom and Lahey (8) propose that attention to and integration of separate sensory stimuli from different modalities is logically related to language learning. Although they stop short of advocating preparatory sensorimotor or sensory integration therapy to facilitate speech and language therapy, Bloom and Lahey concede that children who do not integrate multisensory input in real-life situations may be unable to establish interaction between content and form in language. Jenkins and Lohr (9) call for specific types of sensorimotor therapy to increase

A growing number of researchers have suggested a relationship between vestibular function and language development. Ayres (1) hypothesized that a synchronous relationship exists between speech and language development and motor development. de Quiros and Shrager (2) have outlined the possible role of the development of motor skills (corporal potentiality) and the acquisition of language. They have emphasized the role of the vestibular system in this process. Bailey (3) recently described in detail the anatomical and neurological relationships between the vestibular system and speech centers.
the efficiency of articulation therapy, and theorize an organic etiology that might account for both motoric and articulation disabilities. They have documented significantly lower motor quotients in speech defective groups, compared to nonspeech defective groups. Rider (10) has found that dysphasic children demonstrated more abnormal reflex responses than non-dysphasic children. Stillwell and others (11) suggest a direct relationship between depressed postrotary nystagmus (indicative of vestibular dysfunction) and disorders in articulation, speech, and language acquisition. Finally, Ayres (12) has indicated that the Southern California Postrotary Nystagmus Test (SCPNT) (13) may be a more discriminative indicator of language dysfunction than other more traditionally accepted auditory language tests.

**Review of the Literature Supporting Nonverbal Language Intervention**

A growing number of studies have indicated gains in speech and language areas through nontraditional, nonverbal intervention strategies. Carlsten (14) reported greater gains in language of children with cerebral palsy who received sensorimotor-oriented facilitation as opposed to a more direct table-task-oriented approach. Kawar (15) reported results suggesting that sensorimotor therapy influenced hemispheric specialization for language processing. Morrison and Pothier (16) showed significantly greater increments in gross motor, language, and full-scale scores for children who received prescribed perceptual motor training. Neman and associates (17) also reported language gains in a group of mentally impaired individuals engaged in sensorimotor therapy. Bailey (3) found that an eight-week program of sensory integration therapy improved the quality of language in chronic schizophrenic patients. Clark and associates (18) recently reported sensory integration therapy is equally as effective as traditional speech operant techniques in producing language gains (particularly in frequency of verbalizations) in profoundly retarded adults.

**Experimental Design**

This study was designed to determine whether the use of specific forms of vestibular stimulation would result in an increase in child-initiated intelligible responses immediately following therapy.

**Subjects.** Five of the ten subjects were randomly selected from a pre-school class for the developmentally retarded (age 3 to 6 years) with severe language delay. Subjects from this classroom were labeled as group 1. A second group of five subjects was randomly selected from a primary trainable class (age 6 to 10 years). Children from this class comprised group 2. Placement in either class and subsequent group assignment was based on referral following diagnostic testing by speech and educational personnel. No specific cut-off score on any one test was required for group placement. Rather, a judgment of the child's ability was made by a team of professionals responsible for the child's education. Language skills in the two classrooms ranged from near nonverbal to near normal. The subjects with better language skills were enrolled in the primary trainable class (group 2). All children were ambulatory, and none had physical deformities or restrictions.

**Apparatus.** Vestibular stimulation was introduced by accelerating down a ramp on a scooter (in the prone position), spinning in a net hammock (in the prone position and sitting), and swinging on a platform board (in the sitting position). All of the stimulation was noncontingent, that is, not paired with any specific or functional play activity.

**Procedure.** Data were collected according to the reversal design (ABAB) set forth by Sulzer and Mayer (19). Initial baseline data were gathered for a five-day period in a free play situation during the first week of study. Each child in the study was monitored for a 5-minute period on each day of that week. Intelligible verbal responses were recorded according to standards previously established by each classroom teacher. Responses that were primarily gestures or "noise" vocalizations were not acceptable. The individual classroom teacher determined what was an intelligible verbal response. During the second week, treatment was administered for 10 minutes per day for 5 days. Subjects were monitored for spontaneous verbal language for 5 minutes in a free play situation that immediately followed the stimulation.

The stimulation was individually administered by a therapist experienced in pediatric treatment, including sensory integrative therapy and evaluation. The children were allowed to self-initiate the stimulation, which naturally varied in intensity and duration for each child.

During the third week a second baseline was recorded, using the same procedure employed during the first week of the study. A second series of treatment sessions were administered and data were collected during the fourth week according to the previously established procedure. The total length of the study was four weeks, or 20 days.
Results
Eight of the ten participants showed an increase in frequency of verbal responses from baseline 1 to treatment 1. Nine of ten participants showed increases in frequency of verbal language usage from baseline 2 to treatment 2. Figures 1 and 2 show that both groups showed increases in mean verbal responses from baseline 1 to treatment 1 and from baseline 2 to treatment 2. In addition, the graphic data reveal a decrease in verbal responses upon withdrawal of treatment (treatment 1 - baseline 2) indicating the expected reversal effect when the independent variable was withdrawn. Verbal responses increased again when treatment was reinstated (baseline 2 - treatment 2).

A repeated measures analysis of variance (ANOVA) (20) was computed for each of the groups to expand and clarify the graphic results and to further substantiate the effectiveness of the independent variable (vestibular stimulation) on the dependent variable (verbal responses). The ANOVA for group 1 (developmentally retarded-severe language delay) revealed an F of 5.06 (p < .05, df 3, 12) indicating a significant main effect across baseline and treatment conditions. A Newman-Keuls follow-up procedure was computed to determine where significant differences existed between the group 1 baseline and treatment conditions. The results reveal significant differences between the respective baseline and treatment conditions but no significant differences between the two baseline conditions nor between the two treatment conditions. The ANOVA generated for group 2 subjects (primary trainable) revealed an F of 2.88 (p < .10, df 3, 12), which approached but did not reach the classically accepted .05 level of statistical significance.

Discussion
These results are consistent with a positive tendency for a reversal pattern (19) and show vestibular stimulation as an independent variable with a functional relationship to a particular individual behavior (in this case, the frequency of verbal responses). The degree of this relationship appeared strongest for the group 1 subjects who were younger and with generally fewer language skills. The failure of the independent variable to produce a classically accepted statistically significant result for the children in group 2 suggests that the effect of vestibular stimulation was not as strong for the older children with generally more advanced verbal skills, although the graphic data certainly suggest a change in the mean verbal responses of the children in group 2.

The overall results tentatively support the idea that vestibular stimulation may be an effective stimulation technique for facilitating spontaneous verbal responses in a portion of the developmentally delayed population. The effect of vestibular stimulation appears more pronounced for those younger developmentally retarded children with more severe language delay. This particular group of children are generally less responsive to more traditional methods of language stimulation (21). The implications of these results in terms of facilitating child-initiated verbal responses in younger, severely language-delayed children are important for therapists and educators and indicate the need for collaborative research and therapy in this area.

A decrease in language use was observed in two of the subjects between the baseline and treatment conditions. This finding may indicate a more significant sensory integrative dysfunction in these two particular subjects. It has been suggested that in some cases the immediate result of sensory integrative stimulation may cause temporary disorganization of sensory integrative functioning, but normalization may occur over an extended period (22). Both subjects who showed a
decrease in use were described by their respective teachers as the most unresponsive children in their classrooms. Neither of these children evidenced similar decreases during the second baseline and treatment pairing. This may indicate that some normalization was beginning to take place.

Applied behavioral analysis designs permit a researcher to study the behavior of a small group of individuals over successive observations as opposed to comparing the means of two independent groups of individuals. With such a design it is possible to employ time series measurements or observations and for the subjects to serve as their own controls. However, the limitations of the design used in this study should be emphasized. Graphic representation is the traditional analytical tool most frequently used to present the results of research using applied behavioral designs. Some authorities feel it is not appropriate to employ inferential statistics to applied behavioral designs (29). They argue that the calculations involved in inferential statistics do not generally take into account the differences between successive observations in a time series. In addition, the assumption of independent data cannot be met when using time series strategies often employed in applied behavioral designs. These facts may compromise the “robustness” of some inferential statistics. The use of a relatively small “sample” without an independent control group may further restrict the generalization of the results. Finally, inter-observer reliability coefficients were not obtained in the present study, nor was the dependent variable operationally defined in specific enough language.

These limitations strongly give support to the argument for additional research in this area to replicate the results of this “pilot” study and to further define the parameters of sensory stimulation and the populations for which such stimulation is most effective.

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REFERENCES