VESTIBULAR DYSFUNCTION AS MEASURED BY THE SOUTHERN CALIFORNIA POSTROTARY NYSTAGMUS TEST IN CHILDREN WITH BEHAVIOR DISORDERS

A THESIS

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The behaviors and academic learning of your child are the visible expression of the invisible activity within his nervous system. Learning and behavior are the visible aspects of sensory integration.

A. Jean Ayres, 1979

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CHAPTER I

INTRODUCTION

Statement of the Problem

Despite the fact that serious behavioral problems have been estimated in 10 to 15% of all school age children (Mason, Richmond, and Fleurant 1976), considerable controversy continues to exist concerning the etiology of behavior disorders. Indeed, experts have even been unable to clearly define what constitutes a behavior disorder (Kaufman 1977). Children with behavioral disorders may be described in a multitude of ways. Typical problems include but are not limited to the following: withdrawal from social relationships with peers; inability to tolerate closeness and affection; excessive shyness; inattentive and disruptive behavior in the classroom; temper tantrums and physical aggression; clumsiness; frequent stumbling and falling; difficulty learning to read, write, or talk; frequent crying; undue anxiety or depression; inability to relax and have fun; and poor self esteem (Mason, Richmond, and Fleurant 1976). Educators and occupational therapists have been frustrated in their attempts to teach and treat children with behavioral disorders.

Recent descriptions of children with sensory integrative dysfunction (Ayres 1972, 1979; King 1974) bear striking resemblance to the picture presented of the child with behavioral disorder. The typical child with sensory integrative problems resulting from vestibular system disorder often is clumsy and is frequently noted to stumble and fall. Due to his clumsy pattern of play the child often loses self confidence, tends to withdraw from other children, and thus fails to develop appropriate social relationships. He may become increasingly anxious and depressed. Because he resists involvement in playful movement experiences, the child does not get the sensory input crucial to nervous system development. The problem becomes compounded and the child avoids what he needs most--self integrating activity (Ayres 1979; King 1974).

If children with behavior disorders do have vestibular based sensory integrative disorders, they should be identified so that they may become involved in a sensory integrative program of treatment as advocated by Ayres (1972, 1979).

The purpose of this study was to determine whether children with behavior disorders have vestibular dysfunction as measured by the Southern California Postrotary

Nystagmus Test (SCPNT). Specifically, the questions investigated included:

1. Do children with behavior disorders differ from normal children in duration of postrotary nystagmus when given the SCPNT?

2. Do children with behavior disorders differ from normal children in their reaction to vestibular stimulation when given the SCPNT?

Significance of the Study

The results of several studies have proposed that vestibular system dysfunction may correspond with behavioral abnormalities (Silberzahn 1975; King 1974; Huddleston 1978; Bhatara, Clark, and Arnold 1978). Weeks (1979b) stated that although there are intimations of relationships research is needed to identify the role of the vestibular system in the etiology of emotional disturbance. Ayres (1976) stated that research should be done in regard to the different types of sensory integrative dysfunction in children with behavior disorders. Silberzahn (1975) specifically suggested that further research be done into sensory integrative disorders involving the vestibular system in children with behavior disorders. Information gained from such investigations could result in more effective treatment techniques for the behavior disordered child.

In addition, investigation into typical and atypical responses to vestibular stimulation is needed (Royeen 1980). Ornitz and Ritvo (1976) and Ayres (1977) stated that responses to vestibular rotation provide additional help in interpretation of the functioning of the vestibular system. Although Ayres (1977) made reference to normal and abnormal responses to be observed during administration of the Southern California Postrotary Nystagmus Test, this author found only one study in the literature concerned with identification of typical versus atypical responses to vestibular rotation (Royeen 1980). Royeen (1980) petitioned for further research to be done on responses to rotation in order that such responses may be organized into diagnostic indicators of vestibular dysfunction.

Hypotheses

The following were the hypotheses tested in this study. The hypotheses are presented in both null and alternate form.

I. H_0: There is no significant difference between normal and behavior disordered children in duration of postrotary nystagmus.

H_1: There is a significant difference between normal and behavior disordered children in duration of postrotary nystagmus.

II. H_0: There is no significant difference in maintenance of body balance between normal and behavior disordered children when rotated.

H_1: There is a significant difference in maintenance of body balance between normal and behavior disordered children when rotated.

III. H_0: There is no significant difference in maintenance of head control between normal and behavior disordered children when rotated.

H_1: There is a significant difference in maintenance of head control between normal and behavior disordered children when rotated.

IV. H_0: There is no significant difference in experience of vertigo between normal and behavior disordered children when rotated.

H_1: There is a significant difference in experience of vertigo between normal and behavior disordered children when rotated.

V. H_0: There is no significant difference in experience of dizziness between normal and behavior disordered children when rotated.

H_1: There is a significant difference in experience of dizziness between normal and behavior disordered children when rotated.

VI. H_0: There is no significant difference in experience of nausea between normal and behavior disordered children when rotated.

H_1: There is a significant difference in experience of nausea between normal and behavior disordered children when rotated.

VII. H_0: There is no significant difference in experience of alarm between normal and behavior disordered children when rotated.

H_1: There is a significant difference in experience of alarm between normal and behavior disordered children when rotated.

VIII. H_0: There is no significant difference in experience of pleasure between normal and behavior disordered children when rotated.

H_1: There is a significant difference in experience of pleasure between normal and behavior disordered children when rotated.

Limitations of the Study

This study was limited to children between eight and ten years of age enrolled in special classes for behavior disorders in the Grand Prairie Independent School District (GPISD) and matched controls enrolled in regular classes in the GPISD.

Children with known neurological problems (e.g., cerebral palsy, epilepsy, etc.), gross sensory losses (e.g., blindness, deafness), learning disabilities, and mental retardation were excluded from this study.

Investigation of vestibular system dysfunction was limited to that evident from the postrotary nystagmus evaluation of the Southern California Postrotary Nystagmus Test.

Basic Assumptions

This study is based on the following assumptions:

1. Children enrolled in special classes for behavior disorders in the GPISD do have behavior problems.

2. Children enrolled in regular classes in the GPISD do not have behavior disorders.

3. Disordered postrotary nystagmus reflects vestibular dysfunction.

4. Disordered postrotary nystagmus can be identified by the Southern California Postrotary Nystagmus Test.

5. The term behavior disorder in this study refers to such problems as disruptive behaviors, conduct problems in school, inability to tolerate large groups, and difficulty in relating to peers.

Definition of Terms

Vestibular System--Sensory system that responds to gravity and motion, particularly acceleration and deceleration. Its functions include maintenance of balance, awareness of position, and direction of eye gaze. Anatomically, it consists of the vestibular apparatus in the inner ear, vestibular nerve, vestibular nuclei, and related brain areas (Ayres 1972; Weeks 1979a).

Nystagmus--An involuntary rhythmical jerking of the eyes rapidly in one direction and slowly in the other (Clark 1975).

Postrotary Nystagmus (PRN)--Nystagmus following rotation. Its purpose is to reestablish fixation on a visual field (Ayres 1977).

Southern California Postrotary Nystagmus Test (SCPNT)--A standardized procedure for evaluating the vestibulo-ocular reflex (postrotary nystagmus) in children five to ten years of age (Ayres 1977).

Hyporesponsive PRN--Duration of nystagmus more than one standard deviation below the mean or less than thirteen seconds according to the SCPNT (Ayres 1977, 1978).

Hyperresponsive PRN--Duration of nystagmus more than one standard deviation above the mean or greater than twenty-seven seconds according to the SCPNT (Ayres 1977, 1978).

Vestibular Dysfunction--A defect in the vestibular system which interferes with the processing of vestibular information (Ayres 1972; Weeks 1979a).

Sensory Integration--Neurological process of organizing and interrelating sensory information for functional use (Ayres 1972).

Vertigo--Sensation of a whirling motion of the external environment (Clark 1975).

CHAPTER II

REVIEW OF LITERATURE

This chapter contains a review of literature pertaining to the vestibular system and behavioral disorders. The first section introduces the vestibular system and includes a description of its structure, purpose, and importance. The second section discusses the phenomenon of nystagmus, a common method used to evaluate the vestibular system. The third section discusses the importance of the vestibular system in emotional development. The final section of the literature review provides an overview of vestibular dysfunction in behavior disorders, learning disabilities, and severe forms of mental illness such as autism and schizophrenia.

The Vestibular System

The vestibular system is the sensory system that provides information as to the nature of movements of an organism and its position in space (Brown 1973). It allows the organism to detect acceleration, deceleration, and the direction of the earth's gravitational pull and to distinguish between movement associated with the body versus the environment (Ayres 1972). Its duties include maintenance of equilibrium, direction of eye gaze, and maintenance of a plane of vision dependent upon head position (Weeks 1979a).

Anatomically, the vestibular system consists of the vestibular apparatus, the vestibular nerve, the vestibular nuclei, and the related brain areas (Ayres 1972). The receptor apparatus is the extra auditory portion of the labyrinth consisting of the three semi-circular canals and the two otolith organs, the utricle and saccule (Brown 1973; Wilson 1975). Acceleration forces activate the sensory receptors of the vestibular system. The semicircular canals primarily respond to angular acceleration resulting from rotary motion while the utricle and saccule mainly detect gravity and respond to linear motion and position change (Ayres 1972; Brown 1973; Wilson 1975).

The vestibular system is one of the most widely dispersed sensory systems and consequently has consider-able opportunity to exert influence over all other sensory systems (Ayres 1972). Fibers from the vestibular system reach both the vestibular nuclei and the cerebellum.

From the vestibular nuclei impulses are relayed to the oculomotor nuclei and result in the vestibulo-ocular reflex. The vestibulo-ocular reflex of nystagmus will be discussed in detail in the next section. Impulses are also relayed from the vestibular nuclei to the spinal cord where they result in vestibulo-spinal reflexes thereby influencing muscle tone (Wilson 1975). The vestibular system is closely related to the cerebellum. The cerebellum exerts influence on the vestibular system and vice versa (Ayres 1972).

The vestibular system does not have the conscious properties of such senses as vision, audition, touch, or smell. Man normally is unaware of the vestibular sensations his brain is processing (Ayres 1972; Brown 1973).

Phylogenetically and ontogenetically the vestibular system is one of the first sensory systems to appear (Ayres 1972). Mitchell and Cambon (1969) in a study of vestibular response in the neonate and infant concluded that by six weeks the majority of infants showed a vestibular response to rotary stimuli. Due to the fact that the vestibular system appears phylogenetically early and matures ontogenetically early it can be assumed the vestibular system plays a key role in the developmental sequence (Ayres 1972).

There is further evidence that the vestibular system plays a paramount role in normal development in terms of motor development and postural control (deQuiros and Schrager 1978; Kantner, Clark, Allen, and Chase 1976), development of body scheme (Schilder 1933; Ayres 1972), and psychosocial development (Ayres 1972; Pederson and Ter Vrugt 1973).

Erway (1975) was of the opinion that the vestibular system may be the most important of all the sensory systems in the development of the normal integrative functions of the brain, particularly the cerebellum. Ayres (1979) concurred with this hypothesis and referred to the vestibular system as the unifying system which primes the nervous system to function effectively.

Postrotary Nystagmus as a Measure of Vestibular Dysfunction

The most common methods of evaluating vestibular system function are through the evaluation of nystagmus and through the evaluation of postural responses and muscle tone. This study is concerned with evaluation of the vestibular system through assessment of nystagmus and this portion of the literature review will be limited to that topic.

Nystagmus is the vestibulo-ocular reflex that consists of rhythmical eye jerks rapidly in one direction and slowly in the other direction. The presence of nystagmus demonstrates the intricate relationship between the extraocular muscles and the vestibular system (Ayres 1972). Thus, the eyes may be considered to be the visual key to investigating the vestibular system (Royeen 1980). The purpose of nystagmus is to allow the eyes to remain fixed on stationary objects when the head and body are rotating (Clark 1975). Information gained from nystagmus enables man to know whether he is moving or whether the visual field is moving (Ayres 1972).

Assessment of vestibular functioning is accomplished by artificial stimulation of the vestibular system. Rotary tests are most commonly employed as evaluative procedures (Brown 1973). Rotation causes a flow of endolymph in the horizontal semicircular canal. Vestibular impulses relay this information to the brain and nystagmus results. After rotation is completed momentum causes the endolymph to continue to flow in the same direction the head was rotating. Even though the head is now stable nystagmus continues for some time following rotation (Clark 1975). This is referred to as postrotary nystagmus

(PRN). Rotary tests typically record the duration of PRN with the assumption that vestibular dysfunction is associated with abnormal duration of PRN (Brown 1973).

PRN has been used in examination of vestibular function in neonates and infants (Mitchell and Cambon 1969), children with minor neurological impairments (Steinberg and Rendle-Short 1977), autistic children (Ornitz 1970), learning disabled children (Ayres 1978; Ottenbacher, Watson, and Short 1979), and schizophrenic adults (Leach 1960; Huddleston 1978).

In addition to duration of PRN, observation of the subject's response to vestibular rotation is considered to be important in the assessment of vestibular function (Ayres 1977; Ornitz and Ritvo 1976). Observations of the effects of vestibular stimulation which have been typically used include subjective measures such as sensation of rotation, the appearance of visual field rotation, impression of tilting, and actual motor readjustments following rotation (Brown 1973). In the Southern California Postrotary Nystagmus Test Manual, Ayres (1977) suggested that important observations include maintenance of balance and head control, dizziness, vertigo, nausea, alarm or threat, and pleasure. She hypothesized that the responses of subjects with hyperresponsive or hyporesponsive duration of nystagmus would differ from those with normal duration of nystagmus. In order to determine typical versus atypical responses to vestibular rotation, Royeen (1980) conducted a study in which the responses of twenty-four normal children to the Southern California Postrotary Nystagmus Test (SCPNT) were observed and reported. It was concluded that atypical responses to vestibular rotation included loss of body balance, lack of pleasure, and the presence of alarm.

The Vestibular System and Emotional Development

There is evidence in the literature that the vestibular system is important to psychosocial development. Schilder (1933) proposed that the vestibular system is a major organizer of sensory information and is directly related to emotions. Erway (1975) was of the opinion that the vestibular system bears a direct relationship to emotional security. That the vestibular system is critical for sensory integration and normal personality development was proposed by Ayres (1979).

Ayres (1972) inferred that the vestibular system is essential to a sense of emotional security since it provides man with a spatial relationship to the earth. This gravitational security provides the base upon which all other relationships develop. All relationships will fail to develop appropriately if the child's relationship to the earth is not secure (Ayres 1979).

The fact that body image is critical to emotional development has been well documented in the literature. Schilder (1933) advanced the hypothesis that there was a link between vestibular activity and the development of body image as well as the ability to separate one's self from one's environment. According to Ayres (1972), development of a body scheme is dependent upon the integration of sensory stimuli, particularly the stimuli of the tactile and vestibular systems.

Further evidence that the vestibular system influences emotions may be derived from studies on the effects of vestibular stimulation. Korner and Thoman (1972) compared the effectiveness of contact versus vestibulo-proprioceptive stimulation in soothing infants. They discovered that although contact alone had a significant effect in calming the infants, it was not nearly as powerful as vestibular-proprioceptive stimulation. Similar results were reached in a study on the influence of vestibular stimulation on the emotional state of infant rats (Thoman and Korner 1971). Infant rats were divided into two groups. The first group received contact stimulation through swaddling. The other group was swaddled and received vestibular stimulation in the form of rotation. The group that received both vestibular-proprioceptive and contact stimulation responded almost immediately with an almost total cessation of distress calls. Pederson and Ter Vrugt (1973) concurred that vestibular stimulation has a more powerful calming effect on emotions than tactile stimulation. They in turn researched the effects of frequency and amplitude of rocking on the activity of two month old infants and concluded that higher frequencies and higher emplitudes of rocking had more soothing effects on the infants. They hypothesized that vestibular stimulation may be a powerful tool for parents to control their infant's distress, thus, vestibular stimulation may help foster a secure parent-child attachment.

Gellhorn (1964) discussed the relationship of motion to emotion. He stated that emotions cause changes in both tonic and phasic muscles resulting in facial expressions and postural changes. Conversely, the proprioceptive input resulting from facial muscle contractions can stimulate accompanying emotions. Gellhorn (1964) concluded that emotions give rise to proprioceptive input and proprioception generates emotions.

Vestibular Dysfunction

There is evidence in the literature that vestibular dysfunction is associated with behavioral abnormalities. This section of the literature review will present studies concerned with vestibular dysfunction in behavioral disorders, autism, schizophrenia, and learning disabilities.

Vestibular Dysfunction in Behavior Disorders

Silberzahn (1975) investigated sensory integrative function in eighty-seven children referred to a child guidance clinic for behavior problems. Severely emotionally disturbed children were not included in this study. Results indicated a high incidence of sensory integrative dysfunction, with the postural and bilateral integration syndrome as identified by Ayres (1972) being particularly evident. Since vestibular system dysfunction is closely associated with the syndrome of postural and bilateral integration, this study provided evidence of the presence of vestibular dysfunction in children with behavior disorders.

Labyrinthine righting and postrotary nystagmus were examined as indicators of vestibular function in a group of children with minor neurological impairment and a group of matched controls (Steinberg and Rendle-Short 1977). Children with minor neurological impairment were frequently referred for service due to behavioral problems. Results revealed a highly significant decreased duration of PRN and significantly more abnormal labyrinthine responses in children with minor neurological impairment.

A study of perceptual motor functioning in children identified as emotionally disturbed (Rider 1973) revealed similar results. Disturbed children demonstrated more abnormal reflex responses and scored significantly lower on tests of labyrinthine reflexes than non-disturbed children. Rider concluded that the behaviors which led to the diagnosis of emotional disturbance could have been caused by immature reflex development or other sensory integrative deficit.

Vestibular dysfunction was also reported in a child referred for psychiatric treatment for hyperactivity, constant chattering, temper tantrums, rudeness, and inability to complete a given task (Bhatara, Clark, and Arnold 1978). The child was treated with a vestibular stimulation program which consisted of semicircular canal stimulation using a rotating chair. Following treatment improvements were noted in hyperkinesis, self esteem, and attention span. Constant chattering decreased and the Bender-Gestalt Test revealed improvements in organization, integration, and sense of proportion. Results of this study confirmed the presence of vestibular dysfunction in this hyperactive child and indicated the usefulness of semicircular canal stimulation in the treatment of this disorder.

Contradictory conclusions on the presence of vestibular dysfunction in children with behavior problems similar to those described by Bhatara, Clark, and Arnold (1978) were reached in a study by Colbert, Koegler, and Markham (1959). While children with behavior problems had less duration of PRN than normal children in the study, the difference was not great enough to reach statistical significance.

A study by Piggott, Purcell, Cummings, and Caldwell (1976) offered further support for the hypothesis of vestibular dysfunction in children with behavioral or emotional disorders. Children referred to the Lafayette Clinic for behavioral problems were divided into two groups on the basis of cognitive perceptual motor functioning. Vestibular function was assessed through a PRN test conducted in a rotating chair at different speeds of rotation. The group with a high degree of cognitive perceptual motor dysfunction demonstrated a shorter duration of PRN than the group with a low degree of cognitive perceptual motor dysfunction. This difference was noted only at the lowest speed of rotation. No significant difference was reached for higher speeds of rotation. The conclusion was reached that vestibular dysfunction may be present in emotionally disturbed children and it may be related to cognitive perceptual motor dysfunction.

Vestibular Dysfunction in Autism

Vestibular dysfunction in childhood autism has been investigated by Ornitz (1970), Ornitz and Ritvo (1976), Ritvo, Ornitz, Eviator, Markham, Brown, and Mason (1969), and Colbert, Koegler, and Markham (1959). Ritvo et al. (1969) discovered that autistic children demonstrated hyporesponsive nystagmus following rotational stimulation of the vestibular system when tested with eyes open. No difference was noted with eyes closed. It was hypothesized that autistic children are unable to process both visual and vestibular stimuli concurrently. A later study that investigated the possibility that ocular fixation was responsible for the difference in PRN when eyes were open versus closed was reported by Ornitz and Ritvo (1976). PRN was examined in autistic and normal controls in situations varying ocular fixation. Autistic children had significantly lower duration of PRN in situations in which ocular fixation was allowed and prevented. Thus Ornitz and Ritvo (1976) interpreted these results as support for the hypothesis that autistic children experience vestibular dysfunction.

Further support was evident in a study comparing PRN in schizophrenic children described as autistic-like, non-schizophrenic behavior problems, and normal controls (Colbert, Koegler, and Markham 1959). The majority of the schizophrenic children had markedly depressed or absent nystagmic response to caloric and rotational testing.

The absence of nausea and vertigo experienced by the autistic child during vestibular rotary examination is of additional interest. Ornitz and Ritvo (1976) indicated that this might indicate a more generalized involvement of the vestibular system than a disorder of the vestibulo-ocular reflex alone would imply.

The fact that autistic children frequently engage in such repetitive behaviors as whirling, rocking, hand flapping, and toe walking has been noted by many investigators (Colbert, Koegler, and Markham 1959; Ornitz 1970; Ornitz and Ritvo 1976). The relationship of toe walking to vestibular dysfunction has been discussed by Colbert, Koegler, and Markham (1959) and demonstrated by Montgomery and Gauger (1978). King (1976) stated that engagement in the above described repetitive behaviors may be the child's attempt to procure the vestibular stimulation he so needs. Ornitz (1970) also observed the apparent paradox that while autistic children seek out vestibular stimulation, they at the same time may indicate fear and agitation at antigravity play and motion. According to Ornitz and Ritvo (1976), studies indicate that these disturbances in motility are indicative of central nervous system dysfunction.

Vestibular Dysfunction in Schizophrenia

The association of vestibular system dysfunction with schizophrenia has been investigated by Schilder (1933), Ayres and Heskett (1972), King (1974), Erway (1975), Pollack and Krieger (1958), Huddleston (1978), and Endler and Eimon (1978).

Pollack and Krieger (1958) examined oculomotor and vestibular responses in schizophrenic children and compared them with non-schizophrenic behavior problems and normal controls. Results indicated that nine of fifteen schizophrenic children, one of seven behavior disorders, and zero of nine normal controls were unable to disassociate head and eye movements, had hyporesponsive PRN, and demonstrated head and body turning during passive head turning. The schizophrenic children who displayed these deviant postural and vestibular responses were also described as inattentive and withdrawn. Pollack and Krieger theorized that these deviances were due to a maturational lag of the vestibular system.

Sensory integrative dysfunction in a young schizophrenic girl was reported by Ayres and Heskett (1972). The child was treated with a sensory integrative program which involved primarily tactile and vestibular stimulating activities. The treatment program was based on the hypothesis that somatosensory and vestibular input and integration are imperative for psychic, perceptual motor, and cognitive development. Following six months of treatment the child showed improvement in cognitive function, language ability, and perceptual motor ability. Although schizophrenic symptoms were not analyzed statistically, it was noted that the child demonstrated less bizarre fantasy play and less bizarre verbalizations following treatment. This study supported the hypothesis that schizophrenic children may experience vestibular system dysfunction and could benefit from a treatment program concentrating on vestibular stimulation.

Defects in the vestibular systems of schizophrenic adults were demonstrated by Leach (1960) and Myers, Caldwell, and Purcell (1973). Leach (1960) compared PRN in schizophrenics and normal controls. Results showed that the schizophrenics had decreased duration of PRN. Leach referred to this as a neural defect. Similar results were found in a study (Myers, Caldwell, and Purcell 1973) comparing nystagmus in ten adult male chronic undifferentiated schizophrenics with controls matched for age and sex. PRN was abnormal for all of the schizophrenic subjects with eight out of ten grossly abnormal.

King (1974) presented a theory of schizophrenia etiology which particularly implicated the vestibular component of the proprioceptive feedback mechanism. The theory evolved after clinical evidence indicated that a group of chronic non-paranoid schizophrenic adults demonstrated significant overall gains from a sensory integrative treatment program utilizing a variety of vestibular and proprioceptive activities. King hypothesized that the vestibular system in schizophrenics is underactive and fails to perform its important role of integrating all the sensory systems. Due to this lack of sensorimotor integration schizophrenics suffer from perceptual inconstancy, defective posture, and abnormal muscle tone.

This theory was tested and supported by Huddleston (1978) and Endler and Eimon (1978). Huddleston (1978) compared posture, grasp strength, and PRN in schizophrenic adult males, non-schizophrenic in-patients, and normal controls. Statistically significant differences were apparent between the schizophrenics and normal controls on all three measures. Endler and Eimon (1978) studied postural and reflex integration in adult male schizophrenics. Significant differences between schizophrenic subjects and normal controls in the tonic labyrinthine reflex and in five out of six subtests of the Southern California Sensory Integration Test concerned with postural and bilateral integration were observed. These studies support King's (1974) hypothesis that chronic non-paranoid schizophrenics have abnormal postural and movement patterns due to sensory integrative deficits.

Treatment programs implementing King's (1974) suggestions were described by Levine, O'Connor, and Stacey (1977) and Jorstad, Wilbert, and Wirrer (1977). Both studies consisted of pilot studies on sensory integrative treatment of the chronic schizophrenic utilizing primarily vestibular activity. Levine, O'Connor, and Stacey (1977) reported that all patients demonstrated improvements in awareness of self and others as well as improved scores on selected subtests of the Southern California Sensory Integrative Test Battery. Patients in the study by Jorstad, Wilbert, and Wirrer (1977) demonstrated improvement in socialization, affect, self esteem, and general functioning. Both studies concluded that the chronic non-paranoid schizophrenic adult gives evidence of sensory integrative dysfunction and could benefit from a sensory motor program utilizing proprioceptive and vestibular stimulation.

Erway (1975) agreed that schizophrenics have dysfunctional vestibular systems as demonstrated by abnormal nystagmus, abnormal responses to vestibular stimulation, and immature righting reactions. He attributed this to vestibular end organ disorder and hypothesized that schizophrenics lack the trace elements, manganese and zinc, necessary for effective otolith development.

Vestibular Dysfunction in Learning Disabilities

Literature concerning the association between vestibular dysfunction and learning disabilities is included in this review because sometimes the problems in learning disabilities and emotional disorders are very similar making a clear distinction between the two very difficult (Weeks 1979b). Learning disabilities have often been discovered in children with behavior disorders (Weeks 1979b), and emotional disturbances are often found in children with learning disabilities (deQuiros and Schrager 1978). This portion of the literature review consists of a sample of the literature available relating vestibular dysfunction and behavior disorders to learning disabilities. A detailed analysis of disordered vestibular system development in children with learning disabilities is beyond the scope of this review. The reader who is interested in the relationship of vestibular disorders to learning disabilities is encouraged to consult the works of deQuiros and Schrager (1978) and Ayres (1972, 1978).

The theory that some children with learning disabilities experience vestibular dysfunction as evidenced by disordered PRN, poor muscle tone, primitive postural reflexes, and immature equilibrium reactions has been presented by Ayres (1972, 1978), deQuiros and Schrager (1978), Ottenbacher (1978), and Ottenbacher, Watson, and Short (1979).

deQuiros and Schrager (1978) stated that vestibular disorders are responsible for a considerable number of learning disabilities and that vestibular problems produce disabilities related to motor skills, language development, and the ability to read and write.

Ayres (1978) investigated the specific types of vestibular disorders that contribute to learning disabilities. She concluded that vestibular disorders can be subdivided on the basis of hyporesponsive versus hyperresponsive nystagmus. Learning disabled children with hyporesponsive nystagmus realized greater gains from sensory integrative treatment than did those with hyperresponsive nystagmus.

deQuiros and Schrager (1978) stated that symptoms associated with primary learning disabilities resulting from vestibular dysfunction included hyperactivity and restlessness, thus implying the possibility of behavioral problems. Ottenbacher, Watson, and Short (1979) examined the association between nystagmus responsivity and behavioral problems in children with learning disabilities. All learning disabled subjects were divided into the low nystagmus group or the control group on the basis of scores received from the Southern California Postrotary Nystagmus Test. Teachers rated all subjects on a behavioral rating scale. The results indicated that learning disabled children with hyporesponsive nystagmus tended to exhibit greater behavior disorder although the difference was not great enough to reach statistical significance.

CHAPTER III

METHODOLOGY

Subjects

The subjects for this study consisted of two groups of children between eight and ten years of age. All were enrolled in the Grand Prairie Independent School District (see table 1).

The experimental group consisted of seven children attending special classes for behavior disorders. Subjects ranged in age from eight to ten years and included six males and one female. All seven children were certified as emotionally disturbed by a licensed psychologist or psychiatrist. The most predominant problems which classified these children as "emotionally disturbed" included temper tantrums, disruptive behavior, and general inability to cooperate in a large group or classroom situation. None of these seven children carried additional diagnoses of neurological dysfunction, learning disabilities, mental retardation, sensory loss, or severe emotional disturbance (i.e., autism or schizophrenia).

TABLE 1

DISTRIBUTION OF THE TWO GROUPS IN TERMS OF AGE AND SEX

Ages	Experimental Group (n=7)		Control Group (n=7)	
	Male	Female	Male	Female
8	0	1	0	1
9	4	0	4	0
10	2	0	2	0
Total	6	1	6	1

The control group consisted of seven children of similar age, sex, and grade level attending regular classes at GPISD. Likewise, none of these children were identified as learning disabled, mentally retarded, blind, deaf, or neurologically handicapped.

All children attended classes housed in Austin Elementary School of the Grand Prairie Independent School District. See appendix A for facility permission form.

The parents of all subjects were mailed a description of the study and informed consent form (see appendix B). The author contacted each of the parents by telephone to answer any additional questions concerning the research project. Fourteen informed consent forms were mailed out. One hundred percent were approved and returned.

Instrument

The purpose of this study was to determine if vestibular dysfunction exists in children with behavior disorders. Postrotary nystagmus tests have been used by many investigators as indicators of vestibular dysfunction (Brown 1973; Ritvo et al. 1969; Bhatara, Clark, and Arnold 1978; Kantner et al. 1976; Huddleston 1978; Leach 1960). The postrotary nystagmus test used in this study was the Southern California Postrotary Nystagmus Test (SCPNT) developed by Ayres in 1977. The SCPNT provides a standardized procedure for measuring and comparing against normal expectations horizontal postrotary nystagmus. Researchers who have employed the use of the SCPNT have included Ottenbacher (1978), Ottenbacher, Watson, and Short (1979), Royeen (1980), and Keating (1979).

The normative sample upon which the SCPNT was standardized consisted of 111 boys and 115 girls between five and nine years of age living in the southwestern part of Los Angeles County, California. For the purposes of this study, the experimental group was compared against the control group instead of Ayres' (1977) normative sample.

Materials necessary for the administration of the SCPNT included a stopwatch, nystagmus board, 30 degree angle guide, and the SCPNT manual (Ayres 1977).

The reliability coefficient of the SCPNT was reported to be .834 by Ayres (1977). This value was obtained by having independent examiners test and retest forty-two children. Royeen (1980) conducted a study on the factors which affect the test-retest reliability of the SCPNT and concluded that it is a reliable test not affected by the time of the test administration.

Validity of the SCPNT was demonstrated by Keating (1979) in a study comparing duration of nystagmus in twenty normal females between twenty-five and thirty years of age as measured by the SCPNT and electronystagmography (ENG). ENG has been noted to be a valid and precise method of measurement of postrotary nystagmus (Tibbling 1969). A significant correlation was found between scores of duration obtained from the two tests. This study lends support to the validity of the SCPNT by relating it to an already "proven" measure of postrotary nystagmus.

Additional support for criterion referenced validity of the SCPNT was demonstrated in a study which concluded that four variables identified as related to vestibulo-proprioceptive function (muscle tone, prone extension posture, standing balance eyes closed, and standing balance eyes open) shared significant variance with the SCPNT when subjected to multiple regression analysis (Ottenbacher 1978).

It should be noted that the rotary test of nystagmus is not accepted by all investigators as a valid measurement of vestibular function. deQuiros and Schrager (1978) stated that results of rotary nystagmus tests are related not only to vestibular structures but also to other central structures located primarily at the brain stem. Abnormal postrotary nystagmus is not solely indicative of vestibular dysfunction. For the purposes of this study, however, this investigator accepts the Southern California Postrotary Nystagmus Test as a reliable and valid measurement of nystagmus response and vestibular function.

Procedure for Collection of Data

The SCPNT was administered by the author to each subject individually. All tests were given in the same location. The testing area had minimal lighting and was devoid of auditory and visual distractions. The nystagmus board was placed in the middle of the empty area and mats were placed around the board to provide protection if balance was lost.

All testing was completed during two morning sessions. Care was taken that the test was administered to the children following participation in quiet classroom activities versus physical education activity which might have provided extra vestibular stimulation and thus contaminated the results.

Administration of the SCPNT was according to standardized procedure in the SCPNT manual (Ayres 1977). The child was asked to sit in a crosslegged manner on the nystagmus board and to hold onto the edge of the board. The child's head was ventrally flexed 30 degrees so that the horizontal semicircular canals were parallel with the floor. An angle guide was used to insure proper amount of flexion. The child was instructed to keep his head bent and eyes open while turning, and after stopping, to look up into space. The author passively rotated the child to the left ten times in twenty seconds and then stopped abruptly. Duration of nystagmus was observed and timed to the nearest full second. After cessation of rotation, the author asked the child if he felt all right and was willing to continue. If the child agreed, the procedure was continued with rotation to the right. Fifteen seconds were allowed to elapse before the procedure was repeated to allow the nervous system to return to a more normal state.

Duration in seconds following rotation to the right was added to duration in seconds for the left to yield total duration of nystagmus.

Responses to rotation were observed and rated. Observations were made of the child's loss of body balance, loss of head control, vertigo, dizziness, nausea, alarm, and pleasure. Determination of the presence of vertigo, dizziness, nausea, and pleasure were made by asking the child, "Is the room turning around?" (vertigo), "Does your head feel funny?" (dizziness), "Does your tummy feel funny?" (nausea), and "Was it fun?" (pleasure). Pleasure was also indicated when smiling, laughing, and a desire to continue spinning were observed. Alarm was observed if autonomic nervous system reactions were observed (pallor, sweating, or flushing) or if the child verbalized fear.

Responses to rotation were scored as follows: not observed=3, slight response=2, definite response=1. See appendix C for Sample Scoring Plan.

The total time required to administer the test was approximately seven minutes per child.

Procedure for Analysis of Data

The data relating to each of the hypotheses were analyzed as follows:

Hypothesis I: Duration of PRN--Student's *t*-test was used to test the significance of the difference between duration of PRN of the experimental and control groups. Use of this test required that the data met certain statistical assumptions. First, the population distributions must be normal in form (Hays 1973). The standardization data presented in the SCPNT Test Manual (Ayres 1977) appears to fall in a normal distribution, so it was assumed that this requirement was met. Second, scores must consist of interval or ratio data (McCall 1975). Number of seconds is a ratio scale of measurement. Third, the variances of the populations should be homogeneous (McCall 1975; Hays 1973). McCall (1975) advised that the principle of homogeneity of variance would not be violated if the ratio of variance was two to one. Variance in this study slightly exceeded this ratio but because Hays (1973) stated that relatively large differences in variance can be tolerated when the number of subjects is equal, it was assumed that this requirement was met.

Hypotheses II-VIII: Responses to Vestibular Rotation--The Mann Whitney U Test of Population Differences was used to test the significance of the difference between experimental and control groups in responses to vestibular rotation (i.e., body balance, head control, vertigo, dizziness, nausea, alarm, and pleasure). Use of the Mann Whitney U Test required that the data met certain assumptions. The scale of measurement must be continuous and of an ordinal nature (McCall 1975). Data in this study met both of these assumptions.

Statistical significance was set at the .05 level for all hypotheses.

CHAPTER IV

RESULTS AND DISCUSSION

Results

The results of this study are summarized according to hypothesis as follows (see appendix D for actual raw scores):

Hypothesis I: Duration of PRN--Student's *t* test indicated that there was a significant difference in duration of PRN between normal and behavior disordered children at the .05 level of significance (see table 2). The null hypothesis that there would be no significant difference in duration of PRN is rejected in favor of the alternate.

TABLE 2

t TEST OF DURATION OF PRN

Group	N	df	Mean	Standard Deviation	*t* Value	Significance
Experimental	6*	5	13.00	5.14	-2.88	.05
Control	7	6	24.14	9.44		

*One child was unable to complete the study

Hypothesis II: Loss of Body Balance--The null hypothesis that children with behavior disorders would not differ from normal children with respect to loss of body balance after rotation was not supported by the Mann Whitney U Test (see table 3). A significant difference between the two was noted at the .05 level. The decision is to reject the null hypothesis in favor of the alternate.

TABLE 3

MANN WHITNEY U TEST OF LOSS OF BALANCE

Group	N	Distribution of Ratings			U Value	U Value Required for Significance*	Significance
		1	2	3			
Experimental	7	2	4	1	43	≤ 8	.05
Control	7	0	1	6		≥ 41	

*alpha=.05

Hypothesis III: Loss of Head Control--The null hypothesis that children with behavior disorders would not differ from normal children with respect to loss of head control was supported by the Mann Whitney U Test (see table 4). There was no significant difference in loss of head control between the experimental and control groups at the .05 level of significance. The null hypothesis is not rejected.

TABLE 4

MANN WHITNEY U TEST FOR LOSS OF HEAD CONTROL

Group	N	Distribution of Ratings			U Value	U Value Required for Significance*	Significance
		1	2	3			
Experimental	7	3	4	0	38	≤ 8	N.S.
Control	7	2	0	5		≥ 41	

*alpha=.05

<u>Hypothesis IV</u>: Vertigo--The null hypothesis that children with behavior disorders would not differ significantly from normal children with respect to experience of vertigo was supported by the Mann Whitney U Test (see table 5). There was no significant difference in ratings of vertigo between the experimental and control groups at the .05 level of significance. The null hypothesis is not rejected.

TABLE 5

MANN WHITNEY U TEST FOR VERTIGO

Group	N	Distribution of Ratings			U Value	U Value Required for Significance*	Significance
		1	2	3			
Experimental	7	2	4	1	21.5	≤ 8	N.S.
Control	7	3	3	1		≥ 41	

*alpha=.05

<u>Hypothesis V</u>: Dizziness--The null hypothesis that children with behavior disorders would not differ from normal children with respect to experience of dizziness was supported by the Mann Whitney U Test (see table 6). There was no significant difference in ratings of dizziness between the experimental and control groups at the .05 level of significance. The null hypothesis is not rejected.

<u>Hypothesis VI</u>: Nausea--The null hypothesis that children with behavior disorders would not differ significantly from normal children with respect to experience of nausea was supported by the Mann Whitney U Test (see table 7). There was no significant difference in ratings of nausea between the experimental and control

groups at the .05 level of significance. The null hypothesis is not rejected.

TABLE 6

MANN WHITNEY U TEST OF DIZZINESS

Group	N	Distribution of Ratings			U Value	U Value Required for Significance*	Significance
		1	2	3			
Experimental	7	3	4	0	26.5	≤ 8	N.S.
Control	7	3	3	1		≥ 41	

*alpha=.05

TABLE 7

MANN WHITNEY U TEST OF NAUSEA

Group	N	Distribution of Ratings			U Value	U Value Required for Significance*	Significance
		1	2	3			
Experimental	7	0	3	4	30	≤ 8	N.S.
Control	7	1	3	3		≥ 41	

*alpha=.05

Hypothesis VII: Alarm--The null hypothesis that children with behavior disorders would not differ from normal children with respect to experience of alarm was supported by the Mann Whitney U Test (see table 8). There was no significant difference in ratings of alarm between the experimental and control groups at the .05 level of significance. The null hypothesis is not rejected.

TABLE 8

MANN WHITNEY U TEST OF ALARM

Group	N	Distribution of Ratings			U Value	U Value Required for Significance*	Significance
		1	2	3			
Experimental	7	1	1	5	27.5	≤ 8	N.S.
Control	7	1	0	6		≥ 41	

*alpha=.05

Hypothesis VIII: Pleasure--The null hypothesis that children with behavior disorders would not differ from normal children with respect to experience of pleasure was supported by the Mann Whitney U Test (see table 9). There was no significant difference in ratings of pleasure between the experimental and control groups at the .05 level of significance. The null hypothesis is not rejected.

TABLE 9

MANN WHITNEY U TEST OF PLEASURE

Group	N	Distribution of Ratings			U Value	U Value Required for Significance*	Significance
		1	2	3			
Experimental	7	5	0	2	29.5	≤ 8	N.S.
Control	7	3	2	2		≥ 41	

*alpha=.05

Discussion

Results of this study indicate that children with behavior disorders have vestibular dysfunction as evidenced by abnormal duration of PRN and abnormal loss of body balance following vestibular rotation. Furthermore, the results suggest that children with behavior disorders have hyporesponsive nystagmus, that is their duration of PRN is significantly lower than that of the normal control group.

Although statistical significance was pre-established at the .05 level, duration of PRN actually achieved significance at the .02 level.

Two situations should be noted which might have affected the data. PRN data was not available for experimental subject #2. After the first series of rotation, this subject immediately covered his eyes and demonstrated such an upsetting response to the rotation that the session was discontinued. The other situation that might have produced an effect on the data was the abnormally long duration of PRN (forty-four seconds) demonstrated by subject #13 of the control group (see appendix C). Furthermore, because of the limited sample size used in this study, caution should be used in interpretation of its results.

Although there are several hypotheses theorizing the etiology of hyporesponsive nystagmus, Ayres (1977) stated that the most reasonable one is overinhibition of the vestibular nuclei. This overinhibition could be a result of a hyperactivity of the cerebellum's inhibitory influence or it could be attributed to influence of the reticular formation which accounts for degree of arousal. The effect of overinhibition of the vestibular nuclei, regardless of cause, is that the appropriate amount of vestibular input fails to be integrated in the nervous system resulting in sensory integrative problems and, as this study suggests, behavior disorders.

Unlike the results of the study by Colbert, Koegler, and Markham (1959) which indicated that a number of children with severe mental disorders had a total lack of nystagmus or nystagmus of very short duration (five seconds or less), all experimental subjects in this study demonstrated some nystagmus and only one subject had a total duration of PRN of less than five seconds. Perhaps this suggests that severity of emotional disorder may correlate with abnormality of nystagmus. This proposition receives tentative support from the results of studies by Colbert, Koegler, and Markham (1959) and Huddleston (1978) which compared duration of PRN in schizophrenic patients, non-schizophrenic patients, and normal controls. Both studies resulted in duration of PRN that could be ordered from least to highest for each of the groups as follows: schizophrenics, non-schizophrenic behavior disorders, and normal controls. However, the difference between non-schizophrenics and normal controls did not reach significance and therefore this proposition should only be accepted as conjecture. Further investigation into the correlation of severity of emotional disorder with degree of vestibular dysfunction might be warranted.

Results of this study indicated that responses of dizziness, vertigo, nausea, alarm, pleasure, and loss of head control were not significantly different for the experimental groups. The only significantly different response to vestibular rotation was loss of body balance. The behavior disordered children tended to lost their balance following rotation while the normal controls did not. Two members of the experimental group completely lost their balance and fell to the floor while none of the control members totally lost body balance. Maintenance of body posture was noted in six out of seven members of the control group but in only one out of seven members of the experimental group. These results lend support to the proposition that behavior disordered children have vestibular dysfunction.

Although there was no significant difference in loss of head control, it should be noted that all seven members of the experimental group demonstrated some degree of loss while only two of the seven subjects in the control group evidenced loss of head control. One of these was control subject #13 who had hyperresponsive nystagmus. Because the Mann Whitney U Value for loss of head control ($U=38$) closely approached the value required for significance ($U \geq 41$), perhaps a larger N would have yielded a significant difference.

This study supported Ayres' (1977) statement that the average child experiences vertigo. Some degree of vertigo was experienced by 86% of the subjects (six out of seven in each group). Comments included "the wall is moving" and "the building looks like it's falling down."

There was no difference in dizziness between the groups. The majority of subjects experienced some degree of dizziness. All subjects with the most abnormal durations of PRN (both hyporesponsive and hyperresponsive) rated the highest degree of dizziness. Comments from these subjects included complaints of headaches and statements like "it feels like I'm on a shock wave."

Definite nausea was not a typical response for either the normal children or the children with behavior disorders. A mild degree of nausea was experienced by 43% of the experimental and control groups combined. Descriptions of feelings included "butterflies," "weird," and "my tummy fell out." Only one subject, control subject #13 with hyperresponsive PRN, definitely indicated nausea. These results concur with those of Royeen (1980).

The vast majority, 71% of the experimental group and 86% of the control group, did not give any indication of alarm. The subjects who did indicate alarm included control subject #13 with hyperresponsive PRN and experimental subject #2 who was unable to complete the session because of his response. These results agree with Royeen's (1980) conclusion that alarm is an atypical response to vestibular rotation.

Pleasure was a common response to rotation. Again this result concurs with that of Royeen (1980) and Ayres (1977). Pleasurable statements included "wish I could do this all the time," "this is fun," and "where do you buy one of these?." Many children demonstrated a desire to continue spinning after the test. The four subjects, two control and two experimental, who did not indicate pleasure were the ones experiencing dizziness, vertigo, nausea, and loss of body balance and head control.

Typical responses of the normal children to vestibular rotation included experiences of pleasure (71%), vertigo (86%), and dizziness (86%). Mild nausea was also common with 57% of the normal children expressing some complaint. Atypical responses to rotation noted in this study included experience of alarm (14%), loss of body balance (14%), and loss of head control (29%).

Partial support for these results may be derived from Royeen's (1980) study which concluded that atypical responses included experience of alarm, lack of pleasure, and loss of body balance while turning. The present study indicated that, in addition to pleasure, vertigo and dizziness were typical responses to rotation. Loss of head control was noted to be an atypical response in addition to experience of alarm and loss of body balance. The discrepancies between this study and that of Royeen (1980) may be due to actual population differences or differences between raters. Further research is needed to clarify what constitutes a typical versus atypical response to vestibular rotation.

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

This study was undertaken to investigate the possibility that children with behavior disorders have vestibular dysfunction. Using duration of postrotary nystagmus and response to rotation as indicators of vestibular function, seven children with behavior disorders and seven normal children between eight and ten years of age enrolled in Grand Prairie Independent School District were given the Southern California Postrotary Nystagmus Test. Children with behavior disorders revealed significantly lower duration of postrotary nystagmus and significantly greater loss of body balance following rotation. Other responses (vertigo, dizziness, nausea, alarm, pleasure, and loss of head control) did not yield significant differences.

Conclusion

On the basis of the significant differences in duration of postrotary nystagmus and maintenance of body balance, it is concluded that children with behavior disorders do give evidence of vestibular dysfunction. This study offers support for the contention that vestibular based disorders may correspond with behavioral disorders.

Results of this study hold implications for the clinician working with the child suffering from behavioral disorder. It is suggested that such children should be assessed with the SCPNT for possible vestibular dysfunction which might account for behavioral problems. If assessed for vestibular dysfunction early in life perhaps vestibular based behavioral problems could be discovered. Once identified, such children should be involved in a sensory integrative program of treatment which stresses vestibular activity. It is further recommended that additional clinical research be done on the effectiveness of vestibular based treatment programs for the child with behavior disorder.

Recommendations

Recommendations for future research in this area include the following:

1. A larger sample of subjects including more females and a wider age range should be used in future investigations.

2. Electronystagmography, known to be a more precise method of measurement of nystagmus than direct observation, might be used in the future to lend more credence to the hypothesis that vestibular dysfunction exists in children with behavior disorders. ENG may be particularly useful in testing questionable or difficult subjects.

3. Future investigation should include other indicators of vestibular function (e.g., equilibrium reaction) as well as postrotary nystagmus. Ayres (1977) pointed out that nystagmus is only one measure of vestibular function and normal nystagmus does not mean that all aspects of the vestibular system are normal. Such investigation could result in a screening or assessment tool that would be appropriate for the often uncooperative child with behavior disorder.

4. Further research is warranted into typical versus atypical responses to rotation in order that they may be organized in such a way to assist in diagnosis of vestibular dysfunction. Also, such investigation may

result in operationally defined responses to rotation which would benefit the clinician as well as the researcher.

5. Investigation into the correlation of severity of behavioral disorder with degree of vestibular dysfunction may be of interest.

6. Investigation into the specific behavior problems that are correlated with vestibular dysfunction might produce useful information in terms of identifying the child with vestibular dysfunction.

7. Research into the effectiveness of vestibular based treatment programs versus traditional treatment programs for the child with behavior disorder could offer further support for the hypothesis of vestibular dysfunction in behavior disorders. Furthermore, such research could help specify the treatment techniques most useful for the child with behavior disorder.

APPENDIX A

FACILITY PERMISSION FORM

The Grand Prairie Independent School District gives permission to M. Sheryl Sughrua, OTR to conduct part of a research project concerned with vestibular function in children with behavior disorders using children enrolled in Stephen F. Austin Elementary School and Plan A Special Education. This permission is given on the provision that the parents of the children also give their consent and that no names will be used. It is understood that this research is done in conjunction with Ms. Sughrua's graduate work at Texas Woman's University.

______________________________ __________

Principal — Date
Austin Elementary School
Grand Prairie Independent
School District

______________________________ __________

Director of Special Education — Date
Grand Prairie Independent
School District

APPENDIX B

CONSENT FORMS

May 14, 1980

Dear Parents,

Your child has been selected as a participant in a study on the vestibular sensory system to be done at Austin Elementary School. This study is being conducted for a Master's Degree in Occupational Therapy at Texas Woman's University and has been approved by the Grand Prairie Independent School District.

The vestibular system is the sensory system that responds to gravity and motion. When functioning properly it helps us to keep our balance and to maintain a constant field of vision.

The test to be used is the Southern California Postrotary Nystagmus Test developed by A. Jean Ayres, OTR, Ph.D. The test takes only 5 minutes and will be administered by a registered occupational therapist trained in the procedure.

Results of this test will be released only to parents or legal guardians upon request. All data will be confidential.

Participation in this study is voluntary and your child may withdraw at any time.

If you agree to this study PLEASE SIGN YOUR NAME AND A WITNESS' NAME ON THE ENCLOSED FORM AND RETURN TO ME IN THE ENCLOSED STAMPED ENVELOPE.

I will contact you via phone within the next few days to answer any questions you might have about the study.

Your child's participation in this study will be greatly appreciated.

Thank you,

M. Sheryl Sughrua
Registered Occupational Therapist

Consent Form
TEXAS WOMAN'S UNIVERSITY
HUMAN RESEARCH REVIEW COMMITTEE

Form A - Written presentation to subject

Consent to Act as a Subject for Research and Investigation:

The following information is to be read to or read by the subject. One copy of this form, signed and witnessed, must be given to each subject. A second copy must be retained by the investigator for filing with the Chairman of the Human Subjects Review Committee. A third copy may be made for the investigator's files.

1. I hereby authorize M. Sheryl Sughrua, OTR
(Name of person(s) who will perform procedure(s) or investigation(s)

to perform the following procedure(s) or investigation(s): (Describe in detail)

To test my child's vestibular functioning using the Southern California Postrotary Nystagmus Test. The test takes approximately five minutes. The child will sit on a board 1.5 inches from the floor. The occupational therapist will rotate the child 10 times in 20 seconds to his/her right and then left according to standardized procedure.

2. The procedure or investigation listed in Paragraph 1 has been explained to me by M. Sheryl Sughrua, OTR
(Name)

3. (a) I understand that the procedures or investigations described in Paragraph 1 involve the following possible risks or discomforts: (Describe in detail)

Some children occasionally experience loss of balance, nausea, dizziness, or fear/dislike while being slowly turned. If the child gives any evidence of these effects the occupational therapist will stop the procedure. A mat will be used to protect any child who may lose his/her balance. The child will be allowed to terminate the test at any time.

(Form A - Continuation)

3. (b) I understand that the procedures and investigations described in Paragraph 1 have the following potential benefits to myself and/or others:

Results of this study could provide useful information on vestibular functioning in children and its relationship to behavior. This information may help us to know how to direct the treatment and education of children with behavior disorders in the future.

(c) I understand that - No medical services or compensation is provided to subjects by the university as a result of injury from participation in research.

4. An offer to answer all of my questions regarding the study has been made. If alternative procedures are more advantageous to me, they have been explained. I understand that I may terminate my participation in the study at any time.

____________________________ __________________

Subject's Signature Date

(If the subject is a minor (age ___), or is unable to sign because:

Signatures (one required)

____________________________ __________________

Father Date

____________________________ __________________

Mother Date

____________________________ __________________

Guardian Date

____________________________ __________________

Witness (one required) Date

APPENDIX C

SAMPLE SCORING PLAN

SOUTHERN CALIFORNIA POSTROTARY NYSTAGMUS TEST

SAMPLE SCORING PLAN

NAME ______________________ GROUP ______________________

AGE __________ SEX __________

DURATION OF PRN

Duration of nystagmus following rotation to the left = ______ seconds

Duration of nystagmus following rotation to the right = ______ seconds

Total duration of nystagmus = ______ seconds

RESPONSES TO ROTATION

	1	2	3
1. Loss of balance:	definitely noted	slightly noted	not observed
2. Loss of head control:	definitely noted	slightly noted	not observed
3. Vertigo:	definitely noted	slightly noted	not observed
4. Dizziness:	definitely noted	slightly noted	not observed
5. Nausea:	definitely noted	slightly noted	not observed
6. Alarm:	definitely noted	slightly noted	not observed
7. Pleasure:	definitely noted	slightly noted	not observed

APPENDIX D

TEST SCORES

TABLE 10

TEST SCORES OF THE CONTROL GROUP

Child	Age	Sex	Duration			Loss of Balance	Loss of Head Control	Vertigo	Dizziness	Nausea	Alarm	Pleasure
			L	R	Total							
8	8	F	12	15	27	3	3	1	3	2	3	1
9	9	M	11	10	21	3	3	2	2	3	3	1
10	9	M	8	7	15	3	3	1	1	2	3	1
11	9	M	10	10	20	3	3	3	2	3	3	2
12	9	M	11	9	20	3	1	1	1	2	3	3
13	10	M	25	19	44	2	1	2	1	1	2	3
14	10	M	11	11	22	3	3	2	2	3	3	2

TABLE 11

TEST SCORES OF THE EXPERIMENTAL GROUP

Child	Age	Sex	Duration			Loss of Balance	Loss of Head Control	Vertigo	Dizziness	Nausea	Alarm	Pleasure
			L	R	Total							
1	8	F	5	10	15	2	2	3	2	3	3	1
2	9	M	No Data	No Data	No Data	1	1	1	1	2	2	3
3	9	M	10	6	16	2	1	2	2	2	3	1
4	9	M	2	2	4	1	1	1	1	2	2	3
5	9	M	11	8	19	2	2	2	2	3	3	1
6	10	M	7	5	12	2	2	2	1	3	3	1
7	10	M	6	6	12	3	2	2	2	3	3	1

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