SOUTHERN CALIFORNIA SENSORY INTEGRATION TEST BATTERY ON TWENTY NORMAL STUDENTS WITH ATTENTION TO THE LOW SCORER, TONIC NECK REFLEX AND NYSTAGMUS REPORTS

A THESIS

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CHAPTER I

INTRODUCTION

Statement of the Problem

Tarnopol, in his book entitled Learning Disorders in Children (1971), estimated that 5% to 20% of nonretarded populations have learning disabilities.

The perspective regarding the remediation of learning disorders in children has been broadened since the development and use of two diagnostic tests which supplement psychometric and auditory-language tests. The two additional tests are as follows:

> Southern California Sensory Integration Test Battery (SCSIT) of 17 tests (Ayres, 1972b)
>
> Southern California Postrotary Nystagmus Test (SCPNT) (Ayres, 1975)

Ayres (1972b) reported the standardization of SCSIT for 1095 normal children from 4 through 10 years of age. Later Ayres (1975) reported the standardization of SCPNT for 236 normal children from 5 through 9 years of age. The tests were further substantiated with clinical observations which occurred frequently enough to confirm statistically the nature of the neural process involved (Ayres, 1976).

Through Ayres' work (1972) attention has been called to the maturation of the central nervous system as it influenced the capacity to learn. Ayres used the natural developmental process of the nervous system as the basis for therapy. This contribution to the body of knowledge has given a battery of 18 tests together with clinical observations to help diagnose youngsters struggling in academia.

Purpose of the Study

The purpose of the study was to determine the number of students having completed the first grade who demonstrated unresolved tonic neck reflex, the number of children with an abnormal nystagmus score (depressed or prolonged), the number of children with low-scoring on the SCSIT Battery. Low scoring is defined as -1.0 standard deviation or lower with clusters of two or more scores involving the same sensory system.

Twenty normal children having completed the first grade in a private school were given the following tests:

Southern California Sensory Integration Test Battery of 17 tests (Ayres, 1972b)

Southern California Postrotary Nystagmus Test (Ayres, 1975)

Clinical evaluation which includes assessment of tonic neck reflex integration (Ayres, 1976).

Significance of the Study

During the 1960's some profound changes in focus occurred in the field of Occupational Therapy. Koestler (1970) summarized these changes by stating that the perceptual-motor approach changed from motor output to sensory input, from direct remediation to improvement of underlying dysfunction, and from attention to separate facets of disability to development of integrated function.

Ayres (1963) laid the theoretical foundation for sensory integration therapy, formerly referred to as a perceptual-motor approach. Ayres has continued to build on this foundation using neurophysiological and developmental application to therapy (Hopkins and Smith, 1978).

Ayres' theory was based on the premise that the brain was a self-organizing system (Hopkins and Smith, 1978; Ayres, 1968). Not only did the body and the brain work together as a whole, but the sub-cortical and cortical structures had to be integrated and continually interdependent. If the events between sensation and response could be influenced Ayres could get a more maturely developed and integrated response. Ayres utilized the principles in the developmental process as she selected specific media to facilitate a specific brain response (Ayres, 1963b). She contended the stimulation to specific brain mechanisms and mastery of the correct responses increased capability including correction of kinesthetic and proprioceptive biofeedback (Ayres, 1972).

The Ayres theory on sensory integration was originally designed for the learning disabled. However, experimental application of these principles has proven successful in other areas of Occupational Therapy such as psychiatry (King, 1974), mental retardation (Clark and Shuer, 1978), and blindness (Baker-Nobles, 1979).

Evidence of a need for identifying learning disorders for remediation at an early age was noted in the following studies:

1. Juvenile delinquency reports revealed as high as 80% of delinquents exhibit learning disorders from perceptual-motor deficits (Zinkus, Zinkus and Gottlieb, 1979).

2. School and social dropouts have been linked to learning disorders with resulting cumulative frustration and anxieties (Mac Auslan, 1978; and Ayres, 1979).

3. Self-concept was involved and could be greatly influenced by perceptual motor exercises. Research showed sensorimotor learning was more effective than verbal learning (cognitive-perceptual) in promoting body concept for pre-school children using a drawing test (Platzer, 1976). A healthy body concept is a prerequisite for dressing

(Coley, 1978) and for promoting praxis and spatial concepts (Ayres, 1972).

4. Tarnopol (1971) estimated that if 2% of the population of normal children had findings of perceptual-motor disorders, with one million children in the nation it would cost $120 million per 100,000 children to provide special classes in schools. If 5% would be affected the cost would be astronomical. Tarnopol stated that this was good reason for early detection and intervention.

5. Teachers observed problems in the children they taught, but without testing they were only 48% accurate in identifying areas of difficulty of predicting learning disorders (Kapelis, 1975).

Other sensory-modality tests are available to examine perceptual-motor function. Meier (1976) gave a matrix of the tests available. The matrix involved six sensory modalities: visual, tactile, proprioceptive, vestibular, auditory and visual-motor accommodation. The SCSIT encompassed five of the six modalities; it omitted auditory-language modality, but Ayres (1976a) recommended interpreting the SCSIT with scores on the Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk, McCarthy and Kirk, 1968), the Flowers-Costello Tests of Central Auditory Abilities (FCTCAA) (Flowers, Costello and Small, 1970), and a dichotic listening test. The only other test battery in

Meier's matrix that is similar to the one above is the Denhoff "Meeting Street School Screening Test" designed for children from 5 to 7.5 years of age and omitted the vestibular modality. Of the other 17 tests on the matrix each covered only two to four of the six modalities under consideration.

Definition of Terms Specific to the Present Study

1. Learning - the capacity to interpret the environ-Ment and respond appropriately to it (Ayres, 1972).

2. Normal - those students scoring between ± 1.0 standard deviation on SCSIT standardization.

3. Sensory Integration - the process by which the brain organizes past and present experiences and sensory information for the purpose of determining an appropriate response for a present situation. A perception cannot be associated with other learnings until it is integrated (Farber, 1974).

4. Integrated Tonic Neck Reflex - the ability to move the position of the head in relation to the body without affecting any change in muscle tone or movement throughout the body itself. This independent movement of the head should be possible within 4-6 months of life (Fiorentino, 1963).

5. Low Scorer - subject having a cluster of two or more scores associated with the same sensory system

which are at or below - 1.0 standard deviation on Ayres' battery.

6. Nystagmus - an involuntary, rapid, horizontal back and forth movement of the eyeballs. The reflex movement results from one of the following conditions: stimulation of the semicircular canals of the vestibular system, a certain type of visual input, or, in some cases, brain disorder (Ayres, 1972).

Limitations

1. The test was administered in a classroom with only the student and examiner present; the time was summer and the child came from a vacation environment. The scheduled time was 9 A.M.

2. No auditory or language functions were tested.

3. The study was limited to findings from test procedures and clinical observations.

4. The study was limited to children of parents who requested testing.

Assumptions

1. The children used in this study were considered to be normal and were undiagnosed at this time of any learning disorder.

2. Children with learning disorders frequently may be found in normal classrooms.

3. More effective remediation is possible with early detection of dysfunction.

Review of Literature

Formation of a Philosophy

Ayres (1954) began publishing concepts that have led to the formation of a sensory integration philosophy. Using ontogenetic principles occurring in the development of function of the body she developed therapy based on the developmental sequence. Ayres believed that the return of function after injury followed the same sequential pattern and therapy was more effective when the sequence was considered.

As early as 1958, Ayres began writing about the importance of sensory input in relation to visual-motor function. She wrote about observations of perception, the neurophysiology, and the factors organizing the stimuli in relation to the motor process. With ontogenetic development in mind she spoke of maturation and integration of each step of neuromuscular training (Ayres, 1958). Other researchers, Bobath (1953), Rood (1956), and Fiornetino (1936) were writing on related areas, specifically unresolved primitive reflexes. Ayres (1960) was stressing the restricting influence of the unresolved primitive reflexes on purposeful movement.

Ayres (1963b) delineated hypothetically the areas of perceptual motor dysfunction as follows: Apraxia, Perceptual

Dysfunction of Form and Space, Deficit of Integration of Function of the Two Sides of the Body, Perceptual Dysfunction of Visual Figure-ground, and Tactile Defensiveness. At the same time, Ayres was emphasizing the therapy be applied first to the basic lower brain stem level functions.

The Development of the Southern California Sensory Integration Test

During the interval between 1963 and 1972 Ayres published the following sub-tests individually which ultimately formed the SCSIT:

Ayres Space Test (1962) was developed to evaluate visual perception, particularly perceptual speed and space visualization. The test involved a natural task of using visual methods only to decide which of two blocks fit in a formboard. Very little conceptual ability was involved, but visual rotation of the block within the mind was required before the child touched the block. Directionality and position in space was involved and the element of surprise and flexibility were factors. Two neurological conditions the examiner watched for were blindness for one-half of the field of vision and disregard for one side of the body or space. Since children with brain dysfunction have difficulty changing a response pattern, Ayres stated these test items were presented in unfamiliar configurations which differentiated the normal from abnormal. Ayres also noticed that children with poor space perception slowed down as the test progressed past item #11 of the 60 items first used in the test.

Southern California Motor Accuracy Test (Ayres, 1964) is a timed yet accuracy-oriented test. Although this test is standardized for normal children from 4 years to 10 years of age, it is used to evaluate motor function and accuracy for many physical and neurological disorders (Ayres, 1964). Ayres stated that children who wanted to use one hand for the corresponding side of the page and then, the other for the opposite corresponding side, children who were distractible, careless or tried to do the test too fast (40 sec. or less) were potential perceptual motor disorder suspects. She also stated that the dexterity of both hands can be compared and hand dominance assisted. It was in this test that Ayres first specified how to compute the child's age to compare for standardization. Fifteen days or less are dropped; sixteen days or more are considered to be a whole month.

Southern California Figure-Ground Visual Perception Test (Ayres, 1966) was designed to test figure-ground discrimination which may also be associated with motor planning. It does not require verbal or skilled motor response and so it can be tested on multiple handicapped children. Data gathered from other researchers resulted in Ayres postulating the ability to discriminate foreground from rival background was concerned with inhibitory processes necessary to all brain levels and the ability was subservient to tactile-motor as well as visual integrated function.

Southern California Kinesthesia and Tactile Perception Tests (Ayres, 1966b) was produced as a battery of six tests to evaluate intersensory integration and to work together with the other sensory perception tests to discriminate dysfunction. This group of tests involves much tactile stimulation which seems to be basic to most syndromes. The tests were administered in a specified order to fulfill standardization. Performance below 3 S.D. indicated a severe dysfunction.

Southern California Perceptual-Motor Tests (Ayres, 1968a) was a battery of six tests designed to examine the difference in performance between the right and left sides of the body and the ability to cross the mid-line of the body. Most of the tests in this group were non-verbal and little cognitive.

After 12 years of research Ayres published and marketed the Southern California Sensory Integration test battery of 17 sub-tests (Ayres, 1972b). It included the tests listed above and two additional tests: Design Copy and Position in Space. The selection of the sub-tests were based on knowledge available and extensive factor analysis of the perceptual-motor dysfunctions (Ayres, 1976a).

In 1972 Ayres also published her first text book entitled Sensory Integration and Learning Disorders. The text described the integration process, syndromes and treatment approaches. Specific methods for intervention were pictured and described. The extensive influence of the vestibular system, including its association with extra ocular muscles, was emphasized. The appearance of nystagmus following vestibular stimulation was noted.

Since 1972, Ayres has published the following:

1975 Southern California Postrotary Nystagmus Test Manual

1976a Interpreting the Southern California Sensory Integration Tests.

1979 Sensory Integration and the Child which was published in laymen's terms for the benefit of the parents of these learning disabled children.

Disorders in Sensory Integration

The six behavioral syndromes of sensory integration this battery of tests addresses itself to are:

Developmental Apraxia

An interference with the body's ability to plan and execute skilled or non-habitual motor tasks; with perhaps, the inability to relate the sequence of one motion to another or to generalize to plan unfamiliar tasks. The affected person must be consciously aware where his body parts are in space and how they relate during movement in contrast to the normal who are only semiconsciously aware. Motor planning can be seen in the normal infant as he begins looking for objects that are out of sight and begins to visualize objects desired (Ayres, 1979). Apraxia occurs when discriminatory tactile sensations are underdeveloped and/or diminished kinesthesia, with secondary postural and bilateral dysfunction (Ayres, 1976; Hopkins and Smith, 1978).

Goals of therapy would be to develop tactile integration, vestibular and proprioceptive integration. Treatment stresses posture, balance, muscle tone and eye movements (Ayres, 1972, 1979).

LOWER LEVELS OF BRAIN FUNCTION ARE USUALLY THE SEAT OF THE PROBLEM AND ARE THE FIRST PLACE TO BEGIN THERAPY.

Vestibular Bilateral Integration

A condition caused by a deficit in bilateral integration--inability to perform bilateral activities, balance correctly, operate both sides of the body simultaneously (Hopkins and Smith, 1978). Secondary postural-ocular problem may be caused by poorly integrated primitive reflexes TNR and TLR and hypotonic muscles (deQuiros, 1976).

This neural system perhaps is developed normally in the creeping and crawling stage which is a bilateral action.

Immaturity of the system has been associated with reading problems (Hopkins and Smith, 1978).

Treatment goals are based on the symptoms exhibited and the LOWER LEVEL OF BRAIN FUNCTIONS ARE NORMALIZED FIRST, namely, vestibular and proprioceptive postural mechanisms and tactile system (Ayres, 1979).

Unilateral Disregard

A tendency to avoid moving non-dominant limb as an assistant limb. This condition is characterized by avoiding interaction with that side of the body space or even to accepting stimuli to that side of the body. This behavior is revealed through a strong difference in Motor Accuracy testing between non-dominant and dominant hands, irregularity in postural and ocular mechanism with more errors on the affected side in space visualization and manual form perception test. The ability to cognitively overcome this condition makes evaluation difficult (Ayres, 1972). Treatment goals are essentially the same as those for vestibular bilateral integration (Ayres, 1979). Gross bilateral activities to stimulate touch would be introduced early.

Form and Space Perception Disorder

The demands of reading on visual systems usually brings this disorder into focus if not discovered earlier.

Rarely does this disorder occur alone. It is closely associated with postural mechanisms and usually kinesthesia, tactile and ocular systems (Ayres, 1976). Spatial perception helps the child be a good judge of distance and size later on in life (Ayres, 1979). Children with dysfunction in this have trouble with the space around them. They bump into people or things because of their inability to judge their own position in space. Goal of therapy would be integration of the vestibular, proprioceptive system, tactile, and visual systems, and the lateralization of function (Ayres, 1972, 1976).

Tactile Defensiveness

The dysfunction in this syndrome is the perception of most tactile stimuli as painful or adversive eliciting basic survival responses of "flee or flight." It is a cumulative response; therefore, the response can be built-up with the six somatosensory sub-tests in the SCSIT. Behavioral symptoms associated with this dysfunction are hyperactivity, distractability, diminished tactile discrimination and antisocial behavior. Therapy considers this area basic to other dysfunction and when normalized first the improvement generalizes to other areas of dysfunction (Ayres, 1972, 1979).

Auditory-Language Disorders

The disorder of auditory or language may be easily identified, but when seen in association with deficits in postural and bilateral integration, praxis and visual perception the syndrome is representative of a more extensive neural dysfunction (Ayres, 1972). Therefore, the goal of treatment would emphasize intersensory integration of the somatosensory, the vestibular system, tactile and proprioceptive systems, and lateralization of function (Ayres, 1972, 1979). Children with auditory-language problems frequently showed a depressed nystagmus score and responded well to SI therapy (Ayres, 1979).

Tonic Neck Reflex

For a complete evaluation of sensory integration dysfunction the SCSIT and SCPNT tests must be supplemented with clinical observations (Ayres, 1976). The clinical evaluation used in this study is included in the Appendix and has been verified in the statement of the problem. The clinical evaluation includes an assessment of the tonic neck reflex integration (Ayres, 1976).

Gesell (1938) reported the primitive reflexes in the normal infant and a vital function in that they positioned the head for feeding, decreased the hazard of suffocating and channelled visual fixation on the hand during the first six months of life. Rider (1972) defined the relevance of the tonic neck reflexes through the explanation that primitive reflex patterns diminished to make way for higher patterns of righting and equilibrium. If they were delayed in coming under control they prevented higher, integrated responses. Since reflexes were not dependent upon attention, cooperation or intelligence an individual who might be confused, comatose, stuperous or retarded could be tested.

Illingworth (1971) stated that asymmetrical tonic neck reflex patterns appeared first, preventing the child from rolling prone to supine or vice-versa. Symmetrical tonic neck reflexes later became predominant and modified the asymmetrical. Symmetrical reflexes permitted bilateral activity, bringing the hands to the mouth, and helping the child raise head and shoulders in the prone position. While symmetrical tonic neck reflexes gave support to get on the hands and knees for creeping it had to be inhibited when the child began to creep since limbs required independent action from the head in creeping.

Illingworth (1971) further stated that the primitive reflexes worked together and were responsible for certain basic motor activities. The body-righting reflexes made their appearance in definite chronological order--one reflex subsiding as another came into predominance. The tonic labyrinthine reflexes followed the symmetrical TNR and interacted with the neck reflexes acting on the head. They were noted at two months and were strongest at ten months. These body righting reflexes acted on the body and modified the neck reflexes to play an important role in sitting and standing.

The postural reflex mechanisms never disappear, but are integrated as higher centers of the brain mature (Ayres, 1972). In children with poor sensory integration the reflex may be overactive; in high stress conditions the reflex may reappear throughout life (Ayres, 1979). In the normal infant these reflexes are integrated during the first year of life (Fiorentino, 1963).

Parmenter (1975) tested normal first graders and normal third graders in a study and was able to elicit the tonic neck reflex in both groups of children with more frequency of the reflex among the younger subjects. In the older children the reflex was considered to be the supportive framework of movement. Sieg (1979) described three positions for evaluating ATNR. The quadruped and standing positions with the quadruped reflex inhibiting posture were compared. Sieg found the latter to be more revealing of the presence of ATNR.

Nystagmus

In 1975, Ayres published and marketed the Southern California Nystagmus Test. The test was standardized using

226 children from the ages of 5 years to 9 years of age. Girls were separated from boys since their standards differed. The nystagmus test is used concurrently with the SCSIT battery.

In the normal child, vestibular stimulation by rocking has been found to have profound effects. White and Castle (1964) showed rocking improved visual alertness and responsitivity; Korner and Thoman (1970) demonstrated an alerting and soothing effect as well as a nurturing of the mother-child relationship. Ayres (1979) reported that comforting sensations were integrating and they helped to reorganize a child's nervous system when he was temporarily disorganized by distress. Ottenbacher (1978), deQuiros (1978), and Ayres (1976b) report vestibular and postural patterns were related and were found in a large portion of learning disabled children.

Ayres (1975) used a single-direction rotation method to examine the horizontal nystagmus to detect vestibular and postural disorders. Evaluation of the nystagmus is useful in making differential diagnosis between vestibular dysfunction on the one hand and vestibular disorder with symptoms of hemispherical dysfunction on the other. Prolonged or normal nystagmus may accompany the latter with depressed nystagmus seen with the former.

deQuiros (1978) gave convincing evidence for testing the nystagmus to obtain medical data in regard to vestibular-oculomotor function. He described a child who has just experienced many abrupt turns, starts and stops and the feeling of instability that the experience created. It would effect his concentration to learn, his attention span, and the awareness of the learning rhythm of his peers. In this condition he might realize the difference, react negatively to schoolwork, and become a behavior problem.

Stilwell (1978) in a research study found postrotary nystagmus to be reliable because 1) the time of day had no correlation,2) the direction of the nystagmus pattern (vertical, horizontal, or rotary) had no correlation, 3) the type of disability versus control group had no correlation except for postural stability during rotation. Stilwell found a nystagmus of 8.83 seconds duration or less warranted a complete sensory integration study.

Ayres (1978) reported learning disabled children with depressed nystagmus scores responded best to SI therapy; students with normal nystagmus scores responded the least; and students with prolonged nystagmus scores had symptoms that may suggest left hemispheral inefficiency and gained little academically from SI therapy (Ayres, 1976b).

Ottenbacher (1980) in a study of 109 learning disabled children supported Ayres tentative hypothesis that a prolonged nystagmus represented a more extensive neural-psychological involvement suspected to come from higher control centers in the cortex, while children with depressed nystagmus resulted from overinhibitation of the vestibular system.

There are several methods for testing the nystagmus. SCPNT was evaluated against the electronystagmography by Keating (1979). The SCPNT requires an observation of excursion and timed duration and the electronystagmography gives a permanent record of both. The Keating experiment determined excursion was harder to measure than duration. Ayres' SCPNT scores only the duration, but notes the excursion (Ayres, 1975).

Significance of SI Approach

Ayres (1979) noted that parents have been observing and struggling with children having these "invisible" handicaps. Now they can begin to understand the nervous system and what is going on inside their child and what therapists are doing to correct the condition. Furgang and Yerxa (1979) found that teachers who have statistically held higher expectations for the handicapped over the normal can become more realistic and understanding; Meier (1976) stated traditional testing, usually psychometric, can mislabel children and may need to be supplemented for increased understanding. No longer will these children be overestimated by teachers' "haloing" effect or social desirability (Furgang and Yerxa, 1979). Neither would some children be underestimated by traditional testing and called lazy, stupid, stubborn, naughty or mixed up (Tarnopol, 1971).

CHAPTER II

METHODOLOGY

Procedures for Collecting Data

A request was mailed to forty parents requesting their child to participate in this study (Appendix A). The parents responded and these children formed the study (Appendix B). All of the children agreed to take the test. This dictated the sample population of 13 boys and 7 girls with an age range of 6 years 7 months to 9 years 4 months. Individual week-day appointments were made by the examiner for testing in a local church during June and July. The church was quiet with only the secretary in the building and the examiner in the room with the child. Each student arrived promptly at 9 A.M. and was seated in a small straight chair with a table before him. The walls were without pictures for distraction. The lighting was overhead and adequate. The door to the air-conditioned room was kept closed. Pencils were sharpened daily for the motor accuracy test. The student and the examiner left the room only for two fifteen-minute breaks and when using the scooter board for clinical evaluation. Conversation was limited to break-time. The child was kept physically inactive until after the nystagmus scores were taken. The parents returned for the student upon completion of the battery of tests or during scooter board activity which was reserved to be the last test with a subsequent scooter board ride.

The same day the examiner scored each test and recorded observations. The standardizations were established and the bell curve of scores completed. Inspection of border-line low scores were statistically calculated with standard error of measurement formula to increase the accuracy of interpretaiton (Tables 1-19, Ayres, 1972b). All low scores in one sensory system were re-examined with individual student's other scores in the same system and the range was noted.

The teachers of the children tested prepared a list of students they suspected to be having problems following all testing the list and findings were compared.

The twenty children having completed at least the first grade in a closed classroom situation of a private school were tested using the following tests for each child:

1. Southern California Sensory Integration Test Battery (SCSIT) of 17 tests (Ayres, 1972)
2. Southern California Postrotary Nystagmus Test (SCPNT) (Ayres, 1976)
3. Clinical evaluation which included the following items (Ayres, 1976) (see Appendix C):

   A. Eye Preference and Movement

B. Forearm Rotation-Coordination

C. Muscle tone

D. Co-contraction

E. Flexor Postural Pattern

F. Prone-Extension Postural Pattern

G. A.E.T. Posture (equilibrium)

H. Choreoathetoid Movements

I. Tonic Neck Reflex (symmetrical and asymmetrical)

J. Space Visualization Contralateral Use (SVCU)

The entire battery of tests were administered in one day per student. The examiner's instructions to the student followed standardization. This battery required approximately 2 hours per child. The above list of tests formed the profile of data for each student which were retained in the following form:

1. Protocol Sheet--raw scores (17 tests)
2. Profile sheet with standard deviation scores and bell curve
3. Postrotary Nystagmus record with scores
4. Clinical Observation Sheet (Appendix)

Treatment of Data

Tonic Neck Reflex

Using chi-square, the low scores and normal scores were compared as they related to tonic neck reflex present and tonic neck reflex absent. Yates' (Chase, 1967) correction was applied:

TABLE 1

TONIC NECK REFLEX

	TNR Present	TNR Absent
Low Scorer	5	0
Normal Scorer	14	1

$X^2 = 2.386$ df = 1 $p < .20$

Value needed for .05 = 3.841

The findings were not significant.

Tonic Neck Reflex was recorded in the clinical evaluation in the following manner:

Asymmetrical

Right	Left
3 = no change in elbow position	(TNR absent)
2 = slight or questionable increase in flexion of contralateral elbow	(TNR weak)
1 = positive increase in flexion of contralateral elbow	(TNR strong present)

Symmetrical

Extension	Flexion

3 = no increase in flexion (or extension)

2 = slight or questionable increase

1 = definite increase in elbow flexion (or extension)

A second comparison was made based on the strength of tonic neck reflex:

TABLE 2

STRENGTHS OF TONIC NECK REFLEX

	TNR weak (almost absent)	TNR strong (2-#1 scores or more)	TNR absent (resolved)
Low Scorer	0	5	0
Normal Scorer	8	6	1

$X^2 = 5.4536$ df = 2 $p < .10$

Value needed for .05 = 5.99

The findings again were not significant. The result could be expected since the SCSIT was standardized with 1095 normal children (Ayres, 1972b) who may have had some unresolved tonic neck reflex still present.

Nystagmus

Scoring of post-rotary nystagmus was as follows:

Duration of nystagmus following rotation to left _______ seconds = S.D.

Duration of nystagmus following rotation to right ______ seconds = S.D.

Total number of seconds ___ = S.D.

Using chi-square, the low scorers and normal scorers were compared to depressed total or depressed in one eye, to normal, to prolonged in one eye and prolonged total:

TABLE 3

NYSTAGMUS

	Depressed Total	Depressed (one eye)	Normal	Prolonged (one eye)	Prolonged Total
Low Scorer	0	1	0	2	2
Normal Scorer	0	0	6	5	4

$X^2 = 5.2699$ df = 4 $p < .30$

Value needed for .05 = 9.488

The statistical application showed this examination was not significant.

CHAPTER III

FINDINGS IN THE STUDY

The raw data in the study can be located in Table E (see Appendix).

Although the comparisons were not statistically significant, some interesting trends and observations were noted.

Tarnopol (1971) wrote an estimate that 5% to 20% of the children in the non-retarded population were having learning disorders. The purpose of this study was to test twenty normal children with the SCSIT battery of tests to determine if the findings would approach Tarnpol's prediction. The sample population offered a possibility that an increased percentage of students with difficulty may be found in a private school. Children who were unable to cope with larger public classrooms frequently attended private schools.

When the children's scores on SCSIT were arranged in chronological order, according to age, as in Table 4, some interesting observations were noted. Twenty-five percent of the entire group were low scorers. The low scorers were among the oldest children tested. More boys (31% of boys) scored low than girls (14% of the girls). The indication might be that boys, at this age, have more problems, which in turn, might reveal the high response of parents with boys requesting testing.

Tonic Neck Reflex

Ayres (1972) stated TNR and TLR are present in all individuals at all times, but the degree to which they dominated the sensorimotor system was the point under evaluation. Up to 8 years of age, the reflexes could be elicited because the postural mechanisms of the child were less mature. Therefore, a concern of the present study was how many children displayed TNR present and to what degree, and did the immaturity of the nervous system interfere with normal scoring on the SCSIT.

The results of the present study regarding TNR present or absent and the strength of TNR present were:

1. Nineteen of the twenty children revealed some TNR present (95%)
2. Seven of the children had <u>mild</u> TNR present
3. Nine of the children had <u>moderate</u> TNR present
4. Three of the children showed <u>strong</u> TNR present

The above tally indicated 95% of the children tested had TNR present, but the strength varied. It was noted that all of the five low scoring children on the SCSIT occupied the range of moderate-TNR-present. Therefore, the TNR being present, nor the strength, did not interfer with normal scoring on the SCSIT.

One asymmetrical reflex (left or right) unresolved was the common factor in all the mild TNR present subjects tested. This seems atypical since the asymmetrical reflex appears first and is modified by higher developmental primitive reflexes. The symmetrical TNR is the one reflex expected to mature last. Mild TNR is close to TNR absent.

The symmetrical reflex pattern resulted in 15 children with extension matured and 12 students with flexion matured. Ontogentically, we would expect the extension symmetrical to mature first since it appears first and is important in lifting the head and preventing suffocation. Only one child, the low scoring girl, had low scores in both symmetrical tonic neck reflexes.

Nystagmus

The SCPNT test was a concern to this study for the following reasons:

1. The SCPNT completed the profile of scores

2. The SCPNT contributed to the differentiation concerning the vestibular system, and

3. The SCPNT aids in determining where SI therapy is indicated.

In the present study the following nystagmus scores were noted:

1. Twelve children had a normal nystagmus

2. Eight children had a prolonged nystagmus

3. None had a depressed nystagmus except one child with one eye depressed.

In a comparison of the prolonged nystagmus, 57% of the girls had a prolonged nystagmus to 30% of the boys. The result was not typical. Girls do not usually have a higher percentage of abnormal scores in SCPNT (Ayres, 1975). Ayres (1979) stated that a prolonged nystagmus is the result of lack of inhibition to the vestibular system and may be caused by emotional insecurity regarding gravity and movement. She further stated gravitationally insecure children avoid somersaults and "rough housing" was not pleasurable to them. Seven girls were too small a sample of private students to generate any trend.

Low Scorers

Table 6 (see Appendix) contains the scores of the five low scoring children with ages ranging from 7 years six months to 9 years four months and representing the older children in the study. Four were boys. In chronological order, according to age, the more severe dysfunctions occurred in the middle of the group and were restricted to dysfunction in the space-visual and motor areas or motor areas alone. The less severe dysfunction occurred on the peripheral areas of the group and was restricted to dysfunction of the somatosensory system. All the low scorers had only a moderate amount of TNR present. Immature reflexes did not relate to low scoring on SCSIT. Two had a prolonged nystagmus score and the rest were normal. A retest of the SCPNT may determine to what degree SI therapy would be helpful to the low scorers. Four of the children designated by the teacher to have problems did not score low on SCSIT.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

The results of this study supported several points than were originally theorized. 1) There are children in the non-diagnosed school groups experiencing sensory integration maturation delays. It is recommended that the five low scoring students in this study be examined more extensively for learning disorders. If such problems are confirmed, it would support Tarnopol's prediction (1971) of twenty-five percent found in the non-retarded population. With the use of SCSIT and other testing measures available (Meier, 1976), the problems can be isolated and identified. With the attention of the professional world turned to developmental influences and sensory-motor dysfunction in the last twenty years or more remedial services are available. Teachers and parents do observe problems in children they teach (Kapelis, 1975), but they need professional help with the knowledge of the neurological development and function to assist in diagnosis and treatment (Ayres, 1979). Ayres also stated that everyone had an inner drive to be sensory integrated and the result of complete integration is a more efficient brain and body function. 2) Since 95% of

the children in this study showed TNR present, the findings support the theory that TNR is common in children this age, and it does not interfere with normal scoring on the SCSIT or necessarily contribute to interference of learning.
3) Neither can nystagmus be said to prevent normal scoring on SCSIT according to this present study.

Ayres inspired this researcher's regard because 1) though backed by much scientific fact she stressed her approach was still theoretical, 2) she is willing to grow and change with new evidence, 3) she insists on skilled examiners and certifies her examiners, and 4) she insists on her examiners understanding sensory integration dysfunction. Her approach may mean that untold numbers of children will become productive adults without costly medications, psychiatry or support from society.

The response of the parents, teachers and children was very gratifying. This researcher hopes this study may inspire others to become not too quick in judging children nor too slow to recognize honest struggles in children.

Many possibilities for future studies have emerged in this present study:

1) A larger group of children from public schools to get a greater cross-section of the population

2) A group of students from an Open Concept Classroom to identify the influence extra available stimuli has on the nervous system

3) A study regarding a comparison of the TNR patterns--Asymmetrical versus Symmetrical

4) A study of physical activity in relation to nystagmus scores

5) A study of the character of nystagmus scores between male and female, specifically the number of normal, depressed and prolonged.

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APPENDICES

June 4, 1979

Dear Parents,

St. Alban's Episcopal School has approved all students completing first grade to be eligible for testing in a study of Sensory Integration. This study is being conducted for a Master's Degree in Occupational Therapy at Texas Woman's University.

Sensory Integration is the ability to organize sensory information for use. The test-battery to be used is Southern California Sensory Integration by A. Jean Ayres, OTR, Ph.D. The test has no mental function, achievement scores or pain involved; it contains activities that indicate reflex actions and visual or motor responses to specific stimuli. When the child's infant reflexes are resolved he is better able to concentrate on academic learning. If any areas of your child's nervous system are not equal to this peer group in maturation--these areas of function can be influenced easily for growth before 9 years of age. The results of the tests will be made available to parents--upon request.

Although there will be no charge for this testing the usual cost for this battery is $75-$150 per child. We are negotiating now for therapy, if indicated, to be made available upon request. This type of examination in children may prevent learning disorders later on.

Participation in this study is voluntary and the child may withdraw at any time. If interested, I would appreciate each parent's signature and address, the child's full name and exact birth date. A form to be returned is enclosed for your convenience.

You will be contacted via phone regarding an appointment for testing this summer at St. Alban's School. Make sure the child is rested and has no physical or emotional disability on the day of testing.

It is the hope of this researcher that through this study we should learn not to be too quick to judge children nor too slow to recognize honest struggle in a youngster.

Thank you,

Mrs. Martha Gene Rank, OTR

Enclosure

SOUTHERN CALIFORNIA SENSORY INTEGRATION

Parent's Name: ____

Address: ____

____

Phone No.: ____

Child's Full Name: ____

Exact Birth Date: ____

Request Report:

☐ Yes

☐ No

Kindly return by June 12 to:

Mrs. Martha Gene Rank, OTR
1408 Allegheny Avenue
Arlington, TX 76012

Phone: 261-3927

CLINICAL EVALUATION OF SENSORY INTEGRATION

I. Prone-Extension Postural Pattern:

Pivot-prone position on scooter board. Arms flexed at elbows; elbows about 4" from body. Head, shoulders, and arms raised; legs straight and hyperextended at hips. Hold position for count of 30 (30 sec.).

Score: 3 = 30 sec. held; no difficulty
2 = Less than 30 sec., or clumsy in positioning, or undue energy expended
1 = Unable to maintain, or assume pivot-prone position

Flexor Postural Pattern:

Supine Position - Head, arms and legs flexed off the surface on which body is resting, ankles crossed ("Curl up" without clasping arms around knees). Give resistance to forehead and knees.

Score: 3 = Assumes and holds position 20-30 sec.; withstands resistance
2 = Can assume and hold position with difficulty or clumsiness
1 = Unable to assume or hold position

II. TNR: Quadruped position; eyes closed, elbows slightly flexed to avoid locking.

Asymmetrical - Examiner turns child's head passively to Left and to Right; watch for contralateral increase of elbow flexion.

Score:	Left	Right
3 = No change in elbow position	3	3
2 = Sl. or ques. increase in flexion of contralateral elbow	2	2
1 = Positive increase in flexion of contra. elbow	1	1

Symmetrical - With child's head in mid position, Examiner flexes neck passively. Watch for increase in elbow flexion.

(Flexion) Score: 3 = No increase in flexion
2 = Sl. or ques. increase
1 = Definite increase in elbow flexion

(Extension) With child's head in mid position, Examiner hyperextends or dorsiflexes neck passively. Watch for increase in elbow extension.

Score: 3 = No increase in extension
2 = Sl. or ques. increase
1 = Definite increase in elbow extension

III. AET Posture:

1. Immature Postural Mechanisms (TNR/Equilib.)

Feet together and even; eyes closed; arms extended forward (shoulder flexion to 90°), forearms pronated and not touching; fingers abducted.

Examiner, with forewarning to child, turns child's head from side to side. Note ease of turning head (resistance to head turning); change in arm posture (divergence, convergence, raising, lowering); rotation of body (or shifting of posture); negative emotional responses.

Score: Resistance to Head Turning:
3 = No resistance to head turning
2 = Sl. or ques. resistance
1 = Positive resistance to head turning

Change in Arm Posture:
3 = No change in arm posture
2 = Sl. or ques. change
1 = Positive change in arm posture

Rotation of Body:
3 = No rotation of body
2 = Sl. or ques. rotation
1 = Rotation or shifting of body indicated

Negative Emotional Response:
3 = No change in emotional response
2 = Sl. or ques. negative response
1 = Negative emotional response noted

2. Choreoathetoid Movements:

Assume AET position with eyes closed. Hold position for 20 seconds if possible (have child count with Examiner). Note involuntary or purposeless motion-tremor, wavering, etc.

Score: 3 = No involuntary movements noted
2 = Slight or questionable movements noted (not corrected)
1 = Involuntary motion is obvious

IV. Coordination: (Examiner and child seated facing each other)

1. Ability to Perform Slow Motions (Directions: "Watch me doing this; then do it with me--not too fast and not too slow.")

Position: Shoulders abducted 90° with elbows flexed so fingertips touch shoulders. Slowly extend elbows, then flex to return fingertips to shoulders. Try 2 or 3 times.

Score: 3 = smooth movements
2 = slight irregularity
1 = jerky, too fast

2. Forearm Rotation (Rapid supination-pronation of forearm for 10 seconds)

Begin with hands resting in laps. Demonstrate supination-pronation, making audible slap on thigh with palm. Right hand; then Left hand; then Both hands together. Count number of slaps in 10 seconds of time. Tell child to "do it fast."

Score: (Include no. times)	Right___x's	Left___x's	Both___x's
3 = Smooth, w. coord.	3	3	3
2 = Slight difficulty	2	2	2
1 = Poor or unable	1	1	1

3. Thumb-Finger Touching (Opposition)

Demonstrate touching thumb to each finger beginning with index and touching in sequence to little finger; then return to index, repeating several times. Hands separately and then together. Observe speed, coordination, and R-L differences.

Score:	Right	Left	Both
3 = Well coord.	3	3	3
2 = Sl. irreg.	2	2	2
1 = Poor	1	1	1

4. Tongue-to-Lip Movement

Demonstrate movement (Tongue to upper lip, lower lip, and angles of mouth). Then have child do the same. Repeat if needed.

Score:	Upper Lip	Lower Lip	Sides (Angles of mouth)
3 = No difficulty	3	3	3
2 = Sl. irregular	2	2	2
1 = Poor	1	1	1

V. Co-Contraction:

UE & Trunk - Child grasps thumbs of examiner; Examiner holds hands of child. Child is told to flex elbows and hold in that position. Examiner then tries to push and pull child. Child resists by co-contraction of UE and trunk.

Score: 3 = Strong resistance by co-contraction; no movement by child's arms or trunk
2 = Fair resistance by co-contraction; only slight movement by child's arms or trunk
1 = Poor resistance by co-contraction, or child is unable to resist movement.

Neck - Child is told to hold head still; don't let it turn. Examiner then places hands on top of head and tries to move head back and forth, and side to side (rotation). Flexion normally is weakest.

Score Resistance to:	Flexion	Extension	Rotation Rt.	Rotation Lt.
3 = Strong resistance	3	3	3	3
2 = Fair resistance	2	2	2	2
1 = Weak resistance, or inability to resist	1	1	1	1

Body - Child sits on scooter board (tailor position), grasping a plastic form with hands, stabilizing elbows on knees. Examiner grasps opposite side of plastic form and pushes and pulls child. Scooter board only should move, while child's position remains stable. Give several tries (4 or 5 at least, if necessary).

Score: 3 = No change in body posture
2 = Slight change in body posture
1 = Unable to maintain posture

VI. Muscle Tone:

Stability of shoulder joint: Try lifting child at elbow, with elbows fully flexed and humerous extended and abducted (but not stabilized against body). Tell child to hold stiffly.

Score: 3 = Shoulder joint position maintained readily
2 = Difficulty maintaining position, slight change of shoulder joint
1 = Unable to maintain position of shoulder

Extention of knees: Tell child to stand straight--as straight as possible.

Score: 3 = No hyperextension of knees
2 = Slight hyperextension of knees
1 = Prominent hyperextension of knees

Extension of elbows: Tell child to extend arms forward, palms up (90° flexion, supinated position of forearms). Demonstrate instruction.

Score: 3 = No hyperextension of elbows
2 = Slight hyperextension of elbows
1 = Prominent hyperextension of elbows

Note Cubitus Valgus: Mild________ Moderate________

Extension of wrists: Use same position as above (Extension of elbows). Then tell child to let just his hands drop downward (demonstrate hyper-extension of wrists). Examiner gives slight pressure to palms of subject's hands to judge flexibility.

Score: Amount of movement in extension

3 = To about 90°
2 = Slightly more (hypo.) OR slightly less (hyper.)
1 = Markedly more (hypo.) OR markedly less (hyper.)

VII. Eye Preference and Extraocular Movements:

1. Eye Preference:

	Eye		Hand Used	
Subject's eye through ring of Ex's finger at 6"	R	L		
Subject holds yellow ring, and looks at Examiner through ring	R	L	R	L
Subject's eye through hole in paper; child holds paper	R	L	R	L
Subject picks up kaleidoscope and looks through it	R	L	R	L

Independent eye closure — R only / L only / R and L

	Eye		Hand Used	
If independent, have subject hold yellow ring with arms extended. Using both eyes, locate a designated target within the ring. Have child close each eye separately to determine which eye held the ring.	R	L	R	L
			Both	

2. Eye Movements: Child is told to keep head still; watch, but do not turn head.

General Pursuits (Tracking) - Use rubber tip of pencil or other suitable object about 8-10" from child's eyes, moving in a horizontal, vertical, diagonal, and circular movement.

Horizontal Movement - Left to right and return, somewhat slowly, noting midline crossing particularly.

Quick Localization of target, using rubber tip of pencil in sudden shifts in position within child's visual field (avoid moving head).

Convergence, eyes together and each separately. Have child look at eraser tip as Ex. brings close to subject's eyes. May need more than one try, but do not prolong the process.

Score for each:
- 3 = No difficulty
- 2 = Slight irregularity or difficulty
- 1 = Definitely poor, or unable

Tracking (Gen. Pursuits)	Horizontal Movement (Crossing midline)	Quick Localization	Convergence R	Convergence L	Convergence Both
3	3	3	3	3	3
2	2	2	2	2	2
1	1	1	1	1	1

Note presence of strabismus or nystagmus at any time during testing. If child wears glasses, test him with and without glasses. Try without glasses first.

TABLE 4

RAW DATA

	Chronological Order Age	Sex	TNR R	TNR L	TNR E	TNR F	Number of Low Scores	Nystagmus L	Nystagmus R	Nystagmus Total
1)	6.7	M	3	2	3	3	0	+1.0	+1.4	+1.3
2)	6.8	F	1	1	3	1	0	+1.6	+1.7	+1.8
3)	6.8	M	1	1	2	3	1	+1.4	+0.3	+0.9
4)	6.9	F	1	1	3	3	0	+1.9	+0.1	+1.1
5)	6.11	F	1	2	3	3	0	+0.5	+2.0	+1.3
6)	6.11	F	2	3	3	3	0	-0.9	+0.4	-0.3
7)	7.1	M	1	1	2	3	0	+1.4	+0.0	+0.8
8)	7.4	F	3	2	3	3	1	+1.6	+0.8	+1.3
9)	7.5	M	3	3	3	3	1	+0.7	+0.8	+0.7
10)	7.6	M	3	2	3	1	3	+0.9	+1.1	+1.1
11)	7.6	F	3	2	3	3	2	+0.8	-0.2	+0.3
12)	7.6	M	1	1	1	2	1	+0.2	+1.1	+0.7
13)*	7.6*	M*	1*	1*	3*	3*	3*	+1.6*	+1.9*	+1.9*
14)	7.6	M	1	1	1	2	2	+0.9	+0.5	+0.8
15)*	7.7*	F*	2*	2*	1*	1*	4*	+1.0*	+0.1*	+0.6*
16)*	7.9*	M*	1*	2*	3*	1*	5*	+0.9*	+1.6*	+1.4*
17)*	7.9*	M*	1*	2*	3*	1*	3*	+0.2	+1.1*	+0.7*
18)	7.9	M	2	3	3	3	0	+0.5	+0.3	+0.4
19)	7.11	M	2	3	3	3	1	+0.9	+0.5	+0.8
20)*	9.4*	M*	1*	3*	3*	1*	4*	-1.6*	+0.3*	-0.8*

*Cluster of low scores in same neural system.

TABLE 5

RAW DATA WITH LOW SCORES

Student	Age	Sex	SVCU	TNR R	TNR L	TNR E	TNR F	Nystagmus L.	Nystagmus R.	Nystagmus Total	Low Scores	
1.	6.7	M	28	3	2	3	3	+1.0	+1.4	+1.3	None	
2.	6.8	F	26	1	1	3	1	+1.6	+1.7	+1.8	None	
3.	6.8	M	28	1	1	2	3	+1.4	+0.3	+0.9	SBO	-1.1
4.	6.9	F	28	1	1	3	3	+1.9	+0.1	+1.1	None	
5.	6.11	F	29	1	2	3	3	+0.5	+2.0	+1.3	None	
6.	6.11	F	28	2	3	3	3	-0.9	+0.4	-0.3	None	
7.	6.11	F	28	2	3	3	3	-0.9	+0.4	-0.3	None	
8.	7.4	F	28	3	2	3	3	+1.6	+0.8	+1.3	LTS	-1.6
9.	7.5	M	29	3	3	3	3	+0.7	+0.8	+0.7	Kines.	-2.1
10.	7.6	M	28	3	2	3	1	+0.9	+1.1	+1.1	MA Lt.	-1.8
											MA Rt.	-1.0
											Kines.	-1.4
11.	7.6	F	28	3	2	3	3	+0.8	-0.2	+0.3	Kines.	-1.3
											MA Lt.	-1.2
12.	7.6	M	28	1	1	1	2	+0.2	+1.1	+0.7	MA Rt.	-1.2
13.*	7.6*	M*	28*	1*	1*	3*	3*	+1.6*	+1.9*	+1.9*	LTS	-1.7*
											Graph	-1.2
											BMC	-1.7
14.	7.6	M	29	1	1	1	2	+0.9	+0.5	+0.8	Kines.	-1.2
											SBO	-1.0
15.*	7.7*	F*	25*	2*	2*	1*	1*	+1.0*	+0.1*	-0.6*	PS	-1.2*
											SV	-1.1
											MA Rt.	-2.3
											LTS	-2.9

TABLE 5--Continued

Student	Age	Sex	SVCU	TNR R	TNR L	TNR E	TNR F	Nystagmus L.	Nystagmus R.	Nystagmus Total	Low Scores	
16.*	7.9*	M*	28*	1*	2*	3*	4*	+0.9*	+1.6	+1.4	MA rt.	-3.2*
											MA lt.	-1.1
											SBO	-1.0
											FG	-2.5
											PS	-2.7
17.*	7.9*	M*	28*	1*	2*	3*	1*	+0.2	+1.1*	+0.7*	MA lt.	-2.5*
											MA rt.	-2.0
											SBC	-1.1
18.	7.9	M	28	2	3	3	3	+0.5	+0.3	+0.4	None	
19.	7.11	M	28	2	3	3	3	+0.9	+0.5	+0.8	LTS	-1.5
20.*	9.4*	M*	27*	1*	3*	3*	1*	-1.6*	+0.3*	-0.8*	MA rt.	-1.6*
											MA lt.	-1.4
											MFP	-1.9
											Kines.	-1.3

*Cluster of low scores in same neural system.

TABLE 6

FIVE LOW SCORING STUDENTS

Student Student	Age	Sex	SVCU	TNR R	TNR L	TNR E	TNR F	Nystagmus L.	Nystagmus R.	Nystagmus Total	Low Scores	
13.*	7.6*	M*	28*	1*	1*	3*	3*	+1.6*	+1.9*	-1.9*	LTS	-1.7*
											Graph	-1.2*
											BMC	-1.7*
15.*	7.7*	F*	25*	2*	2*	1*	1*	+1.0*	+0.1*	+0.6*	PS	-1.2*
											SV	-1.1*
											MA rt.	-2.3
											LTS	-2.9
16.*	7.9*	M*	28*	1*	2*	3*	1*	+0.9*	+1.6*	+1.4*	MA rt.	-3.2*
											MA lt.	-1.1*
											SBO	-1.0*
											FG	-2.5*
											PS	-2.7*
17.*	7.9*	M*	28*	1*	2*	3*	1*	+0.2*	+1.1*	+0.7*	MA lt.	-2.5*
											MA rt.	-2.0*
											SBO	-1.1*
20.*	9.4*	M*	27*	1*	3*	3*	1*	-1.6*	+0.3*	-0.8*	MA rt.	-1.6
											MA lt.	-1.4
											MFP	-1.9*
											Kines.	-1.3*

*Cluster of low scores in the same neural system.