THE EFFECTS OF SENSORY INTEGRATION TREATMENT ON THE LOW ACHIEVING COLLEGE STUDENT

A THESIS

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CHAPTER I

INTRODUCTION

Research studies were reported by Ayres (1972) on learning disabled children which linked poor academic achievement to difficulties in sensory integration. As a part of the studies, sensory integrative therapy was given and improvement in the academic performance was documented. The studies resulted from work done throughout the 1960s and further research has been continued. Earlier work (Ayres, 1964) had been done on perceptual motor dysfunction using a neurophysiological frame of reference to interpret some of the faulty sensory integration processes within the central nervous system.

The sensory integration (SI) approach to evaluation and treatment has received wide acceptance in the field of occupational therapy in the remediation of certain areas of dysfunction (Ayres, 1976; Mayberry, 1975; Norton, 1975; Van Benschoten, 1975). While these works have been associated with children, additional work has been done in the remediation of certain psychiatric conditions (King, 1974; Rider, 1973).

Among Texas Woman's University students interested in occupational therapy as a profession, two groups have been of particular concern to the faculty of the School of Occupational Therapy. One group was composed of freshmen who had not achieved adequate scores on SAT or ACT examinations and were therefore not permitted to begin a major in occupational therapy. Such students were classified as General Majors and admitted to the program only after the grade point average was sufficient.

Another group consisted of students who, as occupational therapy majors, were having difficulty in achieving the grade point average of 2.8 for entrance to the senior level and/or clinical fieldwork. In addition, faculty members observed that errors in certain performance tasks of some of the occupational therapy students appeared to be due to perceptual-motor difficulties.

Since theory on which SI was based related poor perceptual-motor performance with inadequate SI functioning (Ayres, 1972), the faculty of the School of Occupational Therapy at TWU recently questioned whether or not SI therapy given to selected college students might help improve the academic and/or perceptual-motor task performance of such students.

Significance of the Study

In the college system, the student with poor academic skills has had no choice but attempt to work hard and risk academic failure. A program of sensory integration intervention might provide a means for him to succeed and enter a profession or occupation that, previous to entering a SI program, he would not have been able to handle.

Sensory integrative therapy ideally should be started in grade school. Ayres, who has studied this area extensively, based most of her research on children four through ten years of age. If sensory integration techniques are found effective in improving academic performance for some of the low achieving college age students the present study may suggest justification for SI programs for other low achieving individuals above childhood age levels.

The present study might serve as a model for occupational therapists working with adolescents for whom evaluation have indicated deficits in SI. It might also serve as a frame of reference for the clinician working in public school settings in which SI techniques may be effective for a wide variety of ages, or for certain students over prolonged periods of time.

Basic Assumptions

The present study was based on the following assumptions:

1. Deficits in visual space perception can be identified by sensory integration testing

2. The standardized tests used will identify the visual perceptual deficits and poor reading skills

3. Deficits in visual space perception and in reading ability affect academic progression of students in the Occupational Therapy program at the Texas Woman's University.

Hypothesis

After participation in a program of SI techniques, students identified as having difficulty in academic subjects would show significant improvement in the following:

1. Tests in figure-ground, position in space, space visualization

2. Tests in reading

Statement of the Problem

The central problem of the study was to determine whether, after a program of SI activities, students would improve in reading skills and in selected tests of spatial perception, specifically figure-ground, position in space, and space visualization.

Definition and Explanation of Terms

Sensory Integration.--A process of the brain to organize incoming stimuli and make an appropriate response to the stimuli. Organization of this information enables man to make appropriate responses to the environment. This process can be enhanced by providing stimuli to activate appropriate brain mechanisms. Sensory integration does not mean the learning of specific skills but the ability to learn how to learn (Ayres, 1972).

Figure-ground.--A foreground figure superimposed or embedded on background figures. In order to perceive the foreground figure, one must be able to disregard the rival background figures. Ability to perceive figure-ground is associated with visual perceptional general integration of the central nervous system (Ayres, 1972).

Form and Space.--The mental manipulation of an object, the process of moving an object to a different position in one's mind. If form and space is not perceived properly, reading ability may be affected.

Position in Space.--The ability to recognize geometric forms presented in different orientations. Inability to perceive position in space relates to perception as associated with directionality.

Limitations

The students participating in this study were enrolled in Occupational Therapy 1223, Developmental Skills. This class was designed primarily for the student who desired to be an occupational therapist but had not satisfactorily met academic requirements. Students eligible for this class and selected for this study were freshmen with an ACT score below 15 or a SAT score below 650, transfer students whose previous academic record was below a 2.5 grade point average, and students currently enrolled in the OT program who had been identified particularly in media courses as having difficulty in academic and/or motor skills.

No student in this study was simultaneously enrolled in a remedial or speed-reading course while enrolled in OT 1223.

The activities of the program were limited to the amount of space and equipment available.

CHAPTER II

REVIEW OF LITERATURE

Ayres (1972) stated that sensory motor development relied on the process of neurological organization, the brain stem being the base of organizing incoming stimuli. More specifically the midbrain was the seat of postural integration which in turn was associated with form and space perception.

Ayres (1972), further stated that form and space perception began with the interpretation of the earth's gravitational force. From the earth's gravitational force the organism distinguished between "up" and "down," relating to the environment as though it were in the middle of it. The organism also related to the environment through postural responses. When the head turned the new position was perceived by the organism through the vestibular system as movement either of eyes, head, total body, or environment.

In addition, Noback and Demarest (1972) stated that the change which occurred in muscle tone, specifically the intrafusal fiber of skeletal muscle, originated from the vestibular system and the proprioceptors. One of the functions of the vestibular system was to interact with eye

movements (Noback, 1967). The interaction could be sufficient to enhance the development of reading along with perception of form and space (Ayres, 1972). If there was insufficient input into the vestibular system, opportunities for faulty interpretation of the environment occurred. Hebb (1949) and Ayres (1972) agreed that when the vestibular system was depressed, kinesthesia, the sense of movement, also had a limited input. Inaccurate perception of movement resulted in inaccurate perception of the environment. Inaccurate perception of movement also resulted in poor ability to manipulate objects in a purposeful manner. Because a decrease in kinesthesia affected the extraocular muscles, the perception of form and space was also affected.

Terry and Gershon (1976) stated that sensory motor function began in the brain stem and that the brain stem cells did not decrease in number with age. The abducens and trochlear nuclei cells, which control one third of the extraocular muscles, have been counted in the age space from newborn through eighty-three years of age with no change in the number of cells. Neurological reorganization from sensory motor activities may still be feasible in young adults, since the brain stem was still intact.

Evidence of the neurological reorganization has been demonstrated by Strauss (1955) in his research on the brain-injured adult. It was shown that in human beings,

most neurological organization was completed in the first decade of life. However, if completion had not taken place, neurological organization could still take place in the older youth (Moore, 1973). In the brain-injured adult, the resources for re-education that the person utilized to compensate for the injury were found in the undamaged portion of the brain.

The research of Ayres (1972) and Punwar (1970) showed that by using SI intervention, academic achievements improved. The subjects in Ayres' study were between the ages of four years through ten years, eleven months. Punwar used seven and eight year olds. Both researchers found that reading skills relied in part on the ability to perceive form and space properly.

According to Ayres (1972), sensory motor experiences were the foundation of learning. Kephart (1960) and Sund (1976) also reached the conclusion that sensory motor experiences were of foremost importance in learning. Ayres (1972) stated that if all motor elements in normal children were learned in childhood, then adult learning would be primarily a matter of interpreting the relationships and associations of the motor elements. However, if the motor elements had still not been learned to a sufficient degree by adulthood, the young adult was not able to integrate perceived relationships and associations properly which

were needed in successful academic pursuits. Beard (1969) stated that sensory motor difficulties still existed in some older children but made no suggestions for remediation.

CHAPTER III

METHODOLOGY

Instruments Used for Testing

As a pretest, students were given Figure-Ground, Position in Space, and Space Visualization tests from the Southern California Sensory Integration Tests (SCSIT) by A. Jean Ayres (1976). Each of these tests was dependent on visual responses only. No motor component was required. Reading skills were measured by The Nelson-Denny Reading Test (Nelson and Denny, 1960) and the Wide Range Achievement Test (WRAT) by Jastak and Jastak (1965).

The Figure-Ground test from the SCSIT battery consisted of identifying three pictures from a rival background. The subject was given a group of six pictures from which he selected three as matching the figures on the stimulus card. The test was divided into two parts. The first part consisted of familiar objects and the second part consisted of geometric designs.

The Position in Space test from the SCSIT measured the ability to perceive the same form in different orientations. The test was divided into three parts. In the first part, the evaluator tested the subject in matching

identical forms. If the subject was not successful, the evaluator explained why the choice was incorrect. This was done so that any differences of formal perceptual training among the subjects were minimized. In the second part, the subject matched the stimulus figure to one of three or four choices which contained the initial stimulus figure. The amount of time required by the subject was computed in the scoring. In the third part, a visual memory element was added. The subject was allowed three seconds to view the stimulus. He then identified his choice from a series of designs.

In Space Visualization of the SCSIT, the subject had two forms to choose from, but only one would correctly fit into the form board. Each item presented a different puzzle by placing a peg in various locations on the form board and by changes in directional placement of the form board.

Reading skills of the subjects were evaluated using two evaluative instruments: The Nelson-Denny Reading Test and the Wide Range Achievement Test (WRAT). On the Nelson-Denny vocabulary test, the student was required to select the correct definition from a list of four definitions for a given word. The student was given ten minutes to complete this section of the test. In the Nelson-Denny comprehension test, the student was required to read a piece of material for twenty minutes. His comprehension was tested by

answering questions concerning the material. The Level II reading section was utilized from the WRAT. The subject was required to pronounce seventy-four words which increased in level of difficulty. These two tests have been standardized for this age group.

The WRAT and SCSIT were administered on an individual basis. The Nelson-Denny test was administered on a group basis. The procedures outlined in the appropriate manuals were strictly followed for the administering and scoring of each test.

Procedures Used for Conducting Study

Pretesting was done within the first two weeks of the semester, and posttesting was done during the last week. Identical test instruments were used for both. The subjects participated in SI activities for approximately 50-minute sessions three times a week in a group situation, and 30-minute sessions twice a week on an individual basis.

The ten week SI program followed a three-level developmental sequence. The first level used primarily activities with the body in an apedal position, the second level positioned the body in quadrupedal position and the third level in a bipedal position. For purposes of programming, the time sequencing of the presentation of levels were spaced throughout the semester. However, the levels

had no time delineation; the students were free to continue at one level of activity until they had integrated the adaptive response for that level and were ready to move to the next level.

In Ayres' (1972) study with children, she suggested that the activities be child-directed, meaning that the child chose what piece of equipment he used as well which activity was done. The rationale was that the child was best able to determine to what level his nervous system had developed. He knew intuitively what types of activities he was ready to try and those that should not be attempted until later. The program sequencing for this study followed Ayres' suggestion and the students were allowed to choose both the equipment and the activity.

Beginning with the apedal level, the body was positioned close to the earth. The activities involved using the body as a whole or using arms and legs as bilateral units. The manner in which the activities were performed was designed to promote interhemispheral integration (Ayres, 1972). The types of activities included rolling a mat, lying on a scooter board and pushing off from the wall using both feet or both hands, relay races with scooter boards, and riding down the ramp on a scooter board. The student rode down the ramp in various positions: prone, supine, head or feet first. Also utilized were several sizes of pillow shaped

inflatables. The student would lie on the inflatable and vigorously or gently rock back and forth, challenge one another to see how close they could come to touching the floor without falling off, or gently push the inflatable of a fellow student to challenge the other's equilibrium. In addition, the students used the equilibrium boards in prone or supine position to rock back and forth at different speeds. Hopscotch was also used at the apedal level as a bilateral activity for the lower extremeties. The students used their body as a whole to jump over regular, irregular, and diagonal intervals.

The scooter board and ramp activities involved stimulating the vestibular system through the acceleration and deceleration in the horizontal position. The inflatables and equilibrium boards encouraged the development of adaptive responses and postural adjustments to prevent falling and to maintain the rocking motion. The hopscotch used quick acceleration and deceleration stimulation to the vestibular system in a vertical position, promoted use of extremities bilaterally, required postural adjustments and stimulated the postural proprioceptors.

The second or quadrupedal level included both the all four's and sitting postures. It was introduced approximately one third of the way through the semester. Most of the students had integrated the adaptive response needed for

the apedal level and were ready to try the activities which placed the body in a quadrupedal posture. Students who had not integrated these adaptive responses were made aware of the activities for this next level.

Activities for quadrupedal position used the same equipment as the apedal; however, at this level the students were asked to assume the all four's or crawling position. In this position, the students got on the scooter board and rode down the ramp. Later, variations of this were used as the students integrated the adaptive response needed. The variations included throwing a bean bag into a box, going through a tunnel, going down backwards, and extending one arm and the opposite leg while maintaining balance on the scooter board. Throwing a bean bag also required eye-hand coordination; going through the tunnel required a sense of body position in space as well as motor planning ability to proceed through the tunnel without hitting it. When going down the ramp backwards the student was required to rotate his head in order to see where he was going. Extending his one arm and the opposite leg in the all four's position produced a unique opportunity to promote mature equilibrium reactions in order to prevent falling from the scooter board.

Other equipment repeatedly used for the quadrupedal level were the equilibrium boards and inflatables. Initially the student would attempt to balance on all four's on the

equipment. To add to the adaptive responses required, two students would bounce a balloon (bilaterally) back and forth while poised on the inflatable, or throw objects into a basket while rocking at various speeds. These activities elicited postural responses and equilibrium reactions in order to maintain balance.

Activities using a sitting position were also introduced during the second level. Sitting required more postural adjustments than an apedal position but maintained the body close to the earth. Students sat and rode the scooter board down the ramp or sat on an inflatable or equilibrium boards while engaged in the bilateral hand or feet activities as mentioned previously (i.e. hitting balloons, or balls). The postural and equilibrium reactions required in the seated position differed from the horizontal position on the inflatable and on equilibrium boards while rocking. In addition to encouraging postural adjustments, many activities designed to encourage eye-hand coordination and bilateral movements were introduced at this level. While the students were sitting or lying on the scooter boards, games such as scooter board basketball, volley ball and baseball were played. While the students were on the scooter boards they would use both hands and/or feet to propel themselves around the room in efforts to retrieve the ball/balloon and make a point for their team.

The third level, bipedal activities was introduced approximately two thirds of the way through the semester. The activities for this level positioned the body either in kneeling or standing. For this level, additional challenge to the equilibrium system as well as motor planning were provided. Some of the bipedal activities were walking on stilts, stilt races, standing or kneeling on equilibrium boards while vigorously rocking and at the same time catching a ball. In a related activity two or three students would stand and rock on the equilibrium board at the same time which required increased amount of equilibrium reactions in efforts not to be knocked off the board. An additional activity done while kneeling was riding the scooter board own the ramp facing forwards or backwards. The kneeling and standing activities required maturation of equilibrium and postural adjustments, while other activities were superimposed on the adjustment.

A "T" stool was also introduced at the third level. It was used at this level because of the refined postural adjustments needed to maintain balance while seated on it. While on the "T" stool the student would kick or catch a ball thrown to him. Catching required fewer postural adjustments because both feet remained on the floor to maintain the balance. Kicking a ball required more postural adjustments as the weight of the body is shifted from a

three point to a two point base of support (one foot and the leg of the stool) in order for the other foot to be free to kick the ball.

It was of interest to note that the latter portion of the semester was to be spent on bipedal activities. Although some of the suggested bipedal activities were used, many students preferred to remain using the apedal and quadrupedal position in their activities. Two factors could be suggested for this occurence: 1) sufficient neurological reorganization had not occurred to allow the required adaptive postural reaction to be made in the bipedal positioned activities, or 2) the leaders of the class were still using activities requiring the quadrupedal position; consequently the other students followed the leaders.

CHAPTER IV

ANALYSIS OF DATA

At the beginning of the semester, the course OT 1223, Developmental Skills, was comprised of thirteen young women from freshman to senior level. One student did not attend class after the third week. The results were based on the remaining twelve students who participated in the entire study.

For the Southern California Sensory Integration Tests, normative data has been accumulated over a three year period by the testing of college level students at the Texas Woman's University (Currie, 1976). The means and standard deviations derived from these data were used to analyze the test results of the present study. As a comparison, the means and standard deviations were also obtained from the scores from the present group. The norms on the WRAT and Nelson-Denny were obtained from the testing manuals. Likewise a comparison was made with the data of the group studied.

After the data had been collected, the *t*-test for related measures (Bruning, 1968) was used to determine whether significant improvement was noted at both the five

and one percent level for all six tests administered. The t-test score value for the visual perceptual tests (figure-ground, position in space, and space visualization) and Nelson-Denny vocabulary was determined to be non-significant at both the five and one percent level. However, the Nelson-Denny comprehension and WRAT t-socre values were significant at both the five and one percent levels.

Table 1 shows the mean for the total group and the standard error of the mean for each of the six tests that were administered. The table also shows the calculated t values on each of the six tests with the significance indicated.

TABLE 1

SUMMARY OF TEST RESULTS

Administered	Pretest $\bar{X}$	Pretest SE	Posttest $\bar{X}$	Posttest SE	t test value	
Figure-ground	32	1.4	33	1.3	1.0	NS
Position in Space	22	1.0	24	0.7	1.9	NS
Space Visual-ization	22	1.3	24	2.1	2.0	NS
Nelson-Denny Vocabulary	26	2.9	28	3.0	1.1	NS
Nelson-Denny Comprehension	28	2.9	35	3.3	3.9	.01
WRAT: reading	42	3.3	47	2.8	3.1	.01

Table 2, page 23, represents the comparison of the mean and standard deviation for the normative population as well as the posttest mean and standard deviation of the tested population. The normative visual perceptual test data were derived from the previous studies on college level students (Currie, 1976). The normative data on Nelson-Denny and WRAT was published in the test manual. In the comparison of posttest standard deviation scores of the test subjects with the normative data on the visual perceptual tests, the subjects' scores were within normal limits. The standard deviation socres on the reading tests, showed the test subjects more restricted.

While table 2 showed the combined mean scores and standard deviation of the entire group, the following three tables represent pre- and posttest scores for the individual subjects on each perceptual test. All standard scores for visual perceptual tests are based on norms established by Currie (1976).

Table 3, page 24 shows the test for figure-ground. For this test forty-eight points are possible. Scores for the pre- and posttest are given. Of the twelve students, six, (50%) showed improvement in both raw scores and standard deviation scores. The subjects are identified by the letters A, C, D, F, G, H. Two of the six subjects (F, H) improved one or more standard deviation scores. Six of the

TABLE 2

COMPARISON OF MEAN AND STANDARD DEVIATION OF NORMATIVE AND TEST SUBJECTS (POSTTEST SCORES)

Tests	Mean		Standard Deviation		SD Difference between Normal and Test Subjects
	Norm	Test Subjects	Norm	Test Subjects	
Figure-ground	36	33.6	5.00	5.43	0.43
Position in space	24	24.3	3.00	2.55	0.45
Space visual-ization	25	24.7	2.00	3.00	1.00
Nelson-Denny vocabulary	38	28.3	15.54	10.60	4.96
Nelson-Denny comprehension	41	35.5	13.94	12.81	1.13
WRAT	58	47.5	13.79	10.02	3.77

TABLE 3

COMPARISON OF PRE- AND POSTTEST SCORES OF INDIVIDUAL SUBJECTS FOR FIGURE-GROUND

Subjects	Raw Score		Standard Score		Change in Standard Score
	Pre	Post	Pre	Post	
	($\bar{x}$ = 36, s = 5)				
A	32	41	-0.8	+1.0	0.2
B	27	24	-1.8	-2.4	*0.6
C	43	44	+1.4	+1.6	0.2
D	31	32	-1.0	-0.3	0.7
E	27	25	-1.8	-2.2	*0.4
F	28	34	-1.6	-0.4	1.2
G	35	38	-0.2	+0.4	0.6
H	30	35	-1.2	-0.2	1.0
I	40	39	+0.8	+0.6	*0.2
J	33	31	-0.6	-1.0	*0.4
K	35	33	-0.2	-0.6	*0.4
L	28	28	-1.6	-1.6	NC

*Indicates decrease in score.

total students who decreased in score, did not decrease more than one standard deviation. Although six of the students failed to show improvement, the difference in the scores was less than one standard deviation. Looking at the pretest

scores, five of the twelve (subjects B, E, F, H, L) were more than one standard below normal. However, on the post-test scores, two of the subjects (F, H) had improved to within normal limits.

TABLE 4

COMPARISON OF PRE- AND POSTTEST SCORES OF INDIVIDUAL SUBJECTS FOR POSITION IN SPACE

Subjects	Raw Score		Standard Score		Change in Standard Deviation Noted
	Pre	Post	Pre	Post	
	($\bar{x}$ = 24, s = 3)				
A	22	27	-0.6	+1.0	1.6
B	16	20	-2.6	-1.3	1.3
C	27	28	+0.6	+1.3	0.7
D	24	21	-0.3	-1.0	*0.7
E	21	23	-1.0	-0.3	0.7
F	25	25	+0.3	+0.3	NC
G	26	27	+0.6	+1.0	0.4
H	25	23	+0.3	-0.3	*1.0
I	20	26	-1.3	+0.6	1.9
J	23	21	-0.3	-1.0	*0.7
K	22	26	-0.6	+0.6	1.0
L	16	25	-2.6	+0.3	2.9

*Indicates decrease in score.

Table 4 shows the scores derived from the Position in Space test. The total possible points is 30. Of the twelve students, eight (66%), improved in the test of Position in Space. These subjects are identified as A, B, C, E, G, I, K, L. One student (subject L), improved above two standard deviations. Four students (subjects A, B, I, K) improved more than one standard deviation. Three other students (subjects C, E, G) improved by at least 0.3 standard deviation. The remaining three students (D, H, J) who decreased in score, remained within normal limits. One student made no change in pretest and posttest score. Looking at the pretest scores, four of the twelve subjects (B, E, I, L) were one standard deviation or more below the mean. However, on the posttest scores, three of these subjects (E, I, L) improved to within normal limits.

Table 5, page 27, represents the scores derived from the Space Visualization test. The total possible points is 30. Of the twelve students, seven (58%) of the total group improved in the test for space visualization. The subjects were identified by the letters A, B, C, E, F, I, L. One student (A) improved seven standard deviations, two students (I, L) improved two standard deviations or more, and the other four students improved by at least one standard deviation. Two students (D, G) showed no change in score. Looking at the pretest scores, four students (A, B, I, L)

were more than one standard deviation below the mean. On the posttest scores, three of these students (A, I, L) improved to within normal limits.

TABLE 5

COMPARISON OF PRE- AND POSTTEST SCORES OF INDIVIDUAL SUBJECTS FOR SPACE VISUALIZATION

Subjects	Raw Score		Standard Score		Change in Standard Deviation Noted
	Pre	Post	Pre	Post	
A	13	27	-6.0	+1.0	7.0
B	13	16	-6.0	-4.5	1.5
C	25	28	0.0	+1.5	1.5
D	25	25	0.0	0.0	NC
E	23	25	-1.0	0.0	1.0
F	24	27	-0.5	+1.0	1.5
G	27	27	+1.0	+1.0	NC
H	24	23	-0.5	-1.0	*0.5
I	21	26	-2.0	+0.5	2.5
J	26	24	+0.5	-0.5	*1.0
K	26	25	+0.5	0.0	*0.5
L	20	24	-2.5	-0.5	2.0

*Indicates decrease in score.

Table 6, page 28, represents a comparison between each subject and the three visual perceptual tests. Two

TABLE 6

COMPARISON OF VISUAL PERCEPTUAL TESTS IMPROVEMENT
NOTED BETWEEN PRE AND POSTTEST SCORES

Subjects	Figure-ground		Position in Space		Space Visualization		Areas of Improvement
	Difference in:		Difference in:		Difference in:		
	Raw Score	Standard Deviation	Raw Score	Standard Deviation	Raw Score	Standard Deviation	
A	9 pts.	0.2	5 pts.	1.6	14 pts.	7.0	FG, PS, SV
B	*3	*0.6	4	1.3	3	1.5	PS, SV
C	1	0.2	1	0.7	3	1.5	FG, PS, SV
D	1	0.7	*3	*0.7	NC	NC	FG
E	*2	*0.4	2	0.7	2	1.0	PS, SV
F	6	1.2	NC	NC	3	1.5	FG, SV
G	3	0.6	1	0.4	NC	NC	FG, PS
H	5	1.0	*2	*0.6	*1	*0.5	FG
I	*1	*0.2	6	1.9	5	2.5	PS, SV
J	*2	*0.4	*2	*0.7	*2	*1.0	
K	*2	*0.4	4	1.0	*1	*0.5	PS
L	NC	NC	9	2.9	4	2.0	PS, SV

*Indicates decrease in score.

FG = figure-ground, PS = position in space, SV = space visualization.

students (A, C) improved in all three areas of visual perceptual skills tested. Six students (B, E, F, G, I, L) improved in two areas, and three (D, H, K) improved in one area. Only one student (Subject J), scored lower in all three areas.

The following three tables represented pre- and posttest scores for each individual on each of the reading tests; Nelson-Denny vocabulary, Nelson-Denny comprehension, and WRAT. The published norms were used to convert each students raw score into a grade equivalent score given as grade levels and number of months within each grade level.

Table 7 represents data on the Nelson-Denny vocabulary test. The grade equivalent score for the pretest ranged from eighth grade fifth month to above the fourteenth grade. Posttest scores ranged from ninth grade fourth month to above the fourteenth grade. Seven (58%) of the students (A, C, D, F, G, H, I, L) improved in the Nelson-Denny vocabulary portion of the reading test. Two students (A, F) improved more than two grade equivalents, two students (H, L) improved by at least one grade equivalent, two students (D, I) improved by at least four months. It was also noted that on the pretest scores seven on the twelve students (A, B, D, E, F, J, L) were below the twelfth grade level but on the posttest scores only five (B, D, E, U, L) were below twelfth grade.

TABLE 7

COMPARISON OF PRE- AND POSTTEST SCORES FOR NELSON-DENNY VOCABULARY

Subjects	Raw Scores		Grade Equivalent		Change in Grade Noted
	Pre	Post	Pre	Post	
					Yrs., Mo.
A	21	33	10.4	12.9	2.5
B	13	10	8.5	7.9	*0.4
C	33	34	12.9	13.0	0.3
D	15	17	9.0	9.4	0.4
E	25	23	11.6	11.0	*0.6
F	20	27	10.1	12.2	2.1
G	50	52	14.0	14.0	NC
H	29	38	12.4	13.5	1.1
I	32	35	12.7	13.1	0.4
J	24	23	11.3	11.0	*0.3
K	33	28	12.9	12.3	0.6
L	14	20	8.8	10.1	1.3

*Indicates decrease in score.

Table 8 represents data from the Nelson-Denny comprehension test. The grade equivalent scores for the pretest ranged from ninth grade to thirteenth grade one month and the posttest scores ranged from seventh grade to

TABLE 8

COMPARISON OF PRE- AND POSTTEST SCORES
FOR NELSON-DENNY COMPREHENSION

Subjects	Raw Scores		Grade Equivalent		Change in Grade Noted
	Pre	Post	Pre	Post	
A	22	30	8.4	10.2	1.2
B	8	14	below 7.0	below 7.0	NC
C	36	54	11.9	13.0	1.3
D	16	18	7.0	7.5	0.5
E	22	32	8.4	10.7	2.3
F	26	34	9.3	11.1	1.1
G	42	58	13.1	above 13.8	0.7
H	40	44	12.7	13.5	0.1
I	30	44	10.2	13.5	3.3
J	30	34	10.2	11.1	0.1
K	42	38	13.1	12.4	*0.9
L	24	26	8.9	9.3	0.6

*Indicates decrease in score.

above thirteenth grade eight months. Eleven students (91%) (A, B, C, D, E, F, G, H, I, J, K), improved on the Nelson-Denny comprehension test. Of these eleven, one student (B) improved only in raw score but the grade equivalent score did not change. One student (I) improved more than three years,

one student (E) improved more than two years, three students (A, C, F) improved more than one year, four students (G, H, J, L) improved more than six months, and one student improved by five months. Looking at the pretest scores, nine students (A, B, C, D, E, F, I, J, L) were below the twelfth grade; on the posttest scores, seven students (A, B, D, E, F, J, L) remained below twelfth grade.

Table 9 represents the reading score for the WRAT. The grade equivalent scores for the pretest ranged from second grade fourth month to eleventh grade sixth month. The posttest scores ranged from third grade second month to tenth grade eighth month. Ten students (83%) improved in the WRAT reading test. Two students (F, L) improved by at least two years, four students (A, B, D, E) improved more than one year, four students (C, G, I, J) improved by at least six months. All students were below twelfth grade on pre- and posttest scores. One explanation for the low scores is that eight (66%) of the students were of a minority ethnic group. The cultural differences may account for the low scores on the WRAT reading test which consisted of the pronounciation of words.

Table 10, page 34, represents the percentile rank of the pre- and post reading tests. In the Nelson-Denny vocabulary, two students (G, H) ranked above the fiftieth percentile on the posttest scores, and five students

TABLE 9

COMPARISON OF PRE- AND POSTTEST SCORES FOR WRAT

Subjects	Raw Scores		Grade Equivalent		Change in Grade Noted
	Pre	Post	Pre	Post	
A	54	58	9.1	10.2	1.1
B	22	25	2.4	3.2	1.2
C	52	55	8.7	9.3	0.8
D	37	48	6.0	7.9	1.9
E	34	38	5.4	6.2	1.2
F	31	47	4.8	7.7	2.1
G	48	50	7.9	8.3	0.6
H	62	60	11.6	10.8	*0.1
I	55	58	9.3	10.2	0.1
J	31	35	4.8	5.6	0.8
K	47	46	7.7	7.5	*0.2
L	40	51	6.5	8.5	2.0

*Indicates decrease in score.

(A, C, F, I, K) ranked above the twenty-fifth percentile. On the Nelson-Denny comprehension test, two students (C,G) ranked above the fiftieth percentile and six students (E, F, H, I, J, K) ranked above the twenty-fifth percentile. On the WRAT, three students (A, H, I) ranked above the

TABLE 10

COMPARISON OF PERCENTILE RANK FOR READING TESTS

Subjects	Nelson-Denny Vocabulary			Nelson-Denny Comprehension			WRAT		
	Pre	Post	Difference	Pre	Post	Difference	Pre	Post	Difference
A	14	40	26	28	23	- 5	39	53	14
B	5	3	- 2	1	5	4	1	1	NC
C	40	42	2	37	50	13	34	42	8
D	7	9	2	5	6	1	10	25	15
E	20	17	- 3	10	28	18	7	12	5
F	13	25	12	16	32	16	5	23	18
G	81	84	3	53	54	1	25	27	2
H	30	53	23	48	38	-10	70	61	- 9
I	37	45	8	23	38	15	42	53	11
J	19	17	- 2	23	32	9	5	8	3
K	40	27	-13	53	42	-11	23	21	- 2
L	5	13	8	13	14	1	13	32	19

fiftieth percentile and four students (C, D, G, L) ranked above the twenty-fifth percentile. On the Nelson-Denny vocabulary, all but four students (B, E, J, I) increased in their percentile rank. On Nelson-Denny comprehension, and WRAT all but two students (H, K) improved in percentile rank.

Table 11, page 36, represents a comparison of students in each of the areas of perception and reading which were tested. Two students (A, C) increased in all six areas tested. Five students (D, F, G, I, L) increased in five areas, two students (B, E) in four areas, one student (H) in three areas, one student (J) in two areas, and one student (K) increased in one area.

TABLE 11

COMPARISON BETWEEN VISUAL PERCEPTUAL TESTS AND READING TESTS

Tests	Subjects											
	A	B	C	D	E	F	G	H	I	J	K	L
Figure-ground	+	-	+	+	-	+	+	+	-	-	-	0
Position in space	+	+	+	-	+	0	+	-	+	-	+	+
Space visualization	+	+	+	+	+	+	0	-	+	-	-	+
N-D vocabulary	+	-	+	+	-	+	+	+	+	-	-	+
N-D comprehension	+	+	+	+	+	+	+	+	+	+	-	+
WRAT	+	+	+	+	+	+	+	-	+	+	-	+

+ = increase, 0 = no change, - = decrease.

CHAPTER V

DISCUSSION OF RESULTS

The study indicated that a group of low achieving college students made significant gains in reading and comprehension skills after their involvement in a program of sensory integrative activities. The study then supported the statement of the hypothesis concerning reading skills, that after a program in SI activities reading skills would improve. It was of importance that such changes were made in only fourteen weeks of the semester without concentrated effort placed on reading skills.

The second part of the hypothesis stated that there would be improvement in visual perceptual skills. Analysis of data showed that individual changes were documented; however, those changes did not prove to be statistically significant. There were several factors which could be taken into consideration to explain this: 1) the pre- and posttest scores; 2) the tests themselves; and 3) the motivational factor among the test subjects. By analysis of the data, the pre- and posttest mean scores (refer to table 2) obtained from the test subjects on the visual perceptual tests were closer to the normative mean than were the scores

on the reading tests as compared with the published mean. Improvement, therefore, may not have been as significant because of the nearness of their scores to the norms.

The second factor relates to the fact that the visual perceptual tests used for this study were originally designed to test four through ten year olds. The mean age of the students tested was 19.8 years.

Table 12 compared the mean scores from three separate studies which used Figure-ground, Position in Space and Space Visualization tests. One difference was made with relation to the scoring. In the Ayres manual, each test was discontinued after five cumulative errors. In both college level groups each student completed each test regardless of errors made. On the Figure-ground and Position in Space tests, improvement in ability as noted by the mean scores increased with age. However, in the Space Visualization test, ability remained the same. The evidence indicated that there was no change in ability between the age of ten year olds through college age as noted in the mean score.

A third factor and perhaps the one with the most influence to the study was that of motivation. The motivational level of these students appeared to be variable throughout the study. The students were told at the beginning of the course how they would be graded in the course and its effect on their continuation in the OT

TABLE 12

COMPARISON OF MEAN SCORES

Tests	10.6-10.11 yrs. (Ayres)	College Age (Currie)	Test Subject (Angelo)
Figure-ground	19	36	33
Position in space	20	24	24
Space visualization	24	25	24

curriculum. Although no objective measure was utilized to measure motivation, subjective observations, such as verbal responses, body language and attendance of the students, were made throughout the study and were indicators of the motivational factor. The clincian and an observer rated the students separately and noted similar ranking of the students. The group was subjectively divided into two groups. On the basis of the indicators one group was considered well motivated and the other group poorly motivated.

Table 13, page 40, presents the subjects as divided into the well and poorly motivated groups. The term "increase," as used in this chart, was designated as any amount of increase in the posttest scores. In the well

TABLE 13

COMPARISON OF MOTIVATION AND STUDENTS' TEST PERFORMANCE

	Subjects											
	Well Motivated						Poorly Motivated					
Tests	A	I	K	C	H	B	G	L	J	E	D	F
Figure-ground	+	-	-	+	+	-	+	0	-	-	+	+
Position in space	+	+	+	+	-	+	+	+	-	+	-	0
Space visualization	+	+	-	+	-	+	0	+	-	+	+	+
N-D vocabulary	+	+	-	+	+	-	+	+	-	-	+	+
N-D comprehension	+	+	-	+	+	+	+	+	+	+	+	+
WRAT	+	+	-	+	+	+	+	+	+	+	+	+

+ = increase, 0 = no change, - = decrease.

motivated group, two students (A, C) improved in six areas whereas in the poorly motivated group four (G, L, D, F) improved in five areas. Motivation therefore did not play as significant a role in the results of improvement in the posttest scores as was expected.

In addition with the consideration of the motivational level, there were two individuals of particular interest. The first individual (subject K) showed lower posttest scores in five areas but was placed in the highly motivated group. It was felt that half way through the semester, the student had a recurrence of a psychological problem which then affected the posttest scores and did not accurately judge this individual's ability. The second student (subject A) had been previously identified in a media course as having a problem in perceptual motor performance. She was then tested and it was affirmed that a perceptual motor problem did exist. She participated enthusiastically and consistently throughout the semester, and showed improvement in all areas tested.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

The study of low achieving college age students was undertaken to assess the application of using a sensory integrative approach to assist such students in reading ability as an aid to improving academic performance. The results indicated that reading was significantly improved after the students had participated in a program of SI activities. When test results were obtained, further support of Ayres' (1974) earlier research was given to the proportional relationship between academic skills and sensory integration. In this study the same relationship was indicated as occurring in the college level students as well as the previously defined age level of four through ten year olds. In visual perceptual tests, pretest scores showed less severe deficits and progress was not significant.

The results of this study also indicated a significance for the OT clinician with a client population of older adolescents who have been identified as having visual perceptual problems and/or academic difficulty. These clients, above ten years of age, identified as having difficulty in academics due to a SI disorder could still benefit from a

treatment program using SI as the frame of reference. This study supported the SI approach being appropriate for the older adolescent population.

The results indicate a need for further research in the area of SI in relation to improving the academic performance in the older child. The test results suggest the following to be taken into consideration for further research: 1) increase the length of the study, to determine if there would be significant gains in visual perceptual ability and if the overall reading improvement would be increased over a longer time period; 2) monitor the effects that motivation had on the subjects involved in the study, by using an objective test which measures motivational level; 3) increase the number of subjects in a study, in order to increase the validity of statistical significance that the study indicates; 4) develop a plan for long term follow up studies on the individual subjects in terms of grade point average, academic and career success; 5) a controlled study using Freshman students matched for experimental variables such as college entrance examination scores and reading levels.

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