WITHIN AND BETWEEN MODALITY MEMORY FUNCTIONS IN GOOD AND POOR READERS

A Thesis Written in Partial Fulfillment
of the Requirements for the Degree of
Master of Arts

Audrey V. Keddy Power
Saint Mary's University
School of Education
April 1974

TABLE OF CONTENTS

ABSTRACT

Average and retarded readers were compared on their abilities to store and transfer information within and between auditory and visual channels. A two stage transfer paradigm was utilized in which initially stored information was retested in an opposite channel.

Retarded readers were inferior to average readers in auditory memory but performed at the same level under visual conditions. Retarded readers transferred from auditory to visual channels with equal facility as average readers thereby demonstrating no faulty cross modal transference. Retarded readers, however, did not demonstrate such transfer success from visual to auditory and although average readers were superior under such conditions they also revealed similar transfer problems. These findings tended to confirm theories of auditory and visual memory deficiencies and at the same time undercut theories proposing faulty intermodal mechanisms in retarded readers.

ACKNOWLEDGEMENTS

The writer wishes to thank Dr. Fred. Dockrill for his advice throughout the planning and writing of this thesis.

Gratitude is also expressed to the principals, teachers and students in Halifax City for their cooperation in this research.

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Defective reading or developmental dyslexia is a term applied to a situation in which a "child is unable to learn to read with proper facility despite normal intelligence, intact senses, proper instruction, and normal motivation (Eisenberg, 1962, p.4)". Wagner (1971), applies the term "dyslexia" to a child with disturbed functioning of the symbolic and perceptual mechanisms and such disorders being manifested in poor reading. This form of reading disability differs from post-traumatic (or acquired) dyslexia in which the disability is usually attributed to neural damage of the left cerebral hemisphere (Benton, 1962). Although developmental dyslexia is not considered to result from emotional disturbances, aberrant emotional patterns consequent to the disability confound the symptomatology. Further, the disorder is very seldom limited to reading disability; also manifest, with considerable variation from child to child, are various inattention phenomena, left-right confusion, mixed hand-eye preferences, and non-specific motor awkwardness (Rabinovitch, 1959).

Dyslexic children do not master language symbols, and they do not perceive left to right and top to bottom. Some dyslexics cannot handle the processes involved in translating spoken language into written symbol forms, often referred to as "encoding". This means that such children cannot put what they hear into an accurate written code. Other dyslexics have difficulty translating symbols into meaning. Thus they are unable to "decode" what they see in printed form. Still others cannot express themselves in writing because they cannot remember how to make specific letter forms correctly. These students are unable to control directionality of written symbols, which results in unacceptable handwriting. These forms of disability are complicated by the tendency to perceive symbols backward, upside down, and in scrambled sequence. Two or more kinds of this perceptual loss usually exist in dyslexic children.

The most prevalent form of dyslexic handicap is that of visual dyslexia. This is basically the inability to translate printed language symbols into meaning. Visual dyslexia is not a matter of seeing poorly; it is a matter of not interpreting accurately what is seen.

Most visual dyslexics see certain letters backward and upside down. To read whole words in the context of a sentence is a jumbled process for such a child. Not only does he perceive individual letters incorrectly, but he also sees parts of words in reverse. When these faults are at work during reading tasks, the child has a disorganized, meaningless, and frustrating experience.

Visual dyslexics are generally handicapped in any situation which requires them to comprehend sequence. Some pupils cannot remember the order of the months of the year, days of the week, or even the day, month, and year of their birth.

Auditory dyslexia has little to do with hearing acuity. Most auditory dyslexics have normal hearing, so far as can be determined by audiometer tests. Because the dyslexic cannot identify some differences between vowel sounds or consonant sounds, he is unable to associate specific sounds with their printed symbols. Traditional phonics instruction is almost meaningless to most auditory dyslexics. They simply cannot identify the discrete variations of speech sounds, nor do the rules and generalizations make sense (Clarke, 1973; Thompson, 1966; Vernon, 1971).

A wide variety of correlated specific cognitive disabilities have been discussed with regard to the gross syndrome of dyslexia - the implication being that these are in some sense causative in the production of the reading disturbance (Bateman, 1965). In this connection there has been some mention of memory functions in the retarded reader and of Charcot's hypothesis that there are "audile" and "visile" ideational types (Money, 1962). Conflicting views have been presented as to whether the dyslexic's fundamental memory weakness is in the auditory or the visual modality, i.e., is the dyslexic a non-audile or non-visile cognitional type. For example, Money (1962) states:

> It is quite conceivable that the dyslexic is a person . . . who is in some manner a non-visile cognitional type. He is perhaps a person weak in visual imagery and visual memory of all types (p. 27).

Bannantyne (1966) offers the opposing point of view:

> The fundamental neuropsychological deficit is the inability to sequence correctly . . . the sequencing problem is essentially an auditory one and any deficit in lateralized visual or ocular motor sequencing is secondary to the auditory one . . . language is almost entirely an auditory sequencing process and a specific language disability could be redefined as a specific auditory sequencing disability (p. 198).

A clarification by Fries (1962) of what is involved in the reading process illustrates the tenability of both these positions and in addition points to a third theoretical possibility. He postulates that the first stage in learning to read is a transfer stage in which the child is learning to transfer the already learned signals of language to a set of visual signs. Having learned to talk, the child already has skill in recognizing the contrasting pattern of sound features that represent the language. For similar language reception through reading, the child needs to develop (with much less practice) a new skill in making high speed recognition responses to the graphic patterns that represent the same language. One can interpret Fries' statement in terms of associational or sequencing processes. In learning to talk, the child has leared to recognize strings of auditory - auditory associations. Not only can he reconize these associations but he can produce them himself when he talks. In order to learn to read the child must learn to make high speed recognition responses to strings of visual - visual associations. This process is accomplished in the transfer stage which involves forming associations between the already learned auditory signs for language signals and the visual signs for the same signals, i.e., the child must form auditory - visual associations. His concept of reading development is further corroborated by Hirsch's (1968) explanation of reading development:

> Learning to read requires the formation of new associations between the printed letter and the sound it represents. The child is asked to respond in an organized way to visual signs. In order to read a little word like "mat" a sequence of sounds heard - a sequence in time - has to be translated into a sequence of letters seen - a sequence in space. A visual image has to be correlated with oral language (p. 98).

Within this framework it becomes clear how a fundamental deficit in either auditory or visual sequencing processes could impede the development of the reading skill. Furthermore, the mechanism facilitating the transfer of sensory information from sound to sight draws attention to a third possibility, that a child who does not learn to read may have difficulty forming auditory - visual associations. Birch (1962) has been a major proponent of a theory stressing this latter possibility. He postulates that some individuals with reading problems are disabled because they have nervous systems in which the development of equivalence between sensory systems is impaired. By sensory equivalence, it is meant that auditory and visual information are responded to in the same way although coded differently within the nervous system. He would expect, therefore, that impairment of audio-visual equivalence would be found to occur more frequently in retarded readers since one of the characteristics necessary for reading skill is the development of the ability to make judgments of auditory visual equivalence.

Research findings concerning the efficiency of auditory and visual learning in good and poor readers have been contradictory. Budoff and Quindland (1964) presented pairs of three or four letter words to grade one children to be learned in both modalities. The aural learning of both groups of good and poor readers was superior to their visual learning. The retarded readers learned more rapidly in the auditory modality and slightly more poorly in the visual modality than did the average group. Raab, Deutsch, and Freedman (1960) also found that the advantage of recall following auditory presentation was more pronounced for fifth grade retarded readers than for normal children. Strasberg (1967) found that good and poor readers (Grade 4) did not differ in their ability to learn aurally six pairs of monosyllabic words in a paired associate paradigm.

In contrast to the above findings are those furnished by two other groups of investigators. Katz and Deutsch (1964) presented monosyllabic nouns aurally and black and white drawings in a serial learning paradigm to first, third, and fifth grade negro retarded and average readers. All Ss found auditory presentation more difficult to remember than they did visual presentation. Retarded readers remembered almost as rapidly as average readers in the visual modality but had significantly more difficulty with auditory stimuli. Johnson and Myklebust (1962) studied 60 dyslexic children, ages 8 to 18. Auditory memory of these children as measured by several standardized tests was found to be considerably more impaired than was their visual memory. This latter function approached the normal range of scores.

With regard to the question of the ability to form auditory - visual associations in poor readers, several studies have shown that retarded readers cannot integrate or associate auditory and visual information as well as good readers can (Berry, 1967; Birch & Belmont, 1964, 1965; Carson, 1971; Katz & Deutsch, 1963; Muehl & Kremenak, 1966; Raab & Deutsch, 1964; Raymond, 1955; Rudnick, Sterrit & Flax, 1967; Sterrit & Rudnick, 1966).

Most of these studies which employed an intersensory task investigated the ability of poor readers to transpose information from the auditory to the visual modality.

Two of the studies, however, (Beery, 1967; Muehl & Kremenak, 1966), demonstrated that retarded readers were, in addition, not as capable as good readers of transferring information in the reverse direction, i.e., from the visual to the auditory modality. Some studies, however, found no impairment in auditory-visual integration with older children both when Ss were matched for I.Q. (Ford, 1967) or even when I.Q. was not held constant (Birch & Belmont, 1965). In contrast, one group of experimenters (Rudnick et al., 1967) showed that reading correlated more highly with an auditory - visual transfer task in older Ss as compared to younger ones.

Thus the research findings to date on the processes of auditory memory, visual memory and auditory - visual integration in retarded readers are not clear-cut. None of the above studies have investigated all of these processes in the same subject, nor have they attempted to use tasks which closely stimulate the associational processes which must be acquired in learning to read.

The present study will attempt to investigate the sensory memory mechanisms in dyslexic children. Such mechanisms as auditory recall, visual recall and auditory - visual integration will be studied. These learning tasks closely parallel those required in developing adequate reading skills. Two, two-stage transfer tasks will be employed. In stage 1 of task A, the children will be required to learn to recall a list of paired associates presented aurally. This task parallels the auditory-auditory associations a child must acquire in learning to talk. In stage 1 of task B, a list of paired associates will be presented visually and the Ss will be required to learn to recognize the response associated with each stimulus from among four alternatives. This task simulates the high speed recognition of visual-visual associations, a skill which must be mastered in learning to read. Thus the first stage of each task is a measure of memory functions within a modality essential for reading, i.e., auditory recall and visual recognition. Stage 2 of both task A and B will be designed to investigate the ability to transfer information between the two modalities. In this stage of task A, the Ss will be presented with the first member of each pair, recalled aurally in stage 1 and now required to recognize in the visual modality the paired member among several alternatives. If the child is able to recognize these auditory-visual associations, then one can infer that the necessary auditory-visual associations between auditory signs for language signals and the visual signals for the same language has been formed and that transfer from the auditory to visual modality has taken place. The second stage of task B will be designed to investigate the analogous intersensory transfer process from the visual to the auditory modality. The children will be presented aurally with the first member of each pair that they had pre-learned visually by recognition procedures. Such a task would not directly parallel the processes involved in learning to read. However, in the same manner that one can infer the formation of the necessary auditory-visual association if stage 2 of task A is learned, one can infer the ability to form visual-auditory associations if this task is successfully carried out. This type of link may be less important in the early phases of learning to read but may be crucial once the child attempts to read by himself, since he is then required to transfer back from a set of newly recognized visual signs to a set of well-known auditory signs for the same language signals. This is clearly illustrated in oral reading.

In summary, average and retarded readers will be compared in auditory and visual memory. The Ss will do this through auditory memory tasks and visual memory tasks as well as transfer from auditory to visual and from visual to auditory modalities.

CHAPTER 2

METHOD

Subjects

Forty-one, fifth and sixth grade children from four Halifax City Public Schools served as Ss. One S was subsequently dropped when he did not meet the criteria described in procedures. At the time of testing the Ss ranged in age from 10 years 2 months to 13 years 11 months. All children selected were from similar socioeconomic backgrounds (lower middle class) that is, the children were from parents of the working class which included skilled and semi-skilled workers and lived in similar houses in the same neighbourhood as members of the middle class families who held jobs in government, business, teaching, and social work. (Proshansky & Seidenberg, 1965). The Ss spoke English as their native language.

Apparatus

The visual stimuli were printed in 5/8 inch letters in black ink on 8 by 11 inch tag board. An example of a visual stimulus is presented in Appendix A. The training cards contained one stimulus response pair of consonant vowel consonant (CVC) trigrams. On the test card the stimulus CVC was clearly set aside by a dividing line from a list of CVC's containing the right response.

Oral presentation of the auditory stimuli was made on an R.C.A. 9 transistor cassette tape recorder Model YZB530E.

Procedure

Pretesting

All students were administered the following tests: WISC, Gates MacGinitie and the Wepman Test of Auditory Discrimination.

As I.Q. scores are known to correlate with reading ability (Muehl & Knemerah, 1966) and our concern was the aspect of reading ability beyond that attributable to intelligence, the two groups of readers were equated as closely as possible for I.Q. as measured by the WISC.

The WISC consists of twelve tests which are divided into two subgroups identified as Verbal and Performance. The WISC was standardized on a sample of 100 boys and 100 girls at each age from five through fifteen years. There are tables which show the interrelationships among the twelve tests of the WISC. The correlations of each test with the Verbal Score, Performance Score and Full Scale Score, and of these three composite scores with each other are also shown. The reliability varies from .92 to .95 and the validity from .54 to .93 according to age (Wechsler, 1949).

Buros (1972) states that the WISC is currently the best available compendium of iidividually administered, subject comparison techniques purporting to measure intelligence.

Reading ability was determined by the average of the three subtests on the Gates MacGinitie Reading Test (Gates, 1964).

The Gates MacGinitie Reading Test is a standardized test which is widely used for language arts skills. It analyzes three skills:

1. speed and accuracy
2. vocabulary
3. comprehension

It is a one hour group test. The reading score is the average of these three subtests. The reliability is +.89 and the validity is +.68 with minor variations from form to form (Gates & MacGinitie, 1965).

Buros (1972) states that the level manuals and the technical manual are quite complete, well organized, and easy to follow. The standardization appears to have been rather carefully done. The tryout sample and the norming group appear to have been quite adequate. As compared with other general reading tests, the Gates MacGinitie Reading Tests would provide usable data on achievement in comprehension, vocabulary and speed.

To control for difficulties in auditory discrimination, the Wepman Auditory Discrimination Test (Wepman, 1958) was administered to all subjects.

The Wepman Test of Auditory Discrimination is an easy to administer method of determining a child's ability to recognize the fine differences that exist between the phonemes (a unit of significant sound) used in English speech.

The task presented to the child is a simple one. It measures only the ability to hear accurately. The child is asked to listen to the examiner read pairs of words and to indicate whether the words read were the same (a simple word repeated - man pause man) or different (two different words - hat pause pat).

The test-retest administration showed a reliability of +.91 (N = 109). The difficulty of each phoneme on the two forms shows a Pearson rank order correlation of +.67 (N = 214). The correlation between auditory discrimination and intelligence is +.32 (Pearson product - moment) N = 145 (Wepman, 1958).

Buros (1965) states that for a quick inexpensive, easy to score, and accurate test of auditory discrimination, the Auditory Discrimination Test is highly recommended.

Pretraining

Even though the Wepman had been administered to screen out general impairments in discrimination, this proeedure did not prevent isolated discrimination errors which could inflate the difficulty of the learning task and possibly obscure the differences between groups. The pretraining was done to minimize pronunciation errors.

Each of the eight nonsense sounds employed in the auditory paired associates tasks was presented in a random order by means of a tape recorder. The S was instructed to repeat each sound after hearing it. The actual verbal instructions used are given in Appendix B.

Training was continued until two perfect trials were reached, that is, until he or she could repeat all eight sounds perfectly in two consecutive trials with no correction necessary.

Each of Tasks A and B consisted of four pairs of consonant, vowel, consonant (CVC) pronounceable trigrams (taken from the Archer (1960) list) with association value less than .35. Using trigrams of low associational value reduces the experimental advantage probably enjoyed by the better readers. Children who can read already have these basic reading associations and by using a lower association you are not giving an advantage to the better readers. The following constraints were imposed on the eight sounds used in each task to minimize intertask similarity.

1. the initial consonants differ
2. each vowel occurs with equal frequency
3. all six letters differ within any stimulus-response pair
4. the incorrect response alternatives employed in the visual recognition tasks are as similar as possible to the correct responses varying by only one letter. Furthermore, the position of the letter substituted differed among the three alternatives. In one, the initial letter was replaced, in the second, the middle letter varied, in the third, the final letter was substituted. This was an experimental control for children's position preferences. Position preferences refers to the serial position effect in which initial and final items are most easily learned (Deese & Hull, 1958). Randomization allows equal preference for each individual item.

Auditory and Visual Learning and Relearning

Task A, Stage 1: Auditory learning by recall. The four pairs of auditory stimulus sounds were presented through the tape recorder.

The first stimulus sound was given followed by a three second anticipation interval. The stimulus sound was repeated followed by the correct response. This procedure was repeated for the four pairs of stimuli which constituted one trial. The intertrial interval (ITI) was five seconds.

The task of the S was to give the correct verbal response during the anticipation interval. Shapiro (1966) points out that this proeedure is useful since the stimulus CVC never becomes confused with the response CVC.

A trial was considered to be complete when each of the four pairs had been presented once. The ITI was five seconds. Ss were tested to a criterion of two perfect trials, that is, until the S could repeat all four sounds perfectly in two consecutive trials. Testing was discontinued after 45 trials if this criterion had not been reached. A pilot investigation revealed that if a child reached 45 trials without success, any further development was nil. One S was dropped because he could not repeat all four sounds perfectly in two consecutive trials after 45 trials. Serial order effects were minimized by the use of three different randomly selected orders of the pairs. The stimuli and order of presentation are presented in Appendix C.

Task A, Stage 2: Visual relearning by recognition

Instructions with the same stimuli as in the previous stage were given. Tagboard cards were employed to present the visual stimuli. A stimulus CVC of a pair (same pairs as Stage 1) was exposed for two seconds on the right hand side of a card. At the top of the next card the stimulus CVC was presented and, below it, four alternatives were exposed, one of them being the correct response CVC.

This was followed by the visual stimulus and a presentation of the original paired stimulus to provide a corrective for subsequent trials. The S had to recognize the correct response CVC among the four alternatives by pointing. The interpair interval (IPI) was two seconds and the ITI was five seconds. A trial was considered complete when each of the four stimulus response pairs had been presented in this manner once. Ss were required to read to a criterion of two perfect trials. To minimize serial order effects, four different orders of the pairs in the list (randomly selected and other than those employed in the auditory task) were used. To rule out a possible position effect, the position of the correct response for any one stimulus was varied from order to order. A further restriction was that within an order the position of the correct responses was randomly varied, each occurring only once.

Task B, Stage 1: Visual learning by recognition.

The procedure was identical to that followed in Task A, Stage 2, the only variation being that in this task, stimulus response pairs which had not previously been presented aurally were employed and therefore Ss could not respond on the first trial. Ss were tested to a criterion of two perfect trials. Testing was discontinued after 45 trials if this criterion had not been reached.

Task B, Stage 2: Auditory relearning by recall.

Ss were given instructions that the words which were presented to them on cards in Task B, Stage 1 would be presented to them through the tape recorder. The stimulus CVC of each pair employed in Stage 1 was presented on tape followed by a three second anticipation interval. The Ss task was to give the correct response CVC. The stimulus was again repeated followed by the correct response CVC. This was intended as a corrective for succeeding trials. A trial was considered to be complete when each of the four stimulus response pairs had been presented once. The task was administered for 45 trials or until two perfect consecutive trials were completed - whichever came first. The ITI and IPI's used in Stage 1 of Task A were employed and serial order effects were minimized in the identical manner.

The procedure described above is presented in summary in Table 1.

TABLE 1

Summary of Procedure

Stage	Task	
	A	B
1.	auditory learning by recall of paired associates	visual learning by recognition of paired associates
2.	visual relearning by recognition of paired associates presented in Stage 1	auditory relearning by recall of paired associates presented in Stage 1

CHAPTER 3

RESULTS

Pretesting

The results of Ages, I.Q.'s, Reading levels and Wepman auditory discrimination scores are presented in Table 2. The mean ages were 11.2 for normal readers and 12.2 for retarded readers. A t-test disclosed no significant difference between these two age groups. The mean I.Q.'s for normal and retarded readers were 98.5 and 90.9 respectively with no significant difference existing. On the Wepman Auditory Discrimination test the normal readers scored a mean of .75 and the retarded readers a mean of 2.4 with no significant difference existing between those two groups as indicated on t-tests. On the Gates MacGinitie Reading tests the normal readers scored a mean grade level of 6.4 and the retarded readers scored 2.7. A t-test disclosed a significant difference between these two groups ($t = 2.8$, $df = 19$, $p < .01$).

See Appendix D and E for the raw data of the pretesting results.

Auditory and Visual Learning

The means for the trials to criterion are presented in

TABLE 2

Mean, Median, Range and Standard Deviation of Ages, I.Q.'s, Reading Levels and Wepman Scores of Normal and Retarded Readers

	Normal Readers	Retarded Readers
Age		
mean	11.2	12.2
median	11-1	12-2
range	10.6 - 12.6	10.2 - 13.11
standard deviation	.53	1.2
I.Q.		
mean	98.5	90.9
median	98.5	90
range	90 - 106	81 - 111
standard deviation	5.2	7.5
Reading		
mean	6.4	2.7
median	6.2	2.3
range	5.3 - 9.1	1.3 - 4.6
standard deviation	1.0	1.1
Wepman		
mean	.75	2.4
median	0	1.5
range	0-3	0-8
standard deviation	.10	2.1

Table 3. The raw data is in Appendix F. The data is arranged to indicate whether visual learning has an effect on subsequent learning of the same material through the auditory modality and whether auditory learning has an effect on subsequent learning of the same material through the visual modality for both normal and retarded readers.

The control groups were comprised of Ss who had not been exposed to the stimuli to be learned prior to initial learning in either the visual or auditory modality. The Experimental groups were comprised of Ss who had been exposed to learning in the auditory modality following initial visual learning and learning in the visual modality following initial auditory learning.

Two, two by two, independent factorial analyses of variance were carried out on both the auditory and visual learning tasks. One factor was reading level, with the two levels being normal and retarded readers. The other factor was condition of learning task, with the two levels being control and experimental as described above.

The results of the analysis on auditory learning are presented in Table 4. Both the main effects are significant and the interaction does not reach a level of statistical significance. Retarded readers take longer to learn the paired associate task in the auditory modality both when the task is and is not preceded by visual learning of the

TABLE 3

Mean Trials to Criterion for Auditory and Visual Learning

Auditory Learning		
	Control	Experimental
Normal Readers	13.80	8.80
Retarded Readers	17.50	13.50

Visual Learning		
	Control	Experimental
Normal Readers	2.80	4.70
Retarded Readers	3.60	6.50

TABLE 4

Summary of Analysis of Variance of Trials to Criterion for Normal and Retarded Readers on Two Auditory Learning Tasks

Source	df	SS	MS	F	p
Total	39	943.60			
Reading Level (RL)	1	176.40	176.40	11.29	<.01
Learning Task (LT)	1	202.50	202.50	12.96	<.01
RL x LT	1	2.50	2.50		
Error	36	562.20	15.62		

stimulus material. For Ss at both levels of reading, auditory memory is facilitated when it is preceded by a visual learning task.

The results of the analysis on visual learning are presented in Table 5. There is no difference in visual learning between normal and retarded readers and the interaction between reading level and learning task is not significant. When an auditory learning task precedes visual learning, however, it interferes with the memory of the visual stimuli.

In initial auditory learning, normal readers took a mean of 13.8 trials to criterion and the retarded readers took a mean of 17.5 (Table 3). A t-test disclosed a significant difference in auditory memory ($t = 2.05$; $df = 9$, $p < .05$). It therefore seems that retarded readers are inferior to average readers in initial auditory learning.

In initial visual learning, however, the normal readers took a mean of 2.80 trials to criterion and the retarded readers took a mean of 3.60 trials (Table 3). A t-test disclosed no significant difference in initial visual learning. It seems that there is little or no difference between normal and retarded readers in initial visual memory tasks.

The groups of Ss who were required to relearn the information via an alternate channel disclosed the following results: The normal readers took a mean of 8.80 trials to relearn auditorially while the retarded readers took 13.5 trials (Table 3). A t-test disclosed a significant difference in auditory relearning ($t = 2.9$; $df = 9$; $p < .05$). The two groups differ in their transfer to auditory relearning after initial visual learning. Visual learning however, disclosed no significant difference as indicated on a t-tes

TABLE 5

Summary of Analysis of Variance of Trials to Criterion for Normal and Retarded Readers on Two Visual Learning Tasks

Source	df	SS	MS	F	p
Total	39	347.60			
Reading Level (RL)	1	16.90	16.90	2.25	
Learning Task (LT)	1	57.60	57.60	7.66	<.01
RL x LT	1	2.50	2.50		
Error	36	270.60	7.52		

CHAPTER 4

DISCUSSION

It was quite apparent from the results that retarded readers have a basic deficiency in auditory but not in visual memory. The implications for this finding will be discussed later in this chapter. When a visual task preceded an auditory task both normal and retarded readers showed an improvement in the rate of learning within the auditory modality. When an auditory task preceded a visual task both groups of readers showed that it interfered with the visual task.

The initial auditory learning task revealed a significant difference between retarded and normal readers ($t = 2.05$, $df = 9$, $p < .05$), whereas no difference existed in the initial visual learning task as indicated on a t-test.

Looking at Table 3, it is apparent that normal and retarded readers were better at recognition under initial visual conditions of learning than they were under recall of initial auditory conditions. T-tests corroborated the statement that normal readers ($t = 7.3$, $df = 9$, $p < .05$) and retarded readers ($t = 11.6$, $df = 9$, $p < .05$) were better at recognition under initial visual tasks as compared to recall under initial auditory tasks.

Fries (1962) as well as Birch and Belmont (1964, 1965) suggest that dyslexic children have problems in moving information from one sensory channel to another and the present study would suggest an interference effect. In other words, initially stored auditory information tended to disrupt later visual information. However, initial visual information tended to facilitate later auditory information. It seems that the direction of information storage is more important than actual transfer.

Auditory learning by recall is inferior to visual learning by recognition and therefore tends to disrupt later visual learning. Future studies should try to use visual information as cues to strengthen auditory learning. Such studies being analogous to fading techniques used by Terrace (1963, 1964), and Moore and Goldiamond (1964).

Studies in animal discrimination (Terrace, 1963, 1964) have demonstrated that a discrimination can be acquired without error when the stimulus differences to be learned are augmented with supplementary cues. These supplementary cues aid the Ss in forming the required discrimination, but they can be removed eventually and control transferred to the actual stimuli to be discriminated. This process is referred to as a fading technique in which easily discriminated cues are used as a "crutch" in forming more difficult discriminations. The success of this technique was clearly demonstrated by Terrace (1963) in which pigeons were trained to discriminate line orientations (horizontal-vertical) using colours (red-green) as cues. All pigeons were trained initially on a red-green discrimination; this is a relatively easy discrimination for the pigeons to form. The birds were then required to learn a horizontal-vertical line discrimination under three different training procedures: (1) red and green superimposed upon either the horizontal or vertical line orientations with these colours being faded out over successive trials leaving the lines as the only cues, (2) superimposing the colours in the identical manner but with a sudden withdrawal after a predetermined number of trials leaving line orientations as the only cues, (3) using the line orientations as the only cues with no colours. Both gradual and sudden withdrawal of the colour cues produced superior discrimination learning than line orientations alone, and gradual fading produced more efficient (i.e., errorless) discrimination than sudden fading.

Moore and Goldiamond (1964) extended this fading procedure to the establishment of visual geometric discrimination in preschool children. They used a matching-to-sample method in which children were required to select the one of three triangles which corresponded in angular rotation to the sample triangle. This discrimination proved difficult for these children. However, when the correct triangle was illuminated (i.e., made brighter than the two incorrect triangles) the discrimination was readily established. The two incorrect triangles were gradually made the same brightness as the correct triangle and discrimination was maintained using only the geometric cues. Both of these studies (Terrace, 1963, Moore and Goldiamond, 1964) demonstrated a method whereby a difficult discrimination may be established through the use of fading procedures in which easily discriminated cues are used in transferring control to those cues which were more difficult to discriminate.

The idea of the fading technique could be applied to reading in the following manner:

(a) First select a cue well known to the student - example - colour

(b) Superimpose the cue (colour) on problem letters, sounds, words, and use the cue as a crutch. This could be done on coloured paper, transparencies, or slides.

(c) Gradually fade out the cue in order to transfer control to pure letter shapes themselves. An example of this is presented in Table 6.

Such a fading procedure could be tested as follows:

An experimental and a control group each containing retarded and average readers could be tested on their ability to associate sounds and letters with and without colour cues. The control group would receive repetitive learning trials on a group of sounds without the aid

TABLE 6

Difficult Sounds

ve		ve		ve	
ew	colour cue blue	ew	colour cue light blue	ew	colour cue no colour
oo		oo		oo	

of colour cues, whereas the experimental group would receive the same learning trials with successive colour fading. Such a comparison would disclose the validity of cueing and fading as a technique for teaching phonics to children in special education programs.

REFERENCES

Archer, N. Analysis of meaning. Psychological Review, 1960, 59, 421-430.

Bannantyne, A. D. The colour phonics system. In J. Money (Ed.), The disabled reader. Baltimore: The Johns Hopkins Press, 1966.

Bateman, B. An educator's view of a diagnostic approach to learning disorders. In J. Hellmuth (Ed.), Learning disorders. Seattle: Special Child Publications, 1965.

Beery, J. W. Matching auditory and visual stimuli by average and retarded readers. Child Development, 1967, 38, 827-833.

Benton, A. L. Dyslexia in relation to form perception and directional sense. In J. Money (Ed.), Reading disability: progress and research needs in dyslexia. Baltimore: Johns Hopkins Press, 1962.

Birch, H. G. Dyslexia and the maturation of visual function. In J. Money (Ed.) Reading Disability. Baltimore: The Johns Hopkins Press, 1962.

Birch, H., & Belmont, L. Auditory-visual integration in normal and retarded readers. American Journal of Orthopsychiatry, 1964, 34, 852-861.

Birch, H., & Belmont, L. Auditory-visual integration, intelligence and reading ability in school children. Perceptual and Motor Skills, 1965, 20, 295-305.

Bowers, J. E., Clement, J., Francis, M. J., & Johnston, M. C. Exceptional children in home, school, and community. Toronto: J. M. Dent & Sons (Canada) Ltd., 1967.

Budoff, M., & Quindland, D. Reading progress as related to efficiency of visual and aural learning in the primary grades. Journal of Educational Psychology, 1964, 55, 247-252.

Buros, O. The Seventh Mental Measurement Yearbook, New Jersey: The Gryphon Press, 1965.

Buros, O. The Seventh Mental Measurement Yearbook, New Jersey: The Gryphon Press, 1972.

Carson, G. I. Intermodal processing mechanisms in average and retarded readers. Unpublished Master's thesis, Dalhousie University, 1971.

Clarke, Louise. How to recognize and overcome dyslexia in your child. New York: Walker and Co; 1973.

Deese, J., & Hull, G. The psychology of learning. Toronto: McGraw Hill, 1958.

Eisenberg, L. Introduction: In J. Money (Ed.), Reading disability; progress and research needs in dyslexia. Baltimore: The Johns Hopkins Press, 1962.

Ford, M. P. Auditory-visual and tactual-visual integration in relation to reading ability. Perceptual and Motor Skills, 1967, 24, 831-841.

Fries, C. C. Linguistics and reading. New York: Holt, Rinehart and Winston, Inc., 1962.

Gates, A. I. Gates reading survey. New York: Bureau of Publications, Teachers College, 1964.

Gates, A. I., & MacGinitie, W. H. Technical Manual of Gates-MacGinitie Reading Tests. New York: Teachers College Press, 1965.

Hirsch, De, K. Specific dyslexia or strephonsymbolia. In G. Natchez (Ed.). Children with reading problems. New York: Basic Books, Inc., 1968.

Johnson, D. T. & Myklebust, H. R. Dyslexia in Childhood. In J. Hellmuth (Ed.), Learning disorders. Seattle: Special Child Publications, 1965.

Katz, P., & Deutsch, M. Relation of auditory-visual shifting to reading achievement. Perceptual and Motor Skills, 1963, 17, 327-332.

Katz, P., & Deutsch, M. Modality of stimulus presentation in serial learning for normal and retarded readers. Perceptual and Motor Skills, 1964, 19, 627-633.

Money, J. Reading disability. Baltimore: The Johns Hopkins Press, 1962.

Moore, R., & Goldiamond, I. Errorless establishment of visual discrimination using fading procedures. Journal of Experimental Analysis of Behaviour, 1964, 7, 269-272.

Muehl, S., & Kremenak, S. Ability to match information within and between auditory and visual sense modalities and subsequent reading achievement. Journal of Educational Psychology, 1966, 57, 230-239.

Proshansky, H., & Seidenberg, B. Basic studies in social psychology. New York: Holt, Rinehart & Winston, 1965.

Raab, L., & Deutsch, M. Modality of stimulus presentation in serial learning for normal and retarded readers. Perceptual and Motor Skills, 1964, 18, 627-633.

Raab, S., Deutsch, M., & Freedman, A. Perceptual shifting and set in normal school children of different reading achievement levels. Perceptual and Motor Skills, 1960, 10, 187-192.

Rabinovitch, R. D. Reading and learning disabilities. In S. Arieti (Ed.), American handbook of psychiatry. New York: Basic Books, Inc., 1959.

Raymond, D. The performance of reading achievers on memory span and associated learning tests. Journal of Educational Research, 1955, 48, 455-465.

Rudnick, M., Sterrit, G. M., & Flax, M. Auditory and visual rhythm perception and reading ability. Child Development, 1967, 38, 581-587.

Shapiro, S. Aural paired associates learning in grade school children. Child development, 1966, 37, 417-424.

Sterritt, G. M., & Rudnick, M. Auditory and visual rhythm, perception in relation to reading ability in fifth grade boys. Perceptual and Motor Skills, 1966, 22, 859-864.

Strasberg, R. Sentence structure retention in good and poor readers. Unpublished Master's thesis. McGill University, 1967.

Terrace, H. S. Errorless transfer of a discrimination across two continua. Journal of Experimental Analysis of Behaviour, 1963, 6, 223-232.

Terrace, H. S. Wavelength generalization after discrimination learning with and without errors. Science, 1964, 144, 78-80.

Thompson, L. J. Reading disability. Illinois: Charles C. Thomas, 1966.

Vernon, M. D. Reading and its difficulties. New York: Cambridge University Press, 1971.

Wagner, R. F. Dyslexia and your child. New York: Harper & Row Publishers, 1971.

Wechsler, D. Wechsler Intelligence Scale for Children. New York: The Psychological Corporation, 1949.

Wepman, J. M. Auditory Discrimination Test Form 1. Chicago: Language Research Association, 1958.

Wepman, J. M. Manual of Directions for Auditory Discrimination Test. Chicago: University of Chicago, 1958.

Wepman, J. M. Auditory discrimination speech and reading. Elementary School Journal, 1960, 60, 325-333.

APPENDIX A

jom   gec

jom

---

gex

gec

yec

gac

APPENDIX B

The actual verbal instructions were as follows:

"I an going to say 8 sounds. First I will say a sound and wait 3 seconds, and then will say the sound that goes with it. Then I will say the second sound and wait 3 seconds and then say the sound that goes with it. I will continue this procedure for 4 seunds.

The second time I say the sounds see if you can give the sound that goes with it."

e.g. fim (3 sec.) cuv

3 sec. pax (3 sec.) rit

3 sec. kur (3 sec.) lec

3 sec. mic (3 sec.) seb

5 sec.

The following instructions were given following the pretraining session.

"Now the sounds are going to be on tape. Listen for the first 8 sounds. After that say the sound whenever you know it."

APPENDIX C

STIMULI

Auditory Learning by Recall (Task A - Stage 1)

Order I	jom	gec
	tuv	mef
	pib	zof
	bav	nux
Order II	bav	nux
	tuv	mef
	jom	gec
	pib	zof
Order III	tuv	mef
	jom	gec
	bav	nux
	pib	zof

Auditory Relearning by Recall (Task B - Stage 2)

Order I	ruv	yab
	dax	fup
	wef	kiv
	hif	vob

Order II	hif	vob
	dax	fup
	ruv	yab
	wef	kiv
Order III	dax	fup
	ruv	yab
	hif	vob
	wef	kiv

Visual Learning by Recognition (Task B - Stage 1)

Order I	wef -	kiv	miv	kuv	kif
	hif -	yob	vub	vef	vob
	dax -	fuv	fup	vup	fep
	ruv -	yeb	yaf	yab	vab
Order II	hif -	vof	vob	yob	vub
	ruv -	yab	vab	yeb	yaf
	dax -	fep	fuv	fup	vup
	wef -	miv	kuv	kif	kiv
Order III	ruv -	vab	yeb	yaf	yab
	wef -	kif	kiv	miv	kuv
	hif -	vub	vof	vob	yob
	dax -	fup	vup	fep	fuv

Order IV	wef -	kuv	kif	kiv	miv
	dax -	vup	fep	fuv	fup
	ruv -	yaf	yab	vab	yeb
	hif -	vob	yob	vub	vof

Visual Relearning by Recognition (Task A - Stage 2)

Order I	pib -	zof	vof	zaf	zov
	bav -	rux	nax	nuc	nux
	tuv -	mej	mef	def	maf
	jom -	gac	gex	gec	yec
Order II	bav -	nuc	nux	rux	nax
	jom -	gec	yec	gac	gex
	tuv -	maf	mej	mef	def
	pib -	vof	zaf	zov	zof
Order III	jom -	yec	gac	gex	gec
	pib -	zov	zof	vof	zaf
	bav -	nax	nuc	nux	rux
	tuv -	mef	def	maf	mej
Order IV	pib -	zaf	zov	zof	vof
	tuv -	def	maf	mej	kef
	jom -	gex	gec	yec	gac
	bav -	nux	rux	nax	nuc

APPENDIX D

Scores of Retarded Readers

Subjects	Ages	I.Q.	Wepman	Gates MacGinitie
1	13-6	91	1	4.5
2	10-9	99	0	4.2
3	10-9	89	3	1.6
4	12-1	85	1	3.9
5	11-8	98	1	3.5
6	13-6	98	4	3.0
7	12-2	111	3	4.1
8	13-11	87	5	4.6
9	10-2	98	1	2.2
10	13-8	86	1	3.4
11	10-8	87	5	1.7
12	11-2	82	5	1.4
13	13-2	83	0	2.2
14	12-2	92	0	2.4
15	12-9	93	8	2.0
16	11-5	81	1	1.3
17	13-1	85	0	2.2
18	11-10	83	3	2.1
19	12-11	92	2	1.7
20	12-4	98	3	2.6

APPENDIX E

Scores of Average Readers

Subjects	Ages	I.Q.	Wepman	Gates MacGinitie
1	11-1	102	0	6.2
2	11-0	97	0	5.3
3	10-6	95	0	5.8
4	10-10	99	0	6.1
5	11-0	90	3	5.3
6	11-3	92	1	7.3
7	11-6	104	3	5.7
8	11-3	90	1	7.0
9	11-7	98	1	5.6
10	12-6	104	0	6.4
11	11-7	102	0	5.9
12	11-0	95	0	5.8
13	11-7	97	2	5.8
14	10-7	92	0	5.6
15	11-3	101	0	9.0
16	11-0	100	2	6.3
17	10-8	106	1	9.1
18	11-0	106	1	7.0
19	11-1	106	1	6.6
20	11-7	95	0	6.4

APPENDIX F

Number of trials

Subjects	Task A Stage 1 Auditory Learning	Task A Stage 2 Visual Relearning
Retarded Readers		
1	18	4
2	18	17
3	21	12
4	23	3
5	15	5
6	16	6
7	12	6
8	18	5
9	13	5
10	21	2
Average Readers		
1	18	6
2	7	3
3	11	3
4	14	11
5	14	6
6	14	5

APPENDIX F continued

	Task A Stage 1 Auditory Learning	Task A Stage 2 Visual Relearning
Average Readers		
7	12	3
8	9	3
9	24	4
10	15	3

	Task B Stage 1 Visual Learning	Task B Stage 2 Auditory Relearning
Retarded Readers		
11	5	13
12	3	9
13	7	11
14	3	12
15	3	9
16	2	15
17	3	18
18	3	18
19	5	12
20	2	18

APPENDIX F continued

	Task B Stage 1 Visual Learning	Task B Stage 2 Auditory Relearning
Average Readers		
11	3	9
12	3	6
13	3	8
14	3	6
15	3	7
16	2	8
17	2	14
18	2	3
19	3	15
20	4	12