AN EXPLORATION OF THE CONSTRUCT VALIDITY OF

DURRELL VISUAL MEMORY OF WORDS: INTERMEDIATE

by

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ABSTRACT

The purpose of the study was to explore the construct validity of the Durrell subtest Visual Memory of Words: Intermediate.

The study was designed to investigate whether the Durrell Visual Memory of Words: Intermediate measures visual memory, as it is purported or includes a measure of an auditory-visual integration process in short-term memory.

The study was conducted in four stages: Stage One described the paradigm for the study and identified tests to represent the constructs, of auditory memory, visual memory and auditory-visual integration. Stage Two of the study required administering two tests of auditory discrimination and three tests of auditory-visual integration, individually to 60 grade four students. The sample was stratified by age, gender and reading level. The results of Stage Two led to the development of a new paradigm for the study and the retention of two measures of auditory-visual integration for use in further exploratory studies. In Stage Three of the study two tests each of auditory memory, visual memory and auditory-visual integration were administered to 22 grade four students, controlling for test order effect. The same six tests were given to 120 grade five students during Stage Four of the study.

The data were subjected to test, item and multiple regression

analysis. Results of the test and item analysis indicated the California Phonics-Visual and the G-F-W Auditory Memory were too easy for the grade five age students. Multiple regression analysis of the data revealed 55 percent of the variance of the Durrell Visual Memory of Words: Intermediate was accounted for by general reading ability plus tests of auditory memory, visual memory and auditory-visual integration.

It was concluded that there was sufficient evidence from the exploratory study to raise the question of whether the Durrell Visual Memory of Words: Intermediate, does in fact contain a measure of auditory-visual integration.

Some implications and suggestions for further research were stated.

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CHAPTER I

INTRODUCTION

Background to the Problem

What is Reading? A search of the literature to attempt to answer this question emphasizes the inter-disciplinary nature of reading. Indeed, definitions and models of reading reflect the disciplines from which they were derived; for example physiology (Holmes, 1970), psychology (Gagne, 1970; Gibson, 1970) and linguistics (Goodman, 1970).

It is important, therefore to be aware of the theoretical base on which a reading model is built. Thus, when attempting to explain visual and auditory processing beyond simple acuity in either channel, the reading model should be based on cognitive aspects of memory. (see Diagram 2)

The ability to process visual and auditory stimuli and the integration of the two channels has been shown to be a major factor in beginning reading success (Murphy, 1940; Crossley, 1952; Zajac, 1958); in reading disabilities (Bateman, 1968; Halton, 1970) and in reading across grade and achievement levels (Katz and Deutsch, 1963; Dornbush and Basow, 1970).

Throughout reading and psychology literature studies dealing with modality processing (visual discrimination, visual memory, auditory discrimination, and auditory memory) are shown to differ in three fundamental ways:

1. The type of stimulus used, whether non-verbal or verbal, digits, designs, letters or words.

2. The variability of the time of exposure for the stimulus (from 250 msecs. to 5 secs).

3. The time and type of response, whether immediate recognition or delayed recall.

Thus, although the tests used in the studies require visual or auditory processing the type of recall demanded is so different that the processes involved cannot be considered equivalent. Each task enables the accompaniment of varying rehearsal systems. Consequently, the basic question arises for the researcher who wishes to measure memory processes: Which level of visual or auditory processing does the test measure?

Given these kinds of difficulties, the average reading teacher would probably feel most secure simply to accept the general statement that visual and auditory processes should be trained and design teaching techniques that attempt to develop both.

The problem becomes less simple, however, where the notion of diagnostic testing is introduced. It is sometimes suggested that if a teacher can detect a weakness in one channel or the

other, a program can be designed to teach through the stronger channel while the weaker is strengthened. On the surface this is an attractive notion and very worthwhile if tests are available that provide valid and reliable measures of the memory processes for each modality.

Unfortunately few of the tests available, while reliable, have been subjected to the appropriate tests of validity that seem almost to be demanded given the remediation programs designed around test results.

Statement of the Problem

Tests of short-term visual memory developed to diagnose a child's strengths and weaknesses in that area are often used by school personnel. Data obtained from such tests are used to develop remediation programmes.

Visual memory may be measured in terms of non-literacy based symbols (designs) and literacy based symbols (words). Among the most widely used tests of visual memory of design are the Benton Visual Retention Test (Benton, 1963) and the Memory for Designs Test (Graham & Kendall, 1960). One of the most extensively used tests of visual memory of words is the Visual Memory of Words: Intermediate subtest of the Durrell Analysis of Reading Difficulty (1937,1955).

The subtest, Visual Memory of Words: Intermediate, is a test designed for children whose reading level is Grade three or above. It consists of 15 six, eight, nine and ten letter words not in the child's sight vocabulary. The words are exposed via a manually operated tachistoscope at the rate of one word per three seconds. A motor response is required by an immediate written recall of the letters.

Studies of short-term memory processes seem to indicate the existence of a fast-decaying visual trace lasting less than one or two seconds, after which the visual memory is strengthened by integration with verbal coding. If this process is functioning during the administration of the test, it may be that the Durrell Visual Memory of Words: Intermediate is measuring a process known as auditory-visual integration rather than visual memory.

Because the quality of remediation is dependent upon the reliability and validity of the measuring instruments, it is important to investigate these aspects of any test.

Purpose of the Study

The study investigated the construct being measured by the Durrell Visual Memory of Words: Intermediate, to identify more specifically the process involved in the test in order that in diagnosis of an individual's strengths and weaknesses, the reading teacher becomes aware of the process involved in the observed performance or behavior. "We should begin to try to look at the process rather than focusing entirely on the output." (Carroll, 1974)

The purpose of the study is to attempt to answer the question, Does the Durrell Analysis Subtest Visual Memory of Words: Intermediate measure visual memory or an auditory-visual integration in short-term memory?

Justification for the Study

Justification for the study, therefore, is summarized by the following points:

1. Studies reveal that visual memory is an important factor in the reading process.
2. From studies of short-term memory it appears that there is a relationship between recall and coding, -- visual and verbal.
3. Remediation programs are developed based on the results of memory tests.
4. It is important that users and interpreters of tests be aware of the test's limitations and attributes, i.e. does the test measure what it purports to measure?
5. The Durrell Analysis of Reading Difficulty is currently under revision. Consequently, the study will add to the body of knowledge relevant to the revision of the tests.

Definitions

For the purpose of the study, the following terms are defined.

visual recognition - matching response of words presented visually.

visual recall - written recall of a word presented visually.

auditory recognition - matching of words presented orally with those words stored in memory, and an oral response.

auditory recall - oral recall of words presented orally.

auditory-visual integration - the ability to recognize or recall words visually which have been presented orally.

Population

The defined population comprised 576 Grade four students attending 15 schools in Maple Ridge School District, British Columbia. The school district includes the area defined by the Pitt River on its western boundary and Mission on its eastern boundary. Within the last ten years this previously rural area has been affected by suburban settlement growth as a result of movement by families from the metropolitan area of Vancouver and immediate vicinity.

For the purpose of the study three samples of Grade four and Grade five students were drawn from this heterogeneous school population. The three separate samples are described in detail at each stage of the study.

Schools were stratified according to socio-economic status and classes of Grade four and Grade five students assigned randomly to participate in the study.

As outlined in Chapter II, reading achievement, gender and age appear to have an influence on performance on tests of auditory and visual memory and auditory-visual integration. Consequently reading achievement scores, gender and age were obtained from the children's permanent records and used as covariates in the analysis, thereby providing for control of these variables. Excluded from the study were those students with known visual and auditory impairments and those students who had repeated a previous grade.

Organization of the Thesis

The first chapter includes a general background of the problem, a statement of the problem, justification for the study, definitions of terms used and an outline of the organization of the study. Chapter Two consists of a review of the related literature and the specific questions to be answered by the study. The third chapter provides a description of the general design of the study. Chapter Four presents the results of the study and an analysis of the data. The fifth and final chapter is a summary of the findings with conclusions and implications for further research.

CHAPTER II

REVIEW OF THE LITERATURE

The problem of measuring short-term memory of skilled readers may be related to measuring auditory and visual memory independently. It may be the case that tests which purport to measure either auditory or visual memory using words, may be measuring an auditory-visual integration process. In order to investigate the dimensions of this problem it is necessary to explore briefly the body of theory and research which deals with short-term memory processes.

The literature is presented in the following areas: theories of short-term memory; (visual and auditory coding, auditory-visual integration), and their relationship with the reading process.

Short-Term Memory

As an introduction to the theories of short-term memory, Conrad (1970) clarifies the nature of the research. He puts the position of the short-term memory researcher in a clear perspective:

> The question now becomes something like this: regardless of the sensory nature of the input of the test material, when the moment for retrieval (recall) comes, in what form, state, color, image, etc., is the memory of the material stored or retained or held. Connoisseurs of the literature on short-term memory will appreciate the need for these uncommitting descriptions. Most readers we hope will accept that short-term memory experiments require something to go in, something to be internally present for a while, and something to come out. The logic of the experiment assumes that the experimenter has control over the first; the subject's report has to be assumed to represent the last. Here we are concerned to see what the discrepancy between the two can tell us about the second. (p. 80)

Two areas of short-term memory research which contain contrasting theories involve: (1) The position of short-term memory within the organization of memory generally, and (2) The question of whether there is a separate and independent storage of auditory and visual material within short-term memory.

Organization of Memory

Traditional approaches to the study of organization of memory owe much to the work of Ebbinghaus (1975). His approach emphasized associative connections as the sole basis for organization in memory. The organization of memory was seen as being unitary in form and depending most importantly upon the particular network of associations previously acquired by the individual. Support for this theory has been shown by word-association studies (Postman & Keppel, 1970) where the relative frequencies of occurences have been interpreted as an index of the strength of associative connections. The basic assumption underlying the study of word association has been that output directly reflects

input. This behaviorist view of the human organism has been rejected by some contemporary psychologists whose view is that inputs are often translated and reorganized in such a way as to prevent straightforward relationships between input and output from being observed, except under rather limited circumstances. (Glanzer & Clark, 1966; Tulving & Thomson, 1971)

Organization of Short-Term Memory

A number of psychologists, (Neisser, 1971; Posner, 1974; Paivio, 1971) believe there are three separate memories, of which long term memory constitutes the most permanent. Sperling (1970) also views short-term memory as representing a different storage system which is itself divided in its functions (see Appendix A).

An early and popular conception of short-term memory involved a verbal acoustic temporary store, distinct from long term memory. This verbal short-term memory maintains information by rehearsal, and is of limited capacity (Neisser, 1967). However, a number of studies provide evidence of a short-term retention not soley verbal but involving a distinct visual modality. These studies have for the most part concentrated on masking, shadowing and interference techniques for tasks of verbal or visual retention. For example, Yuille and Ternes (1975) measured the amount of recall for each modality and across modalities from tasks of purely visual and verbal character after specific interferences differing in required concentration. In the design of their study, experiment one involved a visual task which was followed by interference activities rated as low or high

visual interference, visual motor, low or high verbal interference. There was also an immediate recall n0-interference group, and a rehearsal no-interference group for comparison. Experiment two was of the same design but with only verbal tasks being measured. A comparison of response trends across both experiments showed retention loss due to modality specific effects. It appears that visual motor interference accounted for the most retention loss on visual tasks, whereas high verbal interference accounted for the most retention loss on verbal tasks. Yuille and Ternes (1975) concluded that models of short-term memory should, therefore, take into account the storage of visual and verbal information separately.

In the Yuilles and Ternes experiment the stimuli were non-verbal and presented at 1.75 seconds, which is an important factor in evidence for the existence of separate auditory and visual storage systems, i.e., dual coding.

This dual coding of information in short-term memory is shown in Sperling's model of visual information processing (1967, 1970) (see Appendix A). Coltheart's model (1972), (see Diagram I) conceptualizes parallel coding through the visual code and verbal (name) code. It should be noted that both models contain a purely visual storage memory area, identified in the Sperling (1970) model as visual short-term memory, VSTM, and in the Coltheart (1972) model as "iconic memory". The significance of these areas will be discussed later in relation to the reading process model.

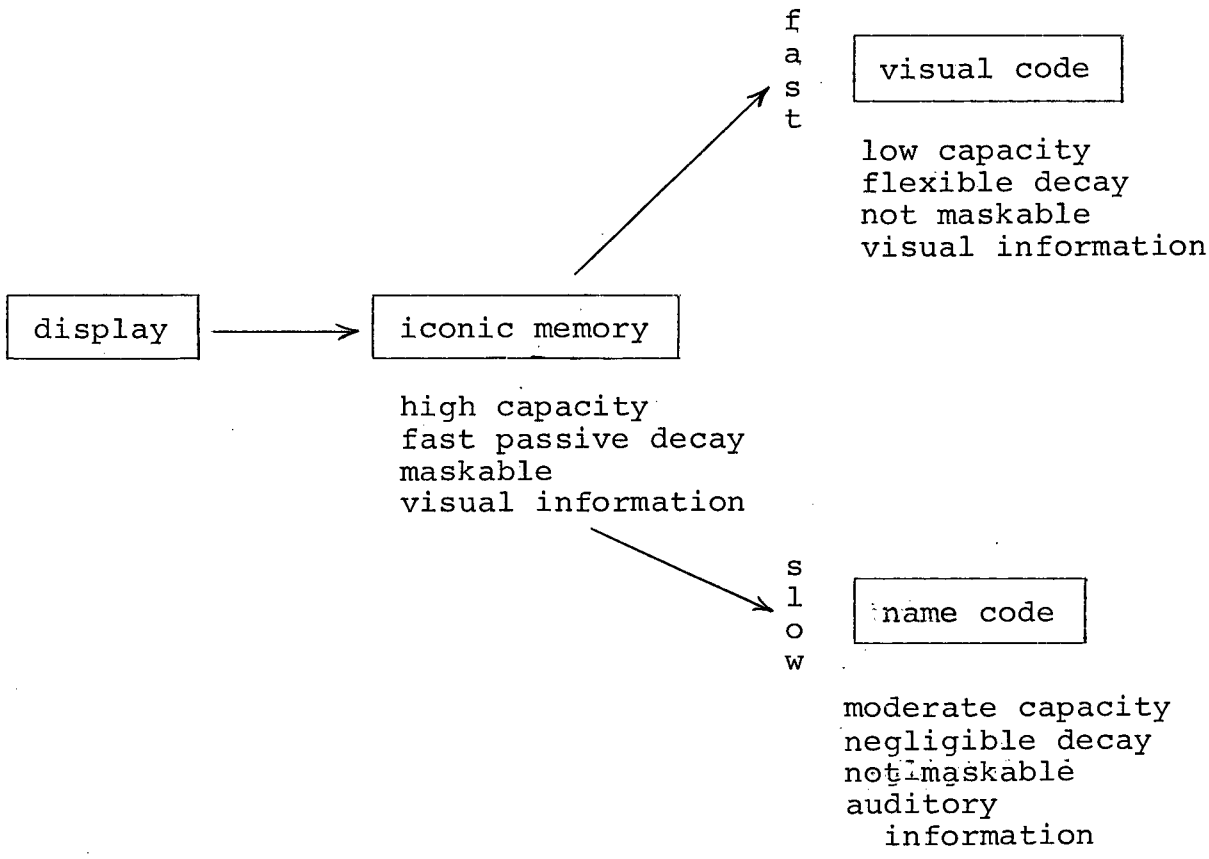

Diagram 1. M. Coltheart, Visual Information Processing (1972)

Further evidence in support of the theory of dual coding in short-term memory has been provided through the research findings of Paivio and Csapo (1971) and Rowe and Rogers (1975). Results obtained from a study conducted by Rowe and Rogers (1975) that investigated the effects of concurrent auditory shadowing on free recall and recognition of pictures and words, supported the Paivio dual coding hypothesis. Likewise, Snodgrass and McClure (1975) found that adult subjects in their experiments naturally stored both pictorial and verbal codes of the simple pictures, whereas they did not naturally encode words.

It appears, therefore, that there exists differing coding processes in short-term memory for the storage and retrieval of verbal and non-verbal materials. This is a major factor to be taken into account when assessing difficulties of visual and auditory memory in relation to the reading process.

Application of Mackworth Model of the Reading Process

Mackworth (1971) developed a Schematic Model of the Reading Process (Diagram 2) which has been adopted for this study. Mackworth views reading as:

> ..... a three-way synthesis between the spatial signs, the spoken word, and meaning. Again, there is a parallel processing of input, this time visual, followed by the sequential verbal processing.
>
> The primary task for the normal child in learning to read is to learn the rules necessary to transform the spatial signs into verbal equivalents, either as overt or as subvocal speech, followed by the linking of the written material to meaning. Memory is an essential part of this activity at all levels. (p. 70)

Her model, (see Diagram 2), clearly shows a relationship between the cognitive, short-term memory process, and reading. To explain this relationship Mackworth uses the following terms:

Visual Input - an active process involving selection, attention, expectancy and prediction

Sensory Visual trace - represents the primary storage of visual input in a visual form. This form lasts ¼ of a second and is masked by the next visual input.

Iconic store - results from recognition and matching of the primary visual input with stored data. At this stage a visual percept is formed which lasts between one and two seconds.

Acoustic Input - the coding of the written word to the spoken word gives meaning to the percept. Recognition of the spoken word involves the mediation of the articulatory system (motor-speech neural patterns stored in the speech area). In skilled readers the acoustic input disappears and articulatory neural activity only remains.

Short-Term Memory - the visual input enters short-term memory as the coded verbal form. At this stage occurs the synthesis of visual, articulatory and auditory forms which are activated from long term memory into short-term memory by the coding process (Mackworth, 1971, p. 70).

The above description represents the part of the model that is relevant to this study. The Durrell Visual Memory of Words: Intermediate purports to measure visual memory of words whereas the length of the presentation (3 seconds) and the stimuli used (words) may result in recall of a "synthesis of visual, articulatory and auditory forms" in terms of Mackworth's model. It must be remembered that input from long term memory is a continuous process through-out the stages outlined. Although Mackworth (1971) sees reading as basically a coding process she emphasizes

> ..... its important aspect, like language and other codes, is the relation between these codes and the primary sense data that the child has already transformed into internal models" (p. 70)

Studies in Relation to the Mackworth Model

The Mackworth model emphasizes the most important considerations in the area of measuring visual memory, auditory memory and an integration of auditory and visual. The following studies deal with symbols of literacy only (i.e. letters and words). The research is organized into those studies dealing with the iconic store and those dealing with the coding process.

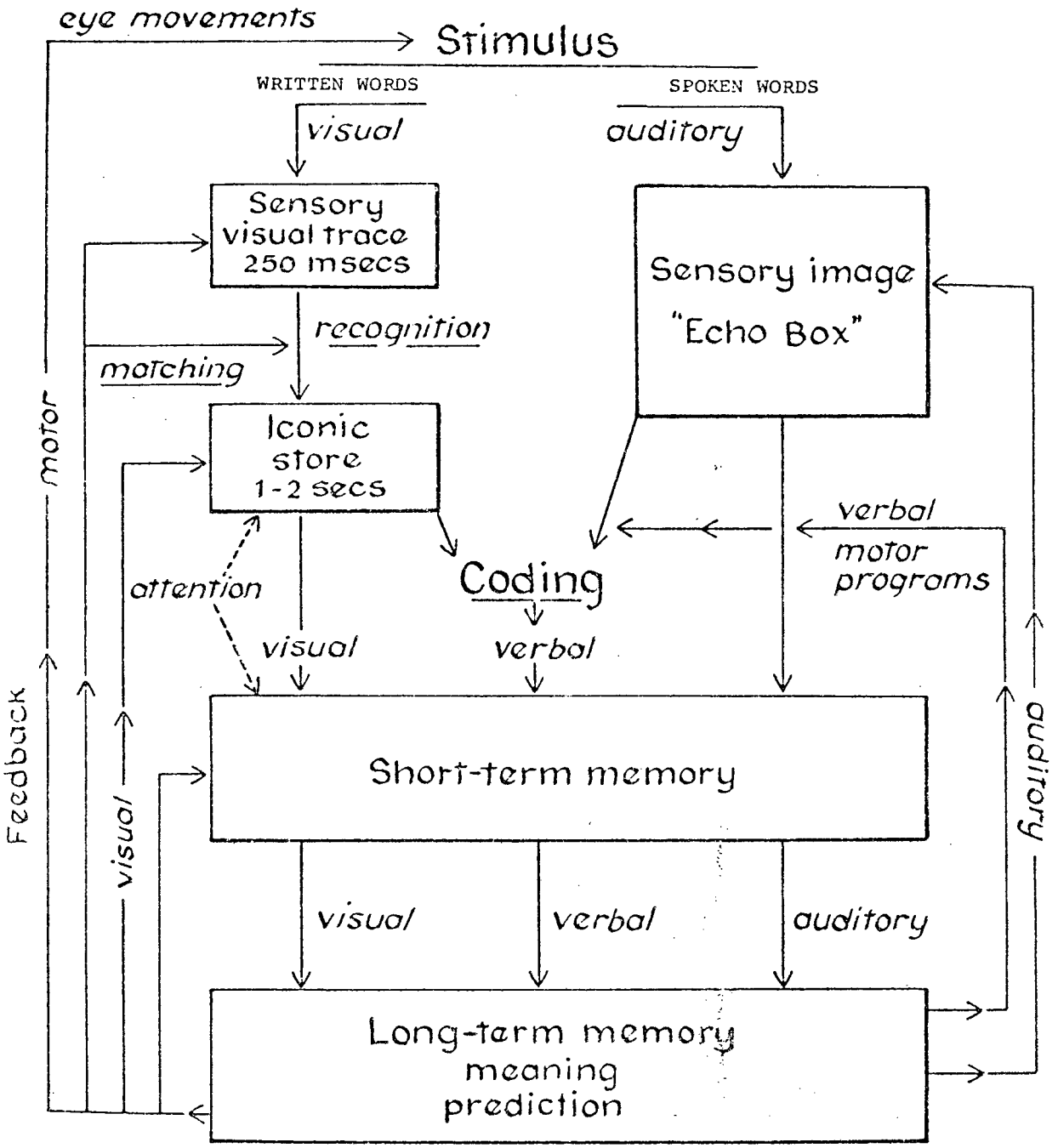

Diagram 2: Model of Reading Process

(After Mackworth, 1971)

Studies of the Iconic Store

Both Posner and Keele (1967) hypothesized that the rate at which a subject responded to two letters being the same, would reflect the information being used to make that match. In a study, using physically identical letters AA and same name letters Aa, they found that immediately after presentation, a physical identity match was faster than one which was based on name. However, this difference disappeared after 1.5 seconds. Posner and Keele (1967) felt that the physical identity conditions were confounded by the fact that upper case letters were used in the same name condition. This condition was corrected in the experiments conducted by Posner, Boies, Eichelman & Taylor (1969) that sought to replicate the previous findings. Results obtained from their three experiments showed that immediately after the exposure of a visual letter, subjects had a complete visual description of that stimulus. However, results also indicated that the matches based on the visual information become relatively less efficient over time. Posner et al. (1969) explained the rate of decay of visual information as being dependent upon:

1. The degree of attention subjects focused on the visual experience.
2. The amount of rehearsal available - recall was more efficient after a one second interval.
3. The generation of visual information with auditory information.

It appears that the findings of Posner et al. (1967, 1969) support those discussed in earlier reports (Sperling, 1960;

Neisser, 1967) suggesting the existence of a visual trace and iconic store in memory organization.

Studies of the Coding Process

The work of Gibson (1962, 1963, 1966) has added a great deal to the body of knowledge concerning the reading process of beginning readers. However, she has made significant contributions also in the investigation of the processes being used by the skilled reader. In an attempt to define the unit of perception in written English, Gibson, Pick, Osser and Hammond (1962) presented tachistoscopically a list of 25 unpronouncable pseudo-words (TNPA) and a list of 25 pronouncable pseudo-words, at speeds of 50ms to 250ms to college students. Results indicated that there was a significant difference between the amounts of pronouncable words recognized and the amounts of unpronouncable words recognized. Based on these results they (Gibson et al, 1962) concluded that "skilled readers are more apt to perceive correctly letter strings which follow the rules of English orthography and spelling-to-sound correspondence". (p. 26)

The subjects of this first experiment were of college age. A similar study was conducted with children at the end of the first and third grade (Gibson et al, 1962). The children were presented with three-letter words (RAN), pronouncable trigrams (NAP), unpronouncable trigrams (RNA) and four and five letter pseudo-words used in the previous experiment. Results indicated first and third grade students recognized three letter words most accurately, followed by pronouncable trigrams and then

unpronouncable trigrams. Of the pseudo-words it was found that third grade children recognized the pronouncable pseudo-words significantly more accurately than the unpronouncable. Gibson (1963) explained these results in relation to,

1. The students' familiarity with the rules of English orthography.
2. Auditory accompaniment aided recall.

In another study conducted by Gibson, Shurcliff and Yonas (1966) the hypothesis that auditory accompaniment to the visual stimulus facilitated recall was tested with hearing and congenitally deaf students. Results indicated that although deaf students read fewer pronouncable pseudo-words than hearing students, the trend remained the same for both groups. Pronouncable words were recognized significantly more accurately than unpronouncable words by the deaf students as well as the hearing students. Gibson et al, (1966) suggested that deaf students were possibly assisted in recall by their familiarity with English spelling patterns that enabled them to process strings of letters in chunks. Gibson (1966) concluded:

> The deaf students had picked up a knowledge of English spelling patterns and were using it to process strings of letters in chunks, even though they had never heard the sounds to which the letters mapped. (p. 28)

Similar findings to those of Gibson et al, (1966) were obtained by Carey and Blake (1974). They presented verbal materials (letters), familiar and nameable materials (geometric shapes), unfamiliar and not easily nameable materials (nonsense figures) to hearing and deaf students. The following hypotheses

were tested:

1. Deaf students who are deficient in linguistic skills, will achieve lower recall scores.
2. Within the deaf population, those subjects with the poorest linguistic skills will achieve lower scores than those who are somewhat more verbally adept.
3. Deaf subjects' errors with letters will display many visual confusions and few auditory confusions by comparison to error data on hearing subjects. (p. 4)

An analysis of correct responses showed the order of stimulus difficulty was similar for hearing and deaf subjects. Letters were recognized more frequently followed by shapes and nonsense figures. Both groups made more visual than auditory confusions, with the letters V and X confused most frequently, and D and Q were confused least frequently. As hypothesized, better readers among the deaf obtained higher scores. Carey and Blake (1974) explained their findings in relation to recall from iconic store rather than from short-term memory. Exposure of the stimulus was from 10 to 320 seconds which may explain the greater number of visual errors compared with auditory errors. They explained the results showing higher scores for better readers among the deaf subjects as indicative of better memories, not of the existence of a linguistic coding, (Conrad, 1964, 1970).

The investigation of short-term memory coding processes in hearing impaired students adds insight to those processes in hearing students. The following section presents studies concerned with the coding of verbal material.

Verbal Coding

Conrad (1964, 1970) asks the question, What do the deaf think

in? He uses memorize synonomously with think. In contrast to the results of Carey and Blake (1974) Conrad found that the primary code for lists of verbal material is a verbal one - the linguistic coding hypothesis. According to Conrad, memory for words in sustained by acoustic and articulatory imagery in hearing subjects. In a study by Conrad and Rush (1965) using deaf and hearing subjects it was discovered that the error matrices differed significantly. This indicated that the deaf subjects used a different memory code than the hearing subjects. However, it was reported that a number of subjects finger spelled during presentation and recall of the letter sequences, thus indicating the existence of a spelling memory code among the deaf subjects.

In an attempt to eliminate the spelling memory code Conrad (1970) conducted a study with deaf students educated in an oral school. He worked with 36 boys aged between 12 and 17 years of age attending a private school for the deaf, that required high standards of educability and very severe hearing loss. From the letters BCHKLTXYZ he designed two tests, one test comprised 45 sequences of 5 letter sequences and another test 45 sequences of 6 letter sequences. He exposed the letters at the rate of 1 second per letter to groups of 3 boys. The boys were instructed every nine sequences to either read the letters silently or out loud. Letters were recalled by writing in the left to right order of sequence. In this study Conrad (1970) also used 75 Cambridge housewives as a control group. An analysis of errors indicated the errors could be divided into two groups,

1.) articulatory errors: BCT, XH

and 2.) non-articulatory errors: KXYZ

A significant relationship was found between subjects who spoke well and articulatory errors, and subjects who spoke less well and non-articulatory errors. Classification was made of the subjects into those apparently memorizing by articulatory cues and those who code by non-articulatory means, such as shape.

In addition, Conrad (1970) presented these articulatory and non-articulatory groups with two word lists. One word list consisted of five homophonous pairs of words, words that sound the same but look different - fort, fought; way, weigh raw, roar; past, passed; sum, some. The other word list comprised five non-homophonous pairs of words, words that look alike but sound different; seem, scan; den, ham; cup, say; race, care; beach, hoard. The words were exposed at the rate of 1½ seconds per word with immediate written recall. The results revealed that although the articulatory group made significantly more errors on the homophone list, (suggesting acoustic confusability) there was no significant difference between the two vocabularies and the non-articulatory group. Conrad (1970) states the results may have been confounded by the similarity of sounds on the non-homophone list, thus producing biased word lists.

In explaining his results, Conrad (1964, 1965, 1970) presented support for his linguistic coding hypothesis, stressing that:

> The profoundly deaf person, however, is unique in relation to verbal memory function, in that he lacks auditory mediatory opportunity, acquiring articulation either with great difficulty or often hardly at all. Because these processes are so intricately involved with memory in hearing persons, memory models which aspire beyond superficiality must also describe processes in persons who have never heard language, and may rarely use overt speech ..... To understand memory processes fully, we have to be able to conceive of a verbal memory store which may be full of pictures of words as written, or as they might appear on finger-spelling hands, on "signing" hands, on speaking lips, not to mention the kinaesthetic tactual analogues of these. (p. 192)

Both Glanzer and Clark (1964) indicate the importance of verbal coding in memory. They have formulated the verbal loop hypothesis in which all kinds of visually presented materials, including nonsense figures, are retained in short-term memory by their verbal coding. Kroll (1975), in agreement with Glanzer and Clark, reaffirmed the role of vocalization in rehearsal of visual stimulus, whereas Posner (1969) showed rehearsal of verbally presented stimulus via visual imagery. Carroll's study (1974) for which he developed a motor-free multiple choice recognition Visual Memory Scale for 5 and 6 year olds, gives further evidence of the importance of the acoustic memory in visual memory. Results from his study involving 198, 5 and 6 year olds, plus groups of non-neurologically and neurologically impaired children revealed a relationship between high reading achievement and low errors on the Visual Memory Scale. Carroll (1974) explained the results in terms of an information process:

> After information is encoded successfully it may have difficulty arriving at, or entering the short-term memory. If it does successfully enter primary memory, it is possible that defects in the rehearsal loop may cause the information to decay rather than be retained and reinforced. (p. 158)

Research (Bateman, 1968; Carroll, 1975) seems to indicate a relationship exists between poor reading achievement and low scores on a visual memory test. The studies investigating the manner of that relationship point to a dual coding of visual and verbal stimuli with subvocalization facilitating greater recall of visually presented material. This suggests the existence of an auditory-visual integration process involved when the visual stimuli is verbal. As described in the studies of Posner et al, (1969) and Gibson et al, (1962) the longer the visual stimulus was presented the greater opportunity for auditory accompaniment to aid in more efficient recall. To reiterate Conrad's theory, memory for words seems to be sustained by acoustic and articulatory imagery in hearing subjects. Derevensky (1977 described this process as cross-modal functioning. The following section presents studies which considered the relationship between cross-modal functioning and the reading process.

Cross-Modal Functioning: Auditory-Visual Integration

Derevensky (1977) presents a comprehensive review of research literature in the area of auditory-visual integration and reading achievement.

Birch and Belmont (1964) developed a measure of auditory-visual integration which has since been found, through further

research, to be a reliable discriminatory measure between good and poor readers, (Beery, 1967; Jorgenson and Hyde, 1974). The Birch and Belmont task consists of three samples and ten test items. A sound pattern consisting of short (½ second) intervals and a long (1 second) interval is tapped on a table top. The response required is to match one of three visual patterns with the previously presented auditory pattern.

From their study, Birch and Belmont found auditory-visual integration ability rapidly increased in children between kindergarten and Grade two but reached an asymptote by the fifth grade. Conversely, Kahn and Birch (1968) found that auditory-visual integration continues to improve throughout the elementary school years.

Auditory-visual integration ability also appears to be a significant factor in reading achievement (Kahn and Birch, 1968; Beery, 1967; Jones, 1971). In reviewing the research Derevensky states:

> In general, the data support the sensory integration hypothesis that auditory-visual integration is positively correlated and educationally meaningful to reading performance. (p. 238)

The review of research in the area of short-term memory and the reading process, suggests the importance of cross-modal functioning. However, several studies found no meaningful relationship between auditory memory and auditory-visual integration skills (Birch and Belmont, 1964; Ford, 1967; Jorgenson and Hyde, 1974). Furthermore, Kahn and Birch (1968) found no significant relationship between visual memory and auditory-visual

integration skills.

It appears, therefore that there is enough evidence from the review of related research to suggest a paradigm may be drawn around two main points:

1. There are different processes involved in the coding of non-literacy based stimuli compared to literacy based stimuli. Therefore, any paradigm must recognize this division.
2. There is evidence to support the theory that auditory memory, visual memory and auditory-visual integration are independent constructs. (Posner et al, 1969; Kahn and Birch, 1968).

It is to the measurement of the construct visual memory of words that this study is focused.

Chapter II has presented a review of related literature in the area of short-term memory (auditory memory, visual memory and auditory-visual integration) in relation to the [illegible] reading process.

From this review has evolved hypotheses stated in the form of questions. The design of the study formed to investigate these hypotheses is presented in Chapter III.

The following questions are investigated:

1. Does the Durrell Visual Memory of Words: Intermediate measure purely visual memory?

2. Does the Durrell Visual Memory of Words: Intermediate measure an auditory-visual integration process in short term memory with a visual input?

These questions are attended to in Chapter III where the four stages of the study are presented, Chapter IV with discussion of the analysis and results of the data and Chapter V which includes conclusions, limitations and implications of the study.

CHAPTER III

DESIGN OF THE STUDY

The major purpose of the study was an attempt to answer the question, Does the Durrell Visual Memory of Words: Intermediate measure visual memory or an auditory-visual integration process in short-term memory?

The study was conducted in four stages. Stage one of the study involved the development of the initial paradigm of the study (see Figure 1). Based on the review of literature the paradigm involved the separate constructs of auditory memory, visual memory and auditory-visual integration, using literacy-based and non-literacy based materials. The measurement instruments considered to measure the constructs pertinent to the research question, were also identified during Stage One.

In Stage Two the five tests identified as measuring auditory discrimination and auditory-visual integration were pilot tested and either modified or discarded and a new paradigm developed on the basis of the insights that resulted from the procedures of Stage One.

Stage Three of the study involved pilot testing two tests each of auditory memory, visual memory and auditory-visual integration. The research question was then attended to directly in the fourth and final stage of the study.

This chapter is organized in terms of these four stages with the procedures of the final study in the last section this chapter. The results of the final study are presented in Chapter IV.

LITERACY BASED		
VISUAL MEMORY	AUDITORY/VISUAL INTEGRATION	AUDITORY MEMORY
Monroe-Sherman Durrell Visual Memory	McCullough California Phonics Durrell Phonic Spelling	
NON-LITERACY BASED		
Yuille & Ternes Matrices		

Figure 1: Initial paradigm of the study

STAGE ONE

Stage One of the study involved the development of a paradigm and the identification of measuring instruments within that paradigm.

Initial Paradigm of the Study

The initial paradigm of the study is presented in Figure 1. Based on the review of research in the area of memory, as outlined in Chapter II three constructs were identified; auditory memory, visual memory and auditory-visual integration. Research studies suggest there may exist a different cognitive process for the coding of verbal and non-verbal stimuli. The paradigm, therefore accounts for this difference by separating literacy based materials from non-literacy based materials.

Constructs to be Measured

The study required appropriate tests of visual and auditory memory and auditory-visual integration. The search of these tests was based on the initial paradigm of the study with the exception that only non-literacy based visual memory and literacy based visual memory were compared. The rationale for this decision is based on the fact that the measurement of visual memory is the focus of the study. Tests of auditory discrimination were chosen to represent aspects of auditory memory. Therefore, the specific tests were chosen with two considerations in mind: the statements by specialists about the particular skill to be measured, and the question of the study.

Materials

The format of each test and scoring procedures are described in this section. Sample tests with instructions for their administration and sample answer sheets are provided in Appendix B.

1. Visual Memory Matrices

Yuille and Ternes, 1975

This task comprises ten 4x4 matrices containing 8 black and 8 white squares printed on a white card. The stimulus configuration to be remembered for reproduction is the pattern created by the eight black squares in each matrix. The patterns used in the study were generated by Yuille and Ternes (1975) through pilot studies:

> The presentation rates were varied until a duration was obtained with which almost no verbalization was reported (1.75 sec.). Then only those patterns for which no labels were given were retained for the subsequent experiments. (p. 363)

Scores are calculated on the number of correct patterns reproduced. Although no published validity data were available, the matrices were used in the study to provide scores assumed to reflect purely visual modality coding of form.

2. Group Diagnostic Reading Aptitude and Achievement Tests, (1939)

M. Monroe and E.E. Sherman

Visual Test 2-Form Memory

The form memory test consists of a set of four white cards on which four designs are printed sequentially in black ink. Each card is shown for ten seconds and the student responds by drawing the designs recalled. Scores are calculated on the number of single designs correct, giving a total possible score of 16.

Norms are published by percentile rank for ages 8 through 15+ years.

Although no published validity data were available, scores from this test were assumed to reflect sequential visual memory of design.

3. Durrell Analysis of Reading Difficulty, Subtest; Visual Memory of Words: Intermediate (1936, 1955)

The test consists of 15 six, eight, nine and ten letter words not in the student's sight vocabulary. The words are shown by tachistoscope, manually operated, at the rate of one word per three seconds. The required response is immediate written recall of the word viewed.

Scores are calculated on the number of words recalled correctly spelled, giving a possible total score of 15.

The subtest was standardized on a population of 1,000 students and norms are given in the form of grade equivalents for grades four, five and six.

In the absence of published validity data, scores on this test are purported to be a measure of visual memory of words.

4. McCullough Word-Analysis Tests (1960, 1962, 1963)

C.M. McCullough

Test 1. Initial Blends and Digraphs

This test "tests the pupil's ability to hear a consonant blend or digraph, and to identify the letters which make the sound." (McCullough, 1963, p. 3)

The test consists of 3 words having the same initial blend or digraph repeated orally at 1 second intervals. The words are taped to ensure consistancy in timing and accent of the administrator. There is a response interval of 5 seconds between each word list in which time the student circles the correct blend or digraph from a list of 5 on the response sheet.

Test 1, Initial Blends and Digraphs with Grade four students, has an internal consistancy reliability coefficient of .96. McCullough (1963) advises:

> The tests will prove diagnostically most valuable if the user employs the separate scores for the seven subtests .... (p. 7)

This is also the recommendation of E. Bliesmer (1972) in his review of the McCullough Word-Analysis Tests.

Scores are based on the correct identification of the visual form of the initial blend or digraph from the words given orally. Although there was no validity data, scores on this test were assumed to measure auditory-visual integration.

5. California Phonics Survey (1963)

G.M. Brown and A.B. Cottrell

Exercise 3, Form 1

The California Phonics Survey Exercise B, was modified by the researcher as suitable for Grade four and five students. The task consists of 10 items, each item being a word repeated three times at one second intervals. The test was taped to keep time intervals and the accent of tester consistent. There was a 5 second response interval between each item. Students responded by attempting to identify the visual form of the word heard aurally from a list of four words. If the word heard was not among the four options the student chose the fifth option "None".

Scores were calculated on the number of correct auditory-visual matches. Although published validity information was not available, the scores on this task were assumed to measure auditory-visual integration.

6. Durrell Analysis of Reading Difficulty

Subtest Phonic Spelling of Words. (1937, 1955)

D.D. Durrell

"The purpose of this test is to discover the child's ability to spell words as they sound" (Durrell, 1955, p. 23). Fifteen multi-syllable words were recorded individually on tape with an eight second response interval. The student wrote the orally presented word as it sounded. Each word was scored as correct if all of the sounds of the word were in the student's spelling. For example polarize should be marked correct if

spelled polerize or polarise. Scores on this test were assumed to measure auditory-visual integration, although no published evidence of validity was found.

7. Domain Auditory Discrimination Test (1968)

J. McLeod

This test is used to assess "consonantal phonemic discrimination" (McLeod, 1968). Word pairs were recorded on tape with a 3 second response interval between each one-syllable word pair. The student's response was an oral reply of "same" if the two words heard orally were the same word repeated and "different" if the two words were not alike. The tester recorded the student's response to the words identified correctly as being the same or different. The total possible score was 50. No reliability or validity data has been published. Scores on this test were assumed to measure auditory discrimination.

8. Murphy Auditory Discrimination Test (1973)

H. Murphy

This non-standardized test consists of multi-syllable words taped individually with a 3 second response interval between each word. The student was asked to listen for the occurrence of a predetermined consonant and record its position and frequency in the word heard. Scores were calculated on the correct number of words in which the consonants were fully identified by frequency and position in the word. The total possible score was 65. Although there was no validity information available, scores on this test were assumed to measure auditory discrimination.

STAGE TWO

A pilot study was undertaken using only those tests identified as measuring auditory discrimination and auditory-visual integration.

Purpose

The purpose of Stage Two of the study was to evaluate the behavior of five tests of auditory discrimination and auditory-visual integration for the purpose of determining the following:

1. The variability of each test for the particular population considered in this study.
2. The appropriateness of each test to the given age level of students, Grade 4.
3. The suitability of one or more tests for use in a further study which would include tests of visual memory.

Sample

From the population of elementary schools in Maple Ridge school district, British Columbia, three schools were chosen according to low, middle and high socio-economic status. Socio-economic areas were determined by a person knowledgeable of the school district who chose the schools randomly from within those areas. From these three schools a sample of 60 Grade four students was drawn and stratified on the basis of reading level and gender. Twelve students were randomly selected from each class as shown in Diagram 2.

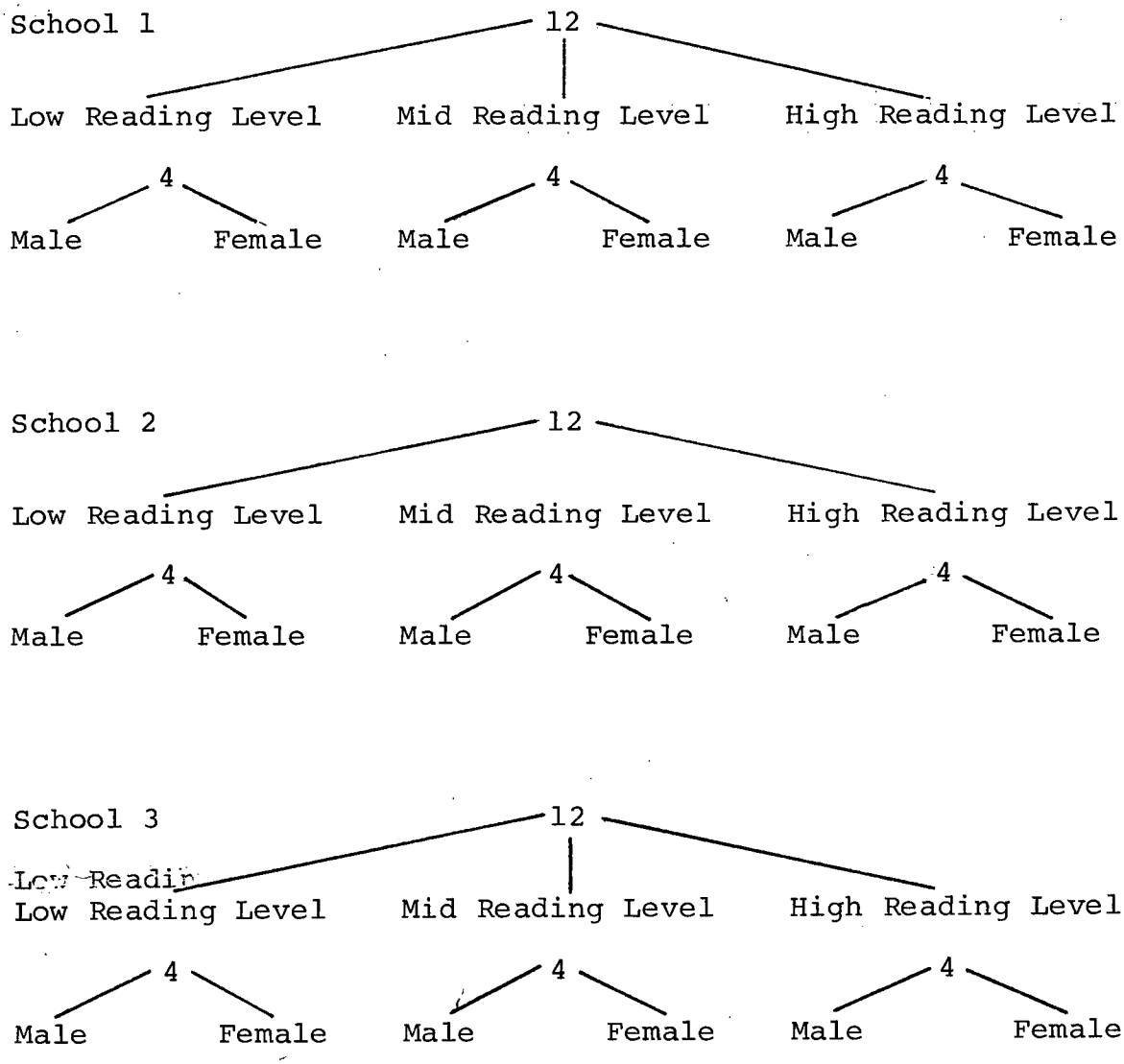

Diagram 3: Sample for Stage Two

Materials

Materials used in Stage Two were the five tests of auditory discrimination and auditory-visual integration described under Stage One of the study. These are summarized in Table 1 below.

Table 1

Materials used in Stage Two

Test	Admin.	Response Interval	Response	Recording
McLeod Auditory Discrim.	taped	3 secs.	oral	by teacher
Murphy Auditory Discrim.	taped	5 secs.	visual/ motor	by student
California Phonics Test.	taped	5 secs.	visual matching	by student
McCullough Word Analysis.	taped	5 secs.	visual/ motor	by student
Durrell Phonic Spelling	taped	8 secs.	written	by student

Administration

All testing was conducted during May and June, 1977. The tests were administered individually to 45 students in the following order sets: McLeod, McCullough and Durrell in one set, and Murphy and California Phonics in another set.

The researcher, plus one trained tester were assigned set one and set two tests randomly, alternating every six students. The students were assigned to test order haphazardly; those students who received set one in the morning received set two in the afternoon and those students who received set two in the morning, received set one in the afternoon.

One student did not complete the procedure and data were therefore discarded from the analysis.

Analysis of Data

The following analysis were conducted on the raw scores of the five tests.

1. An item analysis using Laboratory of Educational Research Test Analysis Package (LERTAP) computer program. The raw scores of those students administered the tests individually were analyzed separately from those receiving administration in a group setting.
2. A test of significance between the scores of those students administered the tests individually compared to those receiving group administration.

Results

The means, standard deviations, internal consistency reliabilities and correlations of the five tests are presented in Table 2. From an analysis of these data it was shown that the McLeod Auditory Discrimination test and the McCullough Word Analysis test produced a ceiling effect, suggesting these tests

were too easy for the age group of students in the study. The lack of variance in the score distribution on the McLeod could explain the low correlation of this test with the other tests in the study (Table 1).

Item analysis revealed the Murphy Auditory Discrimination test was too difficult for the age group tested. Some questionable items appeared from the analysis, for example "g" as in geography, where g is represented by the sound of j and g.

The item analysis further showed that the Durrell Phonic Spelling was suitable up to item nine, after which the students found the items too difficult. The point-biserials revealed the fact that the students who did well on the test as a whole performed poorly from item 9 to item 15.

Conclusions

The conclusions reached in relation to the results and purpose of the first pilot study were:

1. The California Phonics test and the Durrell Phonic Spelling test were judged to be appropriate tests for the age level tested.

2. The McCullough Word Analysis, McLeod Auditory Discrimination and the Murphy Auditory Discrimination tests were judged to be inappropriate for intermediate grade students.

Insights Resulting from Stage Two

The recommendations that resulted from Stage Two of the study are presented:

1. Further studies should be limited to the use of words as the mode of stimuli, limiting the study to literacy-based tests.

   It was decided that to attend to the research question, Does the Durrell Visual Memory of Words: Intermediate measure visual memory or an auditory-visual integration process? then comparable stimuli must be presented in the auditory and visual modalities. i.e. words. Furthermore, control of the response mode was found to be necessary for comparison of tasks. A new paradigm

Table 2

Test Statistics for Stage Two Materials

	Variable				
Total Score	1	2	3	4	5
Total Score	10	50	15	30	65
Indiv. Admin (n=45)					
$\bar{x}$	5.42	43.02	3.50	30.00	26.93
S.D.	2.18	4.59	2.60	6.73	8.30
Hoyt Est. of Reliability	.58	.77	.72	.97	.78
t	-1.21	-1.41	*2.30	*2.08	**1.86

Correlation Matrix

Ind. Admin					
1	1.000				
2	0.295	1.000			
3	0.456	0.284	1.000		
4	0.183	0.150	0.103	1.000	
5	0.464	0.222	0.255	0.132	1.000

* sig. at $p < .05$
** sig. at $p < .05$

Variable 1 = California Phonics
2 = McLeod Auditory Discrimination
3 = Durrell Phonic Spelling
4 = McCullough Word Analysis
5 = Murphy Auditory Discrimination

for the study was therefore developed (see Figure 3) based on the following:

a) The existence of the three constructs auditory memory, visual memory and auditory-visual integration.

b) Instruments for measuring these constructs were limited to the use of words.

c) Each construct should have a task requiring a matching response to reflect a recognition process (Carroll, 1971) and a task requiring sequential recall.

2. The California Phonics and the Durrell Phonic Spelling should be further investigated as measures of the construct auditory-visual integration.

3. The administration of the Durrell Phonic Spelling should be modified to alleviate the rise in difficulty level after item nine as outlined in the analysis. It was decided that the response interval per item should be lengthened from 8 seconds to 10 seconds.

4. The Murphy Auditory Discrimination, McCullough Word Analysis and McLeod Auditory Discrimination should be

discarded from further exploratory studies and a search should be made for more appropriate measures of auditory discrimination/memory.

STAGE THREE

As a result of Stage Two, the Durrell Phonic Spelling and the California Phonics tests were accepted as measures of auditory-visual integration fitting into the following new paradigm (Figure 2).

Task	Modality		
RECOGNITION	AUDITORY ORAL	AUDITORY VISUAL	VISUAL VISUAL
	GFW AUDITORY RECOG. MEMORY	CALIFORNIA PHONICS AUDITORY	CALIFORNIA PHONICS: VISUAL
RECALL	AUDITORY ORAL	AUDITORY VISUAL	VISUAL VISUAL
	JARMAN SERIAL RECALL	DURRELL PHONIC SPELL.	DURRELL VISUAL MEMORY

Figure 2: Stages Three and Four: Paradigm of the Study

Purpose

A second pilot study was undertaken for the following purposes:

1. to evaluate the appropriateness of the tests for the age level chosen

and 2. to refine field procedures for test administration.

Sample

Taking into account the age of the students during the Spring testing, it was decided this stage of the study be conducted using Grade five students in the Fall of 1977.

A class of 22 Grade five students attending a Maple Ridge elementary school were individually tested over a three-day period.

Materials

Sample tests with instructions for their administration and sample answer sheets are provided in Appendix B. An extensive search of tests purporting to measure the construct auditory memory, revealed two instruments:

G-F-W Auditory Memory Tests (1974)

Test 1 Recognition Memory

R. Goldman, M. Fristoe, R. Woodcock

This test consists of 110 mono-syllable words presented

auditorally at one second intervals, in sets of 22 words. The words were recorded on tape to retain consistent time intervals and accent of the female administrator. The student responded "yes" orally if they had heard the taped voice say the word previously and "no" if he/she had not heard the word said before. The number of correct responses are calculated to reach a total number correct out of 110.

The G-F-W Auditory Recognition Memory Test was standardized on a population ranging in age from three to 85 years and has an internal consistency reliability for 9-12 year olds of .96.

Although there was no published validity data available, scores from this test were assumed to measure auditory recognition memory.

Jarman Auditory Serial Recall (1977)

R.F. Jarman

The serial recall task consists of a set of 12 word lists, with five words in each list. Of these lists, six contain words which are semantically similar to one another, and the other six contain five unrelated words. The two types of word lists are randomly ordered in the test. Each list was presented by the use of a cassette tape recording, following which the subject was asked to recall the list in the order given. The total score for each list is the number of words in the correct position, with a possible total score of five per list, giving a maximum test score of 60.

The original Jarman serial recall task of 24 words lists with four words in each list has been used extensively in experimental studies involving Grade four and primary-grade students. Under the direction of Dr. Ron Jarman, the task was modified as described for use with Grade five students.

In 1977 Jarman reported the results of a principal components analysis using the serial recall task in conjunction with five other cognitive tasks. He found evidence to support the inclusion of the serial recall task as a representative of successive synthesis. Therefore for the purpose of this study scores on the Jarman serial recall task are assumed to measure auditory serial recall of words.

California Phonics Survey (1963)

Exercise 3 Form 2

G.M. Brown and A.B. Cotrrell

A test which measures visual recognition memory was not available for the intermediate-age level students. It was therefore decided to use a modification of Form 2 of the California Phonics test, exercise 3.

The words were not in the student's sight vocabulary and were presented visually by tachistoscope for a 1 second duration. The student matched the word shown in the tachistoscope to a list of four, with a "None" option if the word was not one of the four listed.

Correctly identified words and "none" options were calculated for the total scores. Although there was no validity data

available, for the purpose of the study the scores on this task were assumed to measure visual recognition memory.

The three tasks mentioned above, plus the Durrell Visual Memory of Words and the California Phonics Form 1 presented visually, required piloting prior to acceptance as appropriate measures within the current paradigm of the study (see Figure 2).

Administration

Table 3 presents the five tests used in the third stage, the administration format, responses and recording procedures.

Table 3

Materials Used in Stage Three

Test	Admin.	Response Interval	Response	Recording
GFW Auditory Memory:	taped	2 secs.	oral	by tester
California Phonics Vis:	tachist.	2 secs	visual/ matching	by student
Durrell Phonic Spelling:	taped	10 secs.	written recall	by student
California Phonics Aud:	taped	5 secs.	visual/ matching	by student
Durrell Visual Memory:	tachist.	3 secs.	written recall	by student
Jarman Auditory Recall:	taped	5 secs.	oral recall	by tester

The tests were individually administered to 21 students in the following sets: GFW, California Phonics - Visual in one set and California Phonics - Auditory, Durrell Visual Memory and the Jarman Auditory Recall in another set.

Two testers administered both sets of tests with students being assigned randomly to set and tester.

Eight students received the 110 item GFW Auditory Memory test and seventeen students received 66 items on the test in order to ascertain the required test length for this age population.

Coding and Scoring Procedure

All tests were coded by the researcher, keypunched and 100% verification obtained.

Analysis of Data

In relation to the purpose of the pilot study the total raw scores from each of the five measures were analyzed using computer program U.B.C. Triangular Regression Package (TRP). The results are presented in Table 4.

Table 4

Stage Three: Means and Standard Deviations of Tests

Name	Mean	Stand. Dev.	% Mean	Total Score
GFW Auditory Memory	62.57	2.38	95	66
California Phonics-Vis:	7.90	1.64	79	10
Durrell Visual Memory	8.19	3.91	55	15
California Phonics-Aud:	5.66	2.74	57	10
Jarman Auditory Recall:	30.19	14.74	50	60

Results

The GFW Auditory Memory test and the California Phonics-Visual produce high mean scores (95 % and 79 %) suggesting an easy task for this age level. However, high means, together with lack of variance may also have been an artifact of the small

sample size. Performance on the Durrell Visual Memory, California Phonics-Auditory and Jarman Auditory Recall was shown to be appropriate for this age level (See Table 4).

Conclusions

Based on the results of Stage 2, it was decided:

1. To adopt the paradigm as described at the beginning of Stage 2.
2. To employ the 6 tests, namely, GFW Auditory Memory, California Phonics-Visual, Durrell Phonic Spelling, California Phonics-Auditory, Durrell Visual Memory, and Jarman Auditory Recall, with a larger sample of grade five students.

Therefore, although the data was limited, the preliminary stages indicated that these tests were appropriate to answer the major research question posed for this study; namely, Does the Durrell Visual Memory of Words: Intermediate measure visual memory or an auditory-visual integration aspect of short-term memory?

To further investigate this question, Stage Four of the study was conducted in November/December 1977.

STAGE FOUR

Purpose

The purpose of the third stage of the study was to continue to explore the construct validity of the Durrell Visual Memory of Words: Intermediate.

Sample

From the defined population of 575 Grade five students in fifteen schools in Maple Ridge school district the schools were stratified according to socio-economic status and a random sample of six classes drawn from five schools. Excluded from the study were those students:

1. whose primary language is not English.
2. with visual or auditory impairment.
3. who have repeated previous grades.

The sample for Stage Four of the study consisted of 120 grade five students in six classes.

Administration

Table 5 presents tests used in the third stage, administration was consistent with Stage Three (See Table 3).

Table 5

Materials Used in Stage Four

Construct Measured	Name of Test
Auditory Memory - Recognition	Goodman-Fristoe-Woodcock Auditory Recognition Memory (1974)
- Recall	Jarman Auditory Serial Recall (1977)
Auditory Visual Integration	
- Recognition	California Phonics Survey (1963)
Auditory-Visual Integration	
- Recall	Durrell Phonic Spelling
Visual Memory - Recognition	California Phonics Survey (1963)
- Recall	Durrell Visual Memory of Words: Intermediate (1955)

Tests were administered individually in the order and procedure described in Stage three of the study. The 110 item GFW Auditory Memory test was given to all 120 students. Ten testers were trained by the researcher in the administration techniques of all six tests. As four of the tests were recorded on tape and two were presented visually by tachistoscope, tester-student interaction was minimal. The researcher took part in test administration in all three stages of the study.

Coding and Scoring Procedures

One student did not complete the testing procedures and this data were not included in the analysis. The six tests of 119 students were coded, checked and keypunched with 100% verification.

Analysis of Data

The data were collected and analyzed using the following statistical procedures:

a) Zero-order correlation coefficients were examined to conduct a preliminary investigation of the strength of relationships between the construct being measured.

b) The data were subjected to multiple regression analysis using the scores on the Durrell Visual Memory of Words as the dependent variable and the scores on the GFW, Jarman, Durrell Phonic Spelling and the California Phonics as independent variables.

A detailed description of the results of the data for the fourth stage is reported in Chapter IV of this thesis.

CHAPTER IV

ANALYSIS AND RESULTS OF DATA FROM THE FINAL STUDY

Chapter III presented the study in four stages. The purposes, execution and results of Stages One, Two and Three are described. Chapter IV is devoted to the analysis of data and presentation of the results of Stage Four of the study. Discussion of the results, together with a summary and conclusions is presented in Chapter V.

Item and Test Analysis

An item analysis was performed for each of the tests using LERTAP computer program. Inspection of the point-biserials for each item in a given test revealed that all items were performing correctly: that is, those students who performed well on the test as a whole chose the correct option on the individual test reliabilities and correlations are presented in Table 6. A look at the mean and standard deviation of each test revealed the California Phonics-Visual and the GFW Auditory Memory tests were easy tests for the age level tested. For example, the GFW has a mean of 101.94 with a total possible score of 110, and the California Phonics-Visual has a mean of 7.08 with a total possible score

of 10. The frequency polygons presented in Figures 3 and 4 substantiate the fact that these two tests have little variance in this population of Grade five students. Item analysis showed that over 74% of all students responded correctly to all items on the GFW Auditory Memory test.

Test order was shown to have a significant effect on performance on the Jarman Auditory Recall test ($t = 3.68$, $p < .05$). Test order did not have a significant effect on the performance on other tests. However, it was decided to control for test order in the multiple regression analysis by including it as an independent variable.

Multiple Regression Analysis

The zero-order correlation matrix is presented in Table 6. It is important to note the generally low correlations among the tests and the fact that the Durrell Visual Memory of Words: Intermediate has the highest correlation with the California Phonics-Auditory ($r = .61$) and the Durrell Phonics Spelling ($r = .49$). These relationships between the tests are relevant to the multiple regression analysis. A summary of the step-wise regression is presented in Table 7.

Using the Durrell Visual Memory of Words: Intermediate as the dependent variable and the GFW, California Phonics-Visual, Jarman Auditory Recall, California Phonics-Auditory, gender, reading score and test order as independent variables, a multiple regression analysis was conducted to ascertain how much of the variance of the Durrell Visual Memory of Words was accounted for

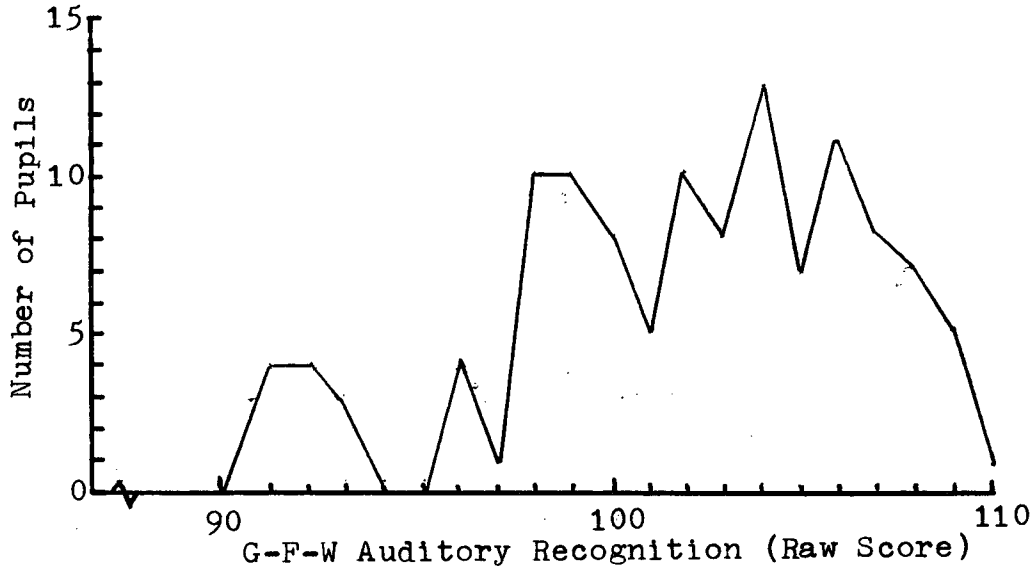

Figure 3. Frequency distribution of raw scores on the G-F-W Auditory Recognition Test

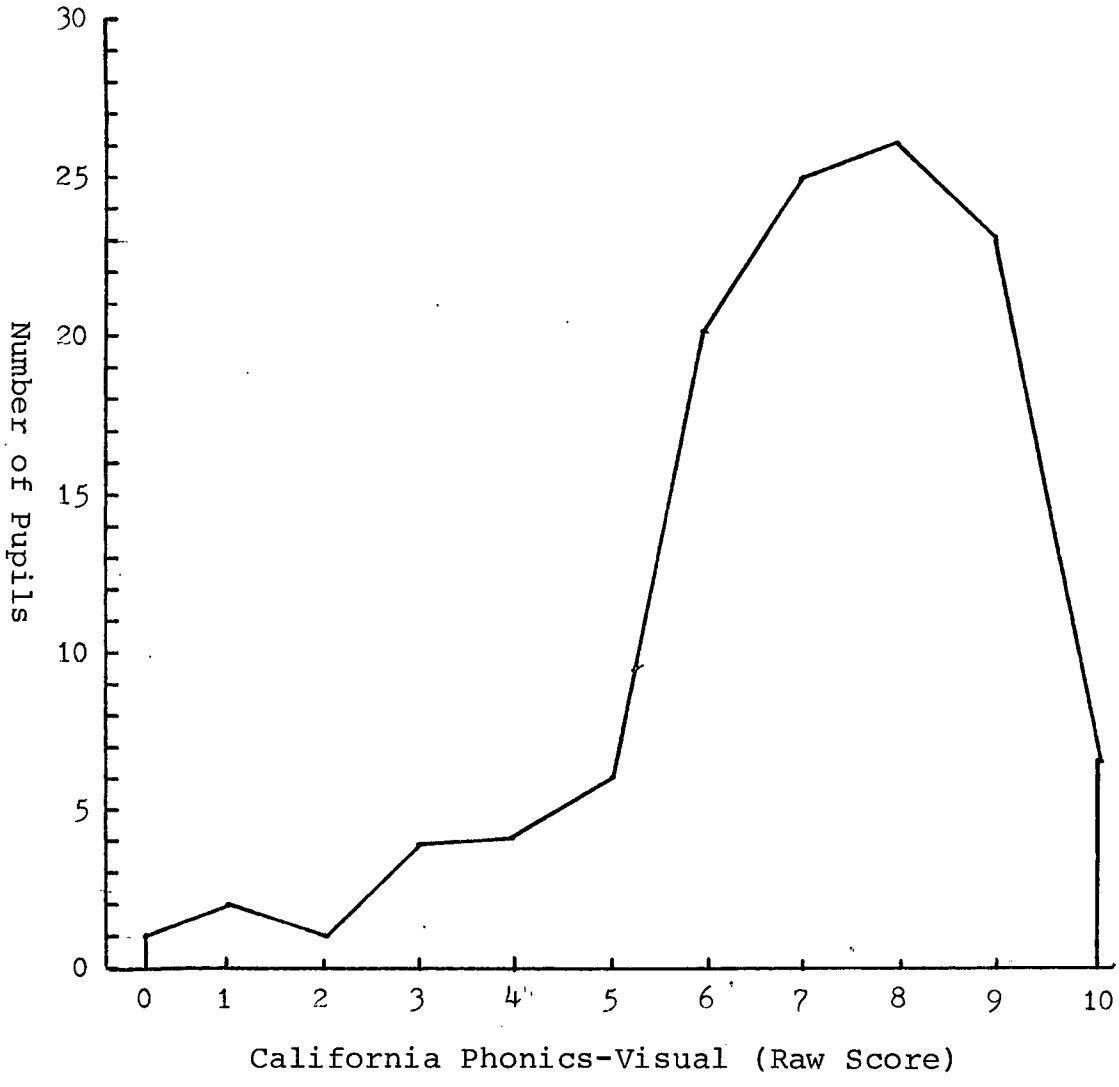

Figure 4: Frequency distribution of raw scores on the California Phonics-Visual Test

by the independent variables described.

The students reading score on the Canadian Test of Basic Skills (CTBS) was assumed to measure general reading competence. This variable was therefore entered first in the multiple regression equation in order to take out the unique variance of the Durrell Visual Memory attributable to the general reading ability of the student. It was found that 18.4 percent of the variance of the Durrell Visual Memory is attributable to the general reading ability of the student as measured by the CTBS. An additional 28.8 percent of the variance of the Durrell Visual Memory is accounted for by the California Phonics-Auditory.

The GFW accounted for an additional 3 percent, Jarman Auditory Recall 2 percent and California Phonics-Visual 1 percent. This results in a total of 55 percent of the variance of the Durrell Visual Memory attributable to general reading ability plus tests of auditory-visual, auditory and visual memory.

The Durrell Phonic Spelling test did not enter in the regression equation when the reading score and the California Phonics-Auditory were entered. This suggests that the Durrell Phonic Spelling influence on the Durrell Visual Memory is accounted for by general reading ability as measured by CTBS and an auditory-visual integration measure, California Phonics-Auditory. The major contribution made by Reading and California Phonics-Auditory to the variance is shown by the step-wise regression (Table 7) and illustrated in Diagram 4. By the end of step 2 47 percent of the variance of the Durrell Visual Memory is accounted for

Table 6

Test Statistics for Stage Four Materials

Variable

		1	2	3	4	5	6
Possible	Total	110	7108	4150	4100	15	60
	$\bar{X}$	101.94	7.08	4.90	4.40	6.76	29.73
	S.D.	4.73	2.00	3.18	2.39	4.54	14.56
	Rel.	.69	.58	.79	.67	.90	.87

Correlation Matrix

	1	2	3	4	5	6	7	8	9
1	1.000								
2	.109	1.000							
3	.265	.259	1.000						
4	.166	.369	.460	1.000					
5	.343	.416	.488	.612	1.000				
6	.140	.121	.309	.314	.402	1.000			
7	.249	.331	.364	.200	.429	.226	1.000		
8	.142	.132	.025	.109	.160	.321	.221	1.000	
9	.041	.198	.118	.222	.234	-.057	.226	.081	1.000

1 = GFW Auditory Memory

2 = California Phonics - Visual

3 = Durrell Phonic Spelling

4 = California Phonics - Auditory

5 = Durrell Visual Memory

6 = Jarman Auditory Recall

7 = Reading score

8 = Test order

9 = Gender

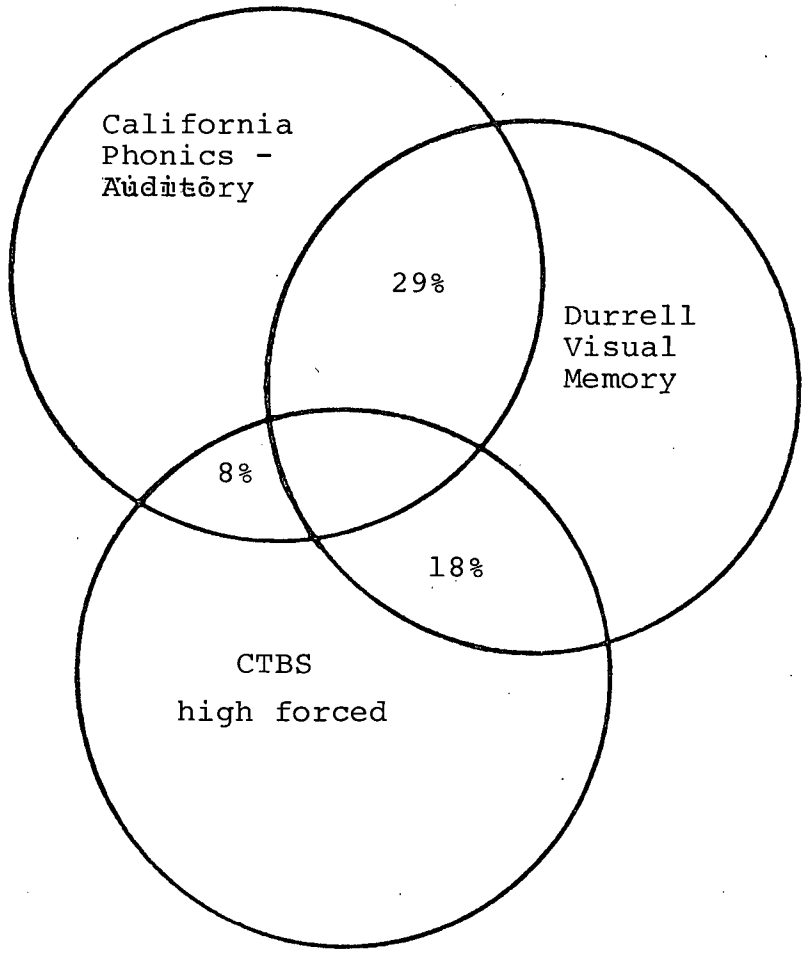

Diagram 4: The largest contributors to the variance of the Durrell Visual Memory of Words: Intermediate

by the two measures mentioned previously. Furthermore, the reduction in the partial correlation between the Durrell Visual Memory and the Durrell Phonic Spelling prior to step 1 (r= .39) and after step 2 (r= .16) substantiates the fact that the Durrell Phonic Spelling is accounted for in the regression equation by the California Phonics-Auditory.

Chapter IV has presented the analysis and results of data for Stage Four of the study. A discussion of these results and a summary of conclusions is presented in Chapter V.

Table 7

Summary of Step-Wise Regression Analysis for Stage Four Data[b]

Variables in Equation					Variables Not in Equation	
Step	Variable Entered	R^2	df	F	Variable	Partial Correlation
1	RDNG[a]	.183	1/117	26.325	GFW	.270
					CALVIS	.321
					DURSP	.394
					CALAUD	.594
					JMANSR	.347
					GENDER	.156
					TEST ORDER	.073
2	CALAUD	.471	1/116	63.261	GFW	.247
					CALVIS	.167
					DURSP	.195
					JMANSR	.233
					GENDER	.058
					TEST ORDER	.041
3	GFW	.504	1/115	7.485	CALVIS	.175
					DURSP	.163
					JMANSR	.227
					GENDER	.070
					TEST ORDER	.021
4	JMANSR	.529	4/114	6.187	CALVIS	.190
					DURSP	.135
					GENDER	.114
					TEST ORDER	-.044
5	CALVIS	.546	5/113	4.255	DURSP	.132
					GENDER	.102
					TEST ORDER	-.056

Y = -0.0 + .179 RDING + .147 CALAUD + .430 GFW + .177 JMANSR + .209 CALVIS

a Forced in to serve as covariate. All others free to enter at any stage. $p < .01$.

b RDNG + CTBS Reading Score; CALAUD = California Phonics - Auditory; GFW = GFW Auditory Memory; JMANSR = Jarman Auditory Recall; CALVIS= California Phonics - Visual; DURSP = Durrell Phonic Spelling

c No attempt was made to set the Y intercept at 0, therefore it can be concluded the additive constant in the model is 0.

(Kerlinger and Pedhazur, 1973, 293)

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of the study was an attempt to answer the question, Does the Durrell Visual Memory of Words: Intermediate measure visual memory or an auditory-visual integration process in short-term memory?

Summary of the Study

To address this question two measures each of auditory memory, visual memory and auditory-visual integration were used. The results of the pilot studies revealed:

1. the paradigm of the study should include only literacy based measures.

and 2. which measures were most appropriate for the age level being tested within the constructs of auditory memory, visual memory and auditory-visual integration.

Thus the final stage of the study was conducted using the following measures: GFW Auditory Recognition Memory, Jarman Auditory Recall, California Phonics-Auditory, Durrell Phonic Spelling, California Phonics-Visual, Durrell Visual Memory. The measures were individually administered to 119 Grade five students, controlling for the effect of test order. Scores from the Canadian Test of Basic Skills were used post-hoc to represent general reading ability

Item analysis and multiple regression analysis were performed on the data. Item analysis revealed the point-biserials on any given test were in the correct order. Analysis of the test statistics showed the GFW Auditory Memory and the California

Phonics - Visual were easy tests for the age-level students tested.

Multiple regression analysis resulted in the final equation which states that 55% of the variance of the Durrell Visual Memory of Words: Intermediate is accounted for by CTBS Reading Score, California Phonics-Auditory, GFW Auditory Memory, Jarman Auditory Recall and California Phonics-Visual.

It was concluded from these results that there was sufficient evidence to question the placing of the Durrell Visual Memory of Words: Intermediate within the construct of visual memory.

Discussion of Results

The summary is presented in terms of the paradigm presented. It is important to keep in mind the basic conceptual framework of the study and the assumptions derived therefrom.

The paradigm as outlined in Chapter III and represented in Figure 5.

To adopt this paradigm one must accept:

1) that the constructs auditory memory, visual memory, auditory-visual integration as presented in Chapter II are independent of each other.
2) that response modes may reflect different memory processes i.e. matching reflects recognition whereas serial responses reflect recall functions in memory.
3) that the tests outlined reflect measurement of the constructs as shown.

Task	Modality		
RECOGNITION	AUDITORY	AUDITORY	VISUAL
	ORAL	VISUAL	VISUAL
	GFW AUDITORY RECOG. MEMORY	CALIFORNIA PHONICS: AUDITORY	CALIFORNIA PHONICS: VISUAL
RECALL	AUDITORY	AUDITORY	VISUAL
	ORAL	VISUAL	VISUAL
	JARMAN SERIAL RECALL	DURRELL PHONIC SPELL.	DURRELL VISUAL MEMORY

Figure 5: Paradigm of the study

Given that it is the construct validity of the Durrell Visual Memory of Words which is being investigated, initial discussion of the paradigm will exclude this test.

Taking statements one and three as correct assumptions, one would anticipate that the measures of auditory memory would have low correlations with the measure of visual memory (excluding the Durrell Visual Memory of Words at this point). It was found that correlation between GFW and the California Phonics - Visual was .109 and the correlation between Jarman Auditory Recall and the California Phonics-Visual was .121.

Auditory-visual integration may be considered to have an auditory and visual memory function. It could be anticipated therefore, that measures of auditory and visual modalities would

have a low positive correlation with measures of auditory-visual integration. The results as shown in Table 7 substantiate this expectation. The range of correlation coefficients is from .166 (the correlation between the GFW and California Phonics: Auditory) to .369 (the correlation between the California Phonics, Visual and California Phonics-Auditory).

Therefore, if the Durrell Visual Memory of Words: Intermediate was indeed a pure measure of visual memory, a similar correlational pattern as described would be expected.

However, results revealed that the Durrell Visual Memory of Words correlated positively with each measure of auditory memory (GFW r=.343; Jarman r=.402), with the measure of visual memory (California Phonics-Visual r=.416) and most highly with the measures of auditory-visual integration (Durrell Spelling r=.488; California Phonics, Auditory r=.612). This pattern questions the placement of the Durrell Visual Memory of Words: Intermediate within the construct visual memory.

Further substantiation for this question is provided by the multiple regression analysis (Table 7) where it was shown that 4 percent of the variance was accounted for by tests of auditory memory, 29 percent by tests of auditory-visual integration and only 1 percent by a test of visual memory.

It would appear, therefore, that the Durrell Visual Memory of Words: Intermediate does not fit into the paradigm of the study as shown in Figure 5. The test does not only measure

recall of words from a visual modality but includes a measure of auditory visual integration. The definition of auditory-visual integration given for the purpose of this study was - the ability to recognize or recall words visually which have been presented orally. This definition should be expanded to include the ability to recognize or recall words visually or orally which have been presented to visual or auditory modalities.

The results supported the existence of different processes being measured by a recognition (matching) task compared with a serial recall task. This is most clearly shown by the low correlation of .140 between GFW and Jarman Recall. From the analysis it appears that the California Phonics-Auditory may also be measuring a recall function rather than a recognition function in memory, thus accounting for the moderate positive correlations with the measures of recall and visual recognition but low correlation with the measure of auditory recognition memory (GFW r=.166). Therefore, the California Phonics-Auditory may not be measuring a recognition process, for the task involves words not in the student's sight vocabulary. Consequently when a word is not part of a student's sight vocabulary the word is recalled in parts (using phonetic cues) rather than recognized by its whole shape.

There seems to be justification for considering the California Phonics-Auditory as requiring a recall task in the auditory-visual integration modality.

Conclusions

The conclusions are stated in relation to the hypotheses. Thus, based on the analysis there appears to be evidence that:

1. the Durrell Visual Memory of Words: Intermediate does not measure a purely visual memory process.

and 2. the Durrell Visual Memory of Words: Intermediate contains a measure of an auditory-visual integration process with a visual input.

It may be that the measuring instruments we have for testing visual and auditory processing of words are not refined enough to assess each modality. However, it may be that in dealing with the skilled reader rehearsal systems are aiding recall of visual and auditory input to such an extent that any measurement of modalities will automatically include an integration of the two.

Limitations of the Study

1. The search for measuring instruments, while thorough, produced a limited number of tests suitable for the constructs being measured with students of grade 4 and 5 age level. Thus non-standardized tests were used to represent the construct being measured: for example, Jarman Auditory Recall and California Phonics presented visually.

2. The number of testers used in the study is seen as a limitation, but instructions for administration of the tests were minimal and four out of the six tests were taped to maintain consistency of time intervals and pronunciation of the words.

3. The generalizations from the results are limited to raising the question as to whether we can indeed test visual memory of words without measurement of an auditory-visual integration process.

Implications of the Study

The study raises the question of if there is a way of testing visual and auditory memory of words independently or whether indeed each includes a measurement of an auditory-visual integration process.

Psychometric implications of the study are that a tester should specify the process to be measured, and ensure that the test being used measures that process. Until validation studies are included in a test's technical report the clinician must be aware of the limitations of any such tests.

Educational implications of the study for the classroom teacher are limited to the knowledge that auditory-visual processing is of importance in the approach to reading instruction. Therefore, any techniques for the teaching of reading to intermediate grade students should include the integration of auditory and visual stimuli.

Implications for diagnosticians of reading difficulties who also recommend remediation programs, are that exercises of auditory-visual integration, using auditory input and visual input, should be included in those programs.

Suggestions for Further Research

The study suggests some possibilities for further research.

1. Further explorations of the construct validity of tests of specific modality and cross-modal functioning.

2. A study to compare visual processing of non-verbal with verbal materials, using the Durrell Visual Memory of Words: Intermediate as a verbal stimulus.

3. Further studies to investigate the relationship between auditory-visual processing and spelling performance. These studies could be conducted with hearing and hearing impaired students to compare both the difficulty level of words and types of error patterns.

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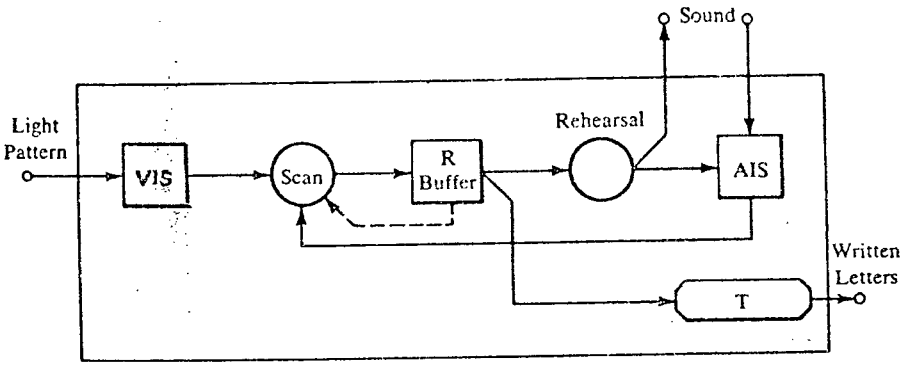
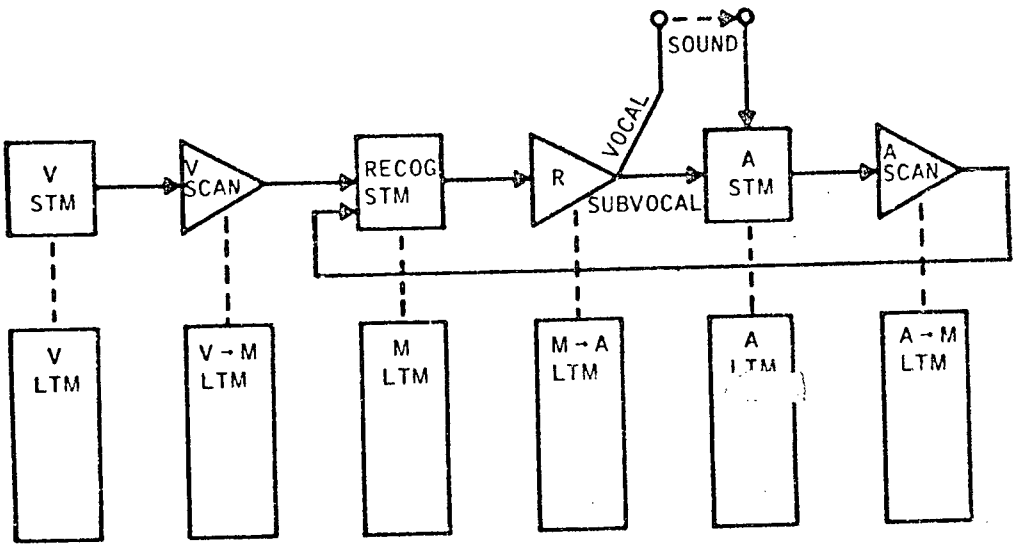
APPENDIX A

MODEL OF MEMORY PROCESSES



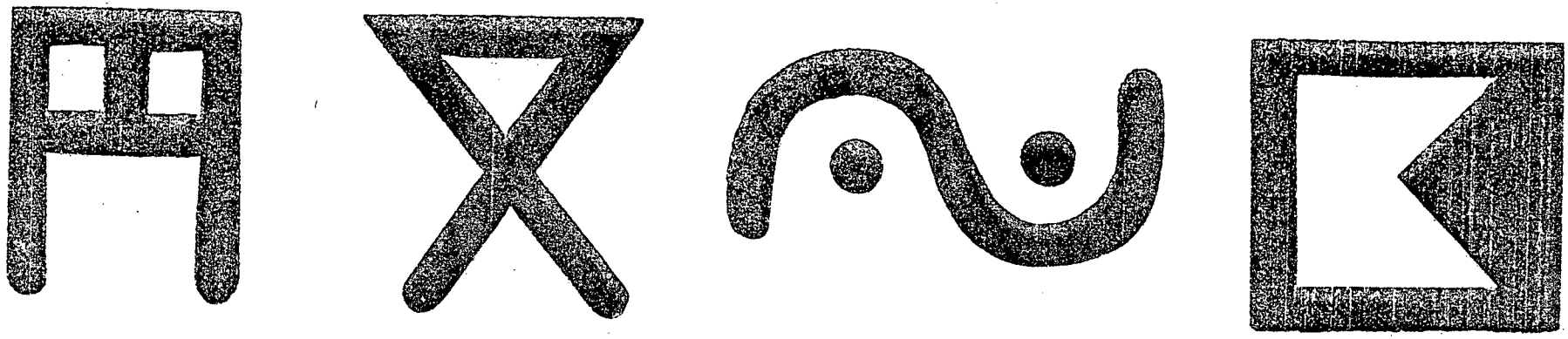
Schematic representation of model of visual-information processing (Sperling, 1967, p. 290).



Schematic representation of model of visual-information processing (Sperling, 1970, p. 199).

APPENDIX B

TESTS USED IN THE STUDY



Visual Test - Form 2

(Monroe & Sherman, 1939)

Monroe & Sherman

Visual Test - Form 2

Directions: The teacher will show you designs on a card. Study these designs until the teacher removes the card. Then draw as many of them as you can remember.

Show each card 10 seconds.

Card 1.

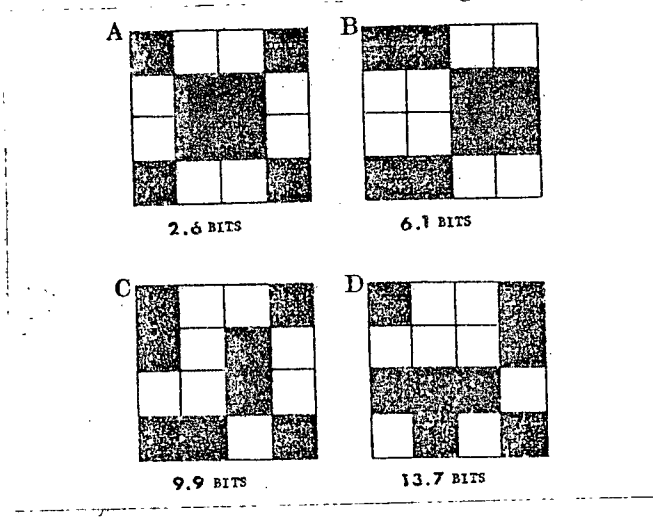
Card 2.

Card 3.

Card 4.

Score _____

(Number of single designs correct)



Visual Memory Matrices

(Yuille & Ternes, 1975)

MURPHY AUDITORY DISCRIMINATION

DIRECTIONS

SAY:

You are going to hear some words and will be told the letter you are to listen for in those words.

If you hear the sound of that letter at the beginning of the word, write the number 1. THE VERY BEGINNING

If you hear the sound of the letter in the middle of the word, write the number 2. ANYWHERE ELSE

If you hear the sound of the letter at the end of the word, write the number 3. THE VERY END

Listen carefully, sometimes you may hear the sound once in a word, sometimes two or three times in one word.

Be sure to record each time you hear the sound of the letter you are told.

Let's try some examples:

Turn tape on: a - antique

Turn tape off, THEN SAY:

Did you hear the a sound at the beginning or the middle or the end of the word antique?
Yes, it was at the beginning, so you record a number 1 on your recording sheet.

If the student does not understand repeat the explanation.

THEN SAY:

Let's try another word.

Turn tape on: 1 - balcony

Turn tape off, repeat the procedure as for example one.

When the student understands the task proceed with the test.

MURPHY AUDITORY DISCRIMINATION TEST

The letters the children are to listen for are listed before the words, and the expected responses are given after each word.

"Listen to tell where you hear the sound made by the letter - in this word ...."

Example: a - antique - 1
1 - balcony - 2

1. b - Bambino - 1,2
2. g - geography - 1,2
3. e - Bethlehem - 2,2,2
4. i - biscuit - 2,2
5. d - dandelion - 1,2
6. o - chocolate - 2,2
7. m - complement - 2,2
8. f - fanfare - 1,2
9. z - horizon - 2
10. 0 - Acropolis - 2,2
11. r - agriculture - 2,3
12. a - alabaster - 1,2,2
13. n - alagonquin - 2,3
14. l - Alleghany - 2,2
15. e - reflection - 2,2
16. d - Bagdad - 2,3
17. b - bibliography - 1,2
18. n - convenient - 2,2,2
19. g - genealogical - 1,2
20. p - hippopotamus - 2,2,2

MURPHY AUDITORY DISCRIMINATION

School _____ Teacher: _____

Name _____ Date _____

Examples:

_____

_____

1.	_____	11.	_____
2.	_____	12.	_____
3.	_____	13.	_____
4.	_____	14.	_____
5.	_____	15.	_____
6.	_____	16.	_____
7.	_____	17.	_____
8.	_____	18.	_____
9.	_____	19.	_____
10.	_____	20.	_____

McLEOD AUDITORY DISCRIMINATION

DIRECTIONS

SAY:

You are going to hear some words. Two words at a time. Listen carefully and tell me if the two words you hear are the same words said twice or two different words. If the two words are exactly the same you say SAME. If they are not exactly the same you say DIFFERENT.

Let's try some pairs for practice.

Turn tape on: MAN - MAN

Turn tape off, THEN SAY:

Did you hear the same word twice or two different words?

Wait for the pupil to answer.
If he says same or yes say THAT'S RIGHT, and switch on the tape recorder for the next pair of words.

If he says different, or no or I don't know, repeat the instructions. When you are sure he understands, SAY,

Let's try another pair.

Turn tape on: HAR - PAT
Turn tape off, THEN SAY:

Did you hear the same word twice or two different words?

Wait for the pupil to answer. Follow the same procedure as for the first pair.
When you are sure the pupil understands go on with the test.
SCORING THE TEST:

On the test form are two response columns, one headed Different and the other headed Same. Make a mark (+) or (-) in the response column corresponding to each word-pair as the subject responds. Mark only in the unshaded box after each word-pair.

Auditory Discrimination Test

p5

				S	D
1.	put	—	put	■	
2.	wish	—	with		■
3.	back	—	bag		■
4.	pair	—	care		■
5.	him	—	him	■	
6.	shop	—	shot		■
7.	done	—	none		■
8.	wood	—	wood	■	
9.	leg	—	led		■
10.	short	—	caught		■
11.	beat	—	meet		■
12.	god	—	got		■
13.	get	—	yet		■
14.	bed	—	dead		■
15.	gold	—	told		■
16.	might	—	night		■
17.	will	—	wing		■
18.	thus	—	thus	■	
19.	thing	—	thin		■
20.	ten	—	then		■
21.	tell	—	sell		■
22.	town	—	down		■
23.	race	—	raise		■
24.	chair	—	care		■
25.	board	—	born		■

				S	D
26.	big	—	bit		■
27.	short	—	thought		■
28.	could	—	good		■
29.	take	—	take	■	
30.	wife	—	wise		■
31.	few	—	view		■
32.	said	—	said	■	
33.	feet	—	seat		■
34.	sing	—	thing		■
35.	well	—	well	■	
36.	had	—	had	■	
37.	both	—	boat		■
38.	chair	—	share		■
39.	wish	—	wing		■
40.	tear	—	pair		■
41.	part	—	pass		■
42.	have	—	hat		■
43.	talk	—	talk	■	
44.	pull	—	full		■
45.	face	—	case		■
46.	right	—	rise		■
47.	pair	—	bear		■
48.	gate	—	date		■
49.	dare	—	their		■
50.	seem	—	seen		■

Error Score S 41 D 9

Domain Auditory Discrimination Test

(McLeod, 1968)

McCULLOUGH INITIAL BLENDS AND DIGRAPHS

DIRECTIONS

Read the directions given on the answer sheet.

Turn tape on: the this them

Turn tape off.

Have the pupils tell what letters these words begin with and put a cross on the th in the row of letters in the sample on their test.

When it is certain that the directions are clearly understood, proceed with the test.

1.	truck	train	trunk
2.	grass	green	grow
3.	steps	stairs	stars
4.	cherries	chair	chicks
5.	crowd	crow	crumbs
6.	flower	flag	floor
7.	pretty	prize	proud
8.	sleep	sled	slight
9.	smile	small	smooth
10.	fruit	fresh	friend
11.	sheep	shawl	shoes
12.	black	blew	blow
13.	skip	skirt	sky
14.	spider	spots	spoon
15.	plant	plate	plane

NAME_____

This is a test of your ability to remember the letters that form the sounds in words. Your teacher will say three words. All of the words will begin with the same two or three letters. You are to decide what letters they are.

Look at the sample and listen for the beginning sound in the words your teacher says. Find the letters that make the beginning sound you hear. Put a cross (X) on them. Complete the test in the same way.

SAMPLE: ch sh th cl

1.	th	dr	tr	fr	16.	sh	sp	cl	sc
2.	cr	gr	ch	bl	17.	qu	wr	ch	cl
3.	sl	fr	st	cl	18.	cl	dr	kn	br
4.	cl	ch	sh	th	19.	sh	bl	th	ph
5.	cr	dr	ch	wr	20.	ch	br	pr	cl
6.	ph	gr	fr	fl	21.	wh	wr	ch	th
7.	pr	br	dr	pl	22.	dr	pr	gl	gr
8.	st	cl	sl	sh	23.	ph	ch	th	sl
9.	sp	sm	ch	sw	24.	br	dr	pl	pr
10.	fr	ch	fl	pr	25.	sw	wh	sh	cr
11.	sl	st	cl	sh	26.	gh	kn	ch	sm
12.	fl	pl	bl	dr	27.	sh	ch	ph	pl
13.	cl	sk	st	sh	28.	sh	st	str	sch
14.	sl	ch	cl	sp	29.	sl	str	spr	tr
15.	bl	br	dr	pl	30.	str	tr	sl	thr

G.F.W. AUDITORY MEMORY TEST

INSTRUCTIONS

TRAINING SECTION

TEST 1 - RECOGNITION MEMORY

The volume of the tape player should be adjusted before starting the training even though the tape player is not used until the Test Section. The examiner should play a portion of the test tape while adjusting the volume to a "comfortably loud" level. If earphones are being used, the examiner should wear the subject's earphones while making the adjustment.

After adjusting the volume, say: I AM GOING TO SAY SOME WORDS. I WANT YOU TO LISTEN CAREFULLY BECAUSE I WILL SAY SOME OF THE WORDS AGAIN. AFTER I SAY EACH WORD, I WANT YOU TO SAY "YES" IF YOU HAVE HEARD ME SAY THAT WORD BEFORE. BUT IF YOU HAVE NOT HEARD ME SAY THAT WORD BEFORE, I WANT YOU TO SAY "NO".

Let's begin by trying a few words -

Kitten.....Have you heard me say that word before? No(examiner shakes head), you couldn't have heard it before because it is the first word I have said.

Kitten.....Have you heard me say that word before? Pause for subject to respond. Nod your head and say: Yes, I have said it before.

Stranger.....Pause for subject to respond. No, I have not said it before.

Artist.....Pause. Yes, I have said it before.

Say: Now we are going to listen to some other words. But this time you will hear the words...through the earphones(or) from this tape player.

After you hear each word, say "yes" if you have heard the word before or say "no" if you have not heard the word before.

If earphones are being used, place them on the subject.* Start the tape player and play the practice set of five words. Do not record the responses.

Practice Word	Correct Response
money	no
vivid	no
money	yes
coral	no
vivid	yes

After the practice set of five words has been presented, stop the tape player (in most cases it will not be necessary to remove the earphones), and say: NOW WE WILL TRY SOME OTHER WORDS. THE LIST OF WORDS WILL BE LONGER THIS TIME. ANSWER IN THE SAME WAY YOU HAVE BEEN, BY SAYING "YES" OR SAYING "NO".

Test 1 — Recognition Memory

TEST SECTION

Test Item	Word	Correct Response	Score (1 or 0)
1	display	no	
2	prospect	no	
3	problem	no	
4	magic	no	
5	problem	yes	
6	display	yes	
7	rolling	no	
8	wretched	no	
9	magic	yes	
10	rolling	yes	
11	prospect	yes	
12	husband	no	
13	service	no	
14	bargain	no	
15	error	no	
16	wretched	yes	
17	service	yes	
18	husband	yes	
19	sugar	no	
20	sugar	yes	
21	bargain	yes	
22	error	yes	

Items 1-22 Number Correct _____ *

Test Item	Word	Correct Response	Score (1 or 0)
23	horror	no	
24	blanket	no	
25	horror	yes	
26	issue	no	
27	issue	yes	
28	farther	no	
29	bucket	no	
30	farther	yes	
31	lovely	no	
32	blanket	yes	
33	chosen	no	
34	wedding	no	
35	bucket	yes	
36	lovely	yes	
37	crooked	no	
38	sleeping	no	
39	peaceful	no	
40	crooked	yes	
41	wedding	yes	
42	chosen	yes	
43	peaceful	yes	
44	sleeping	yes	
45	soldier	no	
46	captive	no	
47	captive	yes	
48	soldier	yes	
49	charming	no	
50	adult	no	
51	bullet	no	
52	victim	no	
53	hover	no	
54	adult	yes	
55	charming	yes	
56	purple	no	
57	wicked	no	
58	member	no	
59	victim	yes	
60	bullet	yes	
61	hover	yes	
62	wicked	yes	
63	member	yes	
64	bottom	no	
65	purple	yes	
66	bottom	yes	

Items 1-66 Number Correct _____ *

Test Item	Word	Correct Response	Score (1 or 0)
67	poison	no	
68	rustle	no	
69	decent	no	
70	torture	no	
71	rustle	yes	
72	torture	yes	
73	shepherd	no	
74	surface	no	
75	mutter	no	
76	poison	yes	
77	decent	yes	
78	surface	yes	
79	hatred	no	
80	shepherd	yes	
81	mutter	yes	
82	prayer	no	
83	prayer	yes	
84	hatred	yes	
85	uncle	no	
86	anger	no	
87	anger	yes	
88	uncle	yes	
89	beaver	no	
90	ribbon	no	
91	coffee	no	
92	coffee	yes	
93	cabin	no	
94	final	no	
95	beaver	yes	
96	mantle	no	
97	cabin	yes	
98	satin	no	
99	ribbon	yes	
100	after	no	
101	satin	yes	
102	final	yes	
103	mantle	yes	
104	darken	no	
105	thicket	no	
106	silence	no	
107	thicket	yes	
108	after	yes	
109	darken	yes	
110	silence	yes	

Test 1 — RECOGNITION NUMBER CORRECT _____

*Refer to Table 1 in the manual for an estimate of the subject's total test score. Record this estimate as the "Number Correct" in the Summary of Scores section.

JARMAN AUDITORY RECALL

DIRECTIONS

SAY: You are going to hear lists of five words. As soon as the five words have been said you are to repeat them to me in the order you remember them. Let's try the examples for practice:

Turn on the tape recorder and work through the three examples. When the child understands the procedure turn on the tape for the test.

JARMAN AUDITORY RECALL

EXAMPLES: A. big long great tall high

B. cow day key few wall

C. wide big high tall long

1. key hot can pen bar
2. wide large big high great
3. day few wall bar pen
4. long big fat great tall
5. pen wall book key few
6. book bar wall hot cow
7. key few hot book wall
8. high fat huge wide long
9. huge great fat large wide
10. key day cow bar few
11. wide tall large huge big
12. bar pen few day cow

Name _____ Date _____

School _____

CALIFORNIA PHONICS SURVEY: AUDITORY

EXERCISE 3

DIRECTIONS

SAY:

You are going to hear some words. All of the words in this exercise are real words.

Some of them may not be familiar to you, but most of them probably are. You are to see if you can find the word you hear among the answer choices on your recording sheet. Put a cross on the answer you think is correct.

If none of the printed words seems to match the spoken word, mark the number 5. None.

Look at sample E on your sheet.

Turn tape on: applause - applause - applause

Turn tape off. THEN SAY:

You see that the correct answer is Number 4, because this spells out the word applause.

Now look at sample F.

Turn tape on: propose - propose - propose

Turn tape off. THEN SAY:

Can you find the word propose? The correct answer is 5, because none of the words printed in sample F could be pronounced propose.

You are to answer the rest of the items in this exercise in the same way as you did the samples. Do you understand?

If the pupil does not understand repeat the instructions. When he understands the task proceed with the test.

CALIFORNIA PHONICS - AUDITORY

SAMPLES:

E.	1 aplomb	2 applesauce	3 plausible	4 applause	5 None __
F.	1 proposition	2 ponderous	3 portrait	4 predicate	5 None __
1.	1 hostility	2 hospitality	3 inhospitable	4 instability	5 None __
2.	1 brandy	2 blemish	3 bandage	4 blandish	5 None __
3.	1 sadistic	2 satiric	3 Satanic	4 statistics	5 None __
4.	1 desperate	2 deprivation	3 disparage	4 separate	5 None __
5.	1 inopportune	2 opportunity	3 importune	4 important	5 None __
6.	1 advantages	2 advantageous	3 misadventures	4 adventitious	5 None __
7.	1 determined	2 undermined	3 terminated	4 detrimental	5 None __
8.	1 maniacal	2 monocle	3 mangle	4 manacle	5 None __
9.	1 demiurge	2 dredge	3 dirge	4 demurrage	5 None __
10.	1 persecution	2 perseveration	3 perversion	4 prevision	5 None __

Name _____ Date _____

School _____

DURRELL PHONIC SPELLING

DIRECTIONS

SAY:

You are going to hear some words one at a time on the tape. Write what you hear in this space:

Point to line 1 on the child's answer sheet.

Start the tape recorder.

WORD LIST:

1. intervent	5. blastment	9. titration	13. epithet
2. carpolite	6. ligulate	10. explicate	14. dissonant
3. tonometer	7. polarize	11. isotherm	15. retrograde
4. introvert	8. stimulus	12. astrolabe	

DURRELL PHONIC SPELLING

School _____ Teacher _____

Name _____ Date _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

CALIFORNIA PHONICS: VISUAL

DIRECTIONS

SAY:

I am going to show you a word for one second and then turn it away.

Show the tachistoscope window without a word showing.

SAY:
If the word you see i
If the word you see is in the line of words on your sheet,

Point to line 1 on the answer sheet,

mark it with a cross(X). If the word you see is not in that list of words, put a cross on "None".

1 hospitality

2 bremish

3 statistics

4 disparage

5 inopportune

6 adventitious

7 determination

8 monocle

9 demiurge

10 perversion

CALIFORNIA PHONICS: VISUAL

1.	[1] hostility	[2] hopitality	[3] inhospitable	[4] instability	[5] None ___
2.	[1] brandy	[2] blemish	[3] bandage	[4] blandish	[5] None ___
3.	[1] sadistic	[2] satiric	[3] Satanic	[4] statistics	[5] None ___
4.	[1] desperate	[2] deprivation	[3] disparage	[4] separate	[5] None ___
5.	[1] inopportune	[2] opportunity	[3] importune	[4] important	[5] None ___
6.	[1] advantages	[2] advantageous	[3] misadventures	[4] adventitious	[5] None ___
7.	[1] determined	[2] undermined	[3] terminated	[4] detrimental	[5] None ___
8.	[1] maniacal	[2] monocle	[3] mangle	[4] manacle	[5] None ___
9.	[1] demiurge	[2] dredge	[3] dirge	[4] demurrage	[5] None ___
10.	[1] persecution	[2] perseveration	[3] perversion	[4] prevision	[5] None ___

Name _____ Date _____

School _____

DURRELL VISUAL MEMORY OF WORDS

DIRECTIONS

Place in the tachistoscope the card "Visual Memory of Words - Intermediate."

Show the child the first word for three seconds, saying. "Look at this word, then write it beside Number 1 on this line."

Do not pronounce the word or ask the child to read it.

As soon as the child has looked at the word, turn the card over and have him write it from memory.

Continue with the rest of the words on the card.

1. welkin
2. ampersand
3. canalize
4. denotable
5. variform
6. wainscot
7. inception
8. monochord
9. tribunal
10. contingent
11. verbalist
12. brigantine
13. gangliate
14. quadruped
15. hydrostat

DURRELL VISUAL MEMORY OF WORDS

School: _____ Teacher: _____

Name: _____ Date: _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____