C 1

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN SELECTED SKILLS AND FIRST GRADE READING ACHIEVEMENT

by

DORIS JEANNE THOMSON

B.Ed., University of Calgary, 1967

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department

of

READING EDUCATION
FACULTY OF EDUCATION

We accept this thesis as conforming

to the required standard.

THE UNIVERSITY OF BRITISH COLUMBIA

September, 1973

Department of **Reading**

The University of British Columbia
Vancouver 8, Canada

Date **October 5, 1973**

ABSTRACT

In a comparative study of successful and unsuccessful readers near the end of first grade, reading achievement tests were administered to one hundred nine subjects and those scoring in the upper and lower quarters of the ordered standard scores were designated as good and poor readers respectively. A battery of seven tests was administered to the fifty-four subjects thus selected. The battery was composed of two tests of visual perception (visual memory of symbols and reversal of symbols), three verbal coding tests (letters, transposition of consonant trigrams, and phonemes, blends, and phonograms), and two tests of meaningful association (vocabulary listening and sentence listening).

It was found that good and poor readers were significantly different (.0001) on the subskills considered simultaneously and beyond the .02 level of significance on each of the seven subskills considered separately.

Different patterns of correlation were evidenced with generally significant correlations within the clusters for poor readers but not for good readers.

Regression analysis indicated that the verbal coding and meaningful association clusters made significant contributions to the prediction of reading category (successful or unsuccessful). The contribution of the visual percep-

tion cluster was also significant when it was entered before the verbal coding cluster.

The subskill variables making the greatest contribution to the prediction of reading category were phonemes and vocabulary listening. All subskills with the exception of reversals were significant predictors if they were entered early in the regression analysis.

Approximately 85 per cent of the variance in reading achievement as designated by successful or unsuccessful category was accounted for by the subskills tested.

ACKNOWLEDGEMENTS

The writer is much indebted to her advisor, Dr. Jane Catterson, for her valuable assistance. Sincere appreciation is also extended to Dr. C. Pennock for his interest and suggestions and to Dr. D. McKie and Dr. S. S. Lee for their advice on statistical procedures.

The assistance in statistical analysis provided by David Kaufman, M.A.Sc., and Murray Thomson is gratefully acknowledged, as is the cooperation of teachers and pupils who participated in the preliminary and main studies.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

THE PROBLEM

GENERAL STATEMENT OF THE PROBLEM

Despite voluminous research, the prevention and correction of reading disabilities remains an educational problem of primary importance. In the interest of providing new insight into the difficulties of disabled readers, this study compared children experiencing difficulty in the early stages of reading acquisition with their successful counterparts.

Adopting the point of view that reading is a tripartite process involving visual perception, verbal coding, and meaningful association, the study compared the performance of successful and unsuccessful readers in grade one on tasks considered to require each type of ability. The comparison was made at a grade one level on the assumption that differentiation of ability was already apparent at that stage but that the factors contributing to the divergence might be less complex than at higher levels.

BACKGROUND OF THE PROBLEM

The numerous statements that have been made about the significant components of the beginning reading process range widely in complexity. Some writers endeavour to isolate a single major factor as crucial, while others suggest a multiplicity of interacting factors. Since it seems unlikely that a single factor can account for success in reading and equally unlikely that the process is too complex to permit analysis, expecially in the earlier stages, there would seem to be value in adopting a middle path and attempting to identify clusters of significant components. A statement by Mackworth suggests an approach to the problem of identifying clusters. She states that:

> 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. (1972, p. 706)

This statement implies a three part process of visual perception, verbal coding, and meaningful association and provides a useful frame of reference within which to examine the evidence and arguments put forward by the various researchers in reading.

There is evidence in the literature, in fact, to support the idea that each strand of Mackworth's model is indeed an important part of the reading process. There is, however, no research directed at combining the strands in a single study and assessing their relative importance for children at early stages of the reading process. This would seem to be a logical approach both to validating the model and to providing guidance for the teacher of reading in grade one.

RESEARCH QUESTIONS

The study was designed to investigate the reading process as it develops in beginning readers. It involved a comparison of the performance of successful and unsuccessful readers in late grade one on tests of subskills considered to be aspects of the global skill called "reading ability".

Seven subskill tests grouped into three "skill clusters", visual perception, verbal coding, and meaningful association, were administered to first grade children who had been classified as successful and unsuccessful readers. The data were analyzed to answer the following questions:

1. Are there significant differences between successful and unsuccessful readers near the end of first grade in the following reading subskills: visual memory, perception of reversal of symbols, letter knowledge, transposition of consonant trigrams, knowledge of phonemes, vocabulary listening, and sentence listening?

2. What correlations exist between the subskills measured for (a) successful readers (b) unsuccessful readers and (c) successful and unsuccessful readers combined?

3. Considering the successful and unsuccessful readers together:

   (a) which clusters of skills (visual perception, verbal coding, and meaningful association) contribute significantly to the prediction of reading category (successful and unsuccessful readers)?

   (b) which subskills contribute significantly to the prediction of reading category (successful and unsuccessful readers)?

4. Can the Mackworth model be validated in the sense that evidence can be obtained indicating that visual perception, verbal coding, and meaningful association do, in fact, contribute significantly to reading achievement of first grade children?

5. Does the Mackworth model imply a developmental sequence? That is, is there evidence that visual perception, verbal coding, and meaningful association are developed and used in that sequence?

DEFINITION OF TERMS

For the purpose of the study a number of definitions were developed.

Reading is defined in terms of (a) vocabulary and (b) comprehension as measured in standard scores by the Gates-MacGinitie Reading Tests, Primary A - Grade 1 (1965).

Successful readers, also referred to for convenience as good readers, are those children who score in the top quarter of the ranked total standard scores obtained on vocabulary and comprehension tests.

Unsuccessful readers, also referred to for convenience as poor readers, are those children who score in the bottom quarter of the ranked total standard scores obtained on vocabulary and comprehension tests.

The term cluster of skills is used to designate a group of tasks considered on a priori grounds to be related to each general area being examined in the study (visual perception, verbal coding, and meaningful association).

Visual perception is defined as the child's ability on tasks of (a) visual memory of symbols and (b) perception of reversals of symbols.

Verbal coding is defined as the child's ability on tasks involving (a) knowledge of letter names, (b) transposition of letters in consonant trigrams and (c) association of letter symbols and letter sounds.

Meaningful association is defined as the child's ability on tasks of (a) vocabulary listening and (b) sentence listening as measured by standardized listening tests.

IMPORTANCE OF THE STUDY

Many educators feel that unnecessarily large numbers of normal elementary pupils experience reading difficulty.

Yet the causes of the disability and definitive means of prevention continue to elude them.

Thus far, comparisons of teaching methods have yielded low returns in the effort to diagnose contributing factors. The survey of teaching methods conducted by Maxwell and Temp led them to conclude that:

> All methods of reading instruction instruct some children (probably the same ones) well and do not succeed with some small portion of others that have been studied. (1971, p. 136)

Their statement suggests that the search for causes or correlates must be directed elsewhere.

Much effort has been expended on studies of physical, intellectual, psychological, and neurological factors which may contribute to reading disability. Generally speaking, however, the research has been of piecemeal nature. A specific aspect has been isolated for examination and correlative or treatment studies have been devised. The contradictory or inconclusive results may be accounted for by the wide divergence in means of selecting subjects, stringency of controls, or criteria for identifying differences. It may also be true that the nature of reading disability cannot be discovered by examining the factors separately.

The present study takes the stance that the most profitable approach to the problem is through a study of the apparent components of the reading process itself. It is assumed that there is value in bringing together for study a number of these components to assess their relative importance to the reading process. If the skills or clusters of skills in which successful and unsuccessful readers in first grade are most widely divergent can be determined, it may be possible to form hypotheses about which kind of teaching is likely to be most profitable to beginning readers.

LIMITATIONS OF THE STUDY

It is considered that there are certain limitations to the study. They are:

1. The study was limited to a comparison of selected components considered to be important to reading achievement. It did not attempt to include measurement of all possible factors related to reading.
2. Subjects were not randomly selected from the population of first grade students. Classrooms were selected on the basis of availability and an assumption of representativeness was based on the heterogeneity of the classrooms. For the initial screening all first grade pupils of each school were included as subjects.
3. Standardized tests employed were published and standardized in the United States and no norms are available on Canadian populations.
4. No attempt was made to control neurological, physical, psychological, social, or environmental factors beyond

the bounds demanded by the tests and the test situation.

5. No consideration was given to intellectual differences as measured by intelligence tests among the subjects or between the groups of successful and unsuccessful readers.

ORGANIZATION OF THE THESIS

The first chapter provides a general statement of the problem, the background of the problem, the specific research questions to be answered by the study, definitions of terms pertinent to the study, statements about the importance and the limitations of the study, and the outline of the organization of the study. The second chapter consists of a review of related literature considered under major headings consistent with the operationally defined clusters of skills. The third chapter is a description of the design of the study and includes the description of subjects, materials, and procedures. The fourth chapter presents the results of the study and the analysis of data. In the fifth and final chapter the summary of findings, conclusions and implications are presented.

CHAPTER II

REVIEW OF RELATED LITERATURE

The review of literature is presented under these topics: visual perception, verbal coding, and meaningful association. The review focuses specifically on studies pertaining to children in the early primary grades.

VISUAL PERCEPTION

Evidence is available in the literature to substantiate the inclusion of visual perception as an important factor in the reading process.

Goins (1958) drew attention to the contribution of visual perception to reading achievement in her statement:

> In spite of the tremendous strides that have been made during the last fifty years in methods of teaching reading and in diagnostic and remedial procedures, a surprisingly large number of children still make slow progress in learning to read or are unable to read at all. Many of these children appear to have adequate sensory efficiency for reading, and their intelligence, language ability, and experience backgrounds compare favorably with those of their classmates who are reading. The evidence suggests that in many cases the difficulty may stem from ineffective visual perception. (1958, p. 31)

Although a further fifteen years of research has been conducted since Goins' statement, educators are still endeavouring to discover the causes of reading disabilities and visual perception continues to be considered as one of the possible contributory factors.

Spache stated that "Obviously reading is first of all a visual rather than a linguistic or a cognitive act". (1966, p. 183)

Gibson (1969) devoted an entire book to the analysis of perceptual learning and much of this sophisticated exposition dealt with types of visual perception. She drew attention to the developmental aspects of the discrimination of letter-like symbols and in a later paper (1970) suggested that reading begins with the spoken language and that the skill of decoding is learning to differentiate the graphic symbols and associate them with the sounds in the language. The visual discrimination of the graphic symbols, then, would be one of the abilities necessary to the process of reading, according to Gibson's analysis.

Visual Discrimination (Non-Verbal) as a Correlate of Reading

One of the problems in examining visual discrimination as it relates to reading achievement is the difficulty of isolating purely visual factors from those with verbal components. Barrett (1965) dealt with this problem in his review of visual discrimination and reading achievement by separating the studies into verbal visual and non-verbal visual classes. He designated those using geometric shapes, non-letter forms, and pattern designs as non-verbal visual.

Barrett's chart of studies of non-verbal visual discrimination summarizes the research through mid 1964.

TABLE I: BARRETT'S SUMMARY OF NON-VERBAL VISUAL DISCRIMINATION INVESTIGATIONS (Reprinted from Barrett, 1965)

Study	*N*	*Reading Achievement Test*	*Non-Verbal Visual Discrimination Test*	*Correlation*
Beck and Beck (1960)	214	American School Achievement Test, Reading	House drawing	
			Teacher score	.15
			Investigator score	.18
Monroe (1935)	85	Gray Oral Paragraphs and Iowa Word Test	Visual tests	.60
Robinson and Others (1958)	87	Word Discrimination Test Chicago Reading Test	Children's visual achievement form	.24
Keogh (1963)	149	Lee-Clark Reading Test	Bender gestalt	.53
Goins (1958)	120	Chicago Reading Test	Pattern copying	.519
			Reversals	.491
			Figures	.390
			Picture squares	.381
			Pattern completion	.339
			Identical pictures A	.318
			Identical pictures B	.318

The highest correlations reported by Barrett are those found on visual tests by Monroe, the Bender gestalt by Keogh, and pattern copying and reversals subtests by Goins. The Monroe tests were largely composed of geometric designs, and the Bender gestalt test used by Keogh requires the child to reproduce geometric patterns. It seems apparent, then, that this type of task provides higher correlations with reading achievement than the other types of visual discrimination tasks summarized in the above chart.

Evidence supportive of this trend was supplied by Feldman (1961) whose study encompassed a greater age range than those Barrett was surveying. Feldman employed the Bender gestalt test with ninety-five subjects ranging from kindergarten to fifth grade. She also used author constructed tests of form sequence and orientation and found a positive correlation of all tests given with reading achievement at all levels where reading was measured. A developmental trend was noted in her examination of the scores on tests of perception, with the largest increments appearing in the first three years and a levelling off occuring in grades three to five.

Similar evidence of the relationship of non-verbal visual discrimination tasks to reading achievement were reported by Kerfoot (1964) and Buktenica (1967). Both studies employed the Goins subtests of Pattern Copying and Reversals with first grade subjects. In addition, Buktenica used the Beery-Buktenica Visual Motor Test. He suggested that, on the basis of the results of these tests, perceptual tests are better predictors of reading achievement than are intelligence tests and require much less time to administer.

Gibson, Gibson, Pick and Osser (1962) devised a set of letter-like forms in an attempt to examine visual discrimination in terms of a task resembling reading. The symbols were originally used in a developmental study of visual discrimination and have since been employed in various studies relating to reading. The original study of children aged four through eight years found a marked developmental trend in discrimination of the forms.

The accumulated evidence suggests that non-verbal visual discrimination is a correlate of reading achievement. It also suggests that the ability to discriminate visually increases with age during the pre-school and early school years.

Visual Memory

Yet discrimination alone may not account for the contribution of visual perception to reading achievement. Anderson and Samuels (1970) compared good and poor readers in grade two and found good readers scored higher than poor readers (.001 level of significance) on a visual recognition memory task using the Gibson-Pick symbols. While it might be hypothesized that the poor readers were, in fact, reading at a grade one level and that visual memory had developed only in the grade two readers, it seems possible that visual memory may have some impact on grade one reading achievement.

A study of visual memory in grade one children was conducted by Astill (1970) and a positive correlation with reading achievement was reported at the .05 level of significance. She tested visual memory of discrete objects as well as discrete symbols by using the Visual-Motor Sequencing Test from the Illinois Test of Psycholinguistic Ability and two tests devised by the examiner. In the analysis of results she found that when the language factor was controlled, the correlation was even higher than the .05 level, particularly for memory of symbols, than it was when the language factor was not controlled.

These studies would seem to indicate that visual memory of symbols is a factor contributing to visual perception in its association with reading.

Visual Perception Training and Reading Achievement

Although there is widespread agreement that visual perception and reading achievement are associated, there is a difference of opinion among researchers as to whether visual perception related to reading can be trained apart from reading and whether such training, if accomplishing a change in perceptual ability, can affect reading achievement.

Frostig devised The Developmental Test of Visual Perception in 1961 and followed it with The Frostig Program for the Development of Visual Perception in 1964. Although the Frostig Test provides scores on five specific areas of visual perception and the training program is organized to develop the areas of weakness so identified, little evidence could be found of researchers who had employed the instruments on a selective basis. There seems to have been a tendency to use them as a global measure and to train with the full battery of exercises rather than in the way they were designed to be used.

A comparison of the studies relating to visual perception training is difficult because of the differences in methods of selecting subjects and in the treatments. Perhaps the most significant comparison can be made on the basis of how the subjects were selected for perceptual training.

Subjects selected on the basis of perceptual deficits. Mould (1965) used the Frostig training program with beginning readers exhibiting clear deficits in visual perception and reported gains in perceptual scores (.02 level of significance) and in oral reading scores (.01 level of significance). While there was no significant gain in total reading achievement for either experimental or control groups during the period of the study, he noted that the amount of reading growth for the experimental group exceeded that for the control group.

The Marianne Frostig Center of Educational Therapy reported using tests and training program devised by Marianne Frostig selectively (1968) diagnosing specific deficits and training only in those areas. It may be more than coincidental that the value of these instruments is more evident in reports from the Center than in results produced by other experimenters.

Klein and Marsh's study (1969) although not on first grade children may have implications for beginning readers. They selected grade two subjects with indications of perceptual deficiencies as well as low reading scores. They established three groups in order to compare the effects of perceptual training with a remedial reading program administered during the same interval. The third group received no treatment and acted as a control. The groups were trained on the Frostig program supplemented by teacher produced exercises for periods of twenty-five minutes twice a week. Post test indicated that the remedial reading group had made significantly greater increases in reading ability than the other groups and that the perceptual training group showed no significant increase in perception. The authors suggested that because these children were in second grade it might be possible that they were too old to benefit from perceptual training. This seems to imply that they might consider training at the first grade level as having a potentially good effect.

Subjects selected on the basis of reading achievement or reading readiness but without tests of perception. McClanahan (1968) randomly selected ninety-two first grade subjects from those scoring below the median on reading readiness tests in kindergarten. After providing training in perception for fifty minutes a day for thirty-five days she reported the experimental group scoring significantly higher than the control group on both the _Frostig Developmental Test of Visual Perception_ and _California Achievement Test - Reading_.

Buckland (1969) also selected subjects scoring low on readiness tests and employed the Frostig training program as had McClanahan. She found no significant differences on either perception or reading scores. She pointed out that means were used in the comparison and that individual gains therefore went unnoticed. She suggested that the Frostig program may be highly beneficial for individuals but is not applicable to all children evidencing difficulty in first grade reading.

Randomly selected subjects. An adaptation of the Frostig training program was employed by Rosen (1965) for twenty-nine days with a group of first grade children selected randomly. The control group received thirty minutes of additional reading instruction during the forty-five minute periods in which the experimental group was involved in perceptual training. He found the experimental group scored significantly higher on post-training tests of perception and that there were no significant differences between the groups on three of the four post-training tests of reading achievement. The control group scored significantly higher on the fourth reading test. He noted that a sub-group of boys testing low on a pre-training test of perception indicated a trend in their reading differences on post-training tests. Although the difference was not significant at the usual levels between those assigned to the experimental and control groups, it was observed that those who had received perceptual training scored consistently higher on reading achievement tests than those who had been in the control group.

Examining a random selection of first grade subjects from a low socio-economic area, Cohen (1969) found 40 percent were at least two and one half years retarded in perceptual development as measured by the Frostig test. Although statistical evidence was not provided he indicated that subsequent training in perception did not result in increased reading achievement.

Fortenberry (1970) provided perceptual training for an experimental group of culturally disadvantaged first grade subjects. The Frostig program was employed for the experimental group and both groups received the same basal reading program. Testing at intervals of six weeks, he found no significant differences in reading achievement after twelve and twenty-four weeks of training. The experimental group was significantly superior at only one point, after eighteen weeks of training. His evidence suggests that while some benefit may be derived from perceptual training it may be of fleeting value.

Summary of the Effects of Visual Perception Training. The results of studies on the value for reading of specific perceptual training seem to provide conflicting evidence. It would seem that when such training is administered to first grade children exhibiting perceptual deficits there is more evidence of positive effects on reading ability than when the training is given to a random selection of subjects. There is no evidence to indicate the value of such training for children beyond a first grade level.

VERBAL CODING

Both logical and empirical evidence indicate that visual perception of some kind is a basic factor underlying the reading process. Crosby and Liston (1968) have suggested however, that true reading begins with the translation of the graphic symbols to a system of verbal coding and Mackworth has stated that " . . . the actual process of reading is the coding of visual symbols into words according to a fixed system". (1972, p. 703)

Miller (1956) discussed verbal coding for reading and suggested a hierarchy of verbal coding with the lowest level that of letter names and progressing through phonemes, words, phrases, and sentences. The ability to process increasingly large "chunks", he felt, is dependent upon the frequency of presentation.

If one can assume that reading itself begins with words, Miller's statement seems to suggest that the levels below reading include coding by letter names and coding by phonemes. A review of the literature shows that both of these levels have been investigated and that, in addition, some researchers have studied the significance of order in coding.

Coding by Letter Names

High correlations between knowledge of letter name at the beginning of first grade and later reading achievement have been reported by a number of researchers over a number of years.

Chall (1967) has pointed out that studies by Wilson and Fleming as early as 1938 and by Gates in 1939 found correlations ranging from .3 to .9 for the levels of letter knowledge increasing in difficulty from matching through identifying, naming, and writing of both upper and lower case letters. She also pointed out that the interest in sight methods was so strong at that time that the evidence of the importance of knowledge of letter names was ignored by designers of reading programs during the 1940's and 1950's.

Durrell, it seems, can be credited with the rediscovery of the correlation between knowledge of letter names and reading achievement. Findings by Nicholson, Olson and Gavel in 1957 in an extensive study of first grade reading caused him to conclude "Tests of knowledge of letter names at school entrance are the best predictors of February and June reading achievement". (1958, p. 5)

Further evidence of the significance of letter names in early word recognition was found in Marchbanks and Levin (1965). They found that children in kindergarten and first grade used letter cues more frequently than word shape in matching words. Initial letters were used by the greatest number of children. Final letters were employed as cues by the next largest group and middle letters were used least but were still more frequently used than word shape. They concluded that the children knew the names of the letters well enough to use them as verbal mediators in remembering the target word.

A multiple regression analysis of nine reading readiness factors found reading letters and numbers ranked first in the six stable regression equations. (Barrett, 1965).

Muehl and King (1967) stressed specific letter differences between words as the vital cue necessary to word recognition. Training in letters alone, they found, increased reading achievement as much as training in letters embedded in words. They concluded that letter naming is highly related to reading achievement.

Bond and Dykstra (1967), reporting on the First Grade Studies, also cited letter knowledge as the single best predictor of reading achievement in first grade and Dykstra (1968) found that letter knowledge in kindergarten retained its predictive value for success in reading to the end of second grade.

Although the research cited seems clear, some writers argue that the correlations obtained do not imply a casual relationship and that one should not conclude that training in letter names should form a part of the reading programme.

A study by Ohnmacht (1969) found that training in letter names increased reading achievement in grade one for children who scored low on readiness tests. Children who achieved average or high scores on readiness tests, however, benefited more from training in the correspondence between names and sounds of letters. She suggested, therefore, that the value of letter names to children with low readiness scores may be only an indication of the increased level of attention resulting from the training and that better ways of training attention may be found. A different interpretation might suggest, of course, that letter naming is a lower level task than grapheme-phoneme correspondence and is, therefore, the logical one for training the weaker pupils in the initial stages of reading acquisition.

Samuels (1970), another critic of the idea that letter names are significant facilitators of reading skill, suggested that learning to attach a name to a symbol is a paired associate task and that the child who learns letter names easily is the one who will learn other associations with ease and hence become a good reader. He implied, then, that a general intellectual factor is functioning to increase word recognition rather than the specific cognitive factor of letter coding per se.

Samuels (1971) provided evidence, in fact, to support his argument that knowledge of letter names was not related to the task of learning to read. He trained one group of first grade children to discriminate three-letter clusters by naming the letters and another group to discriminate the clusters without letter names. Testing the two groups against two control groups on speed of learning to recognize four words by the look-say method, he found no significant differences. Although the experiment employed artificial letter names and words, Samuels concluded that knowledge of letter names did not increase success in learning words. It may be pointed out that Samuels' constructs bore some resemblance to real letter names and it is possible that prior knowledge was affecting scores for both groups to some degree.

The role that knowledge of letter names plays in the acquisition of reading skills is not fully understood but there is extensive evidence that a substantial positive correlation exists.

Significance of Spatial Order in Coding: Letters and Symbols

The studies cited above indicate that coding by letter names has significance in word recognition but they lay no special emphasis on the significance of spatial order of the symbols in the coding process. Some writers and researchers have, however, directed attention to the factor of order of symbols as significant in the reading process.

It was Vernon's contention that:

> The most common feature of reading disability is the incapacity to perform the cognitive processes of analyzing accurately the visual and auditory structures of words. The backward reader guesses wrong letters or the right letters in wrong order. (1957, p. 71)

Vernon elaborated on the idea that disabled readers do not process the letters or phonograms in a left to right order either because of inefficient teaching or because "severe cases of disability seem to have a deeply rooted incapacity to synthesize or blend phonetic units to form complete words". (1957, p. 71)

Mason (1970) indicated that word confusions among beginning and poor readers result from lack of instruction in cue selection. He maintained that children are encouraged to discover cues for themselves but should, instead, be taught to use letter components and letter order.

Calfee (1970) showed that in matching letter bigrams 70 percent of the errors of kindergarten children were reversals of letter order. He drew attention to the bimodal distribution of scores on this test but did not attempt to account for it. He also raised questions about whether the errors were cognitive, that is, memory or attention, or were perceptual in nature. Further research was necessary to answer these questions, he felt.

Both Elam (1969) and Nodine and Hardt (1970) found letter reversals prevalent in their subjects. Nodine and Hardt were testing a general kindergarten population and Elam's subjects were disabled readers from second to sixth grade, yet their findings were similar. It would seem that disabled readers at the upper levels were functioning no better than the children of kindergarten level in distinguishing letter order.

Although the experiments were conducted with children somewhat older than first grade, Blank and Bridger (1966), Bakker (1967), and Lovell and Gorton (1968) employed subjects whose retardation in reading may justify their inclusion in an examination of early stages in the acquisition of reading skills. Blank and Bridger compared nine year old retarded readers to average readers on tasks of matching displays of lights to printed dots. They found the retarded readers scored significantly lower than normal readers and suggested that they had not employed a verbal coding to act as mediator.

Bakker compared poor readers to good on tasks of temporal order of meaningless figures, meaningful figures, letters, and digits. He found no significant difference in their performance on tests of meaningless figures and digits but marked deficiencies for poor readers on tests of meaningful figures and letters. He concluded that poor readers lacked verbal cues to assist in retention of the order.

Lovell and Gorton employed nine tests of perception in their study of good and poor readers aged nine and ten years. They found significant differences in auditory-visual integration, sound-symbol association, spatial orientation, left-right discrimination, and motor ability.

The studies cited provide evidence that difficulties in orientation and sequential order may be associated with retardation in reading.

Coding by Phoneme: Letters and Letter Clusters

Certain researchers seem to stress verbal coding by sound using both letters and clusters.

Glass (1965) stressed conditioning in the process of training symbol to sound associations. He felt that word analysis should not be taught with meaning attached but that sounds of letters and letter clusters should be emphasized. All training, according to Glass should be directed by two questions: What letter(s) says _______? What does ________ say? He suggested that two ten-minute periods each day for three or four months devoted to this type of training would advance first grade children to the equivalent of third grade in analytic skills. Although Glass did not report experimental evidence to support his view, he stated that the method had been employed successfully by him and his associates.

Gibson (1970) stated that reading is based on spoken language and that a child learns to decode the graphic symbols into sounds which are meaningful in terms of the oral language. Since 1962 she has advocated familiarity with spelling to sound as an aid to word recognition. She found in study of first grade children (1963) that words or pronounceable trigrams were perceived more easily than unpronounceable trigrams.

A study by Gotts (1970) compared disabled to successful readers and found that the disabled took more trials to learn phoneme-grapheme correspondence. It would seem that Gotts' finding may point to one of the significant factors which distinguishes successful from unsuccessful readers. Samuels (1970) might interpret this as simply weakness in learning paired associates and indicative of a more general intellectual weakness. Gibson (1962) on the other hand, might contend that it supplies further evidence of the importance to reading of spelling-to-sound learning.

Williams (1970) suggested that the translation of visual cues to auditory units is speeded by the employment of letter clusters, and moves to the lower level of single correspondence, that is, letters, only when clusters are not identifiable. Her statement indicates her belief in the significance of coding whether by single phoneme or phoneme cluster.

Summary of Research in Verbal Coding

Although differing in approach, the researchers cited are in agreement that the association of letters and sounds is an important contributing factor to the skill of word recognition. It may be true that the predictive value of letter names to reading achievement is indicative only of success on a learning task. Learning the grapheme-phoneme correspondence may be translated as a similar measure of learning rate. Yet evidence of reversals and transpositions of letters seems to imply that disabled readers may be deficient in abilities less clearly associated with intellect. In any case, differentiation of graphemes including orientation and order and the association of graphemes and phonemes seem to be the basic skills requisite to succes in reading.

MEANINGFUL ASSOCIATION

Regardless of the intermediate steps, reading must finally entail the interpretation of a visual display to a comprehensible unit. However, there is a lack of agreement among researchers about the stage at which meaning enters the reading process and how it does so. Some would suggest that meaning results from decoding, while others think that meaning must precede decoding.

In a 1965 study Goodman compared recognition of words presented in lists with recognition of the same words presented in stories. Higher scores for words presented in stories led him to conclude that contextual cues contribute greatly to the decoding of words.

In 1970, pursuing the same line of thinking, Goodman suggested that the reading process can be characterized as a psycholinguistic guessing game. He described the proficient reader as one who employs the least possible number of cues to provide the best possible first guesses or replace them if they are unacceptable. According to his description there is a blending of contextual and visual cues in both the prediction and validation tasks.

A reading model proposed by Brown (1970) suggested that syntactic and semantic knowledge is employed by the reader in the formulation of hypotheses about the material to be decoded. His flow chart indicates that validation of hypotheses occurs in terms of comprehensibility. It implies that if the unit as decoded fails the test for meaning, new hypotheses are formulated either by re-working the cues or by selecting additional cues through a more detailed observation of the visual display.

Weber (1970) analysed reading errors in relation to grammatical context at a first grade level. She found that when a word was miscalled the good readers corrected themselves if the word was not grammatically correct but that poor readers ignored the error. She felt that good readers were able to utilize their knowledge of the grammatical structure of the language as one test of verification.

Biemiller (1970) pointed out that contextual information includes information the reader brings to the situation as well as information acquired from preceding sentences. In a longitudinal study of first grade students, he felt that he had identified three stages in reading development in the grade one year. He suggested that early errors were contextual substitutions which resulted from weakness in decoding skills. As children acquired skill in decoding graphic symbols, he said, they tended to rely largely on the graphic information available and gave no response when their decoding skills were inadequate. In the third stage of the acquisition of reading skills they made substitutions of both contextual and graphic nature. His study showed that the sooner the children employed graphic cues, the more skillful they became in reading by the end of the first year of school. The most retarded readers at the year end were those who had never moved into the "no response" stage that, to Biemiller, indicated reliance on graphology. He concluded that over-reliance on contextual cues may, in fact, be inhibiting during the early stages of the acquisition of reading skills.

Counter evidence is put forward by Levitt (1969) in her study of mentally retarded and normal children in first grade. She found both groups superior in recognizing words presented in context to those presented in lists but found no significant difference between the groups as to the degree of superiority of word recognition in context over lists. This would suggest that while good readers are more efficient in the employment of both contextual and graphic cues, the deficiency of retarded readers is no more marked in one skill than in the other.

Denner (1970) also appeared to differ with Biemiller's finding as his study showed disabled readers approached normal readers in identifying symbols they were taught to associate with words. They were much less competent, however, in synthesizing sentences composed of the word symbols. Although they could call the words they were less able to extract the meaning of the larger unit. This implies that retarded readers decode words as single units rather than within a contextual framework.

Venezky and Calfee (1970) suggested that two aspects of processing operate concurrently, the syntactic-semantic integration of information supplied by cues and a forward scanning to identify the "next largest manageable unit". They stated that these units may vary in size from a single letter to a phrase and are defined as the largest chunks which can be processed conveniently by the reader.

Williams (1970) also considered visual cues as units of varying length; they may be single letters, letter clusters, syllables, or words, according to her description. In discussing the current emphasis on context she states:

> Decoding is necessary but not sufficient and other aspects of "reading" - notably,

> of course, comprehension have been attracting attention. The emergence of such interest undoubtedly reflects the very strong influence of cognitive psychology. Reading now tends to be tied to information-processing and other related concepts. Definitions also seem to be growing more general and less focused on what is unique in reading. One can reasonably describe skilled reading, I believe, as a process in which the reader samples the cues on the printed page. Using these partial cues together with previous knowledge both about printed pages and about the world, the reader forms hypotheses (or expectations) which are confirmed or disconfirmed by subsequent samplings. (1970, p. 44)

Various experiments were cited by Hochberg (1970) from which he concluded that good readers form better hypotheses than poor readers, that is, they make better guesses from visual cues. For example, in one experiment with beginning readers he found much less deficit for poor readers when the spaces between words were filled. He suggested that poor readers were less inclined than good readers to rely on cues from peripheral vision and employed, instead, a letter by letter analysis.

Smith and Holmes (1971) seemed to support the evidence cited above of the importance of contextual cues and extended it downward to include the letter level. They rejected the concept that letters must be recognized before words are decoded or that word identification is prerequisite to comprehension. They suggested that letter identification, word identification, and extraction of meaning occur concurrently. According to their view half of the uncertainty about a letter or string of letters is removed by its placement in a word and half the uncertainty about a word is removed by its placement in a meaningful unit.

Vernon (1971) also concluded that the proficient reader is one who can employ meaning both in word recognition and in the translation of larger units. She found that severely retarded readers showed deficiencies in both analysis and synthesis of complex patterns. In her study of perception she states that " . . . frequency and familiarity of syntactic structure and comprehensibility of content are the most important factors, and these interact with each other". (1970, p. 68)

The importance of knowledge of language meanings was also stressed by Mackworth (1972). She suggested that while reading is a coding system it is the relationship between the code and prior data which provides the meaning. She pointed out that words are coded visually and verbally. She cited experiments by Mewhort, Kreuger, and others which indicated that the initial match occurs at a whole word level. If the "guessed" word does not match the context, she suggested, then individual letters are examined. Less skillful readers, she concluded, are less proficient at matching word to context.

Summary of Research in Meaningful Association

While Hochberg (1970) and Biemiller (1970) stress the importance of visual cues, at least in the early stages of the acquisition of reading skills, there is general agreement among other researchers that words presented in a meaningful context are more easily recognized than in a meaningless array. It is further noted that there is a marked correspondence between reading achievement and ability to employ contextual cues.

CHAPTER III

DESIGN OF THE STUDY

The purpose of the study was to compare successful and unsuccessful readers in first grade on clusters of skills designated as visual perception, verbal coding, and meaningful association.

In this chapter the nature of the sample, the materials used to collect data, and the procedures followed are discussed under the headings: Subjects, Materials, and Procedures. The projected analysis of data completes the chapter.

SUBJECTS

The samples of good and poor readers were drawn from the grade one population of Vancouver and environs during the school term 1972-73. A total of 109 subjects was employed encompassing all members present on the first day of administration in each of five classrooms. From these 109 subjects 27 good and 27 poor readers were selected on the basis of reading achievement (upper and lower 25% of ordered total standard scores).

All first grade pupils from two small Catholic schools in Vancouver provided two classrooms in which the pupil-teacher ratio averaged 10 pupils per teacher.

All first grade pupils in a large public school in the suburbs provided three classrooms in which the ratio averaged 30 pupils per teacher.

The subjects, then, were selected from urban and suburban communities, Catholic and public schools, and small and large classes.

MATERIALS

In collecting data for this study the materials consisted of eight tests: three standardized group tests and five informal group tests. These tests were chosen with the following considerations in mind: statements by specialists concerning the components of the beginning reading process; information obtained in research studies of visual perception, visual-verbal coding, and the importance of meaning; the questions of the thesis; and the time that might reasonably be requested from normal school activities. In consideration of these factors the tests listed below were chosen for use in the study.

Names of Tests

A. Standardized Tests

1. Vocabulary Listening subtest of the Durrell Listening-Reading Series, Primary Level, Form D E (1965)
2. The Sentence Listening subtest of the Durrell

<u>Listening-Reading Series, Primary Level, Form D E</u> (1965)

3. <u>Gates-MacGinitie Reading Tests, Primary A, Form 2</u> (1964)

B. Informal Tests

1. Visual Memory of Symbols
2. Perception of Reversals of Symbols
3. Identifying Letters Names, Lower Case, subtest of the <u>Boston University First Grade Success Study</u> (1955)
4. Transposition of Consonant Trigrams
5. Identifying Phonemes, Blends and Phonograms

<u>Assignment of Tests to Clusters</u>

The tests were assigned to the clusters of skills in the following way:

Visual Perception	- Visual Memory of Symbols
	- Perception of Reversals of Symbols
Verbal Coding	- Identifying Letters Named
	- Transposition of Consonant Trigrams
	- Identifying Phonemes, Blends and Phonograms
Meaningful Association	- Vocabulary Listening
	- Sentence Listening

Validity and Reliability of Standardized Tests

The Gates-MacGinitie Reading Tests were standardized in the United States on a large sample of over 4,000 children in 38 communities considered to be representative on the basis of size, location, average educational level of parents, and average family income. The alternative form reliability was reported to be .86 for vocabulary and .83 for comprehension. Split-half reliability was .91 and .94 respectively for the tests. Although the reliability coefficients were not established with the Vancouver sample the assumption was made that the heterogeneity of the sample would insure similar coefficients.

The Durrell Listening-Reading Series consists of reading and listening tests. The manual states:

> Its purposes are to identify children with reading disability, and to measure the degree of retardation in reading as compared to listening. Knowledge of discrepancies between a child's understanding of spoken language and of printed words is basic to analysis of reading disabilities and diagnosis of remedial needs. (1969, p. 3)

Durrell's justification for using listening comprehension as a means of predicting the potential for reading achievement is clarified in his statement:

> Listening comprehension measures language acquisition, the knowledge of the very same words and sentences which are to appear later in reading. In addition, listening requires the perception of separate sounds in spoken words, the very same sounds which are to be found in the

> child's phonics program. To learn to read, the child must establish his "phoneme-grapheme relationships" --- the relation of speech sounds to their forms in print. The closeness of speech to reading in both meaning and sound elements makes listening comprehension the most significant single measure for estimating reading potential. (1969, p. 12)

An assumption of the validity of using listening tests to assess meaningful association is based on this statement by Durrell of the rationale for his tests.

Standardization procedures employed 22,247 students representing eight regions of the United States. Consideration was given to factors of family income and education.

Correlations between Vocabulary Listening and the Metropolitan Readiness Test and Sentence Listening and the same instrument were reported as .47 and .52 respectively. Some degree of construct validity was established by this comparison with a similar instrument.

Reliability coefficients of .94 and .89 were computed by means of the split-half (odd-even) method for vocabulary and sentence listening. The Kuder-Richardson Formula 21 evidenced coefficients of .84 and .86 respectively. While reliability has not been established for Vancouver populations, it was assumed that reliability would be adequate.

Construction of the Visual Perception Tests

The informal tests of visual perception were constructed by the investigator in consultation with her advisor after a review of the literature on the topic. Data regarding the validity of these tests appear following their presentation.

An initial important decision had to be made about the symbols to be used in the visual perception tests. It seemed evident that no use could be made of letters in constructing the tests because the intention was to keep the skill clusters separate and the use of letters in the tests of the visual perception cluster would make them overlap with the tests of the verbal coding cluster. On the other hand, it was considered desirable to use symbols that would not be totally unlike those seen in the normal reading situation.

It was concluded, therefore, that the tests should be based on the letter-like symbols originally devised for the Gibson, Gibson, Pick and Osser study in 1962. The symbols have been employed in subsequent research by Gibson, Pick, and other investigators. The original symbols as displayed by Pick (1970) were adapted to the purpose of this study.

Visual Discrimination. A test of Visual Discrimination in which symbols were matched directly was devised and administered in the first stage of the pre-pilot study but was deleted from the battery in view of the findings (see page 48).

The test was constructed by employing the twelve standards and five of the eight transformations from the Pick display and devising twelve new standards and five transformations of each. The transformations omitted from the Pick display were: left-right reversals, 180 degree rotations, and one other which was either identical or highly similar to another in its set.

The twelve new standards were devised with the intent of preserving the letter-like quality of the original symbols. The transformations were devised to avoid left-right reversals, 180 degree rotations, and highly similar symbols.

The twenty-four sets were arranged in rows with the twelve Pick sets on one 8½ x 11 inch sheet and the twelve new sets on another. In each row the standard was displayed on the left and separated by a line from the target and distracters. The target and distracters were randomly ordered by informal means.

The task was to circle the symbols which matched the standard displayed on the left. Markers were provided to place under each set of symbols during the process of selecting the target.

A copy of the test and a sample target card are exhibited as Appendix A.

Visual Memory of Symbols. The Visual Memory of Symbols test was a variation of the Visual Discrimination test. The standards were removed from the left side of the display sheets leaving only the random arrangement of target and distracters. Targets different from those used in the Visual Discrimination test were selected and were drawn in heavy black lines in approximately 3 x 4 inch size on 5 x 8 inch cards.

The task was to circle the symbol in the set which matched the target displayed on the card. The target was displayed for three seconds during which period the subjects were required to look only at the target.

A copy of the test and a sample display card are exhibited as Appendix B.

Perception of Reversal of Symbols. The Perception of Reversals of Symbols test was also based on the Pick symbols. One symbol of each set constructed for the Visual Memory of Symbols test was selected on the basis that a left-right reversal produced a symbol recognizably different. Thus twenty-four symbols and their reversals formed the test items. The twelve items from the Pick display were placed on one 8½ x 11 inch sheet and the twelve new items on another.

For each item one of the pair of symbols was chosen as target and drawn on 5 x 8 inch cards in the manner described for targets for the Visual Memory test.

The task was to circle the symbol on the page that matched the target, after a three second display.

A copy of the test and a sample display card are included as Appendix C.

Construction of Verbal Coding Tests

All of the Verbal Coding tests were made up of letters and letter combinations. All letters were presented in lower case form.

Identifying Letters Named. This test was reproduced from the Boston University First Grade Success Study (1955). Twenty-six items were displayed in two columns on an 8½ x 11 inch sheet. Each item consisted of five typewritten lower case letters arranged with three spaces between the letters. Markers were provided to place below each item during the selection of the target.

The task was to circle the letter named by the examiner. In the course of the twenty-six items each letter of the alphabet served as a target in the random order devised for the Boston Study.

A copy of the test is exhibited as Appendix D.

Transpositions of Consonant Trigrams. The Transposition of Consonant Trigrams test was devised by employing the Educational Basic non-mat compiler (Hewlitt-Packard 2114) so that the following conditions were met: twenty-four random selections of consonant trigrams were created, repetitions of consonants within trigrams were excluded, and three permutations of each trigram were randomly selected.

The trigrams and their permutations thus produced were displayed in rows with each trigram and its permutations comprising one row on 8½ x 11 sheets. The twenty-four items were hand printed in lower case letters with twelve items on each sheet.

One trigram in each set was randomly selected by informal means to serve as target and was displayed on a 5 x 8 inch card in hand printed letters approximately three inches in height.

The task was to study the target during a three second exposure and then circle the trigram in which the letters appeared in the same order. Markers were provided to place below the item during the selection.

A copy of the test and a sample target card are included as Appendix E.

Identifying Phonemes, Blends and Phonograms. The test designated as Identifying Phonemes, Blends and Phonograms was composed of eight items from the Identifying Phonemes subtest of the Boston University First Grade Success Study (1955), eight items made up of blends selected and arranged by the investigator in consultation with her advisor, and eight items from the Identifying Phonograms subtest of a study by Murphy (1965). Each item consisted of the target and three distracters for the phonograms and the target and four distracters for the phonemes and blends.

The target was pronounced by the administrator in the following way:

Phonemes - "Circle the last sound you hear in ________"

Blends - "Circle the first sound you hear in ________"

Phonograms "Circle the last sound you hear in ________"

The test and the cue words appear as Appendix F.

Validity of the Informal Tests

An assumption of the validity of using symbols in the tests of Visual Memory and Reversals was based on the decision to employ the letter-like symbols devised by Gibson et al (1962) to evaluate the development of visual perception in children aged four to eight years. The symbols have been employed by them and by other reading specialists in subsequent studies and have been accepted as a valid measure of the development of visual perception for kindergarten and first grade subjects. The validity of relating the visual perception of the symbols to first grade reading achievement is being explored as one purpose of this study. Evidence about validity emerged in this study and is presented in Chapter V.

The fact that letter knowledge is considered to be a necessary part of a child's reading curriculum makes it possible to assume that tests of letter knowledge may validly be included in a study on beginning reading. Despite this surface evidence of content validity, however, there may be a need to seek evidence of the validity of including in a study on reading a test of letter clusters presented in a flashed situation. This evidence was found in a study by Chapman, Calfee and Venezky (1970) in which they employed two, three, and four letter groups of consonants. The three and four letter groups were permutated to produce distracters and this technique was followed in the present study. Chapman et al found a bimodal distribution of the scores on their test. The possibility that that feature of the distribution is associated with reading achievement is being explored in this study.

Reliability of the Informal Tests

The purpose of a pre-pilot study was to determine the reliability of the informal tests used with the Vancouver sample, by means of a split-half (odd-even) analysis. It also served to determine the range of scores over the sample population and to provide information about the time required and suitable techniques for the administration of the testing program.

Twenty-four first grade students in one of the Vancouver elementary schools comprised the sample for the first two stages of the reliability study early in March. Twenty-nine first grade students in a school were employed in the third stages of the study in early April. In each case the subjects were divided into two groups for administrative purposes.

Stage One. The three tests of visual perception were administered in the first stage of the pre-pilot study. Each test was preceded by explanation and illustration employing a sample item displayed on a 4 x 12 inch card and a target card 3 x 4 inches.

The results of the Visual Discrimination test showed that the mean was in excess of 80% and that more than 60% of the errors were accounted for by 20% of the items. These results suggested that the test was not appropriate for mid grade one subjects and, as a result, the test was deleted from the battery.

The internal consistency of the remaining two perception tests was computed for this sample by means of Guttman's formula (see Magnusson (1967)) applied to the odd-even items for each test.

The figure of .40 thus obtained for the test of Visual Memory was deemed unacceptable and an item analysis was undertaken. As a result the test was re-written by altering items on which almost all children scored or almost all erred. The items were altered by replacing or changing particular symbols that seemed to provide too great or too little divergence from the target.

A figure of .94 was obtained for this sample on the test of Perception of Reversals. As a result the test as developed was accepted for inclusion in the battery. Scores are presented in Appendix G.

Stage Two. In the second stage of the reliability study the altered form of the Visual Memory test was administered together with the test of Transposition of Consonant Trigrams. The sample was the same as that used in the first stage of the pre-pilot study. Again explanation and demonstration preceded administration.

Guttman reliability for the Visual Memory test had risen to .69 but was still deemed unacceptable. Again an item analysis showed particular items provided very high or very low means. A further revision of the test was undertaken in the same manner as the earlier revision.

The Transposition of Consonant Trigrams test results provided a lower-bound reliability of .94 as computed by the Guttman formula and was therefore included in the battery. Test scores appear in Appendix G.

Stage Three. A sample of twenty-nine subjects was drawn from a different school for the third stage of the pre-pilot study. The latest revision of the Visual Memory test was administered together with the test of Identifying Phonemes, Blends and Phonograms.

Reliability was computed to be .95 for the Identifying Phonemes, Blends, and Phonograms. This test was deemed acceptable for inclusion in the battery.

The test of Visual Memory was re-administered to the same sample three days later to study the test-retest reliability. Reliability was established as .76 and the test was thereby accepted into the battery.

Test scores for both tests are reported in Appendix G.

PROCEDURES

Pilot Study

A pilot study was administered early in April to provide experience in the administration of the tests on which to base decisions about the order, times, and techniques of administration of the tests in the study. The subjects were six first grade students from a classroom different from those previously used. The students were selected by their teacher to provide a range of reading ability in order to assure administration techniques and times suitable to good and poor readers alike.

The Gates-MacGinitie Reading Tests and the battery of seven tests selected or devised for the study were administered in two sittings on successive days. Each sitting was broken by a fifteen minute period for relaxation. The tests were ordered in the following ways:

First Sitting - Gates-MacGinitie Reading Vocabulary Test
Visual Memory of Symbols
Identifying Phonemes, Blends and Phonograms
Vocabulary Listening

Second Sitting - Gates-MacGinitie Reading Comprehension
Perception of Reversals of Symbols

Identifying Letters Named

Transposition of Consonant Trigrams

Sentence Listening

In the reliability studies an exposure time of three seconds had been used for the Visual Memory and Transposition of Consonant Trigrams tests and a one second exposure of the target was used for the Perception of Reversals of Symbols test. It had been noted that the mean of the Reversals test (11.12) was considerably lower than the mean of the Visual Memory test (15.00) and the mean of the Transpositions test (14.33). It was felt that first grade pupils did not find one second an adequate time in which to direct their attention or to orient themselves to the position of the symbol. In view of these possibilities it was decided to increase the exposure time for the Reversals test to three seconds so that exposure times for all three tests were equal. In the pilot study three second exposures were used for the three tests and it was noted that the mean of the Reversals test more closely approximated the means of the other two tests.

After explanations of the tasks, the same technique was used to administer the three tests employing visual targets. The instructions were: Place your marker under Row ______. Ready . . . Look . . . Mark . . .

Results of the pilot study showed that, apart from the reading achievement tests, approximately eighty minutes were required for each sitting to permit adequate time for explanation of each test and a brief rest between tests.

The Study

The tests were administered in late May to 109 subjects comprising five first grade classrooms. Three sittings were required for each class. In the first sitting the Gates-MacGinitie Reading Tests, vocabulary and comprehension, were administered with a brief rest period between.

The reading tests were scored according to directions in the manual and the scores converted to standard scores. The standard scores were totaled for each child and the scores thus obtained were ordered for the 109 subjects. The upper and lower quarters were designated as good and poor readers respectively. These 54 subjects were employed in subsequent sittings.

The battery tests were ordered for the second and third sittings as they had been in the pilot study.

Test Correction and Scoring Procedures

All tests were hand-scored by the investigator. Standardized tests were scored as directed in the accompanying manual of instructions. Informal tests were scored as the number of items correct except for the test of

Reversals. As each item in the Reversals test was composed of only two choices, the score awarded was the number of items correct minus the number of items incorrect.

CHAPTER IV

ANALYSIS OF DATA

In this study of successful and unsuccessful readers near the end of first grade, the subjects were selected on the basis of achievement on tests of reading vocabulary and reading comprehension. After tests of reading achievement had been administered to five whole classes, the summed standard scores were ordered and the upper and lower quarters were designated as successful and unsuccessful readers, respectively. Twenty-seven subjects were assigned to each group in this manner, a total of fifty-four subjects out of a sample of one hundred nine. It was noted that the scores of the good readers were more homogeneous than the scores of poor readers.

A battery of tests was administered to the fifty-four subjects to compare their performance on three clusters of skills, visual perception, verbal coding, and meaningful association, all assumed to be components of reading ability.

The subtests of the first cluster, visual perception, were (1) visual memory and (2) perception of reversals. Both tests employed symbols which resemble letters but, not being letters, did not permit recognition by association with a name or sound. These tests were developed for the study.

The second cluster, verbal coding, was designed to evaluate the subjects' knowledge of phoneme-grapheme correspondences. It included subtests of (1) knowledge of letter names (2) transpositions of consonant trigrams and sounds of single letters and groups of letters. The transpositions test was developed for the study. The other two had been developed for earlier studies.

Meaningful association, the third cluster, evaluated the ability to extract meaning from oral language by using tests of (1) vocabulary listening and (2) sentence listening. These tests were standardized tests.

The battery was designed to study the areas of difference between successful and unsuccessful readers apart from their global reading ability.

The research questions posed in the study were the following:

1. Are there significant differences between successful and unsuccessful readers near the end of first grade in the following reading subskills: visual memory, perception of reversal of symbols, letter knowledge, transposition of consonant trigrams, knowledge of phonemes, vocabulary listening, and sentence listening?

2. What correlations exist between the subskills measured

for (a) the combined group (b) successful and (c) unsuccessful readers?

3. Considering the successful and unsuccesful readers together:

   (a) which clusters of skills (visual perception, verbal coding, and meaningful association) contribute significantly to the prediction of reading category (successful or unsuccessful readers)?

   (b) which subskills contribute significantly to the prediction of reading category (successful or unsuccessful readers)?

4. Can the Mackworth model be validated in the sense that evidence can be obtained indicating that visual perception, verbal coding, and meaningful association do, in fact, contribute significantly to reading achievement of first grade children.

5. Does the Mackworth model imply a developmental sequence? That is, is there evidence that visual perception, verbal coding and meaningful association are developed and used in that sequence?

The comparison of successful and unsuccessful readers as defined in the first question of the study was answered by the application of Hotelling's T^2 test.[1] As significant differences were found between the groups on the subskills considered simultaneously, the subskill scores were compared separately by means of t-tests.[2]

To answer the second question, correlation matrices[3] were developed for the combined group and for the successful and unsuccessful readers considered separately. Correlations were examined to observe both within cluster and between cluster correlations.

Regression analysis[4] determined the contribution of each cluster of skills and each subskill to the prediction of reading category (successful or unsuccessful readers) in answer to the third question. The clusters were entered in six orders to study the effect of ordering.

Questions four and five were answered from interpretation of the analysis of data.

As this study was exploratory in nature it seemed advisable to examine differences down to the .10 level of significance on questions three and four.

The data are presented and analysed under the following headings: comparison of successful and unsuccessful readers on clusters of skills and subskills, correlations among subskills, and prediction of reading category from subskills scores.

In the preparation of the tables and accompanying descriptive material, the terms good and successful and poor and unsuccessful have been used synonymously.

COMPARISON OF SUCCESSFUL AND UNSUCCESSFUL READERS ON CLUSTERS OF SKILLS AND SUBSKILLS

A seven-variate multivariate analysis of variance was performed using as measures the scores of each group on the subskills. A multivariate F-ratio test of significance was used to determine whether successful readers performed significantly better than unsuccessful readers on the seven variables considered simultaneously. The results of this analysis together with the mean vectors and standard deviations for the groups on the tests given are presented in Table II:

TABLE II

OBSERVED CELL MEANS AND STANDARD DEVIATIONS

Variable	Good Readers (n=27)		Poor Readers (n=27)	
	Mean	s.d.	Mean	s.d.
Visual Memory	15.41	2.56	11.70	3.67
Reversals	16.96	5.39	12.67	7.42
Letters	25.89	.32	20.70	6.04
Transpositions	19.56	3.14	12.81	4.87
Phonemes	23.52	.80	12.67	4.00
Vocabulary Listening	82.52	6.23	56.89	14.35
Sentence Listening	36.70	2.93	25.89	6.25

TABLE III

SUMMARY OF ANALYSIS OF MULTIVARIATE CRITERION

F-Ratio for Multivariate Test of Equality of Mean Vectors

F-Ratio = 37.54 Degrees of Freedom 7 and 46 P < .0001

Variable	Hypothesis Mean Square	Univariate F	Error Term Variance	Error Term s.d.
Visual Memory	185.19	18.51**	10.00	3.16
Reversals	249.18	5.92*	42.06	6.49
Letters	362.96	19.86**	18.28	4.28
Transpositions	613.40	36.55**	16.78	4.10
Phonemes	1587.79	191.02**	8.32	2.88
Vocabulary Listening	8867.84	72.49**	122.34	11.06
Sentence Listening	1578.96	66.30**	23.81	4.88

Degrees of Freedom for Hypothesis 1 ** Significant at .01 level

Degrees of Freedom for Error 52 * Significant at .05 level

With mean vectors as shown in Table II, the F-ratio for the multivariate test of equality of mean vectors was 37.54 (df = 7,46). If the population mean vectors were equal the probability of observing an F-ratio of this magnitude or greater would be less than .0001. Successful and unsuccessful readers differed markedly in performance on the subskills.

Since the good and poor readers differed significantly on the seven variables considered simultaneously, a study of the difference was carried out in relation to each of the variables by means of t-tests (equivalent to F with one degree of freedom). Results of these tests are presented in Table III.

Table III shows that all subskills were significantly different beyond the .01 level with the exception of the test of reversals which was significant beyond the .02 level.

CORRELATIONS BETWEEN SUBSKILLS SCORES

The subskill tests were designed or selected to explore three areas considered to be important to the early stages of reading achievement, visual perception, verbal coding, and meaningful association. The correlation matrices for the combined group and for successful and unsuccessful readers are presented in the following tables.

Table IV shows the correlation matrix of subskill variables for the combined group.

TABLE IV

CORRELATION MATRIX OF VARIABLES FOR COMBINED GROUP

	1 Vis. Mem.	2 Rev.	3 Let.	4 Trans.	5 Phon.	6 Voc.	7 Sent.
Visual Memory	1.000						
Reversals	.389**	1.000					
Letters	-.075	-.100	1.000				
Trans-positions	.038	.305*	.481**	1.000			
Phonemes	.252	.021	.359**	.165	1.000		
Vocabulary Listening	.012	.238	.282*	.221	.023	1.000	
Sentence Listening	.143	.271	.186	.429**	-.031	.616**	1.000

df = 52

** Significant at .01 level
 * Significant at .05 level

Table IV shows that for the combined group the correlations of subskills within clusters were significant at the .01 level, with the exception of the correlation between phonemes and transpositions which was not significant.

Table IV also shows that correlations of subskills between clusters yielded three significant correlations. Correlations between transpositions and sentence listening, between reversals and transpositions, and between letters and vocabulary listening were significant.

Table V presents the correlation matrix for good readers.

TABLE V

CORRELATION MATRIX OF VARIABLES FOR GOOD READERS

	1 Vis. Mem.	2 Rev.	3 Let.	4 Trans.	5 Phon.	6 Voc.	7 Sent.
Visual Memory	1.000						
Reversals	.015	1.000					
Letters	.292	-.069	1.000				
Trans-positions	-.001	.572**	.102	1.000			
Phonemes	.361	.165	-.216	.125	1.000		
Vocabulary Listening	.326	.374	.165	.207	.190	1.000	
Sentence Listening	-.081	-.084	.250	.215	-.210	.160	1.000

df = 25 ** Significant at .01 level

Table V shows that within clusters no significant correlations existed for scores on subskills for successful readers.

Only one correlation of subskills between clusters, reversals and transpositions, was significant.

Table VI shows the correlation matrix for unsuccessful readers.

TABLE VI

CORRELATION MATRIX OF VARIABLES FOR POOR READERS

	1 Vis. Mem.	2 Rev.	3 Let.	4 Trans.	5 Phon.	6 Voc.	7 Sent.
Visual Memory	1.000						
Reversals	.579**	1.000					
Letters	-.101	-.121	1.000				
Trans-positions	.055	.180	.570**	1.000			
Phonemes	.263	.003	.368	.184	1.000		
Vocabulary Listening	-.083	.202	.304	.229	.009	1.000	
Sentence Listening	.218	.398*	.199	.499**	-.015	.709**	1.000

df = 25

** Significant at .01 level
* Significant at .05 level

Table VI shows that within clusters significance was at the .01 level for three correlations of subskills, visual memory and reversals, letters and transpositions, and vocabulary listening and sentence listening.

Correlations of subskills between clusters were significant for transpositions and sentence listening and for reversals and sentence listening.

PREDICTION OF READING CATEGORY ON THE BASIS OF SUBSKILL SCORES

Sequential multiple regression analysis was used to examine the contribution of each subskill to the prediction of the reading category (successful or unsuccessful) to which the subjects belonged.

As the results of stepwise regression are affected by the order in which the independent variables are entered, it was decided to conduct six analyses using all permutations of the clusters. This would permit a comparison of the results under the six orders of entering the cluster variables and clarify the relative importance of the variables to the prediction of reading category.

The results of the stepwise regression analyses appear in Tables VII to XII inclusive. Table VII shows the results of entering the variables in the order proposed in the Mackworth model.

The multiple correlation was .92 indicating that approximately 85 per cent of the variance in reading category was linearly predictable from the subskills tested.

TABLE VII

FIRST STEPWISE REGRESSION TO ANALYZE THE CONTRIBUTION OF SUBSKILLS TO CATEGORIZATION BY READING ACHIEVEMENT

Source of Variation	Increment in R^2	df	F	% of Criterion Variance Accounted for
Visual Perception	.2696	2	17.19***	26.96
Visual Memory	.2625	1	33.48***	26.25
Reversals	.0071	1	.91	.71
Verbal Coding	.5337	3	22.68***	55.37
Letters	.1824	1	23.26***	18.24
Transpositions	.0765	1	9.76***	7.65
Phonemes	.2748	1	35.04***	27.48
Meaningful Association	.0478	2	3.05*	4.78
Vocabulary Listening	.0430	1	5.48**	4.30
Sentence Listening	.0048	1	.61	.48

*** Significant at .01 level
** Significant at .05 level
* Significant at .10 level

All three clusters, visual perception, verbal coding, and meaningful association, made significant contributions to the prediction of reading category. Using this order of entering the variables, verbal coding factors contributed 55.37 per cent, visual perception factors contributed 26.96 per cent, and meaningful association factors contributed 4.78 per cent of the total reading achievement variance, amounting to a total of 85 per cent.

The contributions of five variables, visual memory, letters, transposition, phonemes, and vocabulary listening were significant. Two subskills, reversals and sentence listening made no significant contribution to the prediction of reading category.

The phonemes variable accounted for 27.48 per cent, visual memory 26.25 per cent, and letters 27.48 per cent of the total variance in reading achievement. The joint contribution of these three subskills was approximately 72 per cent out of the total variance.

The results of the second order of entering the variables are presented in Table VIII.

The contributions of the three cluster variables, visual perception, verbal coding, and meaningful association, were significant beyond the .01 level of significance. Meaningful association factors contributed 39.27 per cent, visual perception factors contributed 26.96 per cent, and verbal coding factors contributed 18.88 per cent of the total reading achievement variance, amounting to 85 per cent.

TABLE VIII

SECOND STEPWISE REGRESSION TO ANALYZE THE CONTRIBUTION OF SUBSKILLS TO CATEGORIZATION BY READING ACHIEVEMENT

Source of Variation	Increment in R^2	df	F	% of Criterion Variance Accounted for
Visual Perception	.2696	2	17.19***	26.96
Visual Memory	.2625	1	33.47***	26.25
Reversals	.0071	1	.91	.71
Meaningful Association	.3927	2	25.04***	39.27
Vocabulary Listening	.3692	1	47.08***	36.92
Sentence Listening	.0235	1	3.00*	2.35
Verbal Coding	.1888	3	8.03***	18.88
Letters	.0099	1	1.26	.99
Transpositions	.0188	1	2.40	1.88
Phonemes	.1601	1	20.42***	16.01

*** Significant at .01 level
** Significant at .05 level
* Significant at .10 level

Four subskill variables, vocabulary listening, visual memory, phonemes, and sentence listening, made significant contributions to the prediction of reading category. Three subskills, reversals, letters, and transpositions, made no significant contribution to the prediction.

The vocabulary listening variable contributed 36.92 per cent, visual memory contributed 26.25 per cent, and phonemes contributed 16.01 per cent of the total variance in reading achievement.

The third method of ordering the cluster variables is presented in Table IX.

The verbal coding and meaningful association factors were significant in this ordering of the variables but the visual perception cluster was not significant. Verbal coding factors contributed 80.31 per cent and meaningful association factors contributed 4.78 per cent of the total variance in reading achievement which amounted to 85 per cent.

The four subskill variables making significant contributions to the prediction of reading category were letters, transpositions, phonemes, and vocabulary listening. Reversals, visual memory, and sentence listening made no significant contribution in this method of ordering the variables.

The phonemes variable contributed 36.04 per cent, letters 27.64 per cent, transpositions 15.63 per cent and vocabulary listening 5.48 per cent of the total variance in reading achievement.

TABLE IX

THIRD STEPWISE REGRESSION TO ANALYZE THE CONTRIBUTION OF SUBSKILLS TO CATEGORIZATION BY READING ACHIEVEMENT

Source of Variation	Increment in R^2	df	F	% of Criterion Variance Accounted for
Verbal Coding	.8031	3	34.14***	80.31
Letters	.2764	1	35.25***	27.64
Transpositions	.1563	1	19.93***	15.63
Phonemes	.3704	1	47.23***	37.04
Visual Perception	.0001	2	.01	.01
Visual Memory	.0001	1	.01	.01
Reverslas	.0000	1	.00	.00
Meaningful Association	.0478	2	3.05*	4.78
Vocabulary Listening	.0430	1	5.48**	4.30
Sentence Listening	.0048	1	.61	.48

*** Significant at .01 level
** Significant at .05 level
* Significant at .10 level

The results of the fourth method of ordering the clusters are presented in Table X.

TABLE X

FOURTH STEPWISE REGRESSION TO ANALYZE THE CONTRIBUTION OF SUBSKILLS TO CATEGORIZATION BY READING ACHIEVEMENT

Source of Variation	Increment in R^2	df	F	% of Criterion Variance Accounted for
Verbal Coding	.8031	3	34.14***	80.31
Letters	.2764	1	35.25***	27.64
Transpositions	.1563	1	19.93***	15.63
Phonemes	.3704	1	47.23***	37.04
Meaningful Association	.0460	2	5.87***	4.60
Vocabulary Listening	.0409	1	5.22**	4.09
Sentence Listening	.0051	1	.65	.51
Visual Perception	.0018	2	.23	.18
Visual Memory	.0002	1	.03	.02
Reversals	.0016	1	.20	.16

*** Significant at .01 level
** Significant at .05 level
* Significant at .10 level

The verbal coding and meaningful association variables made a significant contribution to the prediction of reading category under this condition of entering the variables. Visual perception factors made no significant contribution. Verbal coding factors contributed 80.31 per cent and meaningful association factors contributed 4.60 per cent of the total predictable variance in reading achievement, amounting to a total of 85 per cent.

Four subskill factors made significant contributions to the prediction of reading achievement, letters, transpositions, phonemes, and vocabulary listening. The other subskill factors did not contribute significantly to the prediction of reading achievement.

The phonemes variable contributed 36.04 per cent, letters contributed 27.64 per cent, and transpositions contributed 15.63 per cent of the total reading achievement variance. The combined contributions of these subskills was 79 per cent of the total variance in reading achievement.

The fifth method of ordering the cluster variables resulted in the data presented in Table XI.

All three clusters of skills, visual perception, verbal coding, and meaningful association, made significant contributions to the prediction of reading achievement under the fifth condition of entering the variables. The meaningful association factors contributed 62.33 per cent, verbal coding factors contributed 18.88 per cent and visual perception factors contributed 3.90 per cent of the total variance in reading achievement.

TABLE XI

FIFTH STEPWISE REGRESSION TO ANALYZE THE CONTRIBUTION OF SUBSKILLS TO CATEGORIZATION BY READING ACHIEVEMENT

Source of Variation	Increment in R^2	df	F	% of Criterion Variance Accounted for
Meaningful Association	.6233	2	39.74***	62.33
Vocabulary Listening	.5823	1	74.25***	58.23
Sentence Listening	.0410	1	5.23**	4.10
Visual Perception	.0390	2	4.97**	3.90
Visual Memory	.0327	1	4.17*	3.27
Reversals	.0063	1	.80	.63
Verbal Coding	.1888	3	24.08***	18.88
Letters	.0099	1	1.26	.99
Transpositions	.0188	1	2.40	1.88
Phonemes	.1601	1	20.42***	16.01

*** Significant at .01 level
** Significant at .05 level
* Significant at .10 level

Four subskill variables, vocabulary listening, phonemes, sentence listening, and visual memory contributed significantly to the prediction of reading achievement. Three variables, reversals, letters, and transpositions, made no significant contribution to the prediction.

The vocabulary listening subskill contributed 58.23 per cent and the phonemes subskill contributed 16.01 per cent of the total reading achievement variance. The joint contribution of these two subskill variables was 84 per cent of the total variance.

The sixth method of ordering the cluster variables is reported in Table XII.

Two clusters, meaningful association and verbal coding made significant contributions to the prediction of reading achievement. The visual perception cluster made no significant contribution. The meaningful association cluster contributed 62.33 per cent and verbal coding contributed 22.59 per cent of the total variance in reading achievement, a joint contribution of 85 per cent of the total variance.

Three subskill variables, vocabulary listening, phonemes, and sentence listening, made significant contributions to the prediction of reading achievement in this order of entering the variables. No other subskills made significant contributions.

The vocabulary listening variable contributed 58.23 per cent and the phonemes variable contributed 20.02 per cent of the total variance in reading achievement, a joint contribution of 78 per cent of the variance.

TABLE XII

SIXTH STEPWISE REGRESSION TO ANALYZE THE CONTRIBUTION OF SUBSKILLS TO CATEGORIZATION BY READING ACHIEVEMENT

Source of Variation	Increment in R^2	df	F	% of Criterion Variance Accounted for
Meaningful Association	.6233	2	39.74***	62.33
Vocabulary Listening	.5823	1	74.25***	58.23
Sentence Listening	.0410	1	5.23**	4.10
Verbal Coding	.2259	3	9.60***	22.59
Letters	.0115	1	1.47	1.15
Transpositions	.0142	1	1.81	1.42
Phonemes	.2002	1	25.53***	20.02
Visual Perception	.0018	2	.11	.18
Visual Memory	.0002	1	.03	.02
Reversals	.0016	1	.20	.16

*** Significant at .01 level
** Significant at .05 level
* Significant at .10 level

FOOTNOTES TO CHAPTER IV

COMPUTER PROGRAMS USED IN THE STUDY

[1] Jeremy D. Finn, State University of New York at Buffalo, April, 1967.

[2] UBC STRIP, University of British Columbia Computing Centre

[3] UBC STRIP, University of British Columbia Computing Centre

[4] UBC BMDO2R, Adapted by Jason Halm from UCLA BMD Documentation, November, 1972.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS, AND IMPLICATIONS OF THE STUDY

The purpose of the study was to investigate the differences between successful and unsuccessful readers in late grade one on tasks assumed to be part of the reading process.

The research questions posed in the study were:

1. Are there significant differences between successful and unsuccessful readers near the end of first grade in the following reading subskills: visual memory, perception of reversal of symbols, letter knowledge, transposition of consonant trigrams, knowledge of phonemes, vocabulary listening, and sentence listening?

2. What correlations exist between the subskills measured for (a) the combined group (b) successful and (c) unsuccessful readers?

3. Considering the successful and unsuccessful readers together:

   (a) which clusters of skills (visual perception, verbal coding, and meaningful association) contribute significantly to the prediction of reading category (successful or unsuccessful readers)?

(b) which subskills contribute significantly to the prediction of reading category (successful or unsuccessful readers)?

4. Can the Mackworth model be validated in the sense that evidence can be obtained indicating that visual perception, verbal coding, and meaningful association do, in fact, contribute significantly to reading achievement of first grade children?

5. Does the Mackworth model imply a developmental sequence? That is, is there evidence that visual perception, verbal coding, and meaningful association are developed and used in that sequence?

Tests were devised or selected to evaluate three clusters of skills, visual perception, verbal coding, and meaningful association.

The visual perception cluster was composed of two tests (1) visual memory of symbols and (2) perception of reversal of symbols.

The verbal coding cluster was composed of three tests (1) letter knowledge (2) transposition of consonant trigrams and (3) identification of phonemes, blends and phonograms.

The meaningful association cluster was made up of two tests (1) vocabulary listening and (2) sentence listening.

The data were analyzed first to determine whether there were significant differences between successful and unsuccessful readers on the three clusters of skills and on the seven subskills that formed the clusters.

Correlation matrices were formulated for the combined group and for the successful and unsuccessful readers considered separately.

The data were further analyzed to determine (a) which clusters and (b) which subskill variables contributed significantly to the prediction of reading category (successful or unsuccessful readers).

The level of significance set for all tests was .10. It was considered that setting the level of significance reasonably low was warranted, given the exploratory nature of the study.

SUMMARY OF FINDINGS

Comparison of Successful and Unsuccessful Readers on Clusters of Skills and Subskills

The seven subskills, considered as a set, markedly differentiated the two groups of readers, successful and unsuccessful. Further, the groups differed significantly on each of the seven variables considered separately.

Correlation Between Subskill Scores

1. For the combined group the within cluster correlations were significant in all cases except between the transpositions and phonemes variables of the verbal coding cluster. Between clusters only correlation, transpositions and sentence listening, was significant. This finding supports the cluster hypothesis.
2. For successful readers there were no significant correlations of variables within clusters. Between cluster correlations were significant for reversals and transpositions, visual memory and vocabulary listening, and reversals and vocabulary listening.
3. For unsuccessful readers only one within cluster correlation, transpositions and phonemes, failed to reach a significant level. There were significant between cluster correlations for reversals and sentence listening and transpositions and sentence listening.

Prediction of Reading Category

The findings are summarized under two headings (1) findings on cluster variables and (2) findings on subskill variables. Data for both are summarized in Table XIII. When reference is made to clusters capital letters are used. The visual perception cluster, then, becomes the VP cluster, the verbal coding cluster becomes the VC cluster, and the meaningful association cluster is referred to as the MA cluster.

FINDINGS ON CLUSTERS

1. Approximately 85 per cent of the variance in reading achievement was accounted for by the three clusters of skills measured.
2. It was only when the VP cluster was entered first in the ordering that it made a sizable contribution (26.96%) to the prediction of reading achievement. When the VP cluster was entered immediately after the MA cluster its contribution was small (3.90%) though significant. When it was entered after the VC cluster or when it was entered last its contribution was negligible.
3. When the VC cluster was entered first it accounted for 80 per cent of the variance. In second position of ordering it accounted for 55 per cent when entered after the VP cluster and 23 per cent when entered after the MA cluster. When the VC cluster was entered last it accounted for 19 per cent of the variance.
4. When the MA cluster was entered first it accounted for 62 per cent of the variance. In second position it contributed 39 per cent when it followed the VP cluster but only 5 per cent when it followed the VC cluster. When the MA cluster was entered last it contributed approximately 5 per cent of the variance in the prediction of reading achievement.

TABLE XIII

COMPARISON OF THE SIX ORDERS OF ENTERING VARIABLES IN THE STEPWISE REGRESSION TO ANALYZE THE CONTRIBUTION OF SUBSKILLS TO CATEGORIZATION BY READING ACHIEVEMENT

	Subskills							Clusters		
Order	1	2	3	4	5	6	7	VP	VC	MA
VP VC MA	26	1	18	8	27	4	0	27	55	5
VP MA VC	26	1	1	2	16	37	2	27	19	39
VC VP MA	0	0	28	15	37	4	0	0	80	5
VC MA VP	0	0	28	16	37	4	1	0	80	5
MA VP VC	3	1	1	2	16	58	4	4	19	62
MA VC VP	0	0	1	1	20	58	4	0	23	62

Code: 1 - Visual Memory
2 - Reversals
3 - Letters
4 - Transpositions
5 - Phonemes
6 - Vocabulary Listening
7 - Sentence Listening

VP - Visual Perception
VC - Verbal Coding
MA - Meaningful Association

Data reported in approximate per cent of variance accounted for.

FINDINGS ON SUBSKILLS VARIABLES

1. Two subskill variables, phonemes and vocabulary listening, made significant contributions to the prediction of reading achievement in all six orders of entering the variables.

Four subskills, letters, transpositions, visual memory, and sentence listening were significant contributors in three of the six orders of entering the variables. One subskill, reversals, made no significant contribution to the prediction of reading achievement in any of the orderings.

2. The visual memory subskill appeared always to make the largest contribution to the prediction and the reversals subskill to make almost no contribution. However, this finding may have resulted from the fact that visual memory was always entered first in the VP cluster. A different ordering might have produced a different result.
3. In the MA cluster the vocabulary listening subskill consistently appeared to make the largest contribution and the sentence listening subskill to make little contribution. This finding may have resulted from the fact that vocabulary listening was always entered first in the MA cluster. A different result might have been produced by a different ordering.
4. The letters and transpositions subskills were significant when the VC cluster was entered first and when it was entered immediately after the VP cluster. When entered after the MA cluster the significance of these subskills was eliminated.
5. The phonemes subskill consistently made a highly signif-

icant contribution to the prediction no matter what the placement of the verbal coding cluster. This was true despite the fact that the phonemes variable was always placed last within the VC cluster.

CONCLUSIONS

The following conclusions were drawn from the findings of the study.

1. Visual perception, verbal coding, and meaningful association, insofar as they do represent clusters of skills, appear to make an important contribution to reading achievement in first grade.
2. Since significant correlations were frequent between clusters for good readers and within clusters for poor readers, it was concluded that for good readers near the end of first grade the process of skills integration within clusters had progressed further than it had for poor readers.
3. The fact that the transpositions variable was most highly associated in good readers with the reversals variable and in poor readers with the letters variable led to the conclusion that a task of the transpositions type may in the early stages of learning require verbal coding skill (naming the letters) but, when experience is gained in decoding letter clusters (words), it becomes a task of visual perception. Again the homogeneity of scores of

good readers compared to the scores of poor readers may have affected the finding.

4. Visual perception as measured by the study probably constitutes an aspect of verbal coding, on which verbal coding partially depends.
5. Meaningful association is probably a factor that influences both visual perception and verbal coding and so cannot be said to occur as a later stage in a developmental model but as a factor in each stage.
6. The Mackworth model can be said to be developmental only in the sense that visual perception may precede verbal coding in the developmental stages. Meaningful association is probably involved at all stages.
7. Of the subskill variables, phonemes was the most powerful contributor to the prediction of reading category as defined by the study.
8. Vocabulary listening was also a strong contributor, although its placement in the analysis may have distorted its significance.
9. Further analysis would be required before any conclusion could be drawn about the relative importance of the visual memory and reversals subskills.

IMPLICATIONS OF THE STUDY

1. Teachers planning programmes for first grade children should be made aware that visual perception, verbal coding,

and meaningful association are all significant subskills of reading achievement. Provision should probably be made for the development of each although this study does not provide experimental evidence of the probable effect of training.

2. Teachers planning programmes for first grade children should be made aware that attention directed to the development of the specific skill of visual memory as a "prior skill" in the eventual development of verbal coding may provide a useful point of departure early in reading instruction. Experimental evidence would have to be sought, however, before confidence could be placed in the implied importance of visual memory to verbal coding.
3. Teachers planning programmes for first grade children should take into account that knowledge of phonemes is strongly associated with reading achievement in first grade.

SUGGESTIONS FOR FURTHER STUDY

1. The Mackworth model should be explored at several stages during the first grade to evaluate what, if any, shifts occur in the relative importance of the subskill factors within the model.
2. The study should be repeated and the full range of reading achievement examined to determine the contributions of the individual clusters and subskills to the

prediction of reading achievement.

3. The study should be replicated with a larger sample and the subskill variables rotated with the clusters in order to examine the relative importance of the subskills in the prediction of reading category. The selection of the sample should be done in such a way as to make possible the inclusion of similar ranges of scores for each group.
4. A treatment study should be initiated to discover whether specific weaknesses identified in tests of subskills can be remediated through training. While the findings of this study indicate that the subskills tested are highly associated with reading achievement, experimental studies are needed to establish what direct benefits may accrue from systematic training in the subskills.

REFERENCES

REFERENCES

Anderson, R.H. & Samuels, S.J. Visual Recognition Memory, Paired-Associate Learning, and Reading Achievement. 16 p. Paper read at American Educational Research Association Annual Convention, Minneapolis, 1970. ED 040 011, microfiche $ .25, hard copy $ .90.

Astill, Dolores E. Visual Memory Deficits and Reading Disabilities. 71 p. Diss. Ab., 30, 3310. Order No. 70-2283, microfilm $3.00, Xerography $4.00, from Univ. Microfilms.

Bakker, D.J. Temporal Order, Meaningfulness and Reading Ability. Perceptual and Motor Skills, 1967, 24, 1027-1030.

Barrett, T.C. Visual Discrimination Tasks as Predictors of First Grade Reading Achievement. Reading Teacher, 1965, 18(4), 276-282.

Barrett, T.C. The Relationship Between Measures of Pre-reading Visual Discrimination and First Grade Reading Achievement. Reading Research Quarterly, 1965, 1(1), 51-76.

Biemiller, A.J. The Development of the Use of Graphic and Contextual Information as Children Learn to Read. Reading Research Quarterly, 1970, 6(1), 75-96.

Blank, Marion & Bridger, W.H. Deficiencies in Verbal Labeling in Retarded Readers. American Journal of Orthopsychiatry, 1966, 36(5), 840-847.

Bond, G.L. & Dykstra, R. First Grade Studies. (Final report, HEW Project No. X 001. University of Minnesota, Minneapolis, 1967). ED 013 714, microfiche $1.50, hard copy $15.76.

Brown, E. The Bases of Reading Acquisition. Reading Research Quarterly, 1970, 6(1), 49-74.

Buckland, Pearl R. The Effect of Visual Perception Training on Reading Achievement in Low Readiness First Grade Pupils. 126 p. Diss. Ab., 31, 1613, microfilm $4.00, Xerography $6.00, from Univ. Microfilms.

Bukentica, N.A. Perceptual Mode Dominance: An Approach to Assessment of First Grade Reading and Spelling. 26 p. (University of Chicago, 1967). ED 026 132, microfiche $ .25, hard copy $1.40.

Calfee, R.C., Chapman, R., & Venezky, R. How a Child Needs to Think to Learn to Read. 48 p. (HEW Contract No. OEC 5-10-154, Wisconsin University, Madison, 1970). ED 046 627, microfiche $ .65, hard copy $3.20.

Chall, Jeanne S. Learning to Read: The Great Debate. New York, McGraw-Hill, 1967.

Chapman, R. Calfee, R. & Venezky, R. Basic Language and Cognitive Skills in Kindergartens. In W.K. Durr (Ed.) Reading Difficulties: Diagnosis, Correction and Remediation. Newark: International Reading Association, 1970, 17-27.

Cohen, S.A. Studies in Visual Perception and Reading in Disadvantaged Children. Paper delivered at College Reading Association, Boston, 1969. 12 p. ED 031 367, microfiche $ .25, hard copy $ .70.

Compton, Mary E. A Study of the Relationship Between Oral Language Facility and Reading Achievement of Selected First Grade Children. 148 p. Diss. Ab., 32, 6848, Order No. 72-17-211, microfilm $4.00, Xerography $10.00, from Univ. microfilms.

Crosby, R.M.N. & Liston, R.A. The Waysiders: A New Approach to Reading and the Dyslexic Child. New York: Delacorte Press, 1968.

Denner, B. Representational and Syntactic Competence of Problem Readers. Child Development, 1970, 41, 881-887.

Durrell, D.D. First Grade Reading Success Study: A Summary. Boston University Journal of Education, 1958, 140(3), 2-6.

Durrell, D.D. & Brassard, Mary B. Durrell Listening-Reading Series, Primary Level, Form DE. New York: Harcourt, Brace and World, 1965.

Dykstra, R. Summary of the Second-Grade Phase of the Cooperative Research Program in Primary Reading Instruction. Reading Research Quarterly, 1968, 4(1), 49-70.

Elam, C.B. Temporal-Spatial Derangement as a Factor in Reading Difficulty. 22 p. (Texas Christian University Fort Worth, 1969, HEW Grant 7-8-000001-029-010). ED 032, 209, microfiche $ .25, hard copy $1.20.

Feldman, Shirley C. Visual Perception Skills of Children and Their Relation to Reading. 98 p. Diss. Ab., 22, 1048. Order No. 61-3878, microfilm $2.75, Xerography $5.00.

Fortenberry, W.D. An Investigation of the Effectiveness of a Special Program Upon the Development of Visual Perception for Word Recognition of Culturally Disadvantaged First Grade Students. Nineteenth Yearbook of the National Reading Conference, 1970, 19(1), 141-145.

Frostig, Marianne. Individual Learning Disabilities. 43 p. Paper presented to Rocky Mountain Educational Laboratory Corp., Denver, 1968. ED 029 418, microfiche $ .25, hard copy $2.25.

Frostig, Marianne. Visual Modality-Research and Practice. In Helen K. Smith (Ed.) Perception and Reading. Proceedings of the Twelfth Annual Convention, International Reading Association, 1968, 12(4), 25-33.

Frostig, Marianne & Horne, D. The Marianne Frostig Program for the Development of Visual Perception. Chicago: Follett, 1964.

Frostig, Marianne, Lefever, W. & Whittlesey, J.R.B. The Marianne Frostig Developmental Test of Visual Perception, Third Edition. Palo Alto, California; Consulting Psychologists Press, 1964.

Frostig, Marianne, Lefever, W., & Whittlesey, J.R.B. The Marianne Frostig Developmental Test of Visual Perception for Evaluating Normal and Neurologically Handicapped Children. Perceptual and Motor Skills, 1961, 12, 383-384.

Gates, A.I. & MacGinitie, W.H. Gates MacGinitie Reading Tests Primary A, Vocabulary and Comprehension - Grade 1. New York: Teachers College Press, Columbia U., 1965.

Gibson, Eleanor J. Principles of Perceptual Learning. New York: Appleton-Century Crofts, Meredith Corp., 1969.

Gibson, Eleanor J. Learning to Read. In H. Singer & R.B. Ruddell (Eds.) Theoretical Models and Processes of Reading. Newark: International Reading Association, 1970, 315-334.

Gibson, Eleanor J., Gibson, J.J., Pick, Anne D., & Osser, H. A Developmental Study of the Discrimination of Letter-like Forms. Journal of Comparative Physiological Psychology, 1962, 55(6), 897-906.

Gibson, Eleanor J., Osser, H. & Pick, Anne D. A Study of the Development of Grapheme-Phoneme Correspondence. Journal of Verbal Learning and Verbal Behaviour, 1963, 2, 142-146.

Glass, G.G. The Teaching of Word Analysis Through Perceptual Conditioning. Proceedings of International Reading Conference, 1965, 10, 410-413.

Goins, Jean T. Visual Perceptual Abilities and Early Reading Progress. Chicago: University of Chicago Press, 1958.

Goodman, K. A Linguistic Study of Cues and Miscues in Reading. Elementary English, 1965, 42(6), 639-643.

Goodman, K. Comprehension Centered Reading. Claremont Reading Conference Proceedings, 1970. Thirty-fourth Yearbook.

Gotts, E.A. Grapheme-Phoneme Correspondence Learning in Children with Reading Difficulties. 183 p. Diss. Ab., 31, 5886. Order No. 71-22, 542, microfilm $4.00, Xerography $6.00, from Univ. Microfilms.

Hochberg, J. Components of Literacy: Speculations and Exploratory Research. In H. Levin and Joanna P. Williams (Eds.) Basic Studies in Reading. New York: Basic Books, 1970.

Kerfoot, J.F. The Relationship of Selected Auditory and Visual Reading Readiness Measures to First Grade Reading Achievement and Second Grade Reading and Spelling Achievement. 305 p. Diss. Ab., 25, 1747. Order No. 64-9492, microfilm $3.95, Xerography $14.75, from Univ. Microfilms.

Klein, Isobel & Marsh, Helen R. Identification and Remediation of Perceptual Handicaps in Learning to Read. Final Report. 17 p. (HEW Contract OEC 1-7-078015-2986). ED 029 773, microfiche $ .25, hard copy $ .95.

Levitt, Edith. Effect of Context on the Reading of Mentally Retarded and Normal Children at First Grade Level. 13 p. (HEW Report No. RR-5). ED 032 701, microfiche $ .25, hard copy $ .75.

Lovell, K. & Gorton, A. A Study of Some Differences Between Backward and Normal Readers of Average Intelligence. British Journal of Psychology, 1968, 37-38, 240-248.

Mackworth, Jane F. Some Models of the Reading Process: Learners and Skilled Readers. Reading Research Quarterly, 1972, VIII (4), 701-733.

Marchbanks, Gabrielle & Levin, H. Cues by which Children Recognize Words. Journal of Educational Psychology, 1965, 56(2), 57-61.

Maxwell, Martha J. & Temp, G. Survey of the Literature on Methods and Materials in Reading. In R. Corder (Ed.) The Information Base for Reading: A Critical Review of the Information Base for Current Assumptions Regarding the Status of Instruction and Achievement in Reading in the United States. 392 p. (Contract OEC-0-70-4792-508). ED 054 922, microfiche $ .65, hard copy $13.16.

McClanahan, L.J. The Effectiveness of Perceptual Training for Slow Learners. 129 p. Diss. Ab., 28, 2560. Order No. 67-17, 543, microfilm $3.00, Xerography $6.20, from Univ. Microfilms.

Miller, G. The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity of Processing Information. Psychology Review, 1956, 63, 81-97.

Miller, G., Bruner, J.S., & Postman, L. Familiarity of Letter Sequences and Tachistoscopic Identification. Journal of General Psychology, 1954, 50, 129-139.

Monroe, Marion. Children Who Cannot Read. Chicago: University of Chicago Press, 1932.

Mould, R.E. An Evaluation of the Effectiveness of a Special Program for Retarded Readers Manifesting Disturbed Visual Perception. 90 p. Diss. Ab., 26, 228. Order No. 65-7706, microfilm $3.00, Xerography $4.80, from Univ. Microfilms.

Muehl, S. & King, Ethel M. Recent Research in Visual Discrimination: Significance for Beginning Readers. In J.A. Figurel (Ed.) Vistas in Reading, International Reading Association Conference Proceedings, 1967, 11(1).

Murphy, Helen A. Reading Research in Relation to the Growth in Perception of Word Elements in Three Types of Beginning Reading Instruction. (Project No. 2675) Boston University, 1965.

Nodine, C.F. & Hardt, J.V. Role of Letter-Position Cues in Learning to Read Words. Journal of Educational Psychology, 1970, 61(1), 10-15.

Ohnmacht, Dorothy C. The Effects of Letter Knowledge on Achievement in Reading in the First Grade. Paper presented at American Educational Research Association, Los Angeles, 1969. ED 028 913, microfiche $ .25, hard copy $ .80.

Pick, Anne D. Some Basic Perceptual Processes in Reading. Young Children, 1970, XXV, (3), 162-181.

Rosen, C.L. A Study of Visual Perception Capabilities of First Grade Pupils and the Relationship Between Visual Perception Training and Reading Achievement. 382 p. Diss. Ab., 26, 5247. Order No. 65-15, 287, microfilm $4.90, Xerography $17.35, from Univ. Microfilms.

Samuels, S.J. Modes of Word Recognition. In H. Singer & R.B. Ruddell (Eds.) Theoretical Models and Processes of Reading. Newark: International Reading Association, 1970, 23-37.

Samuels, S.J. Letter-name Versus Letter-sound knowledge in Learning to Read. Reading Teacher, 1971, 24, 604-608.

Smith, F. & Holmes, Deborah L. The Independence of Letter, Word, and Meaning Identification in Reading. Reading Research Quarterly, 1971, 6(3), 394-415.

Spache, G.D. The Perceptual Bases of Reading. First World Congress on Reading, 1966.

Vernon, M.D. Reading and Its Difficulty. Cambridge: University Press, 1971.

Vernon, M.D. Backwardness in Reading: A Study of the Nature and Origin. Cambridge: University Press, 1957.

Vernon, M.D. Perception Through Experience. New York: Barnes and Noble, 1970.

Venezky, R. & Calfee, R.C. The Reading Competency Model. In H. Singer and R.B. Ruddell (Eds.) Theoretical Models and Processes of Reading. Newark: International Reading Association, 1970.

Weber, Rose-Marie. A Linguistic Analysis of First Grade Reading Errors. Reading Research Quarterly, 1970, 5(3), 427-451.

Weber, Rose-Marie. First-Graders Use of Grammatical Context in Reading. In H. Levin & Joanna P. Williams (Eds.), Basic Studies on Reading. New York: Basic Books, 1970.

Williams, Joanna P. Reactions to Modes of Word Recognition. Theoretical Models and Processes of Reading. Newark: International Reading Association, 1970.

REFERENCES FOR STATISTICAL PROCEDURES

REFERENCES FOR STATISTICAL PROCEDURES

Finn, J.D. Multivariance. State University of New York at Buffalo, 1967.

Graybill, F.A. An Introduction to Linear Statistical Models. Volume 1. Toronto: McGraw-Hill, 206.

Halm, J.A. UCLA BMDO2R Stepwise Regression, adapted from UCLA BMD, Health Sciences Computing Facility, UCLA, 1972.

Magnusson, D. Test Theory. Don Mills: Addison-Wesley Company, 1967, 111.

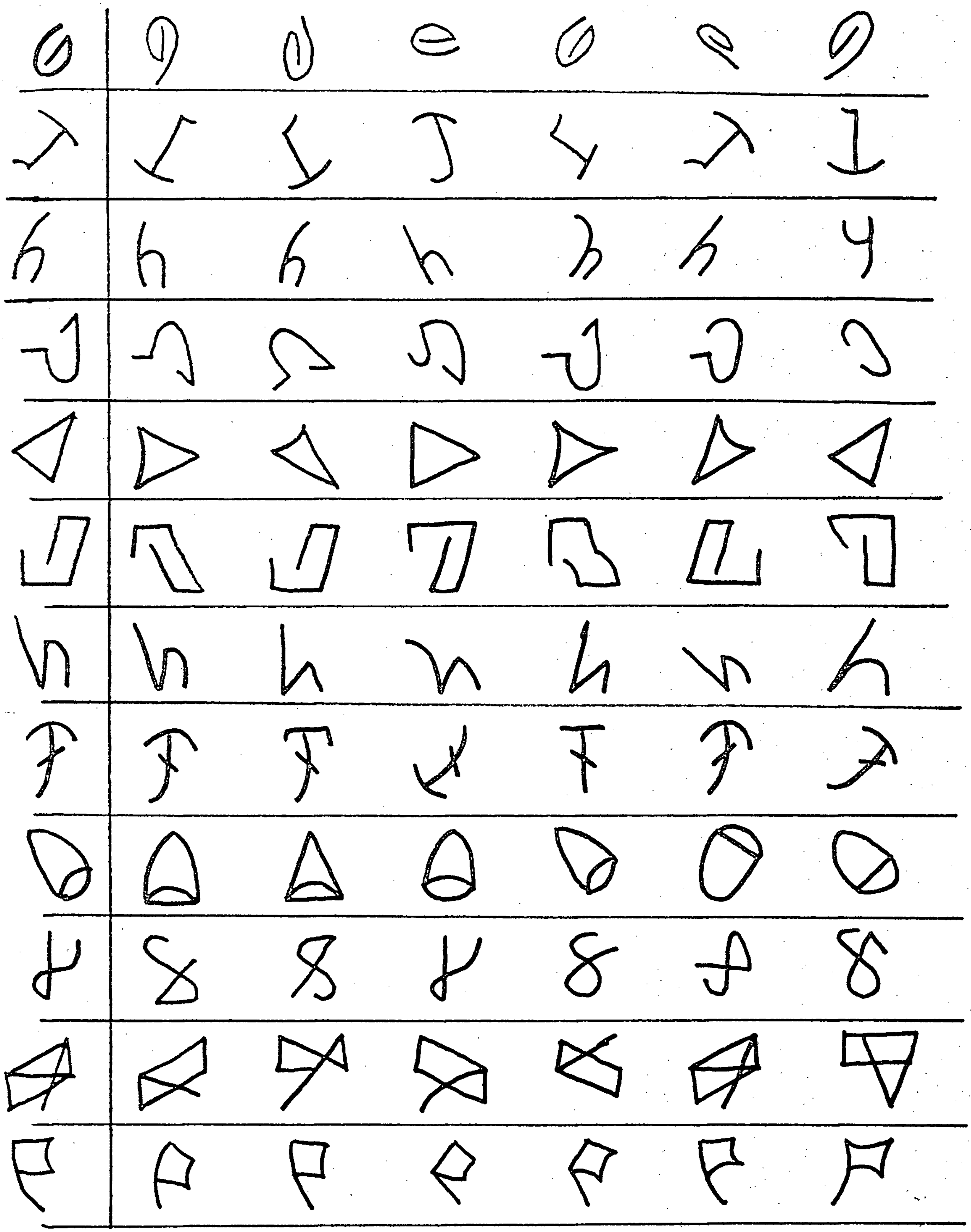
STRIP. University of British Columbia Computing Centre.

APPENDICES

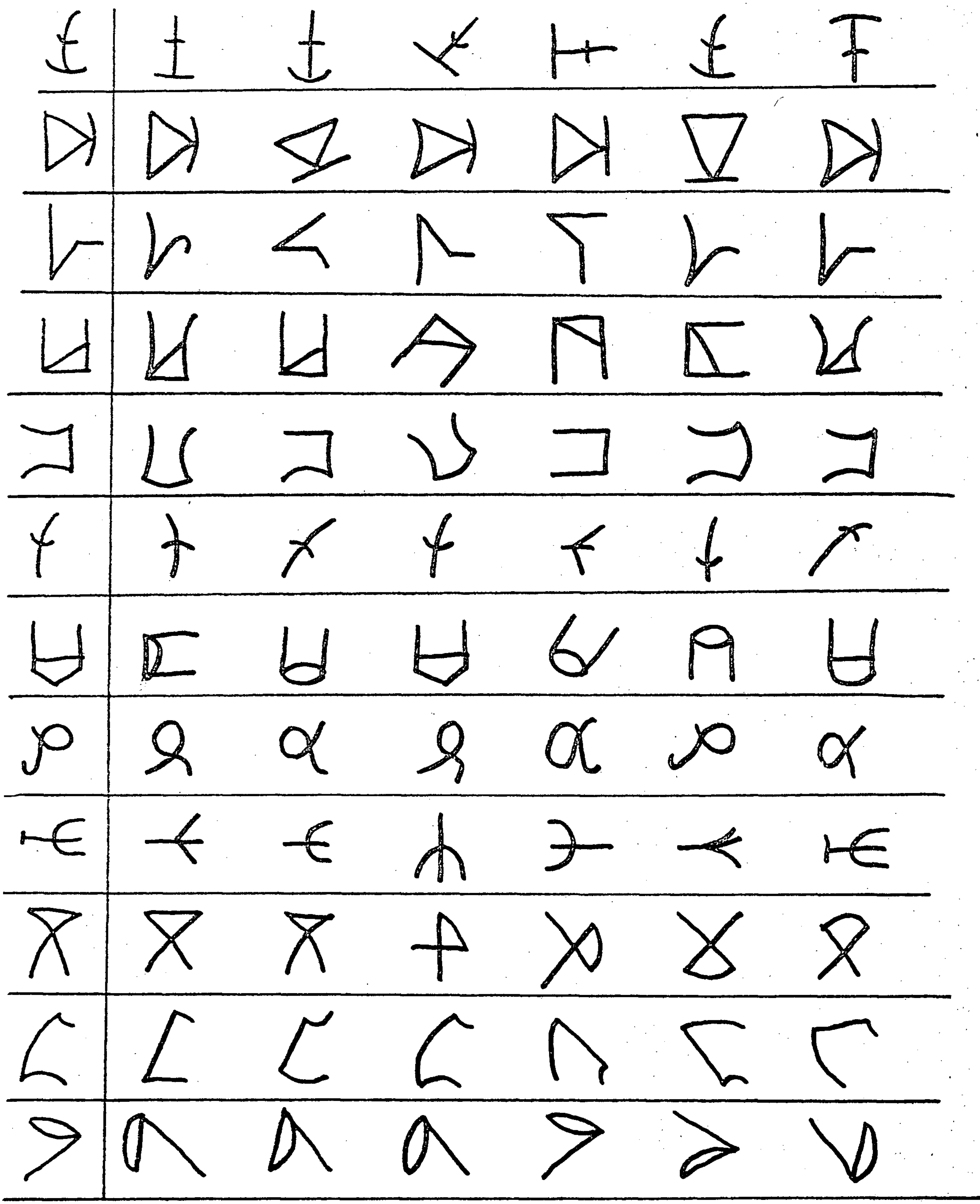
APPENDIX A

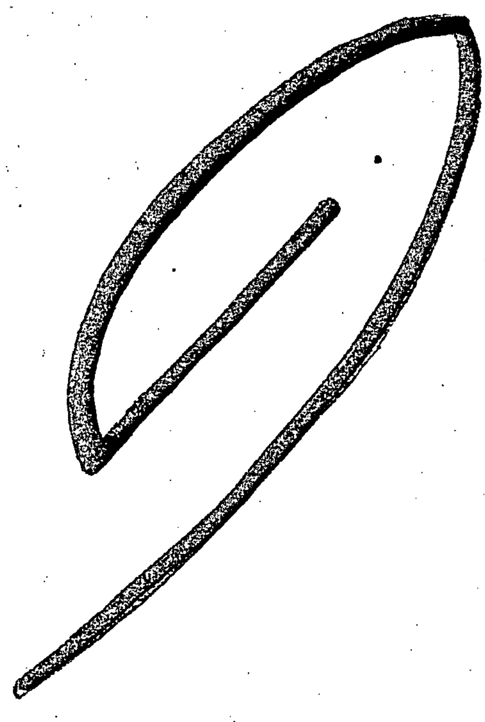
VISUAL DISCRIMINATION TEST

Visual Discrimination - a



Visual Discrimination - b



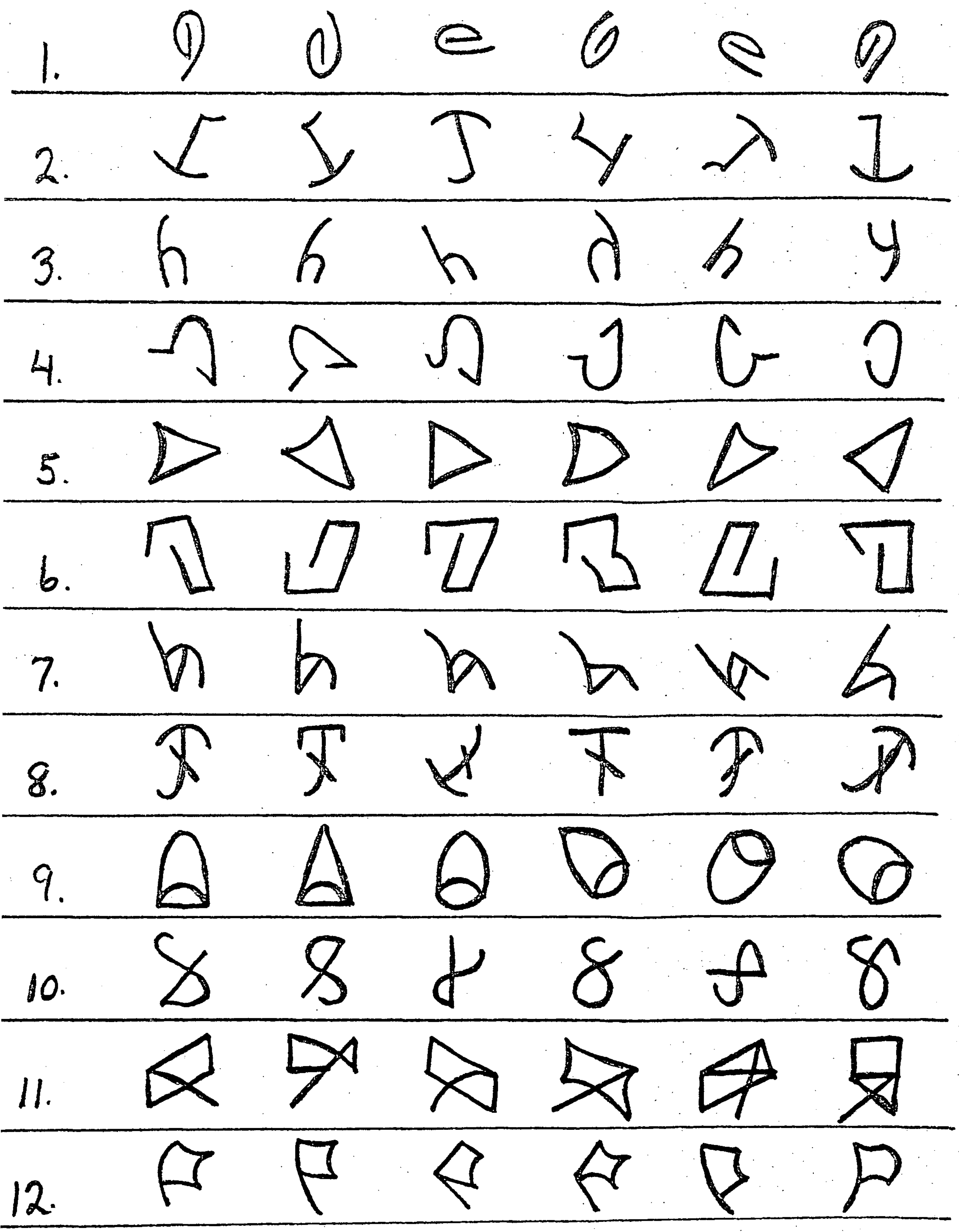


Sample Target for Visual Discrimination

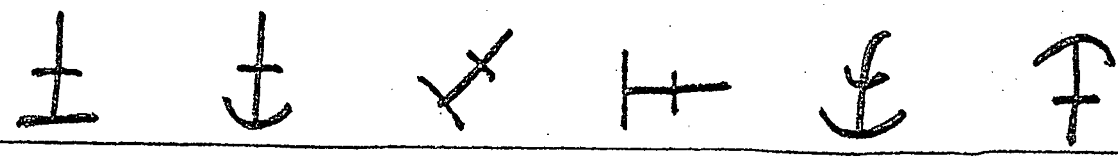
APPENDIX B

VISUAL MEMORY TEST

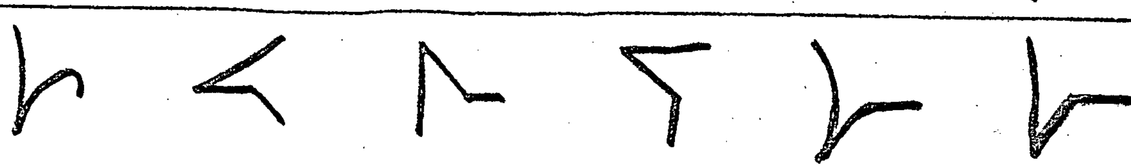
Visual Memory of Symbols - a

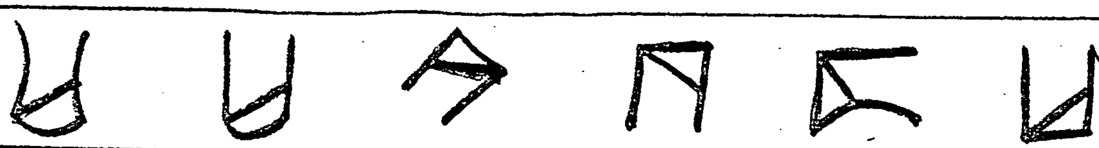


Visual Memory of Symbols - b

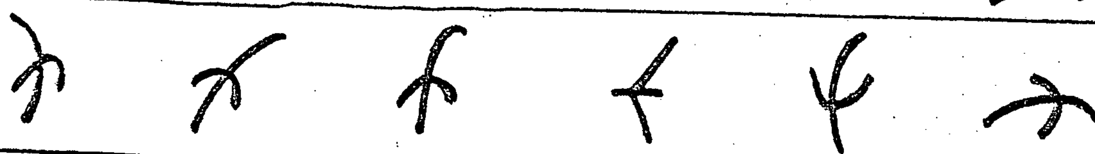
13. 

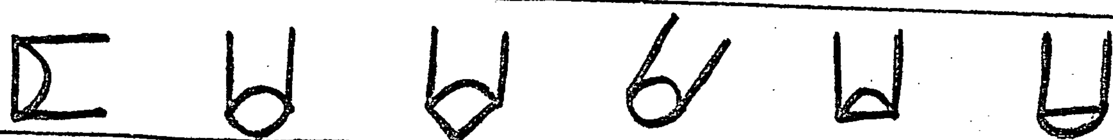
14. 

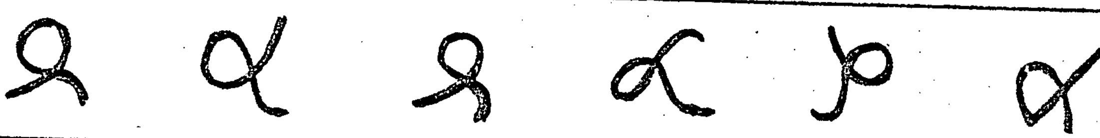
15. 

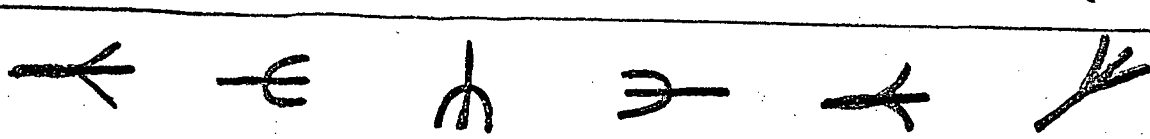
16. 

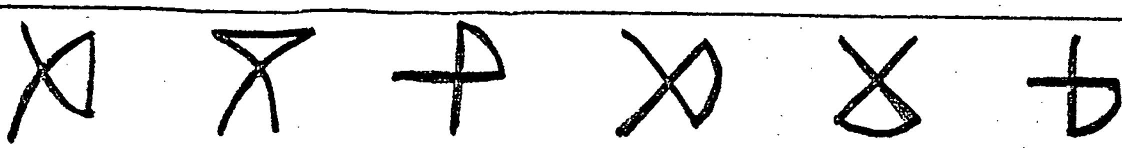
17. 

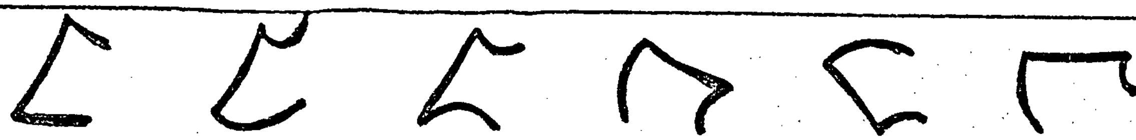
18. 

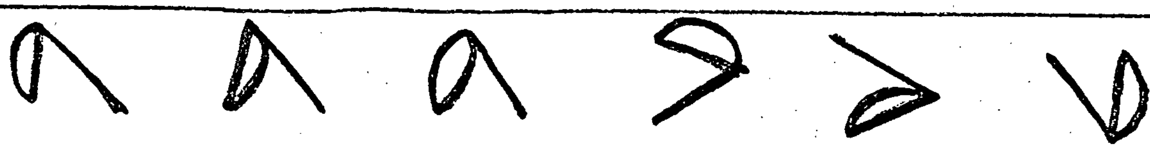
19. 

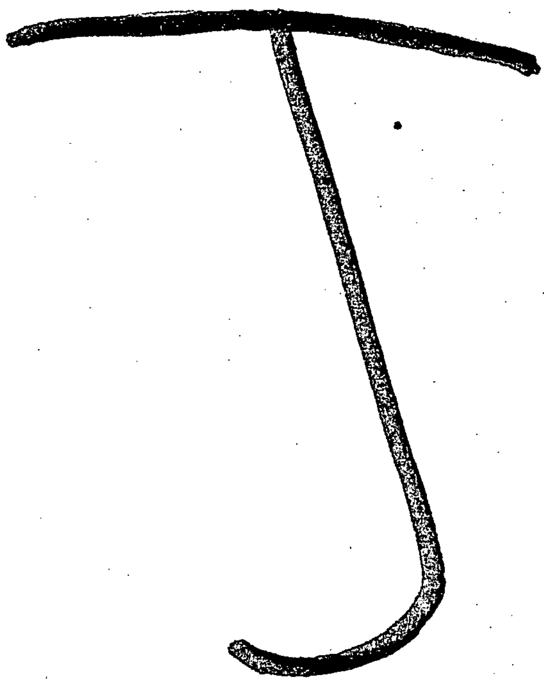
20. 

21. 

22. 

23. 

24. 

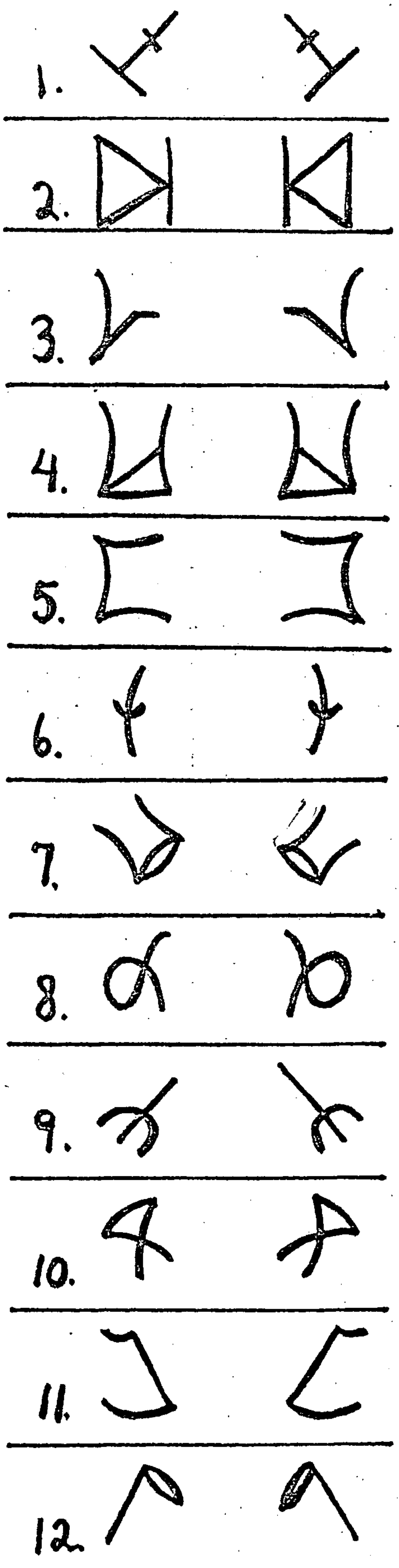


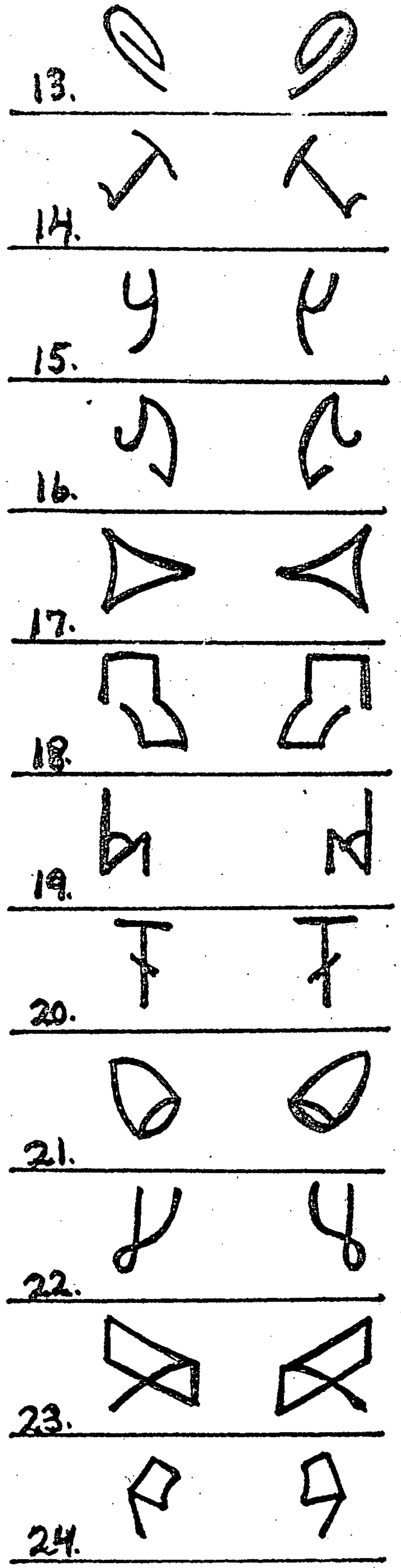
Sample Target for Visual Memory

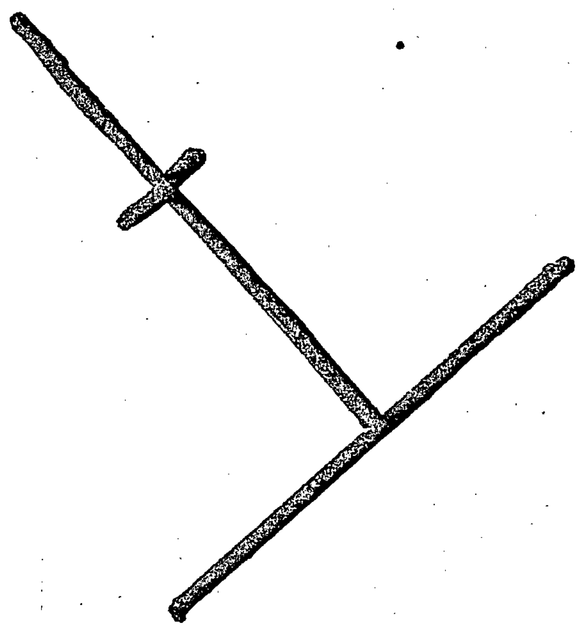
APPENDIX C

PERCEPTION OF REVERSAL OF SYMBOLS

Visual Perception of Reversals - a




13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.



Sample Target for Perception
of Reversals

APPENDIX D

IDENTIFYING LETTERS NAMED

1.	o	s	y	b	m	14.	d	b	g	p	q
2.	r	a	f	m	e	15.	g	b	d	q	p
3.	s	m	o	x	z	16.	b	d	q	p	g
4.	g	p	q	h	y	17.	q	p	d	g	b
5.	k	t	f	l	h	18.	r	m	n	u	o
6.	k	l	h	f	t	19.	o	a	e	g	c
7.	m	f	s	z	e	20.	h	f	l	t	k
8.	l	t	b	k	h	21.	t	e	j	l	i
9.	o	a	e	c	g	22.	g	p	y	j	i
10.	a	r	e	o	c	23.	m	n	u	d	b
11.	n	u	w	r	m	24.	u	n	v	w	m
12.	k	i	g	t	y	25.	c	d	a	e	o
13.	m	v	u	c	h	26.	w	y	v	n	u

APPENDIX E

TRANSPOSITIONS OF CONSONANT TRIGRAMS

Transposition of Consonant Trigrams

1. gpz	gzp	zpg	zgp
2. mdg	gmd	dgm	dmg
3. qdf	dfq	fdq	fqd
4. xlb	xbl	blx	lbx
5. gmq	qmg	mgq	qgm
6. bfz	fzb	zfb	bzf
7. wzr	rzw	zrw	wrz
8. bcm	cmb	bmc	cbm
9. bkf	fkb	kbf	bfk
10. wls	slw	swl	wsl
11. swg	sgw	gws	wsg
12. fms	msf	sfm	smf

Transposition of Consonant Trigrams (cont'd.)

13. mlx	xml	lmx	xlm
14. tws	tsw	stw	swt
15. bwd	wdb	dwb	wbd
16. fcg	fgc	cgf	cfg
17. xkh	xhk	hxk	khx
18. rhc	crh	rch	hcr
19. bpr	brp	prb	rbp
20. pdw	wdp	pwd	dpw
21. hkj	jkh	hjk	jhk
22. tbq	qbt	qtb	btq
23. nph	hnp	phn	pnh
24. cfz	fzc	fcz	zfc

pnh

Sample target for Transpositions

APPENDIX F

IDENTIFYING PHONEMES, BLENDS AND PHONOGRAMS

Identifying Phonemes, Blends, and Phonograms

1.	p	b	t	n	a
2.	e	p	c	d	t
3.	d	f	g	v	h
4.	g	k	v	l	i
5.	k	r	b	d	s
6.	o	s	n	b	t
7.	y	l	d	f	g
8.	f	t	j	r	b
9.	bl	sh	tr	cr	th
10.	ch	fr	wh	sw	gr
11.	st	pl	tw	sk	cl
12.	br	fl	pl	pr	bl

13. tr tw th st sh

14. sh cl cr sl ch

15. cr gr pl gl cl

16. wh th ch ph sh

17. eg ad ip up

18. old ack ush ich

19. iff oes ade ess

20. elt ice oft ars

21. art ead ick out

22. eam ust ane oam

23. ipe ept oze age

24. afe ine ock all

Cue Words for Identifying Phonemes, Blends, and Phonograms

1. pan
2. bed
3. dig
4. ball
5. bus
6. cab
7. cliff
8. jar
9. track
10. church
11. skate
12. bleed
13. twist
14. crash
15. glide
16. whisper
17. cup
18. Jack
19. guess
20. belt
21. shout
22. cane
23. stripe
24. clock

APPENDIX G

RAW DATA ON RELIABILITY STUDIES

TABLE XIV

VISUAL MEMORY TEST-RETEST

Subject	Test Raw Score	Retest Raw Score
1	11	16
2	16	19
3	13	16
4	6	7
5	14	14
6	21	14
7	16	17
8	17	13
9	13	15
10	13	17
11	10	10
12	8	10
13	4	10
14	17	16
15	11	19
16	11	17
17	8	10
18	13	19
19	11	11
20	14	18
21	18	18
22	11	15
23	16	18
24	13	14
25	12	15
26	16	17
27	12	12

TABLE XV

PERCEPTION OF REVERSAL OF SYMBOLS

Subject	Odd	Even
1	12	10
2	10	8
3	10	10
4	4	4
5	6	4
6	4	6
7	0	4
8	6	4
9	6	6
10	2	0
11	4	6
12	0	0
13	4	4
14	8	4
15	12	10
16	8	8
17	0	0
18	2	2
19	8	10
20	12	8
21	10	10
22	0	2
23	2	2
24	10	10

TABLE XVI

TRANSPOSITION OF CONSONANT TRIGRAMS

Subject	Odd	Even
1	8	8
2	7	7
3	2	4
4	9	10
5	10	10
6	6	7
7	4	4
8	5	6
9	10	10
10	10	9
11	7	8
12	9	9
13	9	11
14	3	3
15	1	3
16	8	6
17	8	11
18	8	8
19	9	11
20	8	10
21	4	4
22	12	12
23	8	11
24	5	8

TABLE XVII

PHONEMES, BLENDS AND PHONOGRAMS

Subject	Odd	Even
1	11	11
2	12	11
3	4	3
4	3	3
5	12	12
6	12	12
7	12	12
8	12	11
9	12	11
10	12	12
11	11	7
12	12	11
13	9	10
14	12	12
15	12	12
16	4	4
17	12	11
18	12	11
19	12	11
20	12	12
21	12	11
22	9	6
23	10	12
24	8	7
25	10	11
26	12	12
27	12	11

APPENDIX H

RESULTS OF READING ACHIEVEMENT TESTS

TABLE XVIII

READING ACHIEVEMENT SCORES AS MEASURED BY GATES-MACGINITIE READING TEST

Subject	Raw Scores Vocabulary	Raw Scores Comprehension	Total Standard Score
1	48	34	134*
2	48	34	134*
3	48	33	131*
4	48	33	131*
5	48	32	129*
6	47	33	129*
7	48	31	128*
8	48	30	127*
9	46	33	127*
10	47	32	127*
11	47	31	126*
12	46	32	125*
13	48	27	124*
14	46	31	124*
15	47	29	123*
16	47	27	122*
17	47	27	122*
18	46	29	121*
19	46	29	121*
20	45	32	121*
21	47	25	120*
22	45	31	120*
23	44	32	120*
24	44	32	120*
25	45	30	119*
26	45	30	119*
27	46	25	118*
28	46	24	117
29	43	32	117
30	45	27	116

TABLE XVIII (continued)

Subjects	Raw Scores Voucabulary	Raw Scores Comprehension	Total Standard Score
31	45	28	116
32	45	27	116
33	45	27	116
34	45	26	115
35	44	28	115
36	42	30	114
37	41	31	114
38	41	31	114
39	45	24	113
40	43	27	112
41	40	29	111
42	43	25	110
43	41	27	110
44	42	25	109
45	45	21	109
46	42	24	109
47	44	21	108
48	44	21	108
49	44	20	108
50	42	22	107
51	44	17	106
52	40	21	104
53	36	24	103
54	43	18	103
55	39	21	102
56	41	20	102
57	37	22	102
58	35	24	102
59	42	17	100
60	40	18	100

TABLE XVIII (continued)

Subjects	Raw Scores Vocabulary	Comprehension	Total Standard Score
61	39	18	99
62	37	20	99
63	32	22	98
64	37	19	98
65	33	20	96
66	29	22	95
67	36	17	95
68	33	17	93
69	33	16	92
70	30	19	92
71	34	16	92
72	33	16	92
73	24	21	91
74	38	12	89
75	32	14	88
76	35	13	88
77	37	12	88
78	36	12	87
79	28	16	87
80	27	15	85
81	36	10	84
82	29	16	83
83	32	10	81+
84	32	10	81+
85	23	13	79+
86	29	10	78+
87	28	10	77+
88	27	10	77+
89	27	9	77+
90	25	11	77+

+Unsuccessful readers

TABLE XVIII (continued)

Subjects	Raw Scores Vocabulary	Comprehension	Total Standard Scores
91	23	9	74+
92	23	7	71+
93	28	6	71+
94	19	7	68+
95	16	9	68+
96	14	10	67+
97	18	7	67+
98	16	7	65+
99	12	8	65+
100	11	8	63+
101	14	6	61+
102	11	6	58+
103	25	5	BN+
104	21	4	BN+
105	12	5	BN+
106	13	2	BN+
107	11	0	BN+
108	10	0	BN+
109	7	2	BN+

APPENDIX I

RESULTS OF TESTS ADMINISTERED TO SUCCESSFUL AND UNSUCCESSFUL READERS

TABLE XIX

SCORES OF SUCCESSFUL READERS ON TEST BATTERY

Subject	Reading Ach. Total Stand. Sc.	Visual Perception		Verbal Coding			Meaningful Association	
		Visual Memory	Reversals	Letters	Transposit-ions	Phonemes	Vocab. Listen.	Sentence Listening
1	134	10	16	25	22	24	76	39
2	134	15	22	26	21	24	87	37
3	131	17	16	26	17	24	89	38
4	131	16	14	25	13	24	84	38
5	129	14	22	26	19	24	77	33
6	129	17	18	26	24	24	93	39
7	128	17	22	26	23	24	86	36
8	127	17	22	26	21	24	84	39
9	127	10	16	25	22	24	76	39
10	127	19	10	26	18	24	81	35
11	126	15	12	26	23	24	78	38
12	125	14	24	25	21	24	79	27
13	124	14	8	26	17	23	64	37
14	124	19	20	26	24	24	88	39
15	123	12	18	26	24	23	87	37
16	122	12	20	26	19	23	84	40
17	122	16	12	26	21	23	80	36
18	121	17	20	26	20	23	78	34
19	121	15	24	26	21	24	77	36
20	121	12	6	26	15	23	79	36
21	120	19	22	26	18	24	88	33
22	120	16	14	26	19	24	77	40
23	120	18	16	26	20	24	91	38
24	120	18	8	26	15	22	76	37
25	119	17	22	26	22	24	88	39
26	119	14	22	26	22	21	86	40
27	118	10	18	26	17	22	83	38

TABLE XX

SCORES OF UNSUCCESSFUL READERS ON TEST BATTERY

		Visual Perception		Verbal Coding			Meaningful Association	
Subject	Reading Ach. Total Stand. Score	Visual Memory	Reversals	Letters	Trans-positions	Phonemes	Vocabulary Listening	Sentence Listening
83	81	11	14	25	15	19	47	24
84	81	11	12	25	17	18	79	35
85	79	18	24	23	19	18	63	73
86	78	10	10	25	17	17	55	24
87	77	18	20	23	7	14	59	22
88	77	9	4	24	18	15	58	24
89	77	15	16	24	17	14	65	32
90	77	16	18	25	21	17	58	31
91	74	14	8	25	16	12	50	26
92	71	12	22	23	12	13	79	31
93	71	10	12	23	18	18	53	29
94	68	11	0	20	9	10	51	27
95	68	8	14	20	12	10	62	27
96	67	13	20	17	12	9	69	27
97	67	11	16	21	6	8	55	29
98	65	12	2	20	12	12	62	32
99	63	11	22	19	16	7	58	28
100	61	16	20	22	14	12	43	21
101	58	7	0	22	9	14	33	9
102	BN	14	18	25	11	11	67	30
103	BN	8	12	24	7	11	70	31
104	BN	14	6	20	8	15	68	24
105	BN	8	0	20	13	6	40	18
106	BN	17	16	25	16	4	19	12
107	BN	12	20	19	18	5	37	29
108	BN	7	12	16	13	7	81	27

BN - Below the Norm