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THE RELATION OF AUTOMATIZATION TO THE READING PROCESS IN CHILDREN AND ADOLESCENTS

A thesis presented

by

Charles Henry Drake

to the Faculty of the

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INTRODUCTION

"The fellow in charge of Sumerian said:
'Why don't you speak Sumerian?' (He) caned me.
My teacher said: 'Your hand (writing) is unsatisfactory.'
(He) caned me. I began to hate the scribal art..."

This lament from a professional scribe, preserved on a First Millennium B.C. clay tablet in the library of Assurbanipal at Nineveh, is one of the earliest extant complaints about the workings of a school system (Kramer, 1967). Even as a successful professional, this ancient scribe remembered the boyhood problems he had encountered with language, both in its spoken and its written forms.

This ancient cry of despair is not without its echo in our own time. Even in the better suburban schools, at least one pupil in twelve will become a chronic underachiever in the language arts (reading, spelling, composition, handwriting, foreign languages) by the time he starts high

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school.[1] Extrapolated nationally, this means that at least 300,000 of approximately four million pupils who began school last fall will have "reading problems" severe enough to affect their academic progress negatively by the time they enter adolescence.

Eisenberg (1966) reports a suburban community in which 15 per cent of the students are at least two years retarded in reading by the sixth grade, and 35 per cent exhibit at least one year's retardation. In the inner city, the picture is much more complicated. The same author reports a city in which 28 per cent of the pupils are retarded two years by the time they are in the sixth grade. Conant (1961), in pondering the plight of the inner city child, concludes that the slum school can best serve the disadvantaged child by teaching him to read. This concern for the teaching of reading

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[1]Helmer Myklebust, personal communication, January 18, 1968, based on study of approximately 4,000 grade-school children in middle class communities north of Chicago. Dr. Myklebust reports an 8 per cent incidence of children whom he considers to have a physiologically based learning disability, unrelated to emotional, socio-economic and educational conditions.

Recent studies by a public school system in a Boston suburb noted for its affluence revealed a 12 per cent incidence of children who have fallen behind critically in the development of reading, writing, and spelling skills, despite excellent schools and a large remedial staff. The name of this community is available but not reported here because of the confidential nature of the material.

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and other allied skills is now so widespread that it is difficult to find a public affairs journal, even at the most popular level, which does not concern itself with the problem of the undereducated poor.[2] There is little doubt but that we as a nation are reaching a consensus that we can no longer afford the dead weight of masses of crippled readers and semi-literate dropouts.

This desire for a more literate citizenry has eventuated in a sizeable professional and lay concern for the teaching of reading and other language skills. For example, since its founding in 1956, the International Reading Association has experienced one of the most phenomenal rates of growth of any organization in education. A similar expansion may be noted in the number of NDEA institutes that now blanket the country each summer.

In addition to this interest among those professionally involved with reading, there seems to be a growing concern in other sections of the scientific community not directly

---

[2]See for example: The New York Times Magazine, October 15, 1967, "Slum Children Must Make Up for Lost Time"; January 28, 1968, "Help Wanted: The Hard-Core Unemployed"; February 4, 1968, "Poverty is a Tougher Problem Than Ever."

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associated with public education. Even a cursory examination of recent literature reveals a number of psychologists who are investigating reading skills because of what can be learned about perception and cognition through a study of the reading behavior of human beings: Walters and Doan (1962), Blank and Bridger (1966), Elkind, Larsen and Doorninck (1965), Kagan (1964), Neisser (1967), Kolers (1968), to mention but a few. In addition, many "underachievement" studies turn out to be primarily focused on reading failure.

In the face of this plethora of studies on reading, the question must inevitably arise: Why another?

The rationale can best be stated in the following way:

1. Research often raises more questions than it settles. Certainly past research in reading has left many unanswered questions which need to be examined. This present study seeks to explore an area in which there are more questions than answers at present.

2. More sophisticated approaches to the processes of reading have delineated more discrete dimensions which need study. Chall's (1967) recent study, for example, clearly defines the two quite separate functions in reading: "decoding" and "meaning" (comprehension). While these separate functions

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have long been recognized by those who teach reading, they have been generally ignored by researchers, who have tended to "pool" these differences by giving silent reading tests, thereby making it difficult if not impossible to determine whether an individual reader is having difficulty with decoding or with comprehension. This present study attempts to define "reading" more exactly than has sometimes been done in other research studies, and it is hoped that additional information can be gained thereby.

3. As new approaches in any discipline are developed, new areas of study are demanded. Albert Harris (1967), in presenting a survey of "Five Decades of Remedial Reading" to the International Reading Association Annual Conference, said of the decade 1955 - 1965:

"The major shift in theory was away from psychodynamics and toward a renewed emphasis on physiological, neurological, and constitutional factors."

The present study would fall within the framework of this "renewed emphasis," about which Harris says:

"The work of predicting, preventing, diagnosing and correcting reading failure has been well started. But final answers are a hope for the future rather than a present reality. Much remains to be done."

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CHAPTER I

THE PROBLEM: I

A General Statement About Problems of Research in Reading

Because the field of reading is riven with conflicting views (see Chall, 1967; Harris, 1967), any research in this area must of necessity take these differences of opinion into account and deal with them in some manner. This chapter seeks to deal with some of these basic issues as they affect reading research in general, and this present study in particular, in order that the presuppositions underlying this study may be apparent from the beginning.

Etiology of reading failure

Opinion is sharply divided as to the cause(s) of reading failure. One school of thought suggests a multi-causation model to account for the many types of reading problems, while another insists that one etiological factor can explain almost all cases of reading retardation.

The list of those who suggest a multi-causation model,

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or who report studies indicating a number of causes, is long and impressive: Gates (1922), Monroe (1932), Orton (1937), Fernald (1943), Robinson (1946), Rabinovitch (1959), Traxler (1960), Shedd (1961), Money (1966), Chall (1967), and Harris (1967), to name but a few.

A much smaller group of specialists insists that a single cause can explain all reading problems. While some of the unitary-cause protagonists have made a valiant effort to support their point of view, they generally have had difficulty in attempting to fit all the available data into their particular systems. In general, these systems seem to have built-in flaws that tend to raise more problems than they settle. For example, Smith and Carrigan's (1959) attempt to fit all their data into one biochemical framework is flawed (a) by the fact that, by their own admission, their sample is made up almost entirely of children with severe decoding problems, thereby excluding children with comprehension difficulties; and (b) by the fact that an "anxiety" component had to be introduced into the model to account for some of the findings, thereby essentially vitiating the unitary concept they had attempted to establish.

Again, Malmquist's (1958) finding that differences in socio-economic status accounted primarily for the reading

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problems that he found in a Swedish sampling must certainly be related to some artifact in the Swedish social or educational system, since many middle class children in other countries can be shown to have reading problems. (Eisenberg, 1966; Myklebust, 1968)

Howards' (1965-1966) failure to define what he means by "emotional disturbance" or to name his instruments casts doubt on his contention that "98 per cent" of the children who are poor readers have emotional disorders that cause reading failure. It is also in marked disagreement with Gates' (1941) conclusions: "My estimate is that among cases of very marked specific reading disability, about 75 per cent will show personality maladjustment. Of these, the personality maladjustment is the cause of the reading defect in (only) a quarter of the cases, and an accompaniment or result in three-quarters."

Because the evidence seems so overwhelmingly on the side of those who propose a multi-causation model, this study assumes this to be the most nearly correct position. Whatever the final resolution to the "etiology vs. etiologies" dialogue, the fact seems to be that among "poor readers" there are a number of differing behavioral patterns. These differences in behavior apparently can be diagnostically categorized, and so

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this study has at its core an assumption of the possibility of behavioral categorizations.

Definitions of "reading" as they relate to research

A second area of possible difficulty is that of definitions. In general, most reading specialists give a well-rounded description when they attempt to define reading. Gibson (1966), for example, says:

"...the behavior we call reading...is receiving communication; it is making discriminative responses to graphic symbols; it is decoding graphic symbols to speech; and it is getting meaning from the printed page." (p. 42)

Even more stylistically elegant is the definition proposed by Wiener and Cromer (1967) in their recent "conceptual analysis of reading," one part of which says:

"When identification skills are emphasized, the defining attribute of reading is the correct 'saying' of the word. Comprehension, on the other hand, implies the derivation of some form of meaning and the relating of this meaning to other experiences or ideas..." (p. 621)

Both of these authors are saying what a great many other writers have pointed out--that normal reading behavior exhibits a "process duality" in which both decoding and comprehension

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are involved. Because these two functions are so sequentially melded in normal reading, seldom is the good reader aware that both are going on at the same time. In the case of the retarded reader, however, at least one if not both of the processes are defective.

Chall (1967) points out that this functional duality is at the center of the "great debate" in the field of reading. For half a century there has been conflict over which function should be taught first to beginning readers: decoding or comprehension.

Despite the obvious awareness of these two discrete functions, and the amount of discussion that has revolved around them, researchers have been singularly reluctant to come to grips with the implications of this process duality in terms of the tests they give to measure reading. Instead, most researchers have been content to give standardized silent reading tests (or to accept such reading scores from school records) in which it is difficult if not impossible to determine, where there is "poor reading," whether the problem is one of decoding or of comprehension, or of a lack of understanding on the part of the child as to how to mark the test.

Of 37 studies between 1926 and 1964 relating to the teaching of reading reviewed by Chall (1967), in only five did

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the investigator use an "oral recognition test," and in four a "connection oral reading test." In commenting on this aspect of reading research, Chall says:

"They (the research studies, 1955-1965) show an increasing trend toward the use of standardized silent reading tests. The testing of reading rate almost disappears, with no reports for grades 1 and 2.... Oral reading--both oral recognition pronunciation of isolated words and connected oral reading--received relatively little attention." (pp. 109, 111)

The importance of this particular aspect of reading relates to the "multiple causation" model presented previously. Clinically[3], it is quite observable, for example, that children who are good coders-decoders, but who are poor comprehenders, often tend to perform quite normally on visual-motor gestalt tests and on other tests of perceptual functioning. Indeed, there seems to be one subgroup of children, observed clinically, who perform exceptionally well on tests measuring perceptual motor functioning. However, these pupils perform badly on silent reading tests, but verbalize well on oral

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[3]Based on observations in testing and remedial programs carried on by the Reading Research Institute, Wellesley, Massachusetts, where well over 700 children with coding-decoding anomalies have been studied. While children with a wide variety of difficulties are tested, the Institute works remedially only with children who have coding-decoding problems.

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reading tests if they have good rapport with their tester. Such pupils often seem to have an above-average level of emotional problems.

If indeed there are many causes for "poor reading" and if the term itself subsumes essentially contradictory behavior on the part of groups of subjects being measured, then Kinsbourne and Warrington's (1966) suggestion is probably relevant:

"This (selection of children with 'reading retardation') suggests that the group of backward readers (variously defined and selected by different workers) included children not of one type but of several, so that the test procedures were being applied to a heterogeneous population. Test results might then fail to reach statistical significance on account of dilution of the relevant population by the inclusion of one or more contrasting type of case." (p. 60)

If this is true, then it is of considerable importance educationally that the specific nature of the "poor reading" be found. At the present, this seems to be possible only through the use of one or more oral reading tests, combined with silent tests. As already indicated, silent tests are of little value to the researcher because the "grade score"

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obtained on them is essentially a hypothetical construct, based on a normative curve describing the performance of a sample of pupils on an instrument which poorly defines precisely what is being measured. As indicated above, such a test may be measuring a) decoding skills, or b) comprehension skills, or c) nothing more than the ability of a child to follow relatively complex directions using scoring sheets made up of dozens or hundreds of tiny marking spaces. The resultant "scores" give little or no clue as to which one(s) of these particular behaviors have entered into the production of the resultant digits.

Most oral reading tests, on the other hand, clearly measure certain behaviors in a quite specific way. The examiner is able to determine rather well, for example, whether the reading "problem" is in decoding or in comprehension.

This study therefore assumes that an oral reading test is necessary to determine the specific behavioral patterns of each child, especially as related to decoding skills.

Other definitions

The third area of concern has to do with specific definitions of words used in this study. Since this research is concerned primarily with children who show a

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specific attribute (i.e., poor decoding), the following section will deal with the specifics of "coding" and "decoding".

The terms "coding and "decoding" have come to be used interchangeably to name the process in which the reader looks at a group of graphic symbols that have been arranged into "words", and then translates them into appropriate verbal behavior, either actually (as in oral reading) or covertly (as in silent reading). Ability to understand what is "decoded" is not required, since this falls within the "comprehension" domain.

While the terms "coding" and "decoding", as normally used in the literature about reading, present no problems in definition, they are a cause for concern in this present study because the word "coding" is also widely used to describe a process in which one graphic symbol is used to stand for another--as in the Coding Subtest of the Wechsler Intelligence Scale for Children (WISC). Since this special use of the term "coding" is also employed in this paper, the following definitions are offered to avoid confusion:

1. Coding. A process in which spoken language is translated into some graphic symbolic form: spelling, composition, written formulae, Morse code, etc. (This

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process is sometimes referred to as "encoding", but this word is also used to describe a physiological process related to stimulus input at the central nervous system level, so its use here could lead to confusion. Therefore the term "coding" will be used as defined above.)

2. Decoding. A process in which a group of graphic symbols (from an "alphabet") that have been arranged into conventionalized linguistic units known as words are appropriately translated into spoken language, either verbally as in oral reading or potentially as in the covert verbalization involved in most silent reading. This process is normally assumed to be a part of the "word attack" skills that are taught when sound-symbol relationships are established in the early reading experience of children. "Phonic" or "linguistic" approaches to reading can usually be assumed to be concerned with teaching decoding skills in the initial instructional periods. This process has been defined as one which "emphasizes learning of the printed code for the spoken language..." (Chall, 1967, p. 207)

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A child who is having problems in decoding often exhibits the types of errors described by Durrell (1955): "...low sight vocabulary; word-analysis ability inadequate; errors on easier words; guesses at unknown words from context; ignores word errors and reads on..."

3. Symbol coding. A process in which one set of graphic symbols is systematically translated into another. The Coding Subtest of the WISC is an example of symbol coding. In this test the subject is asked to look at a group of digits, each of which has been arbitrarily assigned a symbol. His task is to match appropriate symbols with randomly presented digits.

The measurement of decoding skills in reading is traditionally obtained through the use of a standardized oral reading test. The following types of tests have been and are widely used in school systems:

A. Tests primarily measuring decoding skills. The Gray Oral Reading Paragraphs Test (1955) is representative of those tests measuring decoding skills. This is an individually administered test in which speed and accuracy of oral response determine the reading score. All errors are recorded. No comprehension measurement is made.

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B. Decoding plus comprehension. The Durrell Analysis of Reading Difficulty (1955) measures both oral and silent reading, plus the ability of the pupil to answer questions or recall information about passages read aloud by the tester.

C. Silent reading, plus "comprehension". The Iowa Tests of Basic Skills (Lindquist and Hieronymus, 1956) is typical of those instruments which ask a subject to read paragraphs silently and to mark multiple choice answers. Normally, this is a group test.

It is immediately obvious that the Gray is quite explicit in measurement of decoding skills only. The Iowa, on the other hand, gives little or no indication as to whether it is measureing a) decoding skills, b) comprehension skills, or c) luck in randomly marking multiple-choice answers.

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CHAPTER II

THE PROBLEM: II

A More Specific Statement Relating to the Research Reported in This Study

"There exists, within the community of poor readers, a specific syndrome wherein particular difficulty exists in learning the conventional meaning of symbols... (which) is of constitutional and not of environmental origin, and often is genetically determined." (Critchley, 1961)

This statement by an English neurologist echoes, after two intervening generations, a concept proposed by another English physician (Morgan, 1896) regarding a child whom he had examined and who exhibited symptoms of "congenital word-blindness." In the two generations between Morgan's finding and Critchley's statement, many specialists have attempted to describe "the" syndrome, and have attached a rather remarkable number of names to the children who presumably share the same disability symptoms relating to the coding and decoding processes in reading and writing.

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Some of those who have written about such children have tended to confine their symptomological parameters largely to the reading-writing-language spheres (Hinshelwood, 1917; Orton, 1937; Cole, 1964). The minimal symptoms as thus described have largely to do with symbolization functions. Despite normal or high intelligence and adequate educational opportunity, often including remedial help, the most severely disabled child is either unable to decode at all or is so severely retarded in this skill as to be unable to compete in school. Spelling is often what can be described as "bizarre" (Gallagher, 1948); handwriting tends to be dysgraphic; and efforts at composition produce garbled attempts at sentences that cannot be decoded (Orton, 1937). Problems of syntax as well as of verbalization are noted in speech. (Johnson and Myklebust, 1967). Less severely affected children show correspondingly milder symptoms. "Mixed dominance" and tendencies toward ambidexterity are often included as collateral symptoms by those who restrict the syndrome primarily to the language area (Orton, 1937).

A much wider set of symptoms beyond the reading, writing, spelling disability has been proposed by a number of other investigators. Smith and Carrigan (1959) report significantly

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lowered scores on the part of poor decoders on such tests as auditory discrimination, perceptual speed, visual blending, visual memory, word fluency, flicker fusion, and other such tests. Shedd (1961) reports difficulties in rhythm, slower oscillation of the Necker Cube, and problems in a variety of other functions. Cavanaugh (1968) reports a much higher incidence of positive reaction to allergenic agents among children with poor decoding skills than among normal readers. Kinsbourne and Warrington (1966) report specific deficits in certain subtests of the WISC. Whiting, Schnall & Drake (1966) and Mathewson (1967) find poor automatization skills but normal restructuring ability. In addition, Bronner (1917), Fildes (1921), Tamm (1943), Schilder (1944), Drew (1956), Herman (1959) and Money (1962; 1966) have all proposed a rather wide array of symptoms beyond the reading-spelling-writing disability.

The syndrome, either in its minimal or expanded form, has received a variety of names. While one early designation, "wordblindness", is still widely used in England and Scandinavia (Herman & Norrie, 1959), another, "strephosymbolia" (Orton, 1937), is now rarely used except in retrospect. Today the terminology is apt to indicate a generalized designation ("developmental dyslexia, learning disability, perceptual-motor disorder"),

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or a specific indicator of presumed etiology: "late and irregular development" of neurological functions (Harris, 1961); "failure in intersensory transfer" (Birch and Belmont, 1964); "minimal brain dysfunction" (Clements, 1966) or "scrambled input" (Eisenberg, 1968). Roswell and Natchez (1964) are content to call it simply "reading disability", but their description of symptoms is classic.

While there are many specialists who have postulated the existence of a "specific syndrome within the community of poor readers," there are some educators who have questioned the entire concept. Durrell (1967) feels that no syndrome can be delineated or, if it can, it exists in so few children that it is of no educational significance. Others seem to feel that children with symptoms as classically described simply represent one extreme of a normal variation (Meyer et al., 1943; Malmquist, 1958). Vernon (1957) has even suggested that the obvious lag in the development of perceptual-motor skills in the case of some poor decoders is a result of the failure to read rather than a cause. Indeed, her skepticism necessitates the following question: After two generations of investigation and research, why is there still such doubt on the part of many reading specialists? Since Vernon's approach probably represents the most extensive

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and detailed set of questions and alternative hypotheses relating to the idea of a specific syndrome, it would seem to be important to examine her book in the light of findings that have occurred in the decade since Backwardness in Reading was written.

In retrospect, the following observations seem warranted in relation to her feeling that the case for a specific syndrome had not been proved:

1. Vernon is correct in questioning the data presented up to the time she wrote her book. Despite a considerable amount of verbiage produced since the turn of the century, the proponents of a distinct syndrome have presented more case studies than they have rigorous experiments. And even to this day, Vernon's list of questions that must be attended to remains largely unanswered.

2. Implicit in the speculations by Vernon is the suggestion that there is no "single syndrome": "The nature of cognitive incapacity--the particular area of failure in reading--may vary in different cases of disability." (p. 197)

Studies in the past decade, such as those relating to differences in performance on the WISC as investigated by Kinsbourne and Warrington (1966), seem to confirm this earlier suspicion that there is no single set of symptoms

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that will describe all poor decoders. These English investigators point to consistent inter-subgroup behavioral differences in "high verbal" as opposed to "high performance" subjects, as measured by the WISC (only subjects with a 20 scaled point difference between Verbal and Performance scores were used), even though both groups have severe reading problems of the decoding type. Rabinovitch et al. (1954) had found the same two subgroups earlier, but these investigators were apparently so concerned about defining a single "pure syndrome" (in this case, "high performance-low verbal" behavior on the WISC) that they eliminated subjects who did not fit into this predetermined matrix. They maintained the consistency of their sample at the expense of failing to recognize other subtypes.

More recently, Johnson and Myklebust (1967) have recognized a number of different subtypes among their clinic population. This concept of several subtypes rather than one well-specified syndrome may possibly remove at least some of the objections raised by Vernon, for no longer do contradictory behaviors on the part of different subgroup members tend to negate each other when research is attempted. Johnson and Myklebust's postulated subtypes seem to match the reality of the data much closer than the single syndrome proposed by Critchley, and perhaps form a better basis for answering some

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of Vernon's demands.

3. Despite some tentative answers to her questions during the past decade, Vernon's basic point of issue still remains. Is the "non-reader and the child with a severe reading disability" (apparently referring to the same child as Critchley) handicapped at a "perceptual" level or are there "cognitive difficulties"? It is Vernon's hypothesis that such children may be suffering from a "cognitive incapacity" rather than a perceptual distortion.

> "...it is also possible that in these cases there has always been something lacking in the child's cognitive capacities--for instance, some immaturity and lack of clarity of thought in associating word shapes and sounds..." (p. 194)

However, the terms "cognitive" and "perceptual" are never defined in Backwardness in Reading, except in operational statements such as that above, or in such passages as follows:

> Finally, we must hope that further psychological investigation will determine whether in fact reading disability is based upon some fundamental cognitive incapacity, as we have suggested above, and will elucidate the nature of this incapacity. So far the methods of investigation have not been satisfactory. What is required is a detailed experimental and clinical investigation of an adequate number of cases, confined to children who cannot read at all, or can only recognize a few words, the shapes of which they have memorized in a vague and inaccurate manner. The first step is then to determine if there are any such cases in which there exist no

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disorders of personality or physique, and no apparent evidence of inadequate or unsuitable teaching. The enquiry of Schilder (1944) seemed to establish that such cases existed, even when there was no evidence of congenital disposition (see p. 79). The essential procedure then is to investigate these children's thought processes, both in reading and in other tasks. It is not sufficient to give them simple tests of visual and auditory perception, imagery, memory and association. Even when the children appear to be somewhat inefficient in some types of perception and imagery (and this is by no means always the case), the inadequacy may be the result rather than the cause of deficiency in the reasoning processes. Again, little is gained by analysing the child's errors in reading into reversals, substitutions, omissions, etc., or into visual and auditory errors, since it is almost certainly the reasoned combination and manipulation of letter and word shapes and sounds which is at fault. What is required is a study of the ability or inability to analyse various kinds of material into their constituent units in their correct order and arrangement; to generalize the rules of combination of these units; and to re-synthesize them in accordance with the rules. It must be established whether there is a lack of these abilities (a) in reading only; (b) with linguistic material generally; or (c) with other, non-liguistic, material. It may be claimed that whenever the measured I.Q. of cases of reading disability is not subnormal, there can be no deficiency in the reasoning processes. But intelligence tests as a rule cover only certain types of reasoning. It may be that these are not closely related to the complex reasoning processes which must be employed in learning to read. In particular, they do not cover the processes of grasping the systematic arrangement in correct order which is so essential in reading. But all cases must be treated individually before it is possible to generalize in any way from these individual cases. The nature of cognitive incapacity-the particular area of failure in reading-may vary in different cases of disability.

At first sight it may appear that such an investigation is of purely theoretical interest, in establishing the psychological nature and basis of reading disability. But if the exact nature of this disability is more clearly understood, it might be possible to design remedial techniques for treating and eliminating it directly, rather than relying upon the only partially successful hit-or-miss methods which are employed at present. (pp. 196-197)

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While the questions and suggestions proposed by the author in the foregoing paragraphs are highly relevant, the problem of attempting to define "cognitive" and "perceptual" as used by Vernon (especially see: Bakan, 1966 edition) is of such major difficulty as to present a well-nigh insuperable barrier to investigation unless there is some resolution. Neisser (1967) may have provided a way out of the problem. He proposes:

> "Visual cognition, then, deals with the processes by which a perceived, remembered, and thought-about world is brought into being from as unpromising a beginning as the retinal patterns. Similarly, auditory cognition is concerned with transformation of the fluctuating pressure pattern at the ear into the sounds and the speech and music that we hear... 'Cognition' refers to all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in image and hallucination. Such terms as sensation, perception, imagery, retention, recall, problem solving and thinking, among many others, refer to hypothetical stages or aspects of cognition.

Such a definition seems to be quite essential if, for example, Bruner (1957, p. 124) is even approximately correct in saying that "all perception is necessarily the end product of a categorization process." "Categorization" would seem to imply a sophistication of function beyond that usually ascribed to a simple perceptual process. Broverman (1964) has assumed essentially the same strategy

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as has Neisser in subsuming "perceptual" functioning under "cognitive processes." Because this particular approach solves a definitional problem, it will be accepted in this study. This shift obviously does nothing to solve the problem of whether or not children with severe decoding problems in reading are different in some significant behavioral attributes from normal readers. However, it opens the way for approaching the vital problems raised by Vernon at a behavioral level, rather than becoming entangled in determining which functions are "cognitive" and which are "perceptual". After behavioral differences--or lack of them--have been established, among good and poor readers, then it may be possible at a later date to return to the labeling problem involved in "perception vs. cognition." In an effort to deal with some of the questions raised by Vernon, the following chapter seeks to outline a specific approach to her suggested areas of study.

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CHAPTER III

Paul Revere, a quick and efficent worker,
is reported to have warned his apprentices:
"A slow person makes me nervous. It makes me
want to take over and do the job myself."

(Sloane, 1967, p. 22)

THE PROBLEM: III

A Specific Approach to Vernon's Question

Critchley (1964) has proposed the existence of a specific subgroup of "language disability" pupils within the "community of poor readers" who show a variety of symptoms suggesting a generalized "symbolic disorder" syndrome. Earlier, Vernon (1957) had questioned the existence of such a specific group, but had suggested that research be undertaken to clarify the issue. This paper examines the test behavior of a group of children who presumably show such "constitutional" symptoms as those described in Critchley's syndrome, compared to the responses of a matched sample of "normal" readers who do not show such a symptomology except as they may occur by chance

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in random sampling. Hopefully, additional data may be contributed to the divergent Critchley-Vernon hypotheses.

Vernon has further suggested that in cases of severe reading disability (the existence of which is agreed to by all), the problem is far more likely to be at a conceptual level than at a perceptual-motor one. Data from this study may contribute to the resolution of that question.

The present study had its genesis in work done with a group of thirty "disabled decoders" during a seven-week remedial summer school conducted on the campus of a private residential school in Fryeburg, Maine, in 1965. The children involved--almost all boys--ranged in age from 12 to 14 years; all were marked by a history of severe underachievement in the decoding process in reading and in the associated language arts: spelling, composition, and handwriting.

In attempting to observe any behavioral differences between this group and a sample of normal readers taken from nearby summer camps, multiple assessments were made. In a study of the WISC profiles of the poor decoders, a depression in the Coding subtest was found in nearly all cases, while an elevation was noted in the Comprehension and Similarities subtest scores. (Drake and Schnall, 1966) When the subsection scores were ipsatized for each individual,

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the low Coding, high Comprehension-Similarities scores stood in sharp contrast to each other.

A study of the literature indicated that this pattern has been found in many previous instances. Burks and Bruce (1955), Kallos et al. (1961), Neville (1961), Robeck (1960 and 1964), Sheldon and Garton (1959), Altus (1956), Graham (1952), Hirst (1960), and Coleman and Rasof (1963) all reported similar findings in which disabled readers performed poorly on the Coding subtest but markedly better on the Comprehension-Similarities subtests. For some unaccountable reason, Kinsbourne and Warrington (1966) apparently did not give the Coding subtest to their sample (the only subtest omitted), and so missed any opportunity to report contrasting scores.

The unanimity of the reported profiles presents a surface impression of high validity. However, a major problem is introduced by an uncritical acceptance of the reported phenomenon as "proof". The Coding subtest is an "isolate" among the Wechsler subtests, and it correlates rather poorly with the other tests (Wechsler, 1958, p. 99). Hopkins and Michael (1961) report a relatively high level of chance variation between the WISC Coding and other subtests. They indicate that a weighted subtest score variation of 5 points

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must be obtained before there is a significant difference between Coding and Comprehension-Similarities, even at the .05 level. Cohen (1959) has pointed out that Coding scores, when subjected to a factor analysis, make relatively little contribution to the measurement of general intelligence (G). Random variation of scores is large, and a specific factor of unknown significance seems to be responsible for most of the variance in Coding scores. However, Cohen goes on to point out that the unknown factor is apparently "real" in the sense that its consistent presence in two studies precludes its attribution to sampling fluctuations in the subtest intercorrelations. He feels that its "reliable variance lies in its specificity."

The reported studies assume that a peak or depression in a WISC profile necessarily indicates a significant performance difference. None of these studies seems to disclose an awareness of the error invited by such an assumption. However, the following considerations suggest further study:

1. There was no way of ascertaining from the studies themselves the extent of the differences found by other investigators. However, those studies were as unanimous in reporting that disabled readers did badly on Coding as they were consistent in finding average or elevated scores in

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Comprehension-Similarities. This suggested at least the theoretical possibility that despite normal or high "conceptual" ability (as measured by the Comprehension-Similarities subtests), pupils with a reading disability might in some way be having a "specific" symbol-coding problem (as measured by the Coding subtest.)

2. A study of the individual protocols in the Fryeburg sample indicated that in most cases a difference of five to eight scaled points existed between the Coding/Comprehension-Similarities scores. This magnitude of difference suggested that the variation was perhaps not a chance one.

3. One additional study seemed to be relevant. Smith and Carrigan (1959) used the WISC Coding subtest as one of the tests in an 18-item battery, in studying over 400 children who showed symptoms of (1) severe (auditory) blending deficiency; (2) abnormally low reading rate on familiar materials; and (3) deficient discrimination of sounds and visual symbols (p. 5) In addition, the selected children manifested poor spelling as well as reading disability. All of these symptoms suggest that a group not unlike those children described by Critchley made up the bulk of the experimental population.

As indicated above, the Coding subtest was not used by Smith and Carrigan as an "intelligence" item, but simply

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became a symbol-coding test. On administration of the entire battery, to the experimental and a matched control group, the Knox Cube Test and the WISC Coding showed the greatest capacity to differentiate between normal and poor readers, with the Coding subtest scores showing the greater variation between the two groups. A factor analysis was performed, and Factor 1, with high loadings on Fluency, Coding and Identical Forms (perceptual speed), was designated as the "rapidity" factor (pp. 51-52).

These various bits of evidence, while not conclusive, seemed to warrant a further study of this "rapidity" or "facility" factor.

Guilford (1967), in his Structure-of-Intellect Model, classifies the WISC Coding B under two factors: "Memory for Symbolic Implications (MSI)" and "Symbolic Units (ESU)." This "Memory for Symbolic Implications" (MSI) factor, is listed under the general heading of Memory Ability. After pointing out that Binet "recognized ability to remember as being a distinct area of intelligence," Guilford goes on to point out that these "hypothesized memory abilities have been supported by the results of empirical analysis." (p. 110) This memory for symbolic implications (MSI) factor is a relatively recently discovered one, since previously the

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abilities contained in it were felt to be in the "number" factor.

In describing the fact that simple arithmetic functioning, together with some other functions such as digit coding, is apparently not just a part of a previously proposed number factor, Guilford says:

"With factor MSI, we come to another special and interesting situation, because of some involvement of the numerical-facility factor...There has been a growing confusion concerning (this) factor...Recent analyses of symbolic-memory abilities have helped to clear up the picutre, but some long-held notions concerning this factor are in need of changes." (p. 132)

While French (1951) had claimed to establish a "clean" delineation of a "number" factor, Guilford points out that, on the other hand, in Thurstone's first PMA analysis, for example, his four numerical operations tests and four others were loaded as follows:

Multiplication	.81	Number Code	.62
Addition	.76	Numerical Judgement	.43
Subtraction	.67	Tabular Completion	.39
Division	.62	Arithmetical Reasoning	.38

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Guilford then goes on to argue that the older concept of a single, simple numerical ability factor is not supported by recent studies:

> Both P. C. Davis (1956) and deMille (1962) found that the Wechsler Digit Symbol test went strongly with a number operations test on a factor that could be identified as numerical facility...The Wechsler test clearly appears to involve memory for implications: digits implying symbols.
>
> In the three analyses in which the Wechsler Digit Symbol test joined with a numerical-operations test to determine a factor, one test of each type was present. In Thurstone's original analysis and in many others following it, two or more numerical-operations tests have usually been present. When this has been true, the tests have functioned much as alternate forms of the same test, having relatively high intercorrelations and also relatively high factor loadings on their common factor. The conclusion seems clear that with more than one numerical-operations test in the analyzed battery those tests have loadings reflecting a confounding of a common factor (common also with non-numerical operations tests) with a factor specific computations test. (p. 133)

In his summary of findings regarding memory ability, Guilford makes a number of conlusions that may well be pertinent to this present investigation:

> Memory abilities have been found quite separable from cognitive abilities on the one hand and production abilities on the other.
>
> The distinction between memory abilities and production abilities means that retention and retrieval of information are distinctly different operations.
>
> Recent analyses have thrown much light upon the factorial nature of two well-known and popular kinds of tests, memory-span and numerical-operations tests, neither of which now appears to be factorially strong and both of which appear to have substantial specific

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> components. The latter feature is probably a reflection of the fact that they are overlearned, special habits. (p. 136)

Guilford goes on to suggest that the digit symbol test also loads as heavily on the "Symbolic Units" (ESU) factor, which he places under the general heading: Evaluation Abilities, as on the Memory for Symbolic Implications (MSI).

> "One of the most successful types of tests for ESU is Symbol Identities which conforms to the type so common in tests of clerical aptitude. Pairs of letter, number, or name sets are to be compared. Members of some pairs are identical, and members of others have a minor discrepancy, a change of a letter or digit or a transposition." (p. 188)

The loading of coding tasks on the ESU factor apparently comes about, according to Guilford, because "... E does considerable checking back and forth between answers and the code." (p. 135)

It seems to be a fair statement that Guilford feels that coding tasks, as well as arithmetic computation tasks, definitely falls within low level cognitive domains of ability, and that they are essentially concerned with memory and with (in the case of coding) rapid evaluation of minor differences in the forms of graphic symbols.

Davis (1956) suggests that the coding test relates to "numerical facility and perceptual speed."

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All of these investigators seem to agree to some extent with Smith and Carrigan's (1959) suggestion that there is a "rapidity" factor, represented, for example, by a test such as the WISC Coding test.

An examination of the test protocols in the Fryeburg sample suggested that although the timing factor of the WISC Coding subtest depressed their scores, the pupils made very few errors.

Were poor "facility" and low speed in coding tasks somehow related to their poor decoding ability when they tried to read? Although a number of studies previously cited had apparently found such a relationship, tests of this sort are not given generally in schools to identify children with decoding problems. Rather, the typical strategy is to give a language achievement battery plus a number of instruments containing novel stimuli, with a diagnosis based on how well the child performs on these unpracticed tasks. This can be seen clearly in deHirsch's (1966) recent study of beginning readers. For example, her use of the Bender Visual Motor Gestalt Test (1956) is rather typical of the type of instrument being used. Few if any tests of the deHirsch battery measured a "speed" or "rapidity" variable.

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The absence of such instruments is not surprising in view of the small amount of theoretical consideration that has been given to such a phenomenon in the literature. It is doubtful that anyone has better described the poor decoding syndrome than Orton (1937), yet he barely mentions the slow handwriting speed of the children with whom he worked. Critchley (1964) presents essentially the same picture. One element that has apparently interfered with the recognition of a low production rate for the poor decoder is the fact that such children are often characterized as "hyperactive' or hyperkinetic." Roswell and Natchez (1964) use such terms as "...restlessness, and hyperactivity." "...trouble controlling their impulses..." "...outbursts of temper..." "...may not be able to sit quietly for any length of time..." All of these attributes could be seen in the younger children at Fryeburg, especially during the early days of the summer program, and the "set" was to anticipate rapid movement on the part of such children, rather than think of them as "slow performers."

In speculating about the apparent slow response-rate of the Fryeburg sample on a test of the coding type, the staff began to make observations that while the children seemed to move rapidly, this speed vanished as soon as they

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tried to read or to write, and they became snail's-pace workers.

This discussion led to a search for some hypothesis which could begin to explain these apparent anomalies.

Kagan's (1965) model of the "reflection-compulsive" bi-polarity did not appear to be appropriate since it did not yet seem to include, as Diana Drake (1967) points out, a cell for the "compulsive" child who makes many mistakes. (Kagan does seem to recognize that a special "problem" exists, however. He takes issue with psychologists who pronounce certain children "brain damaged" because of their poor performance on the Bender Visual Motor Gestalt Test, while attaching little significance to their adequate performance on multiple-choice symbol-matching tests.)

An examination of the "automatization" model proposed by Broverman et al. (1966) seemed much more productive. As Broverman has pointed out, there has been a great deal of interest in the past regarding the way in which human beings are able to learn a simple, repetitive task. For example, Bryan and Harter (1899) were so convinced of the importance of rapid, efficient functioning that they argued that

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"automation is not genius, but it is the hands and feet of genius." (p. 379)

Humphrey (1954) suggests that "habit simplifies our movements, makes them accurate, and diminishes fatigue..." (p. 138). He goes on to argue that while animals act automatically within a narrow range of required functions, man is confronted with a far wider need to automatize because of the large number of things that he does and the enlarged group of skills that he must acquire.

Kass' (1963) studies of the performance of reading disability children on the Illinois Test of Psycholinguistic Ability (McCarthy and Kirk, 1961) indicated that they did most poorly on the "automatic-sequential" tasks, without any apparent impairment on items measuring "comprehension" of the language. Kass also reported that the children with whom she worked had the greatest difficulty with "over-learned" verbal skills within the language--syntax, grammar, and inflection.

Since the description of the Kass sample appeared to describe the Fryeburg sample rather well, her study provided an additional rationale for investigating the automatization phenomenon.

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Automatization: A definition

Automatization is defined (Klaiber, Broverman, et al. 1967) as follows:

"Automatized behaviors are those behaviors which have been so highly practiced that minimums of mental and physical effort are required for their efficient execution. Such behaviors include the bulk of everyday activities, e.g., keeping one's balance, walking, talking, reading, maintaining perceptual constancies, writing, etc.

The cognitive style approach to automatization assesses the strength of automatized responses relative to the individual's general level of mental ability, rather than against performances of other individuals. Thus, the automatization cognitive style is defined as greater ability (Strong Automatization) or lesser ability (Weak Automatization) to perform simple repetitive tasks than expected from the individual's general level of ability." (page 321)

The model includes a style which is termed "conceptual versus perceptual-motor dominance," which is limited to conceptual and perceptual motor tasks which are novel, difficult or concentration-demanding. (Broverman, 1960)

"As task performances become easier through practice, the conceptual versus perceptual-motor distinction loses significance while the extent to which automatization is achieved begins to discriminate individual differences..." (page 168).

More recently, Broverman et al. (1964, 1966) have found a number of tasks which negatively define automatization and have called these "restructuring tasks." High

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automatizers tend to give low restructuring performances, while weak automatizers tend to give high restructuring performances. This strategy suggests that it may be more profitable to think in terms of "automatization" and "restructuring" than in terms of "conceptual vs. perceptual" when considering reading skills development. A more detailed listing and explanation of the above test types will be given in connection with the batteries used to compare children with decoding problems with normal readers, as reported in the next chapter.

Of importance in understanding Broverman's work, however, is his belief that an ipsative approach is necessary in determining a subject's automatization index. He says: "A rapid response rate on simple tasks may not reflect a high degree of automatization in a person who has a very high response rate or greater ability in all categories of behavior; whereas slow response rate might nevertheless reflect a high degree of automatization in an individual with slow response rates in general." (Broverman, 1965, quoted by Matthewson, 1967)

Such an approach is of considerable theoretical interest, but it presents difficulties in the development of instruments

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that may be useful diagnostically within the classroom, since several of the tests (especially the restructuring ones) must be administered individually. It was therefore decided in this present study to resort to a normative approach which can be carried out with easily scored group instruments. Such an approach does not require that each subject be measured against himself on the automatization vs. restructuring axis, and it simplifies the process of screening large populations, if such should become advisable.

With this modification, Broverman's model was used in two studies involving children who exhibited difficulties in the reading and spelling processes. The next chapter will deal with the preliminary studies out of which the two studies reported in this paper were developed.

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CHAPTER IV

TWO PRIOR STUDIES

Prior Research Designed to Determine Whether Poor Decoders Have Normal Automatization Patterns

On the basis of factor analytic studies, Broverman et al. (1964) proposed a bipolar model which included a number of "automatization" tests at one end of the axis, and tests of "conceptual and perceptual" functions (restructuring) at the other. Automatization tests tended to be those involving highly over-learned functions that are performed with a minimum of conscious attention. The colors red, green, and blue are so universally present and so frequently designated either orally or covertly that naming them presumably becomes automatized rather early in life. The same would be true of simple addition or subtraction. Our society requires the adding or subtracting of two digits so frequently in a number of contexts that these become automatic functions which no longer require any conscious attention. Any task requiring

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serial responses to simple repetitive stimuli is susceptible to automatization.

"Restructuring" tasks, on the other hand, require conscious attention. The Block Design and Object Assembly subtests of the Wechsler Intelligence Test for Children are typical of restructuring tasks. The Toothpick Design Test, in which the subject is given six plastic toothpicks and asked to make as many different closed designs as possible within a given time period, is a task of the same sort. Restructuring tasks, therefore, can be seen to require an ability to recognize alternatives readily by "setting aside initial automatized perceptual responses to obvious stimulus attributes in favor of a response to less obvious, hidden stimulus relations." (p. 494). This would seem to imply a capacity for "flexibility" in the normal or high restructurer which is unrelated to the automatization function, since restructuring tests negatively define automatization tests. (Broverman, 1964)

However, the above generality must be somewhat amended to include an age validity component. Broverman's early studies involved late adolescent and early adult males. There are some indications that the bipolarity is not quite so

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perfectly defined among younger children. (Mathewson, 1967; Broverman, 1967)

It is also of importance to recognize that Broverman's early work did not include reading tests as such, and later studies using his model to investigate reading behavior of children were of necessity logical extensions of concepts into the field of reading.

In the summer of 1965 a seminal study which attempted to relate automatization-restructuring tasks specifically to reading scores was undertaken at a summer remedial program for poor decoders at Fryeburg, Maine. The experimental sample, as indicated in the last chapter, was made up of 30 boys between the ages of 12 and 14, all of whom were classified as "poor decoders" with difficulties in spelling and writing as well as reading. All were of average or high intelligence, with an average Full Scale score of 112 on the WISC, and with an average of 116 on the Verbal sub-section of the WISC. They were matched for sex, age, and socio-economic status with a group of normal readers from nearby summer camps. (Whiting, et al. 1966)

Seven automatization tests were given: Simple Addition, Simple Subtraction, Simple Multiplication, Naming Repeated Objects, Stroop Color Names, Stroop Hues, and Stroop

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Interference. Five restructuring tasks were also administered: Wechsler Block Design and Object Assembly, P. M. A. Verbal, Toothpick Design and Witkin-Gottschaldt Embedded Figures.

As indicated in the previous chapter, Broverman ipsatizes the scores for each individual in order that an index for each person may be established. In the Fryeburg study, the median score for the entire group of 60 subjects was computed for each test, and the number of subjects receiving scores above and below the median was then determined. Scores for both experimentals (poor decoders) and controls (good readers) were then compared. Performance on the automatization tests was found to be dependent on group membership ($p < .001$ in all cases) with the control group taking the shorter time to complete each test.

An analysis of the results on the restructuring tests indicated that only one of the five tests revealed any significant difference between the groups (P.M.A. Verbal, $p < .01$). The authors indicate the possibility of contamination in this test, since the tester was forced to deviate in the administration by reading the test to the poor readers rather than having each subject read his own test. In general, however, predictions derived from Broverman's model seemed to be substantiated

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when subjected to an empirical test. Early adolescent boys who are poor decoders tend to take much longer to perform an automatized task than do normal readers, but they are able to perform restructuring tasks as efficiently as normal readers.

The Fryeburg study, which included boys from a wide geographical area of the Eastern U. S., was then replicated in large measure among a socially homogeneous group of 32 boys from two elementary schools of the Protestant School Board of Greater Montreal. (Mathewson, 1967) These boys came from middle-class English-speaking homes, were of average to high intelligence, and showed no severe emotional problems. Sixteen of the boys who had severe decoding problems were matched for I.Q. and age with sixteen good readers. Only children with I.Q.'s between 105 and 120 on the Henmon-Nelson Test of Mental Ability were used. The mean I.Q. was 114. Equal numbers were drawn from grades four and five.

Mathewson gave the following automatization tests: Naming Repeated Objects; Stroop Color Hues and Stroop Color Interference. The Reading Color Names test, often included in the automatization battery, "was not included in the ipsative analysis of the data as it was judged inappropriate

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to compare good and poor readers on a task which involved reading per se." (page 16) A pretest was given in each case to validate the fact that the child was able to recognize the three colors, red, green, and blue.

The restructuring tests given included: WISC Block Design subtest, Porteus Mazes, Children's Embedded Figure Test (CEFT). Results are shown in Figure 4.1, on page 52.

The results obtained in the above study were essentially the same as those seen with the Fryeburg population. The performance of the poor decoders was significantly inferior to that of the good readers on all automatization tasks ($p < .01$).

On the other hand, there was no significant difference in this Montreal sample between the good and poor readers on the restructuring tasks, except in the case of the Mazes subtest. The poor readers were somewhat better ($p < .05$) on this one test than were the good readers.

While the results in this study do not completely confirm Broverman's hypothesis that automatization and restructuring tasks negatively define each other, the results can be interpreted as pointing in that direction (See Figure 4.1). In any case, the results would tend to argue against a conclusion that the poor readers are simply "poor performers"

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FIGURE 4.1

Performance by poor decoders and good readers on automatization and restructuring tests

Performance profile of 16 poor decoders as compared to 16 matched good readers on tests of automatization and restructuring ability, 4th and 5th grades, Montreal, Canada. Difference in means is significant ($p < .01$) in favor of good readers on all automatization tests. Two of three restructuring tests show no significant difference in means; one (Mazes) does show a significant difference ($p < .05$), in favor of the poor readers. (Mathewson, 1967)

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in general. Both the automatization and the restructuring tests were given individually and in sequence during a single testing session. On one cluster of tests (restructuring) the poor readers performed just as well as (indeed, a bit better than) the good readers. On another class of tests (automatization), however, they performed at a significantly ($p < .01$) lower level. This would seem to argue against the presence of any "anxiety" or "motivational" artifact operating here as the primary source of difference between the two groups. Rather, it would suggest the need for additional study to determine if indeed the automatization dimension is specifically related to poor decoding skills.

In addition to an ipsative comparison of differences in task performance, a normative comparison also was made between individuals by Mathewson. *T* tests compared differences between good and poor readers. The results were essentially the same as those obtained on the ipsative comparison: poor readers were significantly inferior to good readers ($p < .01$) on all automatized tasks. No significant difference was found on restructuring tasks, except for Mazes, on which poor readers showed superior ability ($p < .05$). Only one anomaly was noted: very low intercorrelations between the "restructuring" subtests did not

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suggest the close unity that had appeared earlier in Broverman's studies (1964) with older subjects. The explanation for this probably lies in the differential in age between the Broverman and Mathewson samples. Broverman (1967) reports that "correlations steadily decrease" when moving from adults to children on restructuring tasks. Since the battery was originally determined by Broverman and his colleagues through measuring the performance of late adolescents and young adults, it is to be anticipated that a decrease in correlation will occur when younger people are tested.

The two studies reported above would suggest that Broverman's model had considerable validity when applied to reading, and that he was right in suggesting a relationship between automatization skills and reading, at least as far as it applied to children with poor decoding skills.

The findings of these two studies (Whiting et al. 1966; Mathewson, 1967) also would seem to give at least tentative answers to some of Vernon's (1957) questions. There appears to be a specific behavioral dimension that clearly differentiates poor decoders from good readers of the same I.Q. level. The question, however, has shifted from Vernon's "conceptual"

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speculation to another dimension involving automatization and restructuring. This will be dealt with in the following chapter.

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CHAPTER V

THE HYPOTHESIS

The two seminal studies previously cited attempted to relate automatization and restructuring skills to the reading behaviors of children. The data seemed to suggest the possibility that at least three levels of cognitive functioning may be involved in the tasks represented by these studies and by Vernon's hypothesis.

The first order of cognitive functioning may be thought of as involving those tasks requiring rapid perceptual functioning in which a minimal problem-solving component is present. Such tasks require a learned or over-learned response to single items of a unitary class which are encountered in random sequence. The exact form of the response is largely predetermined by the nature of the test itself. (For example, the subject is asked to name three objects presented in random order in an extended series.) This first-order function is classified by Broverman and colleagues as "automatization."

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A second-order function is one in which a wider latitude of creative, problem-solving behaviors is required, and in which the exact form of the response is not absolutely predetermined. (For example, the subject is asked to make as many different figures as he can in a given time period with a given number of tooth picks.) Such a function is described as "restructuring."

A third-order function would be that suggested by Vernon involving "...complex reasoning processes..." such as grasping linguistic structures or understanding symbolic relationships.

The studies by Whiting, Schnall, and Drake and by Mathewson presented no evidence that would deny the existence of a third-order conceptual difficulty in the slow readers as suggested by Vernon. They did, however, suggest that a first-order problem exists in the poor readers without a corresponding deficiency of performance in second-order function.

Despite the apparent unanimity of findings in the two studies cited above, many questions remained. Only a limited number of automatization (first-order) tests were

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used, and they tended to have some higher function components, including some "reading-like" elements, e.g., naming colors, or coding symbols to letters. Would the same aspects of lower performance on the part of the poor readers be obvious if extremely simple, low-level task performance were required, e.g., circling dots, striking letters or other requirements in which only the simplest of perceptual demands were made in the automatization domain?

Other questions also arose. If lowest level perceptual functioning were found to be poorly developed in young readers who were having difficulty with the decoding process, would a similar problem be found in adolescents who had exhibited a long-standing difficulty in reading, spelling, and the acquisition of writing skills?

This investigation was designed to seek data relating to such questions. Therefore, the following working hypothesis was proposed:

If selected poor readers with a history of late and poor development in decoding skills are matched by sex, age, I.Q. and socio-economic status with a normal control group, statistically significant differences in performance will be found at all levels of functioning within the automatization

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domain. The hypothesis predicts that the performance of the poor readers will be consistently lower on all tests within the automatization domain than will the performance of the normal control group, and that this lower performance will be noted at all age levels present within the sample studied, ranging from children in the early grades to high school students in late adolescence.

If statistically significant differences in performance are found between the two groups, it will be assumed that this suggests a probability that the poor decoders are exhibiting deficits in perceptual efficiency. If no difference is found between the groups, it will be assumed that this indicates normal perceptual efficiency and that Vernon's suggestions have high validity.

Low perceptual efficiency on the part of the poor readers will be assumed to be irrelevant to the question of whether or not there are third-order cognitive deficits, as suggested by Vernon, since there is no logical reason that is immediately apparent which would preclude such third-order cognitive deficits being also present in poor readers.

A description of the tests and methods used in testing the validity of this hypothesis is presented in the following chapters.

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CHAPTER VI

METHOD: I

The Test Battery: Rationale for Selection, and An Analysis of the Behaviors Required for Performance on Each Test

In determining the content of the battery included in Appendix I, the following rationale was used:

Broverman et al. (1964) had established an automatization battery consisting of a number of subtests for older adolescent and young adult subjects. The Fryeburg study (Whiting et al. 1966) and the Montreal (Mathewson, 1967) replication reported in Chapter 4 had found no contra-indications regarding the validity of the battery when some of the tests were used with children as young as ten years of age. Both of these previous studies had found that the "restructuring" battery negatively defined the "automatization" battery.

The automatization tests from Broverman's battery used in the present research included:

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Test 1. Simple Addition

2. Simple Subtraction

3. Speed of Naming Repeated Objects

4. Stroop, Reading Color Names

5. Stroop, Naming Color Hues

6. Stroop, Word-Color Interference

These tests were drawn from Broverman's (1964) list of thirty tests which "reflect cognitive ability as opposed to temperament, strength, etc." (p. 489). The above six were chosen because they are simple to administer and score, and because of their reliability.

The three Stroop (1935 a and 1935 b) Tests have been augmented by an additional test devised by Broverman, Naming Repeated Objects (Appendix I). These four tests, plus Simple Addition and Simple Subtraction, cluster well in a factor analysis, as will be indicated later in this study. Commonality between these tests can be observed in the Whiting et al. (1966) study as well as Mathewson's (1967) replication.

These six tests, therefore, served as a criterial battery for determining whether or not the experimental group in this study was behaviorally equivalent to previously examined populations as related to automatization functions.

The additional group of subtests below was selected or

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devised for this present research because each was felt to be a potential source of information regarding behavioral deviations on the part of poor decoders, when compared to normal readers:

Test 7. Dotting Circles (Sharon Laterality Test)

8. Circling Dots

9. Striking out o's

10. Striking out d's

11. Striking out 9's

12. Circling 5's and Striking out 9's

13. Simple Letter Coding

14. Single Letter Coding-Addition

15. Syllable Coding-Addition

16. Word Fluency

17. Audio Letter Span

(Three additional tests that will be discussed later were added in a second study, carried on in a public school.)

In addition to the above 17-item battery, the WISC-WAIS and the appropriate age level of the Otis Quick-Scoring Mental Ability Tests were administered to the Fryeburg sample, as was the Gray Standardized Oral Reading Paragraphs Test. The Durrell Analysis of Reading Difficulty was also given to the subjects found to be reading below the sixth grade level.

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A brief description of each test of this new automatization battery follows, together with an analysis of some of the behaviors involved in performing that task. However, it should be noted that such an analysis is open to question, lest it would seem to imply that all of the behavioral attributes present in even simple acts of cognitive response are known. Apparently they are not well-established except within very broad categories. It is necessary to explore only one of the newer volumes dealing with cognitive psychology (e.g., Neisser, 1967) to realize how difficult it is to speak about such a process with any degree of certainty. However, it is possible to make some observations, and these may be of value in understanding the results of this study.

Basic physiological demands placed on the organism to support essential behaviors may be classified as follows:

1. Visual Acuity. There must be enough visul acuity to support scanning, pattern recognition, symbolic discrimination, and other similar functions.

2. Auditory Acuity. There must be sufficient auditory acuity to receive directions, and to hear letter names in series, as in the Letter-Span Test.

3. Motor Control. There must be sufficient motor control for normal visual fusion and scanning processes, and

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enough finger dexterity to allow for simple stroking and the formation of letters and digits. This implies sufficient "attention" to perform these functions.

"Form Constancy" (Money, 1966) of tests was maintained by using consistent type faces for all items. This maintenance of form constancy was felt to be important, since the experimental group was generally described as having "perceptual difficulties." Any ambiguity or dissonance in the symbolic representations might possibly have negatively influenced performance.

All of the tests except Word Fluency and Letter Span required some form of visual pattern recognition, at least in the initial cognitive stages.

If the Neisser (1967) model relating to visual pattern recognition is accepted, there is a demand for "preattentive processes: wholistic operations which form the units to which

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attention may then be directed, and which can directly control simple motor behavior." (p.86) Such a process seems to be the essential element in the simplest of scanning operations, e.g., selecting o's from a field of other letters.

Frostig (1961) suggests that efficient visual functioning may depend on the following: eye-motor coordination, figure-ground discrimination, form constancy, position in space, and spatial relations ability. Any one or all of these may be necessary in order to recognize visual patterns in differing stimulus fields.

Of the five concepts listed above, "form constancy" is largely irrelevant to this study, since none of the tests involved anything but completely regular, mechanical reproduction of symbols. In the same way, there was no figure-ground anomaly beyond the most primitive level--the separation of black symbols from an unpatterned field. There was no indication that any Ss had difficulty in performing this task, so it is an assumed behavior common to all tasks.

Minsky (1961, p.16) has proposed that viewers must be able to "articulate" any visual fields into parts before recognition can take place. Money (1966) has suggested the necessity for directional constancy in symbolization processes.

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This normally seems to require some sense of left-right and of body schema. Gibson (1966) has proposed a "feature chart" of discrete aspects which are "analyzed" by Ss in discriminating between individual letters: straight segments, curves, intersections, redundancy, and discontinuity.

Attempting to make a coherent system from all of these approaches alone--not to mention a multitude of others that might have been chosen--is to plunge into the heart of some of the heated controversies in cognitive psychology. Instead of attempting to deal with this almost impossible task, the following behavioral analysis is undertaken at a simple, descriptive level, without attempting to deal with moot points.

The first six tests have been previously identified by factor analysis (Broverman, 1964) as belonging to an automatization factor:

Test 1: Simple Addition

Task: S is given a sheet of paper filled with rows and columns of arithmetic problems in which he adds two digits as rapidly as possible. More problems are provided than he is able to finish in the given time.

Behaviors: S must orient himself to the page, and proceed either in rows or columns. He must understand what

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"numbers" are, and be able to add them. There is constant targeting and focusing on each task, while extraneous stimuli must be ignored. "Adding" is apparently an act in which different individuals use a number of different strategies. Motor function is required in writing sums under each problem.

Test 2: Simple Subtraction

Task: Same requirements as above, except that S is asked to subtract instead of add.

Behaviors: Essentially same as above.

Test 3: Speed of Naming Repeated Objects (Object Identification)

Task: S is presented a page on which are printed rows of drawings of three objects in random order: cup, tree, fly. S is asked to name aloud each object in a test line. If he can perform this task, he is then asked to name all of the same objects on the rest of the page as quickly as possible. The number of seconds required to finish the page is his score. High scores on this test mean poor automatization performance, and positive differences in performance are expressed as negatives in the data.

Behaviors: S is required to perceive and discriminate among three object representations. He must scan and

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name from left to right and from top to bottom. This requires spatial orientation and scanning skills. He must call each object by name, and shift rapidly at the verbal level. Any aphasoid tendency would seriously interfere with performance on this test.

Test 4: Stroop, Reading Color Names

Task: Three color names (RED, BLUE, and GREEN) are printed on a test sheet, with a test line at the top of the page. S is asked to read test line. If he knows the three words on sight, he is asked to read the rest of the page, which is filled with rows of the same three words.

Behaviors: This is essentially an oral reading task without any interference to confuse the reading of the color names. Subject reads aloud in a left-to-right, top-to-bottom sequence. His only task is to discriminate between the three color names printed in black, and to verbalize them.

Test 5: Stroop, Naming Color Hues

Task: To "read" (name) colored squares printed on a full sheet of paper. S calls the names of randomly sequenced colors: red, green, blue. A test line determines whether or not he can call the color names. If he is successful on the test line, he continues for the rest of the page.

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Behaviors: Color naming; targeting and focusing; oral response to visual stimulus; minor motor component. Again, a high score on this test indicates a slow, non-automatized response.

Test 6: Stroop, Word-Color Interference

Task: Subject is shown a page with three color names printed repeatedly in colored inks that do not match the named color. The word "red" may be printed in either green or blue ink, but not in red. The same is true for the other two colors used.

Behaviors: S must be able to "read" and to maintain a visual motor constancy while calling words that may or may not present difficulty because of the interference produced by having competing stimuli involved in the same perceptual act.

(Behaviorally it is difficult to see much similarity between adding and subtracting, on the one hand, and the object identification and Stroop Tests on the other. Their commonality seems to rest in the fact that they demand a rapid, efficient automatized response. All of these tasks (with the possible exception of the Interference test) would seem to fall into the classification of simple, repetitive tasks that are highly

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practiced in the case of most individuals.)

Test 7: Dotting Circles (Sharon Laterality Test, Kitchen, undated)

Task: This test consists of 100 circles within a block border. While the page contains four blocks, only the first block was used, since no measurement of "Laterality" (alternate use of hands) was made. Instead, the test was used to measure dotting ability with the preferred hand only, during a specific time period that was short enough to preclude completion of all test items. The test required the placement of dots inside circles approximately 5 mm. in diameter, in such a way as to leave the circumference untouched.

Behaviors: No directional orientation is required, since the task can be approached from any direction. By convention, however, subjects were asked to have the top of the test in a position such that the S's name could be written on lines provided. In the test, S must focus attention and organize his visual and auditory systems to receive instruction. He must comprehend "dot, circle, separate, touching the circumference, start, stop, rapidly and pencil." Sequential placement of dots involves continuous "preattentive"

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targeting on successive circles following each dotting act, which requires hand-eye coordination responses at a fine motor level.

Only the most minimal figure-ground, form constancy discriminations, pattern discrimination and directional constancy are required. No coding or other symbolic fluency is apparently required.

Test 8: Circling Dots

Task: This test requires that S circle dots spaced approximately 1 cm. apart in columns and rows on a page so as to (a) produce a closed circle which (b) does not touch the dot or (c) any other circle.

Behaviors: Performance on this test requires essentially all behavioral components involved in Test 7, with the additional demand for motor control involved in making complete, separate circles. This demand introduces two "touching" variables rather than the one required in the Dotting Circles test. Requiring that each circle be completed demands particular attention to the closure detail.

These two tests present very constricted task demands, and they permit an investigation of perceptual-motor functioning at a very low level of cognitive demand. They were included in the battery for the following reasons:

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1. Poor decoders are reported to have difficulty on a wide variety of tasks such as the Bender Visual Motor Gestalt Test (Bender, 1956), or on such simple motor tasks as are involved in using a pencil, crayon or scissors. (deHirsch, 1966) Barsch (1967) and Cratty (1968) have also pointed out that problems in motor control often seem to accompany poor achievement in school, especially in reading. Plack (1968) reports data indicating positive correlations of up to .83 between reading and the ability to perform on specific motor tests. These tests presumably gave an indication of fine motor ability.

2. No symbolic competence is required. Most of the other tests in the battery demand some kind of symbolic manipulation, thus introducing an associational or translational component. Functioning on the above two tests represents a pre-symbolic stage.

3. Minimal cognitive demands are made in these tests. After the first item response is learned, each subsequent response is nearly identical to the first. Only the most minimal intellectual demands are made on cognitive function, memory, evaluative ability and divergent or convergent thinking. (Guilford, 1959)

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Test 9: Striking o's

Task: S is presented with a sheet containing letters of the English alphabet arranged in haphazard sequence in rows and columns. S is asked to make a continuous search for a given letter, o, and to strike through with his pencil each o that he finds during a given time period. The time period given does not permit completion of the page.

Behaviors: S must be able to comprehend the instructions: "o, other letters of the alphabet, strike, pencil, start, stop." He must target on lines and individual letters. Visual-motor control must allow for a "scanning" function ("preattentive" scanning, Neisser, 1967), selecting o's from all other stimuli. There is interruption of the scanning for marking, with immediate reintroduction of targeting and scanning following each marking episode.

This test and the two following ones are alike in that they all use symbols that are familiar to the S. No Ss were found who could not recognize the o symbol. This test was different from the one immediately following in that the o in this test is a symbol with very high information loading; i.e., its potential for confusion with

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other letters is very low. It seems to present no directional problem since it can be recognized instantly from any direction.

Test 10: Striking d's

Task: Same as Test 9, except that each d is identified and marked instead of an o.

Behaviors: Same as Test 9, except for the low information loading in the d. (b, p, q are essentially the same symbol except for orientation.) This introduces critical directionality into the battery for the first time. S must not only discriminate between the d and all other letters, but a special problem is introduced with the three letters that differ from it only in terms of directional rotation.

Test 11: Striking 9's

Task: The same as two previous tests, except that the matrix is made up of digits in columns and rows. All 9's must be struck.

Behaviors: Essentially the same as Test 9, except that digits instead of letters are used. A minor discrimination task is present: 9 and 6 are inversions of each other.

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Tests 9, 10, and 11 above were included to assess the lowest cognitive levels of symbolic functioning. If the poor decoders in all age groups were found to have no difficulty at this level of functioning, it would support Vernon's statement that there is little or no value in investigating what poor readers do in regard to the perception of individual letters or words ("...little is gained by analysing the child's errors in reading...into visual and auditory errors..." p. 196). It seems to be her contention that "...it is almost certainly the reasoned (italics ours) combination and manipulation of letter and word shapes and sounds which is at fault." Tests 9, 10, and 11 would seem to require a very high level of automatized functioning, and an absolute minimum of reasoning ability, as far as symbols are concerned. Normal performance on these tests by the experimental group, when compared to the control group, would suggest that their problems in reading were related to higher cognitive deficits, whereas poor performance on these tests would suggest deficits at the very lowest level of cognitive functioning.

Test 12: Circling 5's and Striking Out 9's

Task: On a page of haphazardly selected digits,

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arranged in rows and columns, S must circle each 5 and strike through each 9. The allotted time for the task is not long enough to allow S to finish all items.

Behaviors: In this task, S must use the spatial orientation involved in the previous test, and must target on and scan each line or column, marking the digits as prescribed. The scanning and marking process must be reinstituted following each marking. However, this test demands, in addition, a new behavioral strategy. No longer is the preattentive scanning function (searching for a single stimulus figure) adequate. This test requires rapid oscillation of "analyzer functions." S must attend to two competing stimuli, both of equal stimulus value. He must not only discriminate between the two specified digits, but also must reject the seven other digits represented on the page. Motor activity also is raised to another realm of complexity in this test, as opposed to previous ones, in that two different motor acts are required, depending on the digit that is identified. The two tasks must be held in mind until the first digits are marked, since there is no reference model on the test sheet. Once a sample 5 and 9 are appropriately marked, it is possible to refer to them thereafter.

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Test 13: Simple Letter Coding

Task: This is an informally constructed test before which the subject is given approximately one minute in which to familiarize himself with the task and the code key:

a	b	e	g	k	n	d	s	z
4	6	8	7	2	5	9	1	3

S is given a page on which the above code letters are arranged in haphazard order in rows and columns. Under each of the letters is space enough for S to write in the corresponding numeral, based on the code key.

Behaviors: Standard directional, spatial, scanning and targeting behaviors required in previous tests are also required in this one. In addition, letters must be translated into numerals, and a motor response using a numeral must accompany each translation in sequential order. The key is visible for reference. If S can remember the key, all attention can be focused on the coding task itself. If he cannot remember the key, alternating reference to the key is required. This test is different from the WISC Coding subtest in that all of the symbols used are familiar to the subject, whereas the Wechsler Coding subtest requires the use of novel symbols which must be matched to appropriate numbers.

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Because of the many reported studies, noted in Chapter 3, in which poor decoders were poor performers on the WISC Coding subtest, it was decided to give a coding test of the same sort and dimension, but to use familiar symbols to determine whether the WISC Coding problem is an example of a general disability in coding, or whether it contains some unique demand not found in other simple symbol-coding tasks.

Test 14: Single Letter Coding Plus Addition

Task: A Simple code key is provided:

a	b	c	d	e
5	4	3	2	1

Rows and columns of "letter addition" problems, each involving two single letters, are presented and S is instructed to determine the number corresponding to the letters. He is then instructed to add the letter-equivalents and to enter the sum under each equation. Examples are given: e plus d equals 3.

Behaviors: Not only are all the previous symbol-recognition behaviors involved, but this test additionally requires (a) symbol coding and (b) adding. As before, S works with familiar symbols. In addition, however, this test requires that S hold the translated symbols (letters to digits) in immediate memory storage even while the adding

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process is carried on. There may be an added advantage in performance if the S observes that while the a-e series is in normal alphabetical order, the 5-1 series is in reverse order, thereby making it a more orderly structure than the previous test in which letters and numbers were matched on a haphazard basis.

This test and the Syllable Coding Plus Addition test probably represent the highest level of symbolic manipulation in the battery. The Single Letter Coding Plus Addition and the Syllable Coding Plus Addition tests were identified by Broverman et al. (1966) in factor analytic studies as falling into the automatization domain. These two tests were included in the present study as higher level automatization tasks requiring a greater degree of skill in symbolic manipulation than earlier tests, since both the ability to code and the ability to add is required.

Test 15: Syllable Coding Plus Addition

Task: Four nonsense syllables are presented with one digit under each. S is to code each syllable to a number, add two syllables, and express the sum as a digit.

Behaviors: This task involves essentially those behaviors necessary for performance on the preceding test, with the exception that there is apparently a "covert

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verbalization" component involved. During administration, Ss tend to say the syllables aloud in the explanation period preceding the test, and they frequently smile or laugh as they learn the syllables. There are many spontaneous remarks, especially from younger Ss, indicating that this test is "fun." Motivation can therefore be assumed to be high on this test.

Test 16: Word Fluency

Task: S is given a blank sheet of paper and asked to write as many words as he can during a three-minute period. Two prohibitions only are imposed: S is not to write sentences, only single words, and he is not to repeat words. S is reassured that he may spell words the way they sound to him.

The cognitive content of this test is deliberately kept low. No meaning structure or content requirement is placed on the words, and S understands that any words are acceptable. This tests requires both cognitive functioning (thinking of words, writing them in some order on the page, spelling, and not repeating previously used words) and rapidity of motor funtioning associated with the act of handwriting.

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Behaviors: S must engage in a number of behaviors of different orders:

1. Word-finding skills. Any S who has aphasoid tendencies, or who blocks on words in a test situation, would have an initial problem in performing.

2. Writing skills. S must maintain spatial and directional orientation, so as to write lines or columns on a blank page. He must be able to employ sound-symbol relationships, leading to written approximations of conventional spelling. He must engage in a continuous motor activity involving the production of letters of the English alphabet in constantly changing patterns.

3. S must be able to hold in short term memory storage words already used so as not to repeat, or he must be able to continue a scanning process of previously written words to prevent repetition.

Test 17: Audio Letter Span

Task: S is required to remain inactive and listen while the tester reads letter spans aloud in a manner somewhat similar to that used with the Digit Spans of the WISC/WAIS, except that the units are letters of the alphabet rather than numbers. No span resembles any word. Eighteen spans are

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given, with lengths increasing from two to eight letters. When the tester has finished each span, S is asked to write down as many of the letters as he can remember, in the order given.

Behaviors: Listening, short-term memory, serial order recall and motor encoding are all involved in this test. The S must hear the span, must remember it, and must reproduce it in order on paper. This series of behaviors requires that auditory acuity be within normal limits, that the S be able to attach a symbol to each letter name, that he be able to write the symbol, and that he do this in sequence from short-term memory.

This is the only "auditory" test given in the battery, and it explores only one small segment of the total auditory process. All other tests have a major visual-motor loading.

This test was included in the battery as a "marker" instrument which allows at least a tentative exploration of the relationship of visual to auditory skills in relation to reading. Reading is obviously more than a visual-motor act. Chall et al. (1963), Holmes and Singer (1961), Cabrini (1963), Johnson and Myklebust (1967), and others have pointed out the importance of certain auditory skills in relation to the development of decoding skills in reading.

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Auditory memory for letter spans is assumed to be one in a hierarchy of skills involved in the total auditory process, which includes other functions such as discrimination, blending, figure-ground separation, etc. This particular aspect of the auditory process (memory for letter spans) was chosen because it may conceivably be an example of "auditory automatization," since it can be thought of as a very primitive form of coding. Presumably the remembering of sequences which are essentially non-meaningful in themselves is a relatively practiced skill in our society: hearing and dialing telephone numbers, repeating addresses, spelling names after an introduction, etc. Broverman has not generally attempted to establish an "auditory automatization" factor, but has worked primarily with visual-motor tasks. Therefore no background data are available for predicting performance on this task, but repeated observations have been made which suggest that auditory skill deficits can be expected among poor decoders, with memory for letter span difficulties being among them.

All of the above-described tests were used with Part I of the reported research. In addition, parts of this battery, plus three additional tests, were used in Part II of the

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research, involving all of the children in Grades 3 and 4 in two public schools. The following three tests were included in the school studies:

Test 18: Shorthand Aptitude Test (Department of Public Instruction, Brisbane, Australia. Undated.)

Task: S is shown a work sheet with one novel symbol ( ) which is to be reproduced in squares provided on the page. After S is allowed to practice making the symbol, he is then instructed to make the same symbol as many times as he can in two minutes. He is allowed 100 squares in which to make the figure. Only one subject of the 298 who took the test completed all 100 boxes.

Behaviors: S must be able to recognize a novel, non-meaningful symbol and reproduce it repeatedly within a prescribed matrix. This demands that S understand what a "symbol" is (as distinguished from the box in which it is placed), and that he reproduce it within acceptable limits, following practice. Motor control demands require placement within a box approximately 10 x 12 mm. in size.

This test was chosen because of the possibility that some Ss have difficulty in reproducing new symbols. The relation of this particular function to the entire automatization phenomenon has not been fully investigated. This

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test was therefore added to the battery so that it could be studied in a factor analysis.

Test 19: Making Squares

Task: S is asked to make as many closed squares as he can in a given length of time on a blank sheet of paper without permitting the squares to touch.

Behaviors: S makes four marks, enclosing completely a segment of the working field. Visual-motor requirements are that he recognize and reproduce a "square" and that he maintain some clearance between each design and others he produces.

Test 20: Spelling

Task: Twenty-five primary-level words from the Handbook of the Durrell Analysis of Reading Difficulty (1955) are dictated. S is asked to write down as many as he can in conventional English spelling.

Behaviors: S must be able to hear whole word; translate into appropriate standard English orthography; write down word. This is assumed to be the opposite process to oral decoding.

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The next chapter deals with the nature of the samples in the two studies.

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CHAPTER VII

METHOD: II

A Description of Two Samples Used in Separate but Related Research Studies

The two research studies reported in this dissertation are related, but separate and different. The following information about the samples used will serve to distinguish the two groups.

Research Study I

The first study used pupils attending the summer session of the Reading Research Institute, held at Fryeburg Academy, Fryeburg, Maine and Yarmouth Academy, Yarmouth, Maine. This summer session is a seven-weeks program designed to offer specialized remedial help to children and adolescents of average or high intelligence who exhibit not only symptoms of poor decoding ability in reading, but difficulties in spelling and in composition as well. Children with known emotional disorders were not admitted to the program, although

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on projective tests most of the subjects showed slightly immature emotional development that apparently matched their tendency toward minimal delays in general physical development.

Because of the relatively large size of the total enrollment, (N=106), it was necessary to use two different private school campuses to accommodate the group. The younger (8-11 years of age) and the older (15-19 years of age) groups were at Fryeburg and the middle group (12-14 years of age) was at Yarmouth.

The institute was made up primarily of boys (99), although a few girls also attended (7). Geographically, most of the pupils were from the upper East Coast, extending as far south as New Jersey, although eight pupils came from outside this region.

Socio-economically, the group tended to be well above average. This probably related to a number of factors: (a) access to clinics and hospitals where a diagnosis of "language disability" or "dyslexia" could be made; (b) concern for private remedial education on the part of parents; and (c) resources sufficient to afford the relatively expensive summer session. A study of the families of the subjects who finally made up the experimental sample,

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using Hollingshead's Two Factor Index of Social Position (1957), showed the following results:

TABLE 7.1

Index of Social Position of Fathers of Experimental Group

Occupations	Assigned score	No. families in class	Scores
Higher executives, proprietors of large concerns, and major professionals	1	22	22
Business managers, proprietors of medium-sized businesses, and lesser professionals	2	30	60
Administrative personnel, small independent businesses, and minor professionals	3	6	18
Clerical and sales workers, technicians, and owners of little businesses	4	3	12
Skilled manual employees	5	3	15
Machine operators and semiskilled employees	6	0	0
Unskilled employees	7	1	7
Unemployed	8	2	16
		67	150
			$\bar{x}$ = 2.3

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Educational scale

Complete data regarding the exact level of education of the fathers were not available, since they were asked only about college attendance. However, only 18 of the 67 fathers had not attended college, and so the educational achievements of these men were roughly equivalent to their occupational attainments.

These data would suggest that the pupils involved in the study as experimental subjects were in no way environmentally deprived, as far as socio-economic status relates to social and educational opportunity.

Pupil characteristics

Almost all of the pupils attending this program had been previously tested medically, psychologically and educationally in various hospitals and clinics on the East Coast. Children who were of below average intellectual ability or who were reported to have primary emotional problems were not accepted into the program. During the summer only three pupils were removed from the experimental pool because of behavioral attributes that would mark them as being emotionally outside normal range.

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As a group, this sample was above average in intelligence as measured by the WISC/WAIS. The Full Scale average for the three groups was as follows:

TABLE 7.2

Mean Intelligence Scores of the Experimental Group

Pupils	FS WISC/WAIS	SD	Otis	SD
Group I (8-11 years)	114.6	12.2	101.5	15.7
Group II (12-14 years)	112.2	8.7	101.6	13.9
Group III (15-19 years)	113.0	12.2	99.0	17.5

In general, motivational levels were high because the institute was made up primarily of children who were eager to succeed in school, and who came into the program of their own free will. There was little problem with eliciting and maintaining a rather high level of academic participation during the program, even though a six-day week was involved.

Attrition from the pool because of various contingencies (early leaving, failure to receive all the tests, manifest emotional problems, problems in comprehension, inability

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to find a control match, etc.) amounted to 39 subjects. Satisfactory matches were made with 67 controls. Each of the age groups contained 20 or more subjects.

Selection of candidates

The selection of candidates for this program was based on a language development model which defines "language" not only in terms of its verbal behavior aspects, but in its symbolic and motor aspects as well. "Language" in this model tends to refer more to "communication" than to "verbalization."

The diagnostic model which follows presupposes that a normally intelligent, physically intact child born into a literate society and having access to normal educational opportunities will develop, by a series of predictable steps, through a hierarchy of language skills. A child who fails to develop through this hierarchy is atypical of the population, and as an "underachiever" in school is a proper subject for remedial activity.

While a failure to develop the skills indicated in the model may arise from a number of different conditions (mental retardation, low socio-economic environment,

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substandard schooling, lack of motivation, psychopathologies, failure to attend school, etc.), all of the above-mentioned conditions had been systematically eliminated as far as possible from the sample chosen.

An additional attribute of the group was that all members had been classified by hospital or clinic specialists as exhibiting symptoms of a late and/or irregular development of perceptual-motor functioning in association with their lag in language development.

The level and extent of this lag was judged on the basis of their behaviors at each of the steps in the developmental hierarchy proposed in the following model, which suggests that a given individual may experience language learning failures at one or at a number of different levels, and that the term "language disability," sometimes applied to children who show developmental failures or lags, must be interpreted to apply to a broad spectrum of difficulties.

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Language Development Model

Language development in most human beings born into a literate society and having access to normal literacy training is assumed to follow a sequence which contains the following growth stages:

Stage 1. Precognitive language potential--organic noise and movement

"Language" in this model is assumed to grow out of the organic potential inherent in the normal new-born child. (For a concise statement regarding the course of language development in the child, see Carroll, 1964, pp. 32-33) "Babbling" begins during the first few weeks of life, even among congenitally deaf children. Positive reinforcement in the environment probably enhances its development, since hearing children of deaf parents are said not to practice fully this particular behavior, even though it develops normally. (Lennenberg, 1968) Motor movements with communicative potential are also assumed to be organically based. Indeed, early babbling may be primarily useful in terms of motor development of the speech apparatus. A failure to babble may well indicate neurological anomalies.

Stage 2. Cognitive sound and movement signals

Verbal language can be said to have moved from a potential

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(as in stage 1 above) into an actualized state when the child cognitively (consciously, deliberately) employs a "word sentence" (perhaps accompanied by a motor movement) to communicate with other persons.

The cognitive or conscious development of an increasingly complex hierarchy of language skills follows a relatively well-ordered time sequence, and specific verbal language skills can be anticipated, in the case of most children, before or by certain chronological ages. Assuming that a child has normal intelligence and has grown up within an environment where the full range of language skills is normally used, the developmental milestones should have been passed by the upper threshold periods listed below. If a child has not developed each of these verbal skills by the specified age, a maturational lag may well be indicated. (Cavanaugh, 1969)

Behavior	Upper Limits of Normality
A. Babbling, random noises	6 months
B. Use of single words in a meaningful context: "mama; no" etc.	24 months
C. Use of core sentence: "Me want -" or "my daddy go."	30 months

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Behavior	Upper Limits of Normality
D. Use of elaborated sentence: (core sentence + modification) "Me (I) want to..."	48 months
E. Oral composition: recounting an event in detail, or telling a story, or cracking a joke.	72 months

This developmental sequence suggests that a child of six years is able to produce most or all of the phonemes in his dialect, and is able to form syntactically adequate sentences to express a progressive flow of ideas.

In a preliterate society, the child of six years has normally mastered the language form that is demanded of him (verbalization), and future growth in this domain simply requires an increasingly sophisticated use of the single form.

On the other hand, the child in a literate society is faced with a number of additional demands after age six.

Stage 3. Decoding of graphic symbols

Traditionally the first grade in school is a time for beginning to translate conventionalized graphic symbols (words) into verbal behavior, defined earlier as "decoding." The sequential behaviors which are normally elicited in the

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teaching of decoding skills often recapitulate rather closely the schemata involved in the development of verbal skills described in stage 2 above:

A-B. Depending on the system of teaching reading used, the child is asked to decode first, either at a single phoneme level or at a single word level.

C. He is next asked to read a core sentence: "Run, Spot, run." or "Pat a cat."

D. Elaborated sentences are then presented.

E. When the above steps have been mastered, the child is given extended passages to read.

Stage 4. Coding into graphic symbols

Spelling of single words, leading to written sentences and then to composition, is required of a child as or after he learns to decode. Again the sequential A-E hierarchy of skills is normally required, as in steps 2 and 3.

Stage 5. Second language

The learning of a second language (French, music, Morse code, etc.) is normally the last language requirement placed upon pre-adolescent children in literate societies.

The stated model predicts that, in general, a child who has difficulty in learning a language skill at any given point

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within the hierarcy enunciated above, despite being in an educational environment where most of the other children are able to make normal progress, will have difficulties at all skill levels above that point. For example, if a child has trouble in mastering the decoding process at point 3-C or 3-D, it is probable that he will also have difficulty in learning to read, spell and compose in a second language.

The phrase "having difficulty in learning" must be defined in operational rather than absolutest terms, since variables such as student motivation, teacher competency, and adequacy of materials are not subject to easy definition and measurement. However, rough estimations can be made on the basis of standardized test scores as they relate to I.Q., years in school, and the relation of an individual's scores to those of the group in which he is functioning in school. An individual who is achieving on standardized tests and on daily assignments at a level manifestly below his anticipated potential, and the level of his peers, is considered to be having difficulty in learning.

All students in the program were accepted because of continuing problems with some phase of language development as outlined in the model indicated below:

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Stage 1. Precognitive noise

Case histories taken on each child indicated no infant failures to produce normal organic noise and movement.

Stage 2. Cognitive sound and movement signals

Case history information indicated that approximately 40% (twenty-nine) of the children had a reported irregularity or lag in speech development. Parents described a number of different anomalies in speech and language development, such as late talking, lisping, cluttering, problems in word finding, and confusion in story telling.

An examination of each child by a speech therapist in the program revealed that only three children could be classified as "speech defective," but that over 90% showed "poor articulation."

Within the classroom situation, problems in the organization of verbal output, as in telling a story or recounting events, were commonly reported, especially with the younger children. However, these problems were not universal, and in the case of some children organization of verbal language was normal or even superior.

Stage 3. Decoding of graphic symbols

The brochure which described the summer program contained

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this statement:

> Parents can save themselves time and money by making a preliminary decision regarding their child. If he can read orally at a normal pace and without making many errors in word identification, and if he can spell and write with normal ability, it is highly improbable that he needs the Institute program.
>
> There are children who read quite well (as far as being able to "call" words is concerned) but who cannot comprehend or remember what they have read. Such children have a reading problem, but they should not be thought of as candidates for the program of the Reading Research Institute.

Along with this warning, every effort was made to select only those pupils who showed a pattern of very poor word attack skills in oral reading, but who had the ability to comprehend what they were able to decode. Errors in reading included misidentification of words, omissions, inability to identify a word, misreading of small words, and guessing. Loss of place, finger reading, and constant repetition of words were common.

Basic data regarding age, IQ and achievement in reading and spelling for each member of the experimental sample are contained in Appendix II. Expected Reading Scores are based on the formula developed by Bond and Tinker (1957). The Appendix also contains grade scores on the Gray Oral Reading Paragraphs, grade scores on the dictated Stanford Spelling Test, Form D,

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and grade scores for those subjects given the Durrell Analysis of Reading difficulty. A summary of the data relating to age, IQ, and Gray Oral scores is to be found in Tables 8.1, 8.2 and 8.4.

The difference in means between achieved and expected grade scores is shown for each age group among the experimentals in Table 7.2A.

TABLE 7.2A

Comparison of Observed and Expected Reading Grade Score Means, by Age Grouping, Experimental Groups

Age Groups	Observed Mean*	Expected Mean
Group 1	3.4	6.9
Group 2	5.0	9.9
Group 3	6.9	12.0

* See Table 8.4

Spelling scores reported in Appendix II were found to be lower than reading grade scores in the experimental group. This is shown in Table 7.2B.

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TABLE 7.2B

Spelling Grade Scores, Experimental Group, by Age Groups Compared to Gray Oral Reading Grade Scores, Unadjusted

Age Groups	Spelling Means	Reading Means
Group 1	2.9	3.4
Group 2	4.4	5.0
Group 3	4.3	6.9

In approximately one-half of the cases (N = 31), the Durrell Analysis of Reading Difficulty was administered to those scoring most poorly on the Gray. Of the three reading subtests on the Durrell, the group which was tested performed most poorly on Silent reading and best on Listening Comprehension. This can be seen in Table 7.2C.

TABLE 7.2C

A Comparison of Mean Scores on the Oral, Silent and Listening Subtests of the Durrell among 31 of the Poorest Freyburg Readers

Oral Mean	Silent Mean	Listening Compr. Mean
4.1	3.5	5.4

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A similar pattern of higher scores on the Durrell Listening Comprehension than on the other subtests is seen in the data presented in Appendix III, consisting of scores of 50 randomly selected children of normal or high intelligence who had been diagnosed in a clinic as having the same symptoms of learning disability as the children attending Fryeburg.

TABLE 7.2D

Comparison of Mean Scores in Oral, Silent and Listening Comprehension Subtests of the Durrell Among 50 Children with Learning Disabilities Tested in a Clinic

Oral Mean	Silent Mean	Listening Compr. Mean
3.9	4.0	5.1

This sample was selected randomly from the files of the Reading Research Institute in Wellesley, Mass. Subjects ranged in age from 8 to 17 years; all but four were boys. The higher listening comprehension score is generally observed in most of the children who are tested in the Institute. However, in a clinic dealing with a wide variety of "reading problems," the same pattern might not be seen, since children with comprehension problems might well be represented in a way that they are not in the Institute sample. Because of the very specialized services offered by the Institute, reports from the school, the

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child's physician, and from any clinic or institution previously attended must be submitted, before testing is undertaken. If in the preliminary reports there is an indication that the primary problem is one of comprehension, the child is normally referred elsewhere for testing.

Stage 4. Coding into graphic symbols

Perhaps the most all-pervasive symptom present in the experimental population was the inability to spell within normal limits, which was in turn associated with difficulties in written composition. (See Table 7.2B)

In a few cases, especially among those students returning for a second year, decoding skills had been raised significantly during the first summer to near-normal grade levels. However, the spelling problem remained, and they spent the second summer working on spelling and composition.

Stage 5. Second language

No formal test of second language ability was given, but case histories indicated that those older students who had attempted foreign languages were universally unsuccessful.

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One other element went into the selection of the experimental group: the ability to "comprehend" what was read. Since Vernon had suggested the possibility that poor readers might have "cognitive" difficulties, efforts were made to see that subjects who had difficulty in understanding what they had read were not included in the study, under the assumption that poor comprehension might be indicative of a cognitive problem such as is sometimes seen with dull children who have been taught to decode but who cannot grasp what the author is saying.

Adequate measurement of the comprehension ability of the poor decoder is difficult because, by definition, the poor decoder is a poor reader and is not able to read up to his grade level. If a child cannot decode a passage, he obviously cannot comprehend its meaning. Therefore, "reading with comprehension" in the context of this study means that the subject is able to give an adequate verbal report of the material decoded (at least 70% of the questions asked about the passage correctly answered) up to the point that his poor decoding skills no longer allow him to continue "reading." This strategy argues that so long as the subject is able to understand up to the point at which he no longer is able to decode, then his "reading problem" is not primarily

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related to cognition (comprehension) but to decoding.

The tenuous nature of this argument is recognized, since comprehension aids the decoding process just as decoding may aid comprehension. However, this argument does hold to the point that in the children included in this study, decoding skills did not outrun comprehension skills as is sometimes seen with the "verbalizers" who decode with great facility but who remember little or nothing of what they have read.

A second strategy can also be used in which a passage is read to the pupil, and he is then questioned about his memory for the material read, as with the Listening Comprehension subtest on the Durrell Analysis of Reading Difficulty. While the task involved in this particular subtest is not specifically indicative of an ability to comprehend material read orally or silently by the pupil (since the tester reads it aloud to the child), it does give some indication of the child's ability to respond appropriately to a comprehension task and does suggest that there is no "blocking" in regard to remembered material.

While children with "comprehension" problems (as opposed to "decoding" problems) were not knowingly accepted into the summer program, a very few children did prove to have difficulty in understanding what they were able to decode. The

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Gray Oral Reading Paragraphs Test, used as the primary instrument in determining reading levels, does not test comprehension; so the Durrell Analysis of Reading Difficulty Silent Reading subtest (Durrell, 1955) was used to measure this particular function in those children found on the Gray to be reading at or below the 6th grade level. When a child missed no more than two of the six or seven questions asked after each paragraph that he was able to decode on the Durrell, there was an assumption of normality, and he became part of the experimental pool.

In addition, reports from tutors regarding comprehension skills were received regularly, following the use of such materials as the McCall-Crabbs (1961) Standard Test Lessons in Reading, and the Guiler-Coleman (1955) Reading for Meaning series. See Appendix IV for a sample of the report sheet. Any indication from a tutor suggesting comprehension difficulties removed a child from the experimental pool.

Matching the pairs

The matching of pairs was originally planned to take place with pupils from nearby summer camps in the Fryeburg area. This is an area of Maine especially rich in camps, and previous matching of small samples had been accomplished

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without major difficulties. However, the matching of a large number of subjects proved to be extremely difficult, and not all pairs were obtained though the camps. This necessitated using a public school population in the Boston area for obtaining matches not made in the camp. The community used for obtaining these residual matches is middle-class and contains few industries, although it adjoins other towns that are industrialized. The community contains two well-known private schools, and the general level of educational opportunity for a child in the public school is at least average. There was no indication that pupils from this community were more advantaged than the experimental sample.

The camp sample was difficult to measure in terms of socio-economic status, since camp directors were notably reluctant to give out any information about individual children. However, the cost of a summer at camp ($850-$950) would of necessity place most of the campers in an advantaged family status, although there was no indication that they were higher than the experimental sample.

The only problem area encountered in the matching occurred in regard to the I.Q. variable. Recent WISC/WAIS scores were available for all the experimental group, since such testing was required before admission to the program. WISC/WAIS scores were not available for the control group since they

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were not tested before attending camp, and the camp director did not feel that he could release them from their regular, scheduled program for a longer period of time, sufficient for the administration of individual I.Q. tests. The Otis Quick Scoring Mental Ability test was given to this control group, as well as to the experimental group after their arrival in the program.

Because the experimentals were known to have reading problems, and since the Otis has a reading component, it was questioned whether the WISC/WAIS scores might not provide a more valid estimate of the intellectual potential of this group. Following discussion, and in accordance with the original research proposal, matching took place using the WISC/WAIS scores for the experimental group and Otis scores for the control group. All matching was made within a $\pm$ 5 point range.

Following the matching, an anomaly was observed in that the experimental group had mean scores of from 10 to 13 points higher on the WISC/WAIS than on the Otis, depending on age.

Table 7.3 shows the relation of Otis to WISC/WAIS scores for the 67 pairs matched.

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TABLE 7.3

Experimental and Control Wechsler/Otis Means

Tests	Experimental Mean	SD	Control Mean	SD
WISC/WAIS (pooled)	113.3	11.3		
OTIS I.Q. (pooled)	100.3	15.7	112.7	14.2

The apparently anomalous spread between the Otis and the WISC/WAIS scores within the experimental group was investigated. Inquiries to the test departments of the two publishers were largely unfruitful in obtaining studies related to the performance on the two tests by the same subjects in a normal school sample. The publishers of the Wechsler tests knew of no such study. One unpublished and unsigned report was elicited from the publishers of the Otis. This study, from an unnamed school in Connecticut, reports a product-moment correlation of .82 between the Otis Beta and the WISC scores for 57 subjects in grades 7-9.

The Connecticut study reported that "in only four of the 57 pairings was the difference between the two I.Q.'s of the same pupils as great as 15 points." (Harcourt, undated) In the present study, 24 of the 67 experimental subjects scored 15 or more points lower on the Otis than on the WISC/WAIS.

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Table 7.4 shows the reported results.

TABLE 7.4

Correlation: OTIS/WISC - Connecticut Sample

	MEAN	SD	
Otis IQ	110.5	11.7	
WISC IQ	113.6	12.8	r = .82

The verbal report from a member of the test department of the Otis publisher was as follows:

> "Dr. Otis never intended that the Otis be a substitute for the WISC, and he never so claimed it to be. They measure different things." (Mitchell, 1968)

The WISC/WAIS were used, as indicated above, because the experimentals were known to have difficulties with graphic symbols, and a verbal-performance test was assumed to be more valid than a test requiring reading. In addition, traditional clinical practice favors the use of the WISC/WAIS (or Stanford-Binet) with children who are having problems in school.

To minimize any bias resulting from the use of the WISC/WAIS scores, covariance adjustment procedures recommended by Cooley and Lohnes (1962) were used in analyzing the data, with the Otis scores being used for both groups.

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It is of considerable theoretical interest to ask the question: why the markedly lower scores on the Otis? It is tempting to answer this query by attributing it to the poor reading skills of the experimental group, since the Wechslers are essentially verbal tests, and the Otis has a large reading component. However, an examination of the test protocols does not permit this as the full answer. The younger children in Group I were given the Otis Alpha form, which is a pre-reading form involving only pictures. Yet the experimentals showed as much depression on their Otis scores, when compared to their WISC scores, as did the two older experimental groups who were given the Otis Beta, in which reading was necessary.

A second possible explanation would suggest that the problem lies in the rigorous timing involved in the Otis. The far more liberal time allowance provided by the Wechslers may be of help to many children by removing the pressure imposed by the 30-minute limit on the Otis.

While this is a relatively attractive speculation, an examination of the Otis protocols reveals that in each age group fewer than ten percent of the experimentals failed to mark the entire test.

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Interviews with a number of children with known reading problems have revealed the fact that their general strategy is to work desperately during the Otis to finish it, and that many items are marked randomly, especially if they cannot be read. In the case of one of the children in the experimental group, a tutor filed a report of a conversation with him in which he spoke of doing exactly this random marking.

In addition to the above possibilities, there is also some indication that a difference in the specific material contained in the two tests may have an effect. The Verbal section of Wechsler tests is given orally so that the child can focus his entire attention on the process of verbalization. He does not have to wrestle with written words before he can attend to answering the questions.

In addition, most of the Performance items on the WISC/WAIS are capable of being "restructured" (moved, compared, organized in different ways). Performance items on the Otis are fixed on the page and require a "visual image" manipulation. Kuhlman (1960) has shown that children with weak reading skills are also poor at such visual image manipulations, especially at space relations tests.

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Kass (1963) has suggested that children with learning disabilities have difficulty with serial order material. Serial order tasks are much more prevalent in the Otis than in the Wechsler (except for the Digit Span test, which is optional in the WISC/WAIS and does not normally enter into its scoring). The only other serial order task on the Wechsler is Picture Arrangement, which carries a very high cognitive loading, and which apparently requires a different order of functioning than that found in many of the Otis items.

It is of interest to note that a study has been done with two other groups of children with symptoms similar to those that obtained in the experimental group above. These studies, done in subsequent years, revealed almost identical differences between WISC/WAIS and Otis scores, as were found in this study, suggesting that the pattern found with the experimental group reported above is probably not an artifact. These findings would indicate a future area for research that may well be fruitful in reaching a better understanding of the elements involved in this apparent anomaly.

One more point of theoretical interest can be made regarding the I.Q. scores. In only six cases was the

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Performance score of the WISC/WAIS 10 or more points higher than the Verbal score. This preponderance of high Verbal, low Performance subjects is apparently contrary to the usual pattern found in the mid-West among disabled readers (Rabinovitch, 1959; Myklebust, 1968; Barsch, 1968) but does conform to the findings of Kinsbourne and Warrington (1966) that two major WISC/WAIS profiles are discernible among poor decoders. This concentration of high Verbal subjects in the present study was purely accidental and its significance was not understood at the time the subjects were tested. At least two very recent studies suggest that high Verbal children have different behavioral patterns than high Performance ones. (Johnson and Myklebust, 1967; Kinsbourne and Warrington, 1966) Care should, therefore, be exercised in interpreting the data in the next chapter because the results may or may not be applicable to high Performance subjects.

Age matching was on the basis of $\pm$ six months, with the closer age match taking precedence when two matches were possible. No attempt was made to match by grade, since many of the experimental subjects had been retained in the same grade for two or more years in their earlier educational experience. Because of the small number of girls involved,

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no attempt was made to keep them as a separate group.

Testing of the experimentals took place on campus during regular testing periods, starting approximately two weeks after arrival. One tester with an assistant gave all tests, except for the Gray Oral, which was administered by specialists who had been especially trained for the task.

Testing of controls at the camps was carried out by the same tester who administered the battery to the experimental groups. The Otis IQ was given for matching purposes, and after a match had been made, the entire battery was administered to those selected to be controls. The Gray Oral, the three Stroop Tests, and the Object Identification Test were given to each child individually. The rest were administered to the entire group at once.

Essentially the same procedure was followed in the schools, except that the school Otis IQ scores were used.

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Research Study II

Because of the questions of randomization and skewed sample always involved in matched pair studies, it was decided to approach the problem from another direction and to administer several of the tests used in Study I to all the third- and fourth-grade pupils in two different schools in the system from which some of the controls had been drawn for Research Study I. Consequently, 298 third and fourth graders (all those present on the testing day; absenteeism was approximately 12%) were tested.

The test battery used was as follows:

Circling Dots

Addition

Subtraction

Simple Coding

Letter-Coding Addition

Word Fluency

Drawing Squares

Shorthand Aptitude

The Otis Quick-Scoring Mental Ability Test scores were taken from the school records, since this test had been

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administered less than two months before the automatization battery. Also available from even more recent administration were scores from the Iowa Tests of Basic Skills, Form 2 (for the third grade) and Form 4 (for the fourth grade). The Vocabulary and Reading Comprehension subtest scores were used.

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CHAPTER VIII

RESULTS

Research Findings Are Reported

Sixty-seven matched pairs of pupils ranging in age from eight to 19 years of age were used in this study.

Age Grouping

Since Critchley (1964) postulated a specific group of disabled readers showing a maturational lag ("developmental dyslexics") among the total community of poor readers, age separation was indicated in order that any developmental changes might be noted. The following age sub-groupings were established:

Group 1 - Experimentals, 8 - 11 years Group 4 - Matched controls	N = 22
Group 2 - Experimentals, 12 - 14 years Group 5 - Matched controls	N = 20
Group 3 - Experimentals, 15 - 19 years Group 6 - Matched controls	N = 25

Throughout the rest of this study, the groups will be identified by these numbers.

Intelligence

While matching for intelligence was carried out simply

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to establish unequivocal pairing, examination of the results produced data worthy of note.

Because it was impossible to administer the WISC/WAIS to the control group, age-appropriate forms of the Otis Quick-Scoring Mental Ability Test were given. Matching was based on Full Scale WISC/WAIS scores for experimentals and on Otis for the controls.

Table 8.1 shows mean I.Q. scores for both samples.

TABLE 8.1

Mean IQ Scores (pooled)

	Experimental	Control
Otis	100.299 SD 15.7	112.689 11.5
WISC/WAIS	113.284 SD 11.3	

It can be seen from Table 8.1 that matching was within acceptable limits, with the controls having a .575 lower mean than the experimental subjects. Of particular interest was the finding that the Otis scores for the experimentals were quite markedly depressed in all three age groups when

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compared to their WISC/WAIS scores. The Correlated t Test (Ferguson, 1966) was used to test the difference between the two means occurring in the same sample.

Table 8.2 shows that when the experimental groups' WISC/WAIS means were compared with their own Otis means a significant difference was found ($p < .001$)

TABLE 8.2

Comparison of Otis and WISC/WAIS Scores among Experimentals

	Otis	WISC/WAIS	Correlated t-Test	Significance
Group 1	101.5	114.5	3.790	($p < .001$)
SD	15.7	12.2		
Group 2	100.6	112.2	4.650	($p < .001$)
SD	8.7	13.9		
Group 3	99.0	113.0	4.660	($p < .001$)
SD	17.5	12.7		

Table 8.3 shows that in the three experimental groups, the correlation coefficients between the Otis and the WISC/WAIS was low:

TABLE 8.3

Coefficient of Correlation Between Otis and WISC/WAIS

Experimental Groups	
Group 1	.357
Group 2	.596
Group 3	.543

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Whether the smaller coefficient for Group 1 results from the age factor, the non-verbal form of the Otis (Alpha: Form A) administered to the young group, or to some other variable is impossible to resolve on the basis of these data. However, the observation does indicate an area that may merit investigation.

Reading.

In each grade level, reading was found to be significantly retarded for the poor decoders.

Table 8.4 shows a comparison of reading scores between the two samples.

TABLE 8.4

Comparison of Reading Means, Experimentals and Controls Unadjusted

	Experimentals		Controls		t	Signif.
	Means	SD	Means	SD		
Group 1-4	3.37 yrs.	1.40	6.04 yrs.	2.36	-4.548	($p < .001$)
Group 2-5	5.02 yrs.	1.70	8.80 yrs.	2.70	-5.277	($p < .001$)
Group 3-6	6.91 yrs.	3.10	10.80 yrs.	1.66	-5.540	($p < .001$)

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The data in Table 8.4 indicate the degree of reading retardation as measured by the Gray Standardized Oral Reading Paragraphs, an instrument which arrives at its scores on the basis of decoding ability and speed rather than comprehension.

Wilson (1967) and others have suggested that the Otis Quick Scoring Mental Ability Test in its various verbal forms is also a reading test.

Table 8.5 shows that correlation scores between the Otis and the Gray Oral for Groups 2 and 3 are much higher for the Otis than for the WISC/WAIS. On the other hand, the correlation between the Otis Alpha A (a non-verbal test) and the Gray Oral was low (.087).

TABLE 8.5

Correlation of WISC/WAIS and Otis Scores with the Gray Oral

Group	WISC/WAIS/Gray	Otis/Gray
1	.104	.087
2	.495	.837
3	.550	.808
4	*	.494
5		.454
6		.669

*WISC/WAIS not given to Control group.

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Automatization Test Battery

The matched pairs were compared on 17 tests which were selected because they were assumed to measure a relatively wide range of perceptual-motor functions (associated with the automatization phenomenon) ranging from very simple scanning and marking tests through a hierarchy of progressively more difficult tasks, each requiring a higher level of cognitive efficiency. Tests were chosen because they were presumed to represent a linear progression within a single factor, thus supporting the hypothesis that children with a history of slow and defective development of decoding skills in reading would show deficiencies at all levels of functioning, rather than at the higher cognitive levels only.

The Factor Analysis

Test results from the 17 tests which presumably measured automatization provided scores from 134 subjects, both experimentals and controls. (See Table 8.7 for battery). A principal axis factor analysis was performed, with the highest *r* as the commonality estimate, with varimax rotation. Factor scores were computed using Harman's Short Method (1969).

A varimax was done in an effort to separate out a purely perceptual-motor cluster from a more cognitive one. No

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separation appeared and so unrotated factor scores were used throughout. Because of the overwhelming presence of the general factor, the unrotated scores were felt to be appropriate.

Table 8.6 shows the matrix of factor loadings.

Table 8.7 shows the results of the factor analysis. The data were reduced to a single factor containing 76.57% of the common variance.

Table 8.7 indicates that the second root accounted for only 7.72% of the common variance. When three and four roots were rotated both orthogonally (varimax) and obliquely (oblimin), no clarification of the structure was observed.

In all further analyses the linear function of variables known as Factor 1 will be referred to as the "Perceptual Efficiency" (PE) Factor.

Because those two variables (Coding and Adding, and Syllable Coding & Addition) that provide the heaviest loading on Factor 2 are presumed to require that graphic symbols be held in short term memory while manipulations are being carried on, this factor will be referred to as the "Symbolic Memory Manipulation" (SMM) factor.

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TABLE 8.6

MATRIX OF FACTOR LOADINGS AND LATENT ROOTS

	1	2	3	4	5	6	7	8
Latent Roots	10.35	1.04	0.84	0.52	0.32	0.28	0.22	0.11
O/OTRC	76.57	7.72	6.19	3.82	2.39	2.04	1.60	0.79
F Load								
1	0.87	0.16	-0.05	0.20	0.10	0.05	-0.20	-0.16
2	0.88	0.19	-0.05	0.21	0.10	-0.09	-0.10	-0.07
3	0.71	0.14	-0.02	0.35	-0.20	-0.06	-0.04	0.17
4	0.82	-0.08	0.12	0.17	-0.09	0.01	0.03	-0.05
5	0.84	-0.03	-0.02	0.18	0.03	0.17	0.04	0.12
6	0.68	0.01	-0.13	0.10	0.29	0.23	0.21	-0.01
7	0.74	-0.03	0.18	-0.13	-0.31	0.17	-0.04	-0.08
8	0.78	-0.06	0.21	-0.12	-0.11	0.21	0.05	-0.00
9	0.65	-0.16	0.39	-0.15	0.13	0.00	0.01	0.01
10	0.72	0.08	0.41	-0.07	0.17	-0.18	-0.03	0.07
11	0.79	-0.03	0.32	-0.05	0.03	-0.11	0.00	0.01
12	-0.81	0.30	0.20	-0.06	0.09	0.17	-0.21	0.07
13	-0.80	0.32	0.29	0.18	-0.01	0.03	0.06	-0.08
14	-0.84	0.33	0.14	0.01	0.04	0.16	-0.06	0.06
15	-0.78	0.26	0.30	0.19	-0.08	-0.07	0.23	-0.06
16	0.77	0.51	-0.14	-0.25	-0.03	-0.05	0.05	-0.02
17	0.74	0.54	-0.21	-0.19	-0.04	-0.04	0.07	0.03

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TABLE 8.6 Contd.

	9	10	11	12	13	14	15	16	17
Latent Roots	-0.07	-0.07	-0.06	0.06	-0.04	0.03	0.03	-0.02	-0.00
O/OTRC	-0.54	-0.50	-0.44	0.41	-0.33	0.25	0.19	-0.14	-0.02
F Load									
1	-0.01	0.00	-0.07	-0.02	-0.09	0.01	-0.04	0.00	-0.01
2	0.08	-0.02	0.06	0.01	0.10	-0.08	0.06	0.01	0.00
3	-0.03	0.11	-0.02	-0.04	-0.01	0.01	0.01	0.01	-0.01
4	-0.00	-0.05	0.05	0.03	0.09	0.10	-0.07	0.02	0.01
5	0.03	-0.14	-0.02	0.01	-0.06	-0.02	-0.00	-0.01	0.02
6	-0.03	0.09	0.06	0.02	-0.01	0.02	0.02	-0.01	-0.01
7	-0.03	0.00	0.11	0.02	-0.05	-0.01	0.05	0.01	-0.00
8	0.01	0.02	-0.10	-0.01	0.09	-0.07	-0.04	-0.03	-0.01
9	0.03	0.01	-0.02	-0.14	-0.01	0.02	0.03	0.07	0.01
10	-0.12	-0.04	0.06	0.03	-0.01	-0.04	-0.04	-0.02	-0.01
11	0.11	0.04	-0.06	0.11	-0.03	0.06	0.05	-0.04	0.00
12	0.08	0.06	0.08	-0.03	0.01	0.01	-0.04	-0.03	0.01
13	-0.12	-0.01	-0.05	-0.04	0.03	0.02	0.05	-0.04	0.02
14	-0.02	-0.06	-0.05	0.09	0.02	0.02	0.03	0.07	-0.02
15	0.10	0.00	0.03	-0.01	-0.06	-0.04	-0.04	0.02	-0.01
16	-0.04	0.07	-0.03	0.05	-0.01	-0.03	-0.03	0.04	0.02
17	0.04	-0.08	0.01	-0.08	0.01	0.06	0.02	-0.03	-0.02

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TABLE 8.7

Factor Loadings

Variable	Factor 1	2	3	4
1. Simple Addition	.87	.16	-.05	.20
2. Simple Subtraction	.88	.19	-.05	.21
3. Object Identification	.81*	.30	.20	-.06
4. Reading Color Names	.80*	.32	.29	.18
5. Naming Color Hues	.84*	.33	.14	.01
6. Word Color Interference	.78*	.26	.30	.19
7. Dotting Circles	.74	-.03	.18	-.13
8. Circling Dots	.78	-.06	.21	-.12
9. Striking o's	.65	-.16	.39	-.15
10. Striking d's	.72	.08	.41	-.07
11. Striking 9's	.79	-.03	.32	-.05
12. Circling 5's & Striking 9's	.82	-.08	.12	.17
13. Simple Letter Coding	.71	.14	-.02	.35
14. Letter Coding & Addition	.77	.51	-.14	-.25
15. Syllable Coding & Addition	.74	.54	-.21	-.19
16. Word Fluency	.84	-.03	-.02	.18
17. Audio Letter Span	.68	.01	-.13	.10
Latent Root	10.35	1.04	0.84	0.52
Percent of Variance	76.57	7.72	6.19	3.82

* - The negative sign has been changed in these four tests since the scores represent the number of seconds required to complete 100 test items.

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Two-Way Anova with Covariance

Scores on the PE Factor (Factor 1) were computed, and a two-way analysis of variance (ANOVA) design was implemented, as shown in Table 8.8.

TABLE 8.8

Two-way Design

Reading Ability-Cell Sizes

Age Group	Experimental	Control	Total
8-11	22	22	44
12-14	20	20	40
15-19	25	25	50
Marginal	67	67	134

In this design the Otis measure of I.Q. was used as a covariance adjustor, in an attempt to offset the slightly lower I.Q. of the slow readers when the assessement was made with the Otis.

No attempt was made to control for the matched pairs across the Reading Ability Variable in this analysis. Such

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a correction would serve to decrease further the within-cells of squares, and increase the sensitivity of the tests. The effect of the matching was crude, but a subsequently reported analysis indicated that it did not materially affect the tests of significance.

The results of this analysis for each effect are given in Table 8.9 and 8.10.

TABLE 8.9

Significances—Adjusted for Otis*

Effect	SS	df	F Ratio	Probability
Age	56.04	2	91.5	$P < .001$
Reading Ability	11.75	1	38.4	$P < .001$
Interaction	0.19	2	-	NS
Within	38.88	127		

TABLE 8.10

Factor 1 Means Adjusted for Otis Differences for Effects Tested in Table 8.9

Age Group	8 - 11	12 - 14	15 - 19
	-0.83	0.01	0.72
Reading Ability	Experimentals	Controls	
	-0.33	0.33	

*Deviation effects from a grand mean of 0. SD = approx. 1.

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Table 8.11 indicates that the slow readers scored approximately 13 points lower on the Otis than did the controls, even though the slow readers as a group had scores some 12 points higher on the WISC than they did on the Otis.

TABLE 8.11

Otis I.Q. Means Used for Adjustment

Age Group	8 - 11	12 - 14	15 - 19
	108	106	106
Reading Ability	Experimentals	Controls	
	100	113	

Another adjustor (The Gray Oral Reading Paragraphs Scores) was added, thereby treating the Gray as a test of PE. This strategy argues that the use of this procedure would reduce the significance of the group difference if the Gray were purely a PE test.

Tables 8.12, 8.13 and 8.14 suggest that the Gray does contain a large PE component, and a correlation of .83 was observed between the PE Factor and Gray Scores.

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TABLE 8.12

Significances Adjusted for Otis and Gray Oral Reading

Effect	SS	df	F Ratio	Probability
Age	10.17	2	21.2	$p < .001$
Reading Ability	2.22	1	9.2	$p < .01$
Interaction	0.11	2	NS	NS
Within	30.34	126		

TABLE 8.13

Means Adjusted for Otis and Gray Oral Reading

	8-11	12-14	15-19
Age	-0.50	0.01	0.43

	Experimentals	Controls
Reading Ability	-0.16	0.16

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TABLE 8.14

Gray Reading Means

	8-11	12-14	15-19
Age	4.7	6.9	8.9

Reading Ability	Experimentals	Control
	5.2	8.6

Grand Means		
	Factor 1	0.00
	Otis	10.64
	Gray	6.92

Even with the adjustment in Otis scores, the Otis and the Gray Reading are significantly correlated with Factor 1 as shown in Table 8.15:

TABLE 8.15

Correlation of Adjusted Otis and Gray Reading Scores with Factor 1

	Otis	Gray	Factor 1
Otis	1	-	-
Gray	.54	1	-
Factor 1	.41	.83	1

Reading as measured by the Gray Oral test appears to be

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correlated highly (.83) with Factor 1. These correlations are computed from the within groups sums of squares, and so do not reflect the differences of the group means.

Analysis of Factor 2

Although Factor 2 accounted for only 7.72% of the seventeen test battery common variance, factor scores on it were generated and have been analyzed in the two-factor ANOVA model, with the Otis as a covariable. Table 8.16 gives the results.

TABLE 8.16

Two-way Design Adjusted for Otis - Age by Reading Ability

Criterion is Factor 2

Reading Ability	SS	df	F-ratio	Probability
Age	16.63	2	13.4	$p < .001$
Status	7.53	1	12.1	$p < .001$
Interaction	7.55	2	6.0	$p < .01$
Within	79.18	127		
Total	110.89	132		

All effects are significant on this factor which loads heavily on the Coding and Adding, and Adding Syllable variables. The directions and magnitudes of the differences are given in Table 8.17.

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TABLE 8.17

Effect Means for Factor 2 - Adjusted for Otis I.Q.

Age Groups	8-11	12-14	15-19
	0.31	-0.53	0.15
Reading Ability	Experimental	Control	
	-0.26	0.26	

Interaction Table Means

Ages	Experimental	Control
8 - 11	0.37	0.26
12 - 14	-1.07	0.01
15 - 19	-0.17	0.46

Second Anova Analysis

In order to compensate for the matching of subjects (however crude) a second design was implemented. This is a three-way model: by age, by Otis level ("high",110 or above; and "low", below 110),and by reading ability. This is shown in Table 8.18:

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TABLE 8.18

Cell Sizes

Reading Ability

Ages	Experimental I.Q.		Control I.Q.		
	High	Low	High	Low	
8-11	6	6	6	6	
12-14	6	6	6	6	
15-19	6	6	6	6	Total = 72

Table 8.19 gives the ANOVA results after applying the matched pairs computations to these cells. Subjects were randomly dropped in order to equalize the design (a requirement of this particular computer program). Obviously, cases arose which did not match on Otis IQ since they were matched WISC vs. Otis. These were also dropped.

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TABLE 8.19

Three-way Analysis of Variance:

Otis by Age by Reading Ability

Effect	SS	df	F Ratio	Probability
Age	21.69	2	32.43	$p < .01$
Otis	7.46	1	22.29	$p < .01$
Reading Ability	7.99	1	45.88	$p < .01$
Age by Otis	.44	2	0.66	NS
Reading Ability by Age	.83	2	2.37	NS
Reading Ability by Otis	.14	1	0.80	NS
Three way	.84	2	2.42	NS
Error Terms				
Subjects within groups	10.03	30	.334	
Reading ability by subjects within groups	5.22	30	.174	

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Table 8.20 gives the effect means:

TABLE 8.20

Effect Means

Age	8-11	12-14	15-19
	-.70	.01	.65
Otis		Low	High
		-.33	.31
Reading Ability		Experimentals	Controls
		-.34	.32
Grand Mean	-.01		

Analysis by Variables

Seventeen one-way ANOVA's were done, one for each criterion variable. This procedure was followed to confirm the results of the multiway ANOVA's using the first factor score. Tables 8.21 and 8.22 show that the experimental and control group differences are manifest in all variables to a significant extent except for Coding and Striking o's.

No interaction was found in the multiway ANOVA's, so there appears to be justification for treating the Otis I.Q. and age as covariables in these analyses, controlling

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for them but in a different, and perhaps more precise way, since they were not first categorized. Since no correction for matched observations was used, the probability levels may be somewhat overestimated, but since most of the differences were found to be very significant, this was not felt to be a serious problem.

Table 8.22 shows the direction of effects for each variable to be consistent, with the experimentals performing less well then the controls.

The correlation (loading) of each variable with the best discriminating function of all variables is given in Table 8.23. This function is capable of explaining 56% of the between groups variance, as contrasted with 34.4% of the best single discriminator (Adding Coded Syllables). The significance of function by Rao's test is beyond ten to the minus eleventh power. ($p = 8.68$; df 1 - 17; df 2 - 114; $p - .43 \times 10^{-12}$).

This analysis again shows, in terms of loadings, that the primary definers of this function are tests such as Coding and Adding, Adding Syllables and Simple Adding. The first two tests require that the S maintain one set of graphic symbols in a translated capacity in short term memory while he performs an addition function. The Simple Adding test requires only that he add two digits.

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Tables 8.21, 8.22, and 8.23 follow.

TABLE 8.21

Significance and Strength of Differences between Experimental and Control Group Means. Variances Adjusted for Covariance of the Otis IQ Test and Age.

Variable	F-ratio*	Probability less than	Percent of Var. Exp. by Groups
1. Simple Addition	33.27	10^{-5}	20.4
2. Simple Subtraction	22.42	10^{-3}	14.7
3. Object Identification	10.79	.01	7.7
4. Reading Color Names	17.81	10^{-3}	12.0
5. Naming Color Hues	18.62	10^{-3}	12.5
6. Word Color Interference	19.04	10^{-3}	12.8
7. Dotting Circles	8.11	.01	5.9
8. Circling Dots	15.82	10^{-2}	10.8
9. Striking o's	0.93	.34	0.7
10. Striking d's	10.65	.01	7.6
11. Striking 9's	11.02	.01	7.8
12. Circling 5's & Striking 9's	12.10	10^{-2}	8.5
13. Simple Letter Coding	0.10	.75	0.0
14. Letter Coding & Addition	65.63	10^{-8}	33.5
15. Syllable Coding & Addition	68.07	10^{-9}	34.4
16. Word Fluency	3.82	.05	2.8
17. Audio Letter Span	11.76	10^{-2}	8.3

* $df_1 = 1$ $df_2 = 130$

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TABLE 8.22

Group Means Adjusted for Otis IQ and Age for the Two Groups

Variable	Experimental $N_1 = 67$	Control $N_2 = 67$
1. Simple Addition	97.79	126.15
2. Simple Subtraction	93.42	120.22
3. Object Identification	86.17	75.65
4. Reading Color Names	65.82	54.65
5. Naming Color Hues	90.88	77.59
6. Word Color Interference	71.65	58.55
7. Dotting Circles	59.14	67.92
8. Circling Dots	41.40	49.44
9. Striking o's	21.25	22.34
10. Striking d's	6.90	8.93
11. Striking 9's	20.17	23.18
12. Circling 5's & Striking 9's	88.51	98.85
13. Simple Letter Coding	86.20	84.81
14. Letter Coding & Addition	21.70	48.39
15. Syllable Coding & Addition	22.91	47.31
16. Word Fluency	43.32	47.41
17. Audio Letter Span	10.61	12.10

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TABLE 8.23

Discriminant Loadings of Variables

Variable	Loading
1. Simple Addition	0.44
2. Simple Subtraction	0.36
3. Object Identification	0.25
4. Reading Color Names	0.33
5. Naming Color Hues	0.33
6. Word Color Interference	0.34
7. Dotting Circles	0.22
8. Circling Dots	0.31
9. Striking o's	0.07
10. Striking d's	0.25
11. Striking 9's	0.26
12. Circling 5's & Striking 9's	0.27
13. Simple Letter Coding	-0.02
14. Letter Coding & Addition	0.62
15. Syllable Coding & Addition	0.64
16. Word Fluency	0.15
17. Audio Letter Span	0.26

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The Age Variable

The hypothesis predicted that differences in functioning on the criterial test battery would not only be observed in younger children, but in older ones as well. The best test of this part of the hypothesis was considered to be an examination of the scores of those who were 15 years of age and above. This older group was of particular importance since they represented a sample of adolescents who could hardly be considered "late bloomers." If major differences in performance were to be found between these two groups, then it could be assumed that the low automatization phenomenon in the experimental group was not essentially a developmental artifact, but a continuing state among those who showed a late development in language functions.

Twenty-five experimental subjects, 15 years and above, made up the older group, together with matched controls, (groups 3-6). The means for each test were compared, using the t test. While admittedly crude, the t-test was nonetheless sufficiently sensitive to show a significant difference in means ($p < .01$) between the two groups on all tests except two: Striking o's and Simple Coding. Table 8.24 shows this.

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TABLE 8.24

Comparison of Performance on Criterial Battery, 15 Year Olds and Above, 25 Experimentals and Matched Controls Compared by t Tests.

Variable		Group 3	Group 6	Difference	S.E.	d.f.	t-Test	Significance
Simple Addition	Mean	125.84	155.44	-29.60	7.77	48.0	-3.80	($p < 0.001$)
	SD	35.70	15.31					
Simple Subtraction	Mean	125.64	162.84	-37.20	10.45	48.0	-3.55	($p < 0.001$)
	SD	38.17	35.71					
Letter Coding	Mean	97.64	109.44	-11.80	6.89	48.0	-1.71	($p < 0.094$)
	SD	30.68	15.73					
Circle 5/Strike 9	Mean	102.44	115.52	-13.08	3.56	48.0	-3.67	($p < 0.001$)
	SD	15.96	7.90					
Word Fluency	Mean	52.16	63.52	-11.36	3.52	48.0	-3.22	($p < 0.002$)
	SD	14.01	10.70					
Audio Letter Span	Mean	11.92	13.92	-2.00	0.70	48.0	-2.83	($p < 0.007$)
	SD	2.66	2.32					
Dotting Circles	Mean	67.52	82.32	-14.80	4.44	48.0	-3.32	($p < 0.002$)
	SD	18.47	12.38					
Circling Dots	Mean	48.44	58.32	-9.88	3.37	48.0	-2.92	($p < 0.005$)
	SD	12.32	11.53					
Striking 0's	Mean	24.04	25.04	-1.00	2.20	48.0	-0.45	($p < 0.652$)
	SD	8.64	6.85					

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TABLE 8.24 (Contd)

Variable		Group 3	Group 6	Difference	S.E.	d.f.	t-Test	Significance
Striking D's	Mean	8.60	11.28					
	SD	3.60	4.02	-2.68	1.08	48.0	-2.47	($p < 0.017$)
Striking 9's	Mean	23.20	28.24					
	SD	4.68	4.73	-5.04	1.48	48.0	-3.40	($p < 0.001$)
Object Identification	Mean	75.28	62.68					
	SD	15.46	10.62	12.60	3.75	48.0	3.35	($p < 0.002$)
Color Names	Mean	58.56	45.92					
	SD	14.72	8.73	12.64	3.42	48.0	3.69	($p < 0.001$)
Color Hues	Mean	79.44	64.56					
	SD	15.85	10.19	14.88	3.77	48.0	3.94	($p < 0.001$)
Interference	Mean	66.80	48.84					
	SD	15.92	10.45	17.96	3.80	48.0	4.71	($p < 0.001$)
Coding-Addition	Mean	41.05	69.00					
	SD	12.23	17.42	-27.95	4.60	48.0	-6.06	($p < 0.001$)
Syllable Coding Addition	Mean	42.40	61.24					
	SD	14.82	12.04	-18.84	4.00	48.0	-4.70	($p < 0.001$)

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Discussion

A Problem in the Data

One major problem arose in the handling of the data. In matching the experimental and control groups, the Wechsler intelligence scores were used for the experiments and Otis scores were used for the controls. While emperically and clinically it can be strongly argued that the Wechsler tests are a more valid measure than the Otis of the intelligence of children who are having difficulty reading, nevertheless certain theoretical problems were raised by the procedure used.

Any problem raised by this matching procedure was mitigated, if not solved, by the use of a two-way analysis of variance (ANOVA) design. In a sense, this design transmuted the experimentals into "duller" children than the Wechsler scores would indicate. This had the effect of placing an additional "burden of proof" on the experimentals. Since they were counted as being duller than their controls, a poorer performance on all tests was automatically expected from them when compared to the normals.

This "negative handicap" demanded, in essence, that the

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difference in performance between the two groups had to be somewhat enhanced before it could become statistically significant, whereas there would have been a lower level of demand, had the two groups started with equal I.Q. scores. Any observed differences in performance levels, therefore, carried a strong suggestion that these are not likely to be the result of a statistical artifact. The two-way analysis of variance procedure is assumed to have introduced a particular rigor into this study, so it is probable that the findings can be approached with a considerable degree of confidence.

Findings

Critchley has suggested the existence of a specific language disability syndrome in only a part of the total group of poor readers. His model posits a perceptual-motor disorder that is quite discrete in its symptomology. Vernon, on the other hand, has expressed a feeling that the problem lies primarily in the inability of disabled readers to conceptualize language, but does not necessarily involve low-level perceptual deficits. The results of this study would strongly suggest that Vernon has underestimated the extent of the perceptual-motor deficit observable in at least a

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certain type of poor reader, and that Critchley may have a valid argument when he suggests a specific syndrome.

The experimentals in this study scored at significantly lower levels ($p < .01$) on 15 of the 17 tests given. Only on tests involving Simple Coding and Striking o's were performances of the two groups similar enough to suggest no basic difference in ability.

A number of observations emerged from the study that seem worthy of comment.

The first concerns the very high loading of all 17 tests on a single factor which has been named Perceptual Efficiency (PE). This PE factor seems to relate quite specifically to the automatization factor described by D. Broverman, along with I. Broverman, Klaiber, Palmer, Kabayashi, and Vogel, in several collaborative studies made since 1960.

The sheer magnitude of the loading of so many tests on a single factor raises an immediate question. Is this factor simply a general one describing intelligence or motivation or some other global attribute? This is always a possibility, of course, and had the tests and the samples been randomly conceived, there would be a strong suspicion that this might be true.

The research of Broverman and his colleagues would seem

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to have eliminated the motivational variable. In their work in establishing the automatization factor, they have given their subjects not only tests of simple, repetitive functioning (automatization tasks) but always, as well, a battery of restructuring tasks involving another domain of functioning. Their findings have been that low automatizers perform normally on restructuring tasks, when both types of tests are given in the same battery.

When the same procedure of presenting both automatization and restructuring tasks to children known to have difficulty with the decoding process in reading has been followed (as by Whiting et al. and by Mathewson), the same results have been obtained. The children performed normally on restructuring tasks, but at a significantly lower level on the automatization tasks. Since the automatization and the restructuring tasks were given in mixed order during the same testing period, it is difficult to imagine that the low automatizers were specifically "motivated" to perform poorly on one type of test item but not on another.

"Naming" a factor, of course, does not guarantee the validity of the nomenclature. The data in the present study do not "prove" the existence of a syndrome relating to poor perceptual efficiency, since there is always the possibility

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that the factor is related to anxiety, poor teaching, or some other variable.

However, the data do not seem to suggest a major difference in performance among poor decoders whether they are working higher or lower cognitive symbolic manipulations.

Whatever the underlying behavior involved, it seems to be stable throughout the entire testing sample and it does not vary greatly from one test to another. This seems to fit rather well with the idea of a syndrome, proposed by Critchley.

It is of importance to point out that the development of the test battery was not the result of a "data fishing expedition" (such as sometimes characterize studies employing a large number of subtests in the hope that some of the items may prove to bear some positive relationship to the variable(s) under study). The battery was specifically designed to test the assumption that children with a history of poor development in decoding functions would show deficits over a fairly wide range of task demands involving rapid functioning on simple repetitive tasks. The data would seem to support this assumption, and to argue that, with a homogeneous group of poor decoders, a common symptomology is present.

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One of the interesting observations that emerged from this study was the finding that the experimentals actually performed closer to the controls on oral reading tasks than they performed generally on the criterial battery of automatized tasks. This can probably be ascribed to the fact that a number of the experimentals had through the years received a considerable amount of special training in oral reading because of their continuing language difficulties. A number of the experimentals had been in special schools or programs designed to develop decoding skills, including attendance at the summer camp at Fryeburg in previous years. The data can be interpreted to mean that, while specific decoding skills had increased through intensive remedial efforts, general perceptual efficiency had not developed at a similar rate.

Another observation should be made in regard to the age variable as related to test performance, since subjects ranged from eight to 19 years in age.

The original hypothesis stated that low automatization skills would be found throughout all three age groups among the poor decoders when compared to a normal control sample. T tests were done, comparing the means for each test in each

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age group. While the results indicated that the older group of experimental subjects generally showed the same order of significantly lower scores on the automatization battery as was found with the younger experimental group, this procedure was felt to present certain inherent weaknesses. It did not allow for covariance adjustment, and it raised the problem of chance differences. When multiple tests are given to two groups (experimentals and controls), chance theory would predict that some spurious differences would be found in the performance of the two samples. The giving of a 17-test battery therefore made the t test results suspect.

A more appropriate strategy (see Table 8.7) was therefore employed in an effort to find an answer to the question of the age variable. Factor 1 shows a quite homogeneous structure, with a minimal loading on Factor 2 (7.72%).

Since each test of the 17-item battery loaded, Factors one and two can be said to stand rather well for the entire battery (83% of the total battery variance). The analysis of variance design indicated no interaction between age and reading ability. This indicates that the PE deficit among the experimentals remained roughly constant at all age ranges.

In Factor 2, a weak interaction was observed. This came about when the younger experimentals did not show as extensive

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a deficit as did the older group of experimentals. The controls stayed roughly the same, while the experimentals showed a depression with increasing age.

In one sense, the data do indicate that Vernon's impressions regarding the importance of higher cognitive functions probably have validity. While a significant difference was found in the performance of the experimental and control groups at all levels of functioning, the greatest differences were found on the most cognitive of the tests, such as Letter Coding & Addition and Syllable Coding & Addition. Indeed, these two tests account for most of the variance found in Factor 2. This would suggest the probability that children with a learning disability not only have difficulties in the most basic PE functions, but that there are probably higher cognitive problems as well. The investigation of this particular aspect of their behavior should certainly be an area for future research.

One consideration which needs to be taken into account revolves around the following question: Why were the experimentals able to perform as well as the normals on

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Simple Coding and Striking o's, when they performed so poorly on the 15 other tests? The answer to this question is certainly not clear.

The task demands in these two tests are quite different. Striking o's probably represents the lowest level, in terms of task demands, of any of the scanning and striking tasks. Striking d's, Striking 9's and Circling 5's & Striking 9's probably present discrimination problems not involved in scanning for the completely unequivocal o. Finding the o may represent an extremely simple task because no other lower case letter approximates it in appearance. Only the e has a similar silhouette, but its incomplete circle and the internal cross-bar contain enough information to make discrimination possible on an automatic level. On the other hand, the d can be (and often is) easily confused with the b, and to a lesser extent with p and g. The 9 is an inversion of the 6, and so it is possible that the same problem in directional confusion is built into the form of the digits as is present in the case of the b,d,p,q group.

This leads to the speculation that the experimentals could scan and mark appropriately so long as they were required to make only very simple discriminations, but that they were

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forced to work at a slower pace as soon as equivocal and competing letter forms were presented. This, too, is an area for future research. Fortunately the suggestion of an hypothesis stated above lends itself readily to study.

The Simple Letter Coding test presents another problem. The answer to it may possibly lie in the specific nature of the coding task involved in the particular instrument used. The code key in the Coding subtest of the Wechsler is made up of nonsense graphic symbols matched to consecutively ordered digits. Knowing the order of digits from 1 through 9 may be helpful in deciding where to target in the key if the specific digit-symbol relationship cannot be remembered. In the coding key used in this battery, nine letters were placed in haphazard order above nine digits, also placed in haphazard order. One digit was assigned to each letter. This haphazard sequence of <u>both</u> letters and digits may well have presented so large a random effect in the code key that the normals were unable to grasp it and use it any more efficiently than the experimentals in the relatively short time allowed in the test. This observation would suggest that the task was so difficult that even the normals had considerable difficulty on it, and that the test had moved

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beyond the automatized domain into a different order of functioning. The loading of this particular test in the factor analysis does not particularly support this suggestion, but it appears to be the only logically consistent explanation at the present time. The whole question of coding performance using ordered vs. unordered key items would seem to be another area that is worthy of exploration in future research.

One last observation needs to be made. A truncated battery involving several of the tests used in this matched pairs study was used on a much larger sample consisting of all third and fourth graders in two public schools. When given to this heterogeneous sample (in contrast to the presumed homogeneous experimental sample described above), somewhat different results emerged, as is reported in the following chapter.

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CHAPTER IX

A SECOND STUDY

The Third and Fourth Grades in Two Public Schools are Tested.

In addition to the search for basic information about the automatization behavior of poor decoders in the matched-pairs study reported in the previous chapters, a second study was undertaken. The entire third and fourth grades of two public schools, located in a New England town, were given a modified test battery similar to that used in the matched-pairs study, except that a smaller number of tests was used.

The second study was conceived as an extension of the first project in the following areas:

Group Testing.

As already indicated, standard administration of the automatization battery as described by Broverman et al. (1966) is a rather time-consuming procedure. A further burden is imposed by the ipsative procedures, recommended by Broverman et al. (1966) which demand that a negatively defining battery -- Kohs Blocks, Porteus Mazes, and other restructuring tasks -- be

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administered in order to establish an index. This requirement makes the battery somewhat cumbersome under ordinary school conditions, where there is little opportunity for individual testing. It is apparent that if a test battery is to be developed for use by regular school personnel, it must be in the form of a screening procedure. It should be comprised of tests which can be administered to a relatively large group of pupils in a fairly short period, and should have pupil responses arranged for ease of scoring. The battery given in this study, therefore, was designed to meet these criteria.

Selection of "Language-disability" Pupils from the "Poor-reader" Group.

If Critchley (1964) is right, there should be a "language disability" group among the "community of poor readers." It would be most desirable, therefore, to be able to identify tentatively the language disability pupils by means other than the employment of an extensive battery of individually administered instruments.

The practical importance of being able to make this selectivity rests in the fact that a number of states now have laws requiring the identification of children with learning disabilities. Special funds for remedial efforts often depend on such identification.

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The screening of large numbers of children in an effort to identify those probable candidates who should have individualized testing to qualify under the law is a relatively time-consuming and expensive process if the work must be done individually. There is an obvious need for group techniques for selecting out those "high risk" children who can then be examined on an individual basis for possible inclusion in a special program.

Giving a group reading and spelling test is not an adequate substitute for a more thorough screening battery, since poor reading and spelling can arise from a number of different causes, in addition to the legally defined "learning disability." (See Chapter 1) By selecting those pupils who score poorly not only on reading and spelling tests, but on automatization tests as well, the probability would seem to be increased for better selecting those children who, on further testing, would qualify for inclusion in a state-subsidized program for perceptually handicapped children.

Being able to identify the "low automatizer" also has implications for educational practice, both in instruction and testing. For example, many teachers tend to reward rapidity of performance on simple class tasks and to punish

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slowness by the giving or withholding of verbal rewards and grades. This largely unconscious behavior on the part of teachers may be conditioning a significant minority of children to expect continued failure on a whole class of tasks.

Validation of Tests.

While the basic automatization battery is well-established (Broverman et al. 1964, 1966), a number of the tests used in the battery described in this chapter had not been validated. A normal grade-school population was considered more appropriate for validating these newer tests than the summer-camp populations of the previously described study.

Testing Strategy.

A satisfactory screening battery was considered to be one which (a) was normative, (b) could be administered easily by a classroom teacher or guidance counselor, (c) was short enough to be given within a single class period and (d) could be scored both accurately and easily with a minimum of decisions required of the scorer. To ascertain the administrative ease, timing and scoring, and to minimize the possibility of confusion in the testing situation, the test forms were bound together and the tests were given in rapid sequence. All tests were group administered.

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A second purpose of the test battery was to essay the selection of the postulated language-disability pupils from the mass of poor readers. The chosen instrument for attaining this goal, in addition to the automatization battery, was a brief written spelling test (since bizarre spelling is so often cited as a symptom of a specific language disability). In other words, it was anticipated that if two or more subgroups are indeed submerged among the total of poor readers, then one group might demonstrate a measureable difficulty in the automatization/perceptual-motor tasks which would be lacking in the other group(s). It was further postulated that differences in spelling "style" would be apparent (i.e., irrational letter combinations as compared with logical but non-standard phonetic spelling). A much lower spelling score by the language-disability group also was anticipated, when compared to that of the balance of poor readers.

The third objective was to determine whether, in a normal sample of third and fourth graders, the lower-level

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tasks (Dotting Circles, Striking 9's, etc.) were defined by a factor analysis as belonging to the same factor as the battery used by Broverman et al. (Object Identification, Stroop Color Tests, Addition, etc.).

The experimental battery which emerged from these considerations was based largely upon subjective observations. Two of the tests (Shorthand Aptitude and Drawing Squares) were not employed in the earlier experiments. The following instruments constituted the chosen test battery: Addition, Subtraction, Circling Dots, Simple Coding, Coding and Addition, Word Fluency, Shorthand Aptitutde, Drawing Squares, and Spelling.

An auxiliary study was required when it was disclosed that the school system schedules a substantial remedial program during the third year for the benefit of pupils who are falling behind in reading. This policy introduced the probability that fourth graders who had received remedial help might not show as clear a disability pattern as third graders who had not yet undergone a full year of such assistance.

Otis scores from the school files were used as the measure of intelligence, and reading proficiency was determined from scores on the Vocabulary and the Reading

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Comprehension subsections of the Iowa Tests of Basic Skills (Lindquist and Hieronymus, 1956). The two subtests rely upon the answering of multiple-choice questions in judging reading efficiency. An overall reading score is obtained from the subtests in the Iowa.

Mean full-scale scores for each grade and sex group are contained in Table 9.3

The use of this silent reading test provided an opportunity to investigate the relationship of the automatization tests to a different type of reading instrument than the Gray Oral used in the Fryeburg study.

Characteristics of the Sample

The community in which the two schools are located is predominantly middle-class, having few impoverished families and many homes of substance. Townspeople have local employment in several research and electronic firms and a few light industries. Approximately 60% of the high school graduates continue their academic training.

The total of 298 pupils in the sample includes all of the third-and fourth-grade children who were in school on the day that the tests were administered. The group was sorted by sex and by grade, yielding four separate samples.

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The sex differentiation was made because of the usual finding that, at any given age-level, girls score higher on reading tests than do boys. The sample was divided as follows, Table 9.1.

TABLE 9.1

Grouping by Sex

Grade	Girls - N	Boys - N	Totals
Third	80	67	147
Fourth	73	78	151
TOTALS	153	145	298

School records showed the girls to be reading better than the boys, and to have attained a slightly higher mean score on the Otis, Table 9.2.

TABLE 9.2

Mean Otis Scores by Sex

Sub-groups	Otis (Mean)
Grade-three girls	113
Grade-three boys	110
Grade-four girls	112
Grade-four boys	110

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Method and Results

The first objective of the study was met in that the battery was given by the investigator in each administration within a single 50 minute class period. However, it is probable that one or possibly two of the tests could be eliminated, thus assuring administration comfortably within time limits.

In an attempt to separate the "language disability" cases from other "poor readers," the following methods were used:

The entire group was divided on the basis of grade and sex, thus giving four sub-groups. Each sub-group was then studied separately. It was anticipated that the third grade boys would show the lowest reading and spelling ability and such was the case, Table 9.3.

TABLE 9.3

Language Scores - Reading & Spelling

Sub-groups	Reading (IOWA)	SD	Spelling Raw Score	SD
Third Grade				
Boys	3.5	1.2	15.7	5.6
Girls	3.8	1.1	16.4	6.1
Fourth Grade				
Boys	4.6	1.4	19.1	3.6
Girls	5.1	1.2	20.3	4.0

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"Poor-readers" were defined as those Ss whose Iowa Comprehension scores were one year or more below the class and sex mean. This is a more rigorous designation than is sometimes made (e.g., Reed, 1968). However, it was felt that this rigor was justified because of the above-average I.Q. of the group. Using this technique, the subsamples are indicated in Table 9.4.

TABLE 9.4

Ss Scoring One Year or More Below Sex and Class Mean

	Girls	Boys
Third Grade	16	12
Fourth Grade	21	14

This designated the "poor reading" pool which was to be studied.

An "automatization threshold" was then set up, using essentially the same technique. A critical score of minus one Standard Deviation below the mean was determined for each test, and the scores for each S were examined to determine on how many of the eight tests given he might have fallen below the first Standard Deviation. Falling below the critical score on three or more tests placed him

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in the "poor automatizer" group. Reading and automatization status were then compared.

This procedure could theoretically produce four different subgroups:

1. Normal readers / normal automatizers.
2. Normal readers / poor automatizers.
3. Poor readers / normal automatizers.
4. Poor readers / poor automatizers.

The four groups were indeed represented. The majority of the class fell into the first category of "normal reader / normal automatizer" by definition. Within the second category (normal reader / poor automatizer) were four girls and one boy. The one boy had the highest IQ in the class: Otis 149. The girls were also bright, with a mean Otis I.Q. of 118. (This may possibly mean that in some cases very bright children can manage to overcome the reading problem in so far as it is affected by the automatization phenomenon.)

The third category (poor readers / normal automatizers) contained 16 Ss. Of these, seven scored below the first Standard Deviation on two tests (the criterion for identification as a "poor automatizer" was to score low on three or more tests). Seven others scored low on one of the tests.

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Only two Ss scored low on none of the automatization tests given. This pattern would suggest that at least some of the poor readers who were classified as "normal automatizers" were actually "borderline."

The fourth group (poor readers / low automatizers) contained 18 Ss, 10 males and 8 females. These were assumed to be probable "language disability" cases as predicted by Critchley. An effort to test this hypothesis was instituted in the form of a spelling test, under the assumption that poor readers / good automatizers would not show the bizarre spelling patterns that would be observable among the poor readers / low automatizers.

Any person scoring below the first Standard Deviation below the mean for his sex on the spelling test was considered to be a "poor speller." Those spelling within the first S.D. below the mean were considered "normal spellers."

Separating the "poor spelling" and "normal spelling" groups within the "community of poor readers" resulted in the chi square shown in Table 9.5.

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TABLE 9.5

Spelling Scores Among Third and Fourth Grade "Poor Readers" as Related to Automatization Skills

	Poor Spellers	Normal Spellers	F Ratio	Probability
Normal Autom.	11	22	13.9	$P < .001$
Poor Autom.	21	9		

These data would suggest that low automatizers were far more apt to be poor spellers ($p < .001$) than were good automatizers. This would further suggest that spelling tests probably have some validity as a screening test for language disability cases.

One of the interesting side-products of this study was an opportunity to see if the "bizarre spelling" speculation (Gallagher, 1948) was observable in the third grade in the school study. Among the "poor readers" were found both normal and poor automatizers. An examination of the spelling protocols from the two groups was quite revealing as a manifestation of the qualitative aspect of the spelling process. All spelling protocols from the third grade boys, "poor readers", are reproduced in Appendix V in two groups.

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Group 1 is made up of poor readers/poor automatizers. The groups are separated by an explanatory sheet. The obvious difference in performance between the two groups (despite the fact that both are "poor readers") would again point up the probable validity of Critchley's contention that language disability cases make up only a part of the "community of poor readers."

The Factor Analysis

A principal axis factor analysis with highest rs as commonality estimates was performed with varimax rotations, following procedures recommended by Cooley and Lohnes (1962).

Table 9.6 shows intercorrelations between the tests.

The highest correlation, as would be expected from past experience, was between the tests involving Simple Addition and Simple Subtraction (.81); lowest was between Shorthand Aptitude and Coding (.21).

A varimax was done in an effort to separate out the low level PE factor found in the Fryeburg study from a higher level cognitive SMM factor found in the same study. Table 9.7 shows the factor loadings. A separation appeared, with both factors 1 and 2 showing clustering.

The first two roots accounted for approximately 82% of the common variance.

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TABLE 9.6

Correlation Matrix

	1	2	3	4	5	6	7	8
Means	42.30	126.21	73.39	72.17	61.21	26.91	26.64	80.14
S. D.	13.87	30.76	21.37	22.42	17.35	9.22	8.25	19.92
R Matrix								
1. Shorthand Aptitude	1.00							
2. Circling Dots	0.30	1.00						
3. Simple Addition	0.34	0.40	1.00					
4. Simple Subtraction	0.31	0.34	0.81	1.00				
5. Simple Coding	0.21	0.36	0.55	0.54	1.00			
6. Coding & Addition	0.33	0.33	0.62	0.67	0.55	1.00		
7. Word Fluency	0.28	0.47	0.50	0.45	0.46	0.40	1.00	
8. Making Squares	0.36	0.51	0.35	0.28	0.31	0.27	0.43	1.00

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TABLE 9.7

Factor Loadings

Factors	1	2	Factor 3	4
1. Shorthand Aptitude	0.18	0.29	0.49	0.08
2. Circling Dots	0.18	0.65	0.16	0.15
3. Simple Addition	0.81	0.31	0.17	0.20
4. Simple Subtraction	0.82	0.18	0.20	0.28
5. Simple Coding	0.41	0.33	0.02	0.53
6. Coding Plus Adding	0.52	0.15	0.31	0.54
7. Word Fluency	0.33	0.56	0.06	0.26
8. Making Squares	0.10	0.65	0.29	0.07
Sums Sqrs.	1.94	1.50	0.52	0.78

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Addition,Subtraction, Coding and Adding, and Simple Coding provided most of the weight in the first factor. These tests appear to be related to a higher level cognitive functioning than do some of the other tests in the battery, and they most nearly fit the concept of a "Symbolic Memory Manipulation" (SMM) factor, previously identified in the Fryeburg study as Factor 2.

The Factor 2 clustering contained Circling Dots, Making Squares, and Word Fluency. This is probably a cluster made up of low level "Perceptual Efficiencey" (PE) skills requiring rapid hand-eye control and coordination, but not much cognitive manipulation of symbols. The one surprise was to find Word Fluency so closely associated with Circling Dots and Making Squares as it seemed to be in this study. This finding would suggest that performance on the Word Fluency test is probably quite specifically related to the ease with which an individual is able to perform the physical act of writing.

Shorthand Aptitude appeared as an isolate on the third root, with a weak loading.

The fourth root may have contained some type of specific "coding" component, since the two tests most represented there both have a heavy coding element in them.

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The clear separation of lower level PE functions and of higher level SMM functions may be related to the fact that the group tested represented a quite heterogeneous distribution, and that the traditional separation between perceptual-motor and cognitive functions was being observed here. In any case, the separation that did not occur in the Fryeburg study did appear with the two-school group.

It is very doubtful that this separation is an artifact, since the entire battery in both cases was made up of tests that empirically seem to fall within the same domain, i.e., speed of perceptual-motor functioning. The batteries are identical in six tests, and similar in the other two that were included in the public school samples.

Children taking the tests, on the other hand, were presumed to be quite different. The Fryeburg pupils were known to have difficulty with processing of symbols, so one-half of the sample was already weighted toward a particular style of behavior. In the Public School study, on the other hand, the entire class group was tested, and it is presumed that no more than 10% (Myklebust, 1968) of the pupils were like those tested at Fryeburg.

A test-by-test comparison of the battery produced the following observations:

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Simple Addition and Simple Subtraction load very heavily on the first factor on both samples. (Fryeburg: .87 and .88; Public School: .81 and .82) This would suggest that these two tasks are very highly related to each other (as is obvious), and that they are relatively "pure" in their demands. This demand is probably related to the "computational" tasks found by a number of experimenters and discussed in detail by Guilford. These computational tasks in math seem to be poorly related to the "concepts" aspect of math. Simple Addition and Subtraction probably emerge as relatively pure automatization tasks that remain constant throughout the population.

Coding tasks, on the other hand, seem to be relatively more complex in that within a normal population the scores load on two different factors almost equally. This finding is in line with Guilford's suggestion that coding tests of the Wechsler type seem to load on two factors. This would suggest that coding has at least two tasks involved, and that they are articulated when a normal population is presented with such a task. The experimental group at Fryeburg seems to have performed in quite the same way on both sub-tasks, indicating that they were not able to perform in a normal manner on either of the sub-tasks. However, the pattern is not clear, because of the anomalous finding that the Simple Coding test was one of

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two tests out of the 17-test battery that did not show a significant difference in means when the experimentals and controls were compared. The general finding in this area points to a need for further study.

Circling Dots and Word Fluency loaded on the second factor (.65 and .56), with a very weak loading by Word Fluency on factor one. It is difficult to explain this concurrence on logical grounds, since the two tests seem to be so different in task demand. However, the answer may rest in the motor aspects of the tests. The Fryeburg experimentals did much more poorly on Circling Dots than they did on Dotting Circles (See Table 8.20). This would suggest that Circling Dots has a rather large motor component, probably involved with precise control of the writing instrument. It may be that Word Fluency (writing as many words as possible within a given time period) also has a considerable amount of this same element involved, and that they are similar because they both require a relatively precise motor control of writing instruments. This is an hypotheis that needs to be investigated.

Since one of the reasons for doing this study was to determine if the test battery had any validity in predicting reading and spelling difficulties, the question was asked:

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Does knowing the test battery results help to predict reading and spelling scores beyond the prediction that might be made by the Otis? In the carefully selected Fryeburg sample, the tests had been quite predictive in regard to oral reading skills. Would they have any validity when only a silent reading score was available?

Table 9.8 shows the analysis of variance table for step 1 in the stepwise regression that was performed. It indicated that 24% of the variance in Vocabulary scores is predictable from the Otis I.Q. scores.

When Factor 1 was added, there was a noticeable increase in predictability. The square of the multiple correlation increased by approximately 16%, from .2398 to .3861. The multiple $\underline{r}$ increased from .4896 to .6214. Table 9.9 shows this.

Table 9.10 indicates that when Factor 2 was added, the multiple correlation was raised to .4000, a rise of approximately 2%, while the multiple $\underline{r}$ rose to .6325. These data would indicate that Factor 1 adds greatly to the predictive value of the Otis in regard to Vocabulary while Factor 2 does not.

Essentially the same procedure was used in dealing with the Comprehension score from the Iowa. Table 9.11 shows the

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TABLE 9.82

Otis/Vocabulary

Source	N.d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	1	8216.2765	8216.2765	93.35	
Prev. Regress.	0	0	0	0	
Increase	1	8216.2765	8216.2765	93.35	P<.001
Residual	292	26053.0002	88.0169		

The Square of the Multiple Correlation = 0.2398

Multiple R = .4896

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TABLE 9.9

Otis/Vocabulary/Factor 1

Source	N.d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	2	13231.2875	6615.6437	92.77	
Prev. Regress.	1	8216.2765	8216.2765	93.35	
Increase	1	5015.0110	5015.0110	70.32	P<.001
Residual	295	21037.9893	71.3152		

The Square of the Multiple Correlation = 0.3861

Multiple R = 0.6214

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TABLE 9.10

Otis/Vocabulary/Factors 1 & 2

Source	N.d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	3	13709.0505	4569.6835	65.34	
Prev. Regress.	2	13231.2875	6615.6437	92.77	
Increase	1	477.7631	477.7631	6.83	P<.01
Residual	294	20560.2263	69.9327		

The Square of the Multiple Correlation = 0.4000

Multiple R = 0.6325

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TABLE 9.11

Otis/Comprehension

Source	N.d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	1	15982.1140	15982.1140	117.19	
Prev. Regress.	0	0	0	0	
Increase	1	15982.1140	15982.1140	117.19	P<.001
Residual	296	40367.2539	136.3759		

The Square of the Multiple Correlation = 0.2836

Multiple R = 0.5326

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first step in the stepwise regression when the Otis was used as a predictor for the Iowa Comprehension scores.

The Otis score has a 28% predictive value, which the addition of Factor 1 increases to 43%. The addition of Factor 2 increases this by only 2%. Tables 9.12 and 9.13 show this.

When the relationship between the Otis and spelling score was observed, the Otis was seen to have a predictive potential of 18%, which the Addition of Factor 1 doubled (37%). Factor 2 added less than 1%. This is shown in Tables 9.14, 9.15 and 9.16.

There seems to be overwhelming evidence that while Factor 1 was a good predictor of language skills development as measured by tests of Vocabulary, Comprehension, and Spelling, Factor 2 was not.

The implications of this and other findings are considered in the discussion section which follows.

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TABLE 9.12

Otis/Comprehension/Factor 1

Source	N.d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	2	23970.3218	11985.1609	109.19	
Prev. Regress.	1	15982.1140	15982.1140	117.19	
Increase	1	7988.2078	7988.2078	72.78	P<.001
Residual	295	32379.0464	109.7595		

The Square of the Multiple Correlation = 0.4354

Multiple R = 0.6522

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TABLE 9.13

Otis/Comprehension/Factors 1 & 2

Source	N. d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	3	24723.5088	8241.1696	76.61	
Prev. Regress.	2	23970.3218	11985.1609	109.19	
Increase	1	753.1870	753.1870	7.00	P<.01
Residual	294	31625.8594	107.5709		

The Square of the Multiple Correlation = 0.4388

Multiple R = 0.6624

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TABLE 9.14

Otis/Spelling

Source	N.d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	1	1140.9080	1440.9080	63.22	
Prev. Regress.	0	0	0	0	
Increase	1	1440.9080	1440.9080	63.22	P<.001
Residual	296	6746.2482	22.7914		

The square of the Multiple Correlation = 0.1760

Multiple R = 0.4195

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TABLE 9.15

Otis/Spelling/Factor 1

Source	N.d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	2	3008.7269	1504.3635	85.70	
Prev. Regress.	1	1440.9080	1440.9080	63.22	
Increase	1	1567.8189	1567.8189	89.31	P<.001
Residual	295	5178.4293	17.5540		

The Square of the Multiple Correlation = 0.3675

Multiple R = .6062

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TABLE 9.16

Otis/Spelling/Factors 1 & 2

Source	N.d.f.	Sum Sqrs.	Mean Sqrs.	F Ratios	Signf.
Due to Regress.	3	3044.8454	1014.9485	58.03	
Prev. Regress.	2	3008.7269	1504.3635	85.70	
Increase	1	36.1185	36.1185	2.06	NS
Residual	294	5142.3107	17.4909		

The square of the Multiple Correlation = 0.3719

Multiple R = 0.6098

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Discussion of the two-school study

Ideally, each child in this study should have received an individual oral reading test to determine the exact level of his decoding skills and of his comprehension. However, school administrators were extremely reluctant to release children for more than the one hour required for the group battery, so it was necessary to be content with scores from a silent reading battery already given by the school.

Despite obvious shortcomings in the data, it is probable that a number of meaningful observations emerged from the study. These findings include the following:

The chosen battery proved to be suitable for administration within a 50-minute class period, and no difficulties were encountered by pupils taking it. Because of its simplicity, teachers felt quite comfortable with it and a part of the battery is still being used for diagnostic purposes in the schools.

A study of the results suggests that subgroups do exist within the "poor reader" group as measured by the Iowa. One group of "poor readers" showed no loss of ability in other language areas. Spelling was normal in the case of this group, and they were normal automatizers. Another subgroup, however, seemed to fit the description given by Critchley. This group

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not only exhibited poor reading symptoms, but spelling bordered on the bizarre and they were very poor automatizers. This latter group made up approximately 10% of the population, and there is a strong suspicion that they should be classified as having a learning disability.

Being able to select this group of high-risk language disability cases is potentially very helpful in securing candidates for special programs that may receive state funds. Indeed, some of the tests used in this research have been used since the study was done in the school system.

In another dimension, certain findings are worthy of note. These findings are in the area of levels of cognitive functions as they relate to reading as measured on a silent reading test.

Whereas in the Fryeburg sample both low level and higher level cognitive functions seemed to be relevent to the reading task, it was the higher level cognitive functions that proved to be the significant predictors among the normal public school sample taking part in the two school study. This raises an important theoretical question which is stated in the Summary Chapter which follows.

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CHAPTER X

SUMMARY

Critchley has speculated that among the community of poor readers is a subgroup of children who show very specific difficulties with lower-order cognitive functions (classically referred to as "perceptual-motor") in association with their learning disability.

Vernon accepts the fact that the atypical reading behaviors described by Critchley do indeed exist, but has suggested that the reading difficulty is primarily a result of disturbances in higher-order cognitive functions.

The research undertaken in this study was designed to secure data relating to the variant hypotheses proposed by Critchley and Vernon.

The research sample consisted of 67 children, ranging in age from 8 to 19, who had demonstrated a late and irregular development of such language functions as verbal output, decoding, encoding, and second language learning, despite normal access to educational resources, normal or high intelligence, and sound emotional health. This group was selected from among students attending a summer school in

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Fryeburg, Maine.

This sample was matched with controls who were presumed to be normal readers and average or high achievers, on the basis of age, sex, intelligence and socio-economic status. The sample was divided into three groups, by age.

When both groups were administered the Gray Oral Reading Paragraphs test, the controls exhibited significantly better ($p < .01$) reading ability than the experimentals, at each age level.

Seventeen tests measuring various levels of cognitive functioning were administered to the experimental and control groups.

When compared to the experimentals, the control group of normal readers was found to perform significantly better on all of the tests, except for two: Circling Dots and Simple Coding. A factor analysis was performed, and all of the tests were found to load very heavily (76%) on a first factor which has been named "Perceptual Efficiency" but which seems to correspond well to Broverman's "automatization" factor. A weak loading was found on Factor 2, which was called "Symbolic Mental Manipulation."

While the overwhelming loading on Factor 1 raises a number of questions, the possibility is suggested that the

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behaviors involved are a significant component in learning the decoding process in reading, and without the presence or development of this component, the decoding process is difficult to master.

Age was found not to be a significant variable, since the differences in test behaviors were of the same order among the oldest students as among the two younger groups.

While there was a slight tendency for the experimentals to do less well on the tests requiring the highest level of cognitive manipulation of symbols than on those tests requiring very low levels of cognitive input, tasks at all conceptual levels still presented difficulties to the experimental group.

These data would suggest that there is a need to continue the exploration of Critchley's suggestion relating to a special group of poor readers who exhibit a specific syndrome. The rather remarkable unity of behavior exhibited by the experimentals in this study across a span of tests would suggest the need for additional investigation.

The data would also suggest caution in accepting wholeheartedly Vernon's intuitive impressions that the problem readers described by Critchley are suffering only from a higher level cognitive deficit. While she is almost certainly

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right in stating that the children involved are suffering higher level cognitive problems, they also seem to be exhibiting lower order problems as well.

A second investigation was carried out, using essentially the same tests but in smaller number, with a public school sample of 298 third and fourth graders.

Reading scores from the Iowa tests of basic skills were used to measure reading skills, and the Durrell Spelling List was used to determine spelling ability.

When the scores were factor analyized, a clear seperation appeared between the tests. Simple Addition, and Simple Subtraction loaded very heavily on Factor 1, with a lesser loading in the case of Coding Plus Adding and Simple Coding. This factor seems to be essentially the same as Factor 2 in the Fryeburg study: Symbolic Mental Manipulation. Dot Circling, Making Squares, and Word Fluency loaded on the second factor, and they seem to represent the lower level cognitive functioning usually designated as "perceptual-motor." Reading ability among this normal school sample was found to be much more related to Factor 1 (SMM) than to Factor 2 (PE).

The finding that Word Fluency (a written task) is closely related to Circling Dots and Making Squares suggests that the motor act involved in writing words may be of more significance than is usually suspected.

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A group of poor readers was identified within the total sample, and their automatization scores were compared. Those students who were both poor readers and poor automatizers were found to be poorer spellers than those children who were poor readers but normal automatizers.

The best that can be said about this investigation is that it has probably raised a number of questions which point the way for future study. Of particular importance to this writer are the following areas that need to be investigated:

1. A broader understanding of "cognitive" function. Performance on the Wechsler Intelligence Scale for Children and making circles are both subsumed under "cognitive" as the term is currently used. It is quite obvious more precise definitions are needed, even beyond Guilford.

2. Does Critchley's special subgroup of children exist? If so, what is the exact nature of their malfunctioning? The above data would suggest that they do exist, but this study certainly does not <u>prove</u> their existence beyond a speculative level. The need for additional study to specify the exact nature of the "poor reader syndrome" is obvious.

3. What is the importance of the SMM factor among normal children as they learn to read, and why is the perceptual-motor factor apparently so important to the disabled readers as to throw it into the same factor as the SMM?

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REFERENCES

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REFERENCES

Altus, G. T. A WISC profile for retarded readers. J. consul. Psychol., 1956, 20, 155-156.

Austin, Mary, Bush, C. & Huebner, J. Reading evaluation. New York: Ronald Press, 1961.

Bakan, P. (Ed.) Attention. Princeton, N. J.: Van Nostrand, 1966.

Barsch, R. Movegenic curriculum guide. Vol. 1. Seattle: Special Child Publications, 1967.

Barsch, R. Personal communication, 1968.

Bender, Lauretta. (Ed.) Psychopathology of children with organic brain disorders. Springfield, Ill.: Charles C. Thomas, 1956.

Birch, H. & Belmont, L. Auditory-visual integration in normal & retarded readers. Amer. J. Orthopsych., 1964, 34, 852-861.

Blank, Marion, & Bridger, W. Deficiencies in verbal labeling in retarded readers. Amer. J. Orthopsych., 1966, 36, 840-847.

Bloomfield, L. Language. New York: Holt, 1961.

Bond, G. & Tinker, M. Reading difficulties: their diagnosis & correction. New York: Appleton-Century-Crofts, 1957.

Bronner, A. F. The psychology of special abilities and disabilities. Boston: Little Brown, 1917.

Broverman, D. M. Cognitive style and intra-individual variation in abilities. J. Pers., 1960, 28, 240-256. (a)

Broverman, D. M. Dimensions of cognitive style. J. Pers., 1960, 28, 167-185. (b)

Broverman, D. M. Normative and ipsative measurement in psychology. Psych. Review, 1962, 69, 295-305.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Broverman, D. M. Generality and behavioral correlates of cognitive styles. J. consul. Psychol., 1964, 28, 487-500.

Broverman, D. M. Personal communications, 1967 & 1968.

Broverman, D. M., Broverman, Inge K., Vogel, W., Palmer, R. D. & Klaiber, E. L. The automatization cognitive style and physical development. Child Develpm., 1964, 35, 1343-1357.

Broverman, D. M., Broverman, Inge K., & Klaiber, E. L. The ability to automatize and the automatization cognitive style: a validation study. J. Percept. Motor Skills, 1966, 23 (2), 419-437.

Bruner, J. Going beyond the information given. In Contemporary approaches to cognition: a symposium held at the University of Colorado. Cambridge, Mass.: Harvard Univer. Press, 1957.

Bryan, W. L. & Harter, N. Studies on the telegraphic language: the acquisition of a hierarchy of habits. Psychol. Review, 1899, 4, 345-375.

Bryant, N. D. Conference address, Symposium on the Optometric Care of the Dyslexic Child. Optometric Congress, New York, Nov. 19, 1967.

Burks, H. F. & Bruce, P. The characteristics of poor and good readers as disclosed by the WISC. J. Educ. Psychol., 1955, 44, 488-493.

Cabrini, Sister M. Auditory memory span and functional articulatory disorders in relation to reading in grade 2. J. develpm. Reading, 1963, 7, Aug.

Carroll, J. B. Language and thought. Englewood Cliffs, N. J.: Prentice-Hall, 1964.

Cavanaugh, J. J. A. Allergy, hearing loss, and learning disability in children. Paper presented to American College of Allergy, Denver, Colorado, March 28, 1968.

Cavanaugh, J. J. A. Personal communication, Nov. 3, 1969.

Chall, Jeanne. Learning to read: the great debate. New York: McGraw-Hill, 1967.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Clements, S. D. Minimal brain dysfunctions in children: terminology and identification, Task Force I document of the Nat'l Project on Minimal Brain Dysfunctions in Children. Washington, D. C.: Gov't Printing Office, March, 1966.

Cohen, J. The factorial structure of the WISC at ages 7 1/2, 10 1/2, and 13 1/2. J. consul. Psychol., 1959, 23, 285-299.

Cole, E. M. Reading and speech problems as expressions of a specific language disability. Disorders of Communication Research Publication, XLII, 1964.

Coleman, J. and Rasof, B. Intellectual factors in learning disorders. Percept. Mot. Skills, 1963, 16, 139-152.

Conant, J. Slums and suburbs. New York: Mc-Graw-Hill, 1961.

Cooley, W. W. & Lohnes, P. R. Multivariate procedures for the behavioral sciences. New York: John Wiley & Sons, 1962.

Cratty, B. J. Movement behavior and motor learning. Philadelphia: Lea & Febiger, 1964.

Critchley, M. Inborn reading disorders of central origin. Transactions of the Ophthalmological Society of the United Kingdom, 1961, 81, 459-80.

Critchley, M. Developmental dyslexia. Springfield, Ill.: Charles Thomas, 1964.

Davis, R. B. A factor analysis of the Wechsler Bellevue Scale. Educ. psychol. Measmt., 1956, 16, 127-146.

Deal, Margaret. A summary of research concerning patterns of WISC sub-test scores of retarded readers, J. reading Specialist, May, 1965, IV: 4, 101-111.

DeHirsch, Katrina, Jansky, J. & Langford, W. Predicting reading failure. New York: Harper & Row, 1966.

Drake, C. & Schnall, M. Decoding problems in reading: research and implication. Pathways in Child Guidance, 1966, 8, 1-7.

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Drake, Diana. Perceptual correlates of impulsive and reflective behavior. Unpublished doctoral dissertation, Harvard U. Graduate School of Education, 1967.

Drew, A. L. A neurological appraisal of familial congenital word-blindness. Brain, 1956, 79, 440-460.

Durrell, D. D. Analysis of reading difficulty. New York: Harcourt, Brace & World, Inc., 1955.

Durrell, D. D. Dyslexia: nothing new here. The Mass. Teacher, Mass. Teachers' Assn., November, 1967.

Eisenberg, L. The epidemiology of retardation and a program for preventive intervention. Chap. I, in J. Money, (Ed.) The disabled reader, Baltimore: Johns Hopkins Press, 1966.

Eisenberg, L. The child with learning disabilities: medical psychiatric, and behavioral considerations. Paper presented at 5th Annual Conference for Children with Learning Disabilities, Boston, Feb., 1968.

Elkind, D., Larson, M. & Van Doorninck, W. Perceptual decentration learning and performance in slow and average readers. J. educ. Psychol., 1965, 66, 50-56.

Ferguson, G. A. Statistical analysis in psychology and education. (2nd Ed.) New York: McGraw-Hill, 1966.

Fernald, Grace. Remedial techniques in basic school subjects. New York: McGraw-Hill, 1943.

Fildes, L. G. A psychological inquiry into the nature of the condition known as congenital word blindness. Brain, 1921, 44, 286-307.

French, J. W. The description of aptitude and achievement tests in terms of rotated factors. Psychometr. monogr., 1951, No. 5.

Frostig, Marianne. Developmental test of visual perception. Palo Alto: Consulting Psychologists Press, 1961.

Gallagher, J. R. Can't spell, can't read. Atlantic Monthly. June, 1948, 188, 35-39.

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Gates, A. I. The role of personality maladjustment in reading disability, J. genet. Psychol., 1941, 59:77.

Gibson, E. Experimental psychology of learning to read. Chap. 3 in J. Money, (Ed.) The disabled reader. Baltimore: Johns Hopkins Press, 1966.

Gofman, Helen F. Etiological factors in learning disorders of children. J. neurol. Sciences, 1965, 2.

Graham, E. Wechsler-Bellevue and WISC scattergrams of unsuccessful readers. J. Consul. Psychol., 1952, 16, 268-71.

Gray, W. Gray oral reading paragraphs test. Indianapolis: Bobbs-Merrill, 1955.

Guiler, H. & Coleman, R. Reading for meaning series. Chicago: Lippincott, 1955.

Guilford, J. P. The nature of human intelligence. New York: McGraw-Hill, 1967.

Harcourt, Brace & World, Some data on the relation of Otis Beta I.Q.'s to I.Q.'s on the WISC from the _____, Conn., Schools, Xeroxed typescript. New York: Author, undated. Rec'd 1968.

Harman, H. Modern Factor Analysis, Second Edition. Chicago: Univ. of Chicago Press, 1969.

Harris, A. Report of preconference workshop. J. A. Figurel (Ed.) Changing concepts of reading instruction. Internat'l Reading Assn. Conf. Proceedings, 1961.

Harris, A. Five decades of remedial reading. Report to the Internat'l Reading Assoc., Seattle, Wash. May 5, 1967, mimeo.

Herman, K. Reading disability: a medical study of word-blindness and related handicaps. Springfield, Ill.: Charles Thomas, 1959.

Herman, K. & Norrie, Edith, Is congenital word-blindness an hereditary type of Gerstmann's syndrome? Psychiatrie et Neurologie, 1959, 136, 59-73.

Hinshelwood, J. Congenital wordblindness. London: Lewis, 1917.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Hirst, L. C. The usefulness of a two-way analysis of WISC subtests in the diagnosis of remedial reading problems. J. exper. Educ., 1960, 29, 155-156.

Hollingshead, A. B. Two-factor index of social position. New Haven: August B. Hollingshead, Yale Sta., 1957.

Holmes, J. A. & Singer, H. The substrata factor theory: Substrata factor differences underlying reading ability in known-groups. Berkeley: Univer. of Calif., 1961.

Hopkins, K. D. & Michael, W. B. The diagnostic use of WISC subtest patterns. Calif. J. educ. Res., 1961, 12, 116-117, 130.

Howards, Melvin. Radio and public pronouncements. Boston: Northeastern University, 1965-66.

Humphrey, G. Thinking. New York: Wiley & Sons, 1954.

Johnson, D. & Myklebust, H. Learning disabilities. New York: Grune & Stratton, 1967.

Kagan, J. Reflection-impulsivity and reading ability in primary children. Child Develpm., Sept. 1965, 36, No. 3.

Kallos, G. L., Grabow, J. & Guarino, E. The WISC profiles of disabled readers. Personnel and Guidance J., 1961, 39, 476-478.

Kass, Corinne E. Some psychological correlates of severe reading disability. In Selected studies on the ITPA. Madison, Wisconsin: Photo Press Inc., 1963.

Kinsbourne, M. & Warrington, Elizabeth. Developmental factors in reading and writing backwardness. Chap. 4 in J. Money, (Ed.) The disabled reader. Baltimore: Johns Hopkins Press, 1966.

Kitchen, Beatrice. Sharon school laterality test, Sharon, Mass., offset, undated.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Klaiber, E., Broverman, D. & Kobayashi, Y. The automatization cognitive style, andrangens, and monoamine oxidase. Psychopharmacologia (Berlin), 1967, 11, 320-336.

Kolers, P. A. Bilingualism and information processing. Scientific American, 1968, 218, 3, 78-89.

Kramer, S. Cradle of civilization. New York: Time, Inc., 1967.

Kuhlman, Clementine, Visual imagery in children. Doctoral dissertation, Radcliffe College, 1960.

Lenneberg, Eric. Biological foundations of language. New York: John Wiley & Sons, 1967.

Lindquist, E. & Hieronymus, A. Iowa tests of basic skills. Boston: Houghton Mifflin, 1956.

Malmquist, R. Factors related to reading disabilities in the first grade of the elementary school. Stockholm Stud. on Educ. Psychol., 2, Stockholm: Almquist and Wiksell, 1958.

Mathewson, Suzanne. Oral reading problems in children: a cognitive style approach. Unpublished master's thesis, McGill University, Montreal; 1967.

McCall, W. A. & Crabbs, Lelah. Standard test lessons in reading. New York: Teachers' College Press, Columbia Univ., 1961.

McCarthy, J. J. & Kirk, S. A. Illinois test of psycholinguistic abilities, Experimental ed. Institute for Research on Exceptional Children, Univ. of Ill., Urbana, Ill., 1961.

McDonald, A. Research for the classroom. J. Reading, Nov. 1964, Vol. 8 (2), 115-118.

McLeod, J. Reading expectancy from disabled learners. J. Learning Disabilities, Feb. 1968, Vol. I (2), 97-105.

Meyer, H., Norgaard, B. & Torpe, H. Laesesvage coerm ag dares. København: Meddelelser fra Dansklaererforen. 1943.

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Minsky, M. Steps toward artificial intelligence. Proceedings, Inst. radio Engrs., 1961, 49, 8-30.

Mitchell, B. Personal communciation, Feb. 25, 1968.

Morgan, W. P. A case of cogenital word-blindness. British Medic. J., 1896, 2, 1378.

Money, J. (Ed.) Reading disability: progress and research needs in dyslexia. Baltimore: Johns Hopkins Press, 1962.

Money, J. (Ed.) The disabled reader. Baltimore: Johns Hopkins Press, 1966.

Monroe, M. Children who cannot read. Chicago: Univ. of Chicago Press, 1932.

Myklebust, H. Personal communication, Jan. 18, 1968.

Neisser, D. Cognitive psychology. New York: Appleton-Century-Crofts, 1967.

Neville, D. A comparison of WISC patterns of male retarded and non-retarded readers. J. Educ. Res., 1961, 54, 195-197.

Orton, S. T. Reading, writing and speech problems in children, New York: W. W. Morton, 1937.

Otis, A. S. Otis quick-scoring mental ability tests, Alpha & Beta. New York: Harcourt, Brace & World, 1936.

Plack, J. J. Relationship between achievement in reading and achievement in selected motor skills in elementary school children. Research Quarterly, 1968, 39:4, 1063-1068.

Rabinovitch, R. D., Drew, A. L., DeJong, R. M., Ingram, W., & Withey, L. A research approach to reading retardation. Chap. 15 in R. McIntosh and C. C. Hare (Eds.) Neurology and Psychiatry in Childhood. Proceedings of the Association for Research on Nervous and Mental Disorders, Vol. 34, Baltimore: Williams and Wilkins, 1954.

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

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Reed, J. C. The ability deficits of good and poor readers. J. Learn. Disablts., Vol. 1, (2), Feb. 1968, 134 139.

Robeck, M. Subtest patterning of problem readers on the WISC. Calif. J. educ. Res., Mary, 1960, 11, 110-115.

Robeck, M. Intellectual strengths and weaknesses shown by reading clinic subjects on the WISC. J. develpm. Reading, 1964, 1, 120 129.

Robinson, H. Why pupils fail in reading. Chicago: The Univ. of Chicago Press, 1946.

Roswell, Florence, & Natchez, Gladys. Reading disability: diagnosis and treatment. New York: Basic Books, 1964.

Schilder, P. Congenital alexia and its relation to optic perception. J. genetic Psychol., 1944, 65, 67-68.

Shedd, C. L. The diagnosis and treatment of symbolic confusion. In J. A. Figurel, (Ed.) Changing Concepts of Reading Instruction. Inter. Reading Assoc. Conf. Proceedings, 1961.

Sheldon, J. and Garton, J. A note on 'A WISC profile for retarded readers'. Alberta J. of Educ. Research, 1959, 5, 264-267.

Sloane, Eric. The cracker barrel. New York: Funk and Wagnalls, 1967.

Smith, D. E. P. and Carrigan, Patricia M. The Nature of Reading Disability. New York: Harcourt, Brace & World, 1959.

Stroop, J. R. The basis of Ligon's theory. Amer. J. Psychol., 1935, 47, 499-504. (a)

Stroop, J. R. Studies of interference in serial verbal reactions. J. exp. Psychol,, 1935, 18, 643-672 (b).

Tamm, A. Ordblindhed hos barn. Pedagogiska Schrifter, 1943, 5, 179.

Thurstone, L. L. & Thurstone, Thelma. The Chicago tests of primary mental abilities, ages 11-17 normal. Washington, D. C.: Amer. Council on Educ., 1941.

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Traxler, A., with assistance of Educ. Records Bureau staff. Research in Reading. New York: Educational Records Bureau, 1941, 1946, 1955, 1960.

Vernon, Magdalen D. Backwardness in reading--a study of its nature and origin. Cambridge, England: University Press, 1957.

Vernon, Magdalen D. Perception, attention and consciousness, in P. Bakan. (Ed.) Attention. Princeton, N. J.: Van Nostrand, 1966, 37-57.

Walters, C. & Doan, H. Perceptual and cognitive functioning of retarded readers. J. Consult. Psychol., 1962, 26, 355-361.

Wechsler, D. The measurement and appraisal of adult intelligence. Baltimore: Williams & Wilkins Co., 1958.

Whiting, D., Schnall, M. & Drake, C. Automatization in dyslexic and normal children, Wellesley, Mass.: Reading Research Institute, 1966.

Wiener, M. & Cromer, W. Reading and reading difficulty: a conceptual analysis. Harvard Educational Review, 1967, 37, 620-643.

Wilson, R. M. Diagnostic and remedial reading for classroom and clinic. Columbus, Ohio: Charles E. Merrill, 1967.

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A P P E N D I X

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APPENDIX I

Sample copies of tests given in both research studies, together with directions for administration.

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DIRECTIONS FOR TEST #1

SIMPLE ADDITION

"When you turn the booklet over, you will find a page of simple two-digit addition problems. When I say "begin," you will have three (3) minutes to complete as many as you can. Work quickly and accurately. Are there any questions? Ready, begin."(TIME: 3 minutes)

(This is one of the Automatization tests making up the C riterial B attery.)

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3 ADDITION

4	3	4	1	9	7	2	2	2	4	1	9	8	1	1
1	1	0	8	9	1	9	5	8	8	1	2	8	1	6
0	7	1	0	8	1	2	3	5	0	3	5	0	3	4
1	2	9	7	1	7	1	6	5	9	0	4	8	6	5
5	4	1	5	7	2	8	4	0	0	8	9	7	6	9
2	2	2	3	3	7	4	8	8	1	5	9	8	9	5
5	7	6	0	5	7	7	9	3	9	9	6	0	7	5
7	8	7	0	6	6	4	8	7	5	4	8	7	0	6
9	5	6	3	4	1	9	8	6	1	6	1	6	3	3
1	0	6	2	3	5	0	2	4	4	5	8	5	8	4
1	1	7	2	6	5	3	0	6	8	6	0	2	0	2
3	6	7	0	1	4	3	8	0	3	2	4	2	2	4
3	3	3	2	3	6	2	9	0	6	3	2	6	2	9
4	9	3	3	5	3	3	3	6	3	9	6	6	6	3
6	3	6	0	0	5	7	8	7	9	8	9	8	8	4
8	9	9	3	7	1	0	5	0	4	5	3	2	5	9
4	3	1	6	2	8	0	5	7	1	3	2	6	5	1
2	5	7	0	5	1	4	1	2	3	0	2	2	4	6
2	3	3	0	4	3	0	3	0	2	4	6	7	4	2
2	5	6	7	4	3	3	7	1	3	4	9	5	2	1
2	4	7	6	3	7	8	1	4	9	0	4	8	7	0
6	0	7	5	8	4	5	7	5	9	0	1	5	7	8

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DIRECTIONS FOR TEST #2

SIMPLE SUBTRACTION

(Give these directions as soon as the previous test is finished, and before the students turn the page.) "On the next page, you will find two-digit subtraction problems. Take the bottom number away from the top number. You will have three minutes to do as many as you can. Work quickly and accurately. Any questions? Ready, begin."

(TIME: 3 minutes.)

(This is one of the Automatization tests making up the Criterial Battery.)

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4 SUBTRACTION (Take Away)

6	3	7	4	5	8	6	6	2	5	9	5	5	1	6
3	1	1	3	5	4	5	1	1	2	9	2	4	1	3
2	4	6	9	4	5	0	3	5	9	8	6	3	3	7
1	2	6	8	3	1	0	1	3	6	3	2	1	3	5
7	4	9	7	2	5	8	3	9	5	8	4	2	5	6
4	1	5	7	0	4	2	1	6	4	3	4	1	3	5
9	6	7	3	8	5	9	6	3	4	7	6	5	9	3
4	6	5	1	7	2	3	5	1	2	3	5	4	8	2
4	6	9	4	2	7	3	9	8	3	5	7	5	2	4
2	2	7	3	1	5	0	6	4	2	3	6	5	1	4
4	9	6	8	2	1	5	3	7	2	8	5	9	7	2
3	7	2	7	1	0	5	2	4	1	6	3	1	2	0
9	7	4	8	3	4	8	2	4	9	6	3	7	3	9
5	7	4	3	2	0	7	1	3	6	3	1	2	1	7
1	6	8	4	9	2	7	5	9	4	2	5	3	6	9
1	5	2	1	4	0	4	5	3	2	1	4	2	5	3
5	4	9	2	6	4	7	3	8	5	1	4	5	5	3
3	1	9	1	3	1	5	2	3	4	0	1	3	2	1
4	9	6	8	3	6	5	3	7	2	8	5	0	7	2
3	7	2	7	1	3	5	2	4	1	6	3	0	2	0
6	3	7	5	9	3	5	2	7	8	1	9	4	3	7
2	1	5	3	8	2	1	2	5	4	0	7	2	1	3
8	3	6	2	7	5	3	7	9	4	7	3	6	4	2
6	2	3	1	4	3	1	2	8	1	5	2	6	0	1
3	4	1	8	5	9	2	8	4	8	9	4	3	6	8
1	0	1	7	3	5	1	7	1	0	5	3	1	2	6

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DIRECTIONS FOR TEST #3

SPEED of NAMING REPEATED OBJECTS

(This is one of the Automatization tests making up the Criterial Battery.)

S is handed the sheet and is told: "This sheet contains pictures of a cup, a tree, and a fly. You are to name these objects as rapidly as you can. We will begin with the first line. Name each object in the first line. Do not skip any objects. If you make an error in calling the name of any object, you should correct it. Now start."

When the tester is certain that the S can name the objects satisfactorily in the first (practice) line, he says:

"Good. Go on to the next line, and do not stop until you have named all the objects on this page. Start"

S is timed and the number of seconds required to complete the page becomes the score.

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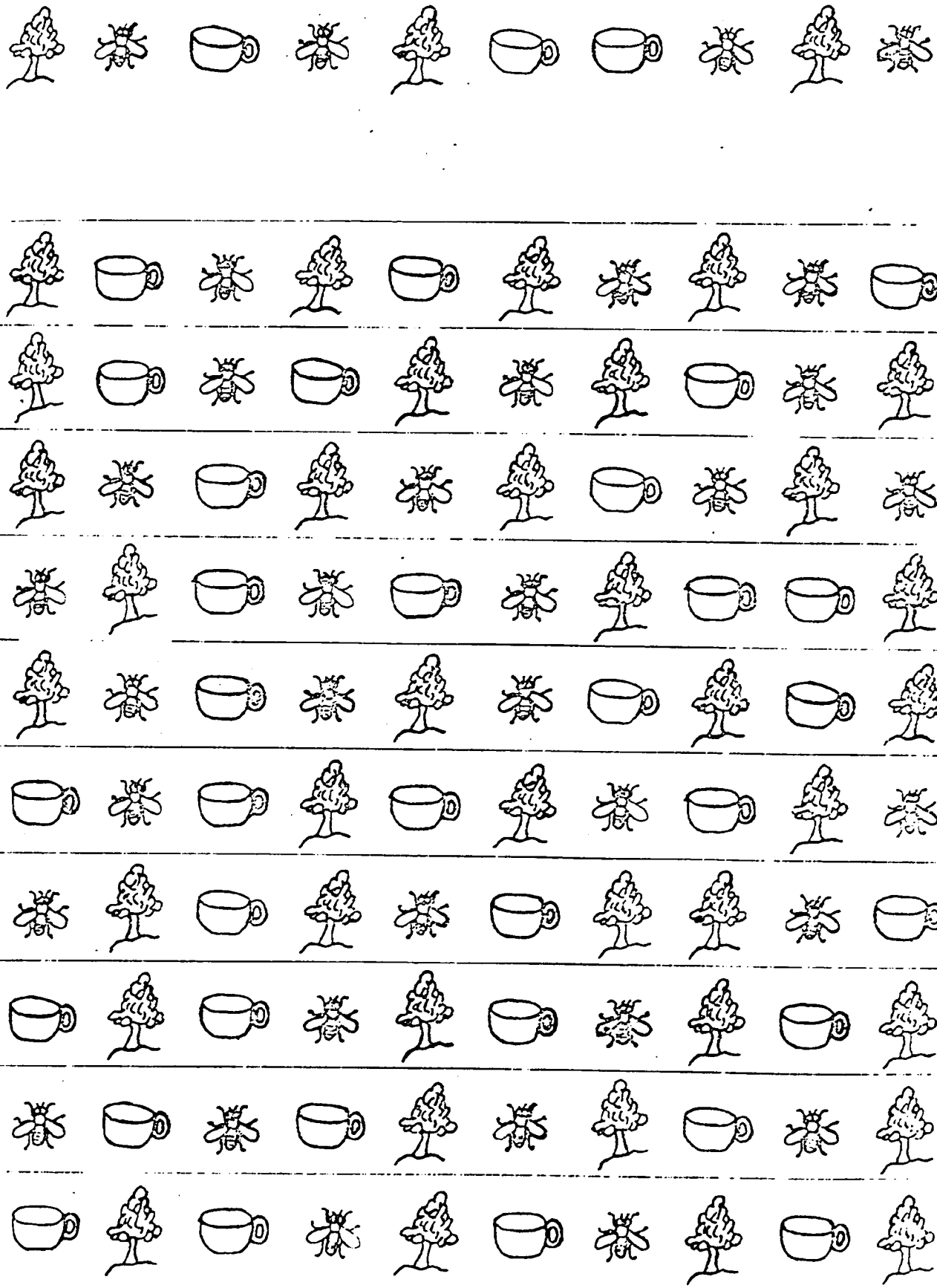

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DIRECTIONS FOR TEST #4

STROOP READING COLOR NAMES

(This is one of the Automatization tests making up the Criterial Bettery.)

S is given the sheet containing repeated color names (red, blue, green) printed in black ink. The tester says:

"This page contains three color names: red, blue, green. You are to read these color names as rapidly as you can. Please read the words in the first line. Do not skip any words. If you make a mistake, correct the error. Now start."

When the tester is sure that the S can read all three words in the first (practice) line, he says:

"Good. Go on to the next line, and do not stop until you have read all the color names on this page. Start."

S is timed and the number of seconds required to complete the page becomes the score.

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GREEN RED GREEN BLUE BLUE RED GREEN GREEN RED BLUE

RED BLUE RED GREEN BLUE RED GREEN BLUE RED BLUE

RED GREEN BLUE RED GREEN RED BLUE GREEN BLUE GREEN

RED BLUE RED GREEN BLUE RED GREEN BLUE RED BLUE

BLUE GREEN RED RED BLUE GREEN RED BLUE RED GREEN

GREEN RED BLUE GREEN RED BLUE RED BLUE GREEN BLUE

GREEN BLUE RED BLUE GREEN RED GREEN BLUE GREEN RED

RED BLUE BLUE RED GREEN BLUE GREEN BLUE RED GREEN

GREEN RED GREEN BLUE RED GREEN RED BLUE GREEN RED

RED GREEN BLUE RED GREEN RED BLUE GREEN BLUE RED

BLUE GREEN RED GREEN RED BLUE RED GREEN BLUE RED

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DIRECTIONS FOR TEST #5

STROOP NAMING COLOR HUES

(This is one of the Automatization tests making up the Critical Battery.)

S is handed the sheet containing repeated squares which are blue, red and green. (Color reproduction of this test for inclusion with this paper was not possible. The colors have been indicated in the first line by outlining each square in the color that the block is printed in the original test.) The tester says:

"This page contains blocks that are colored, as you can see. Please name the colors which you see in the first line. Do not skip any block when you name the colors. Now start."

When the tester is sure that the S can name the three colors correctly, in the first line, he says:

"Good. Go on to the next line, and do not stop until you have named the colors on this page. Start."

S is timed and the number of seconds required to complete the page becomes the score.

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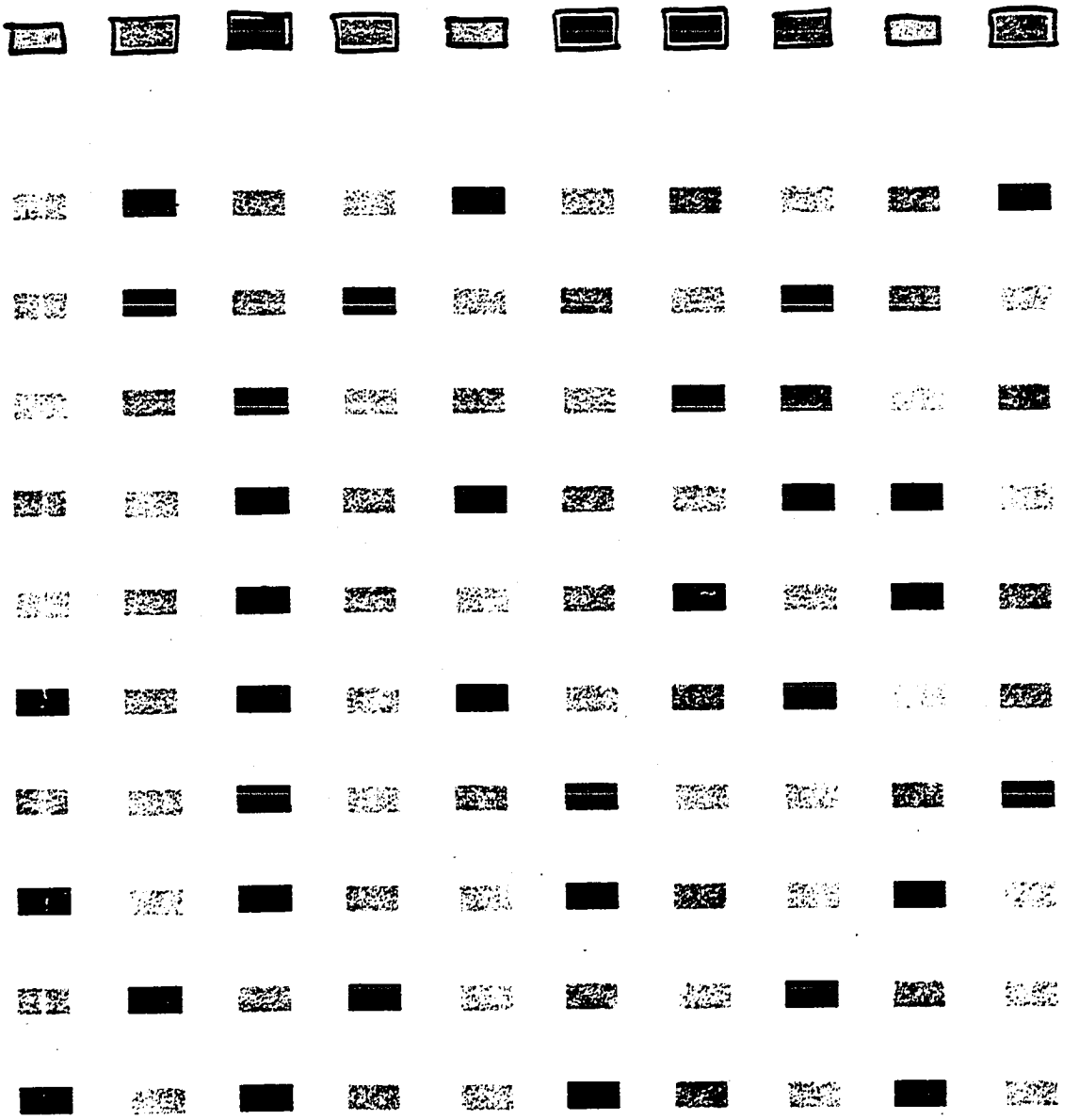

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DIRECTIONS FOR TEST #6

STROOP WORD-COLOR INTERFERENCE

(This is one of the Automatization tests making up the Critical Battery.)

S is given the sheet containing the three color names (red, blue, and green). Each name is printed in a color different from the color named by the word. Red, for example, is always printed in either blue or green ink. The tester says:

"This page contains three color names printed in different colored inks. You are to read the word, not call the name of the color in which the word is printed. Do not skip any words. Please read the words in the first line. If you make a mistake, correct the error. Now start."

When the tester is sure that the S understands the directions and can read the three words in the first line, he says:

"Good. Go on to the next line, and do not stop until you have read all of the color names on this page. Start."

S is timed and the number of seconds required to complete the page becomes the score.

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RED GREEN BLUE GREEN RED BLUE BLUE GREEN RED

RED BLUE GREEN RED BLUE RED GREEN GREEN BLUE

RED BLUE GREEN BLUE RED GREEN RED BLUE GREEN

RED BLUE RED RED BLUE GREEN RED

GREEN RED GREEN BLUE GREEN RED BLUE RED

RED BLUE GREEN RED BLUE RED BLUE GREEN

GREEN BLUE RED RED GREEN BLUE RED

RED RED BLUE RED RED

RED GREEN RED GREEN RED RED

GREEN BLUE GREEN RED RED BLUE

RED BLUE RED BLUE GREEN RED RED

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DIRECTIONS FOR TEST #7

DOTTING CIRCLES
(Sharon Laterality Test)

Write your name on the line provided. Where it says "grade," put your age. Also fill in the date. If you are left-handed, raise your hand. Would those people please put a big "L" on the top of the front page.

When I say begin, take your pencil in the hand you usually write with, and place a dot in the center of each circle. Work only in the top rectangle. Be sure the dots do not touch the outside of the circle. I will time you, so work as quickly and as accurately as you can. Are there any questions? Ready, begin.(TIME: 45 seconds.)

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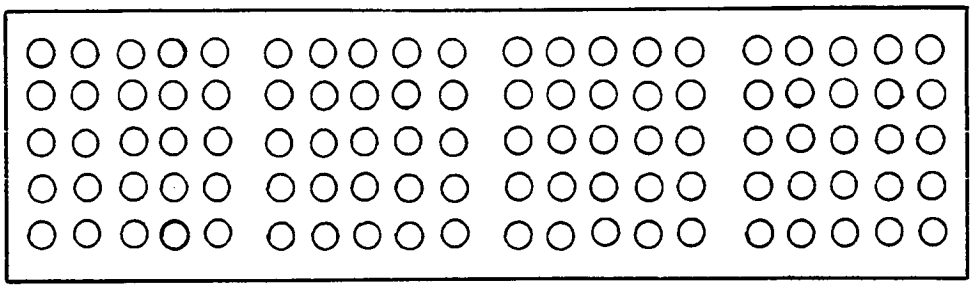
SHARON PUBLIC SCHOOLS

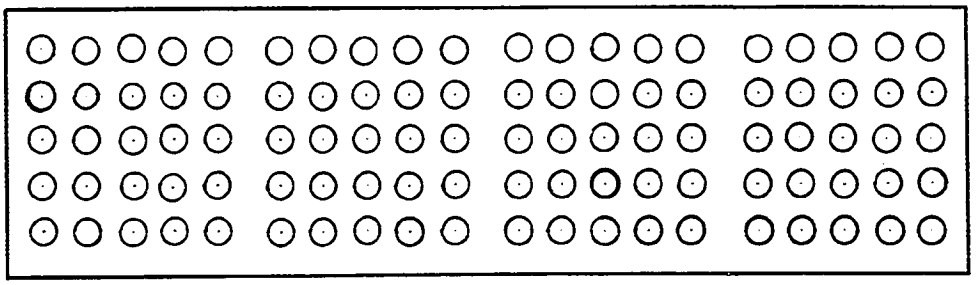
LATERALITY TEST

NAME_____ GRADE_____ SCHOOL_____ DATE_____

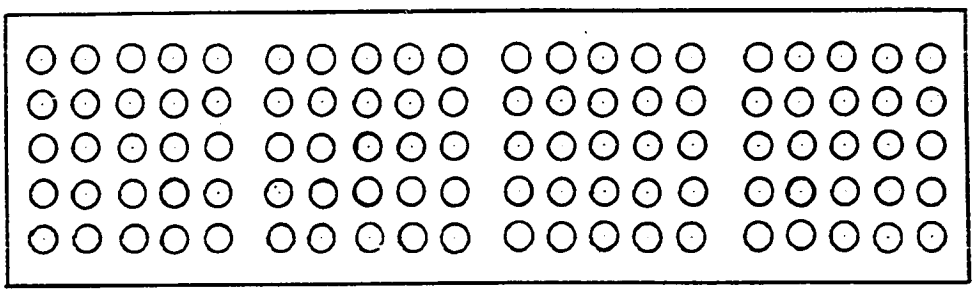
R



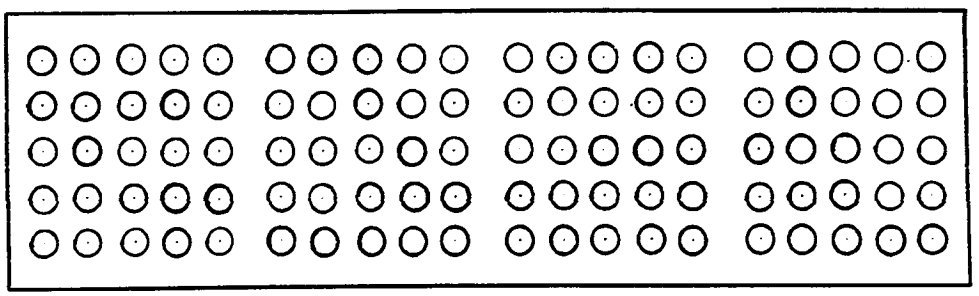
L



R



L



	R SCORE L	PREFERENCE
Handedness		_____
Dots	____ ____	
Scissors	____ ____	
Ball	____ ____	
Spoon	____ ____	
Footedness		_____
Hopping	____ ____	
Climbing	____ ____	
Kicking	____ ____	
Eyedness		_____
Sighting	____ ____	
Pinhole	____ ____	

B.S. Kitchen

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DIRECTIONS FOR TEST #8

DOT CIRCLING

Please turn to the next page, which has dots on it. Follow the directions at the top of the page as I read them aloud. "Place a circle around each dot on this page. Work as quickly and as accurately as you can. Be sure the dots don't touch the circles, and that the circles don't touch each other." Are there any questions? Ready, begin. (TIME: 45 seconds.)

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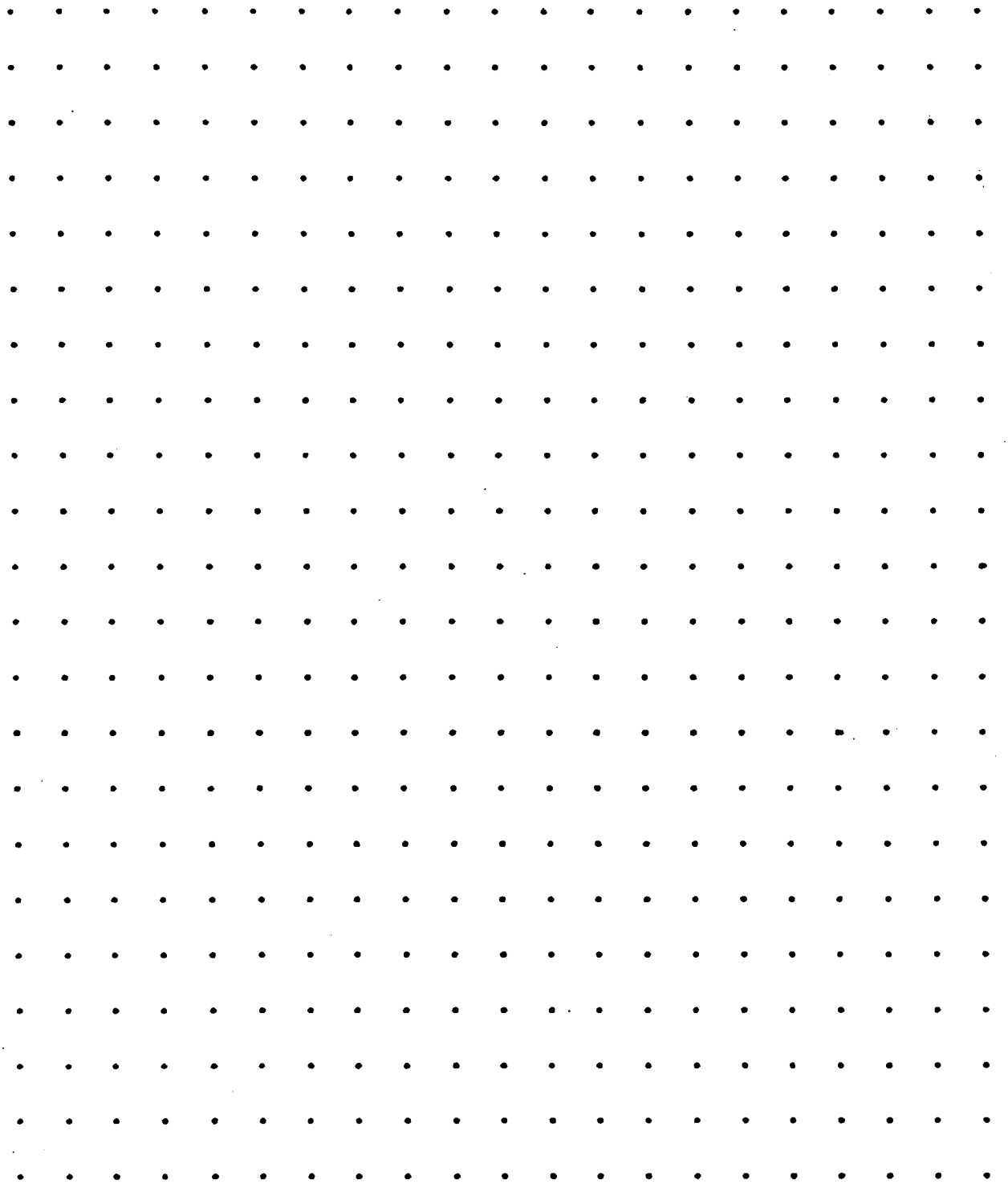
DRAW A CIRCLE AROUND EACH DOT. WORK AS QUICKLY AND AS ACCURATELY AS YOU CAN. BE SURE THAT THE DOTS DO NOT TOUCH THE CIRCLES, AND THAT THE CIRCLES DO NOT TOUCH EACH OTHER.



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DIRECTIONS FOR TEST #9

STRIKING OUT o's

Please turn to the next page, which has alphabet letters on it. Follow the directions at the top of the page as I read them aloud. "Strike out all of the 'o's" on this page. Work as quickly and as efficiently as you can. Are there any questions? Ready, begin." (TIME: 45 seconds.)

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STRIKE OUT ALL OF THE "O'S" ON THIS PAGE. WORK AS QUICKLY AND AS EFFICIENTLY AS YOU CAN.

a x c d g w q j a b r j e c k x g o x m w e v s

t o q y o i a n h f b o f o u w b n k o b g p a

t f e g u v h p m g o a y w s d a e o i c y k o

z r f c q v u g h d o a p z c y l k t o o a j q

c i o e a d s w y a f e g u b h p m g t a p g b

o k n b i g f b c o g x k c e j r b a j q w g w

c x a y k b z r f c q v u g h k a b m i b f a y

u y x r w h n g y k g l j v f k u q w b h k d c

s b o v s x d t g k t o b h k r o x y f g p a f

g p a f a w g q u p m j x o t o c v c y g b s h

g u y x a j o q f g b v w k u l h z d b x m r c

i w j d b h v e c g o f n k o b h d r a p z c y

u y a d r a v m d g o e d i e i c d t d n t a x

o w t g o c v k l z t c o o b m r a x o c d g q

c o f u b h v s y d o e a f n h i t y p d y l k

t x o r w h n g y k g l o b u k o t x g a m s z

p f q o b o c d f u t g w x o r n h f v l j r d

x w m n o d b a g k o t d z s v o b s c d y u y

a f b i m b a x r w a n e g y k g l e b u k o t

x g a m s z p f q o b o c d f u t g w x o r n h

f v l j r d x w m n o d b a g k o t d z s v o b

s c d y u y a f b i m b a x r w a n e g y k g l

k h b w u k f v j e c d c s b o v s z d t o r d

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DIRECTIONS FOR TEST #10

STRIKING OUT d's

Please turn to the next page, which also has letters on it. This time I want you to strike out all of the "d's" on this page. Work as quickly and as accurately as you can. Any questions? Ready, begin. (TIME: 45 seconds.)

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STRIKE OUT ALL OF THE "d's" ON THIS PAGE. WORK AS QUICKLY AND AS EFFICIENTLY AS YOU CAN.

a x c d g w q j a b r j e c k x g o x m w e v

s t o q u o i z n h f b o f o u w b n k o b g

p a t a e g u v h p m g o a j w s d a e o i c

y k b z r f c q v u g h d o a p z c y l k t o

o a j q c i o e a d s w y a f e g u b h p m g

t a p g b o k n b i h f g x o g x k c e j r b

a j q w g d c x a y k.b z r f c q v u g h k a

b m i b f a y u y x r w h n g y k g l c j v f

k u q w b h k d c s b o v s z d t g k t o b h

k r o x y f g p a f a w g q u p m j x o t o c

v c y g b s h g u y x a j o q f g b v w k u l

h z d b x m r c i w j d b h v e c g o f n k o

b h d r a p z c y u y a d r a v m d g o e d i

e i c d t d n t a x o w t g o c v k l z t c o

b m r a x o c d g q c o f u b h v s y d o e a

f n h i t y p d y l k t x o r w h n g y k g l

o b u k o t x g a m s z p f q o b o c d f u t

g w x o r n h f v l j r d x w m n o d b a g k

o t d z s v o b s c d y u y a f b i m b a x r

w a n e g y k g l k h b w u k f v j e c d c s

b o v s z d t o r d h b o t k g w x y f g p e

p a p a f q e g q o u p m o c z q i g a w y o

j a c o w a z e y i z o w u v a t e s i r o q

u p a n e m i l o k u j a h c z v c q p a c i

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DIRECTIONS FOR TEST #11

STRIKING OUT 9's

Turn to the next page, which is also filled with numbers. This time, strike out all of the "9's" on the page. Work quickly and accurately. Any questions? Ready, begin. (TIME: 45 seconds)

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1 3 9 2 7 6 4 9 8 5 1 8 3 7 6 4 2 5 9 8 2 4

6 3 2 5 9 8 2 4 6 1 5 3 2 6 1 6 5 3 9 6 2 8

7 9 5 6 1 4 3 7 5 9 4 8 7 2 3 5 1 4 3 1 7 8

5 3 4 6 2 2 6 5 9 8 9 5 6 7 9 8 2 6 5 8 2 5

1 9 2 3 2 7 1 6 4 7 1 3 9 2 7 6 4 9 8 5 1 8

3 7 6 3 2 5 9 8 2 4 6 1 6 5 3 2 6 1 6 5 3 9

6 2 8 7 9 5 6 1 4 3 7 5 9 4 8 7 2 3 5 1 4 3

1 2 8 5 3 4 6 2 2 6 5 8 9 8 3 6 7 9 8 2 6 5

8 2 5 1 9 2 3 2 7 1 6 4 7 1 3 9 2 7 6 4 9 8

5 1 8 3 7 6 3 2 5 9 8 2 4 6 1 5 3 2 6 1 6 5

3 9 6 2 8 7 9 5 6 1 4 3 7 5 9 4 8 7 2 3 5 1

4 3 1 2 8 5 3 4 6 2 2 6 5 9 8 9 2 6 7 9 8 2

6 5 8 2 5 1 9 3 3 2 7 1 6 4 7 1 3 9 2 7 6 4

9 8 5 1 8 3 7 6 3 2 5 9 8 2 4 6 1 5 3 2 6 1

6 5 3 2 6 1 6 5 3 9 6 2 8 7 9 5 6 1 4 3 7 5

9 4 8 7 2 3 5 1 4 3 1 2 8 5 3 4 6 2 2 6 5 9

8 9 3 6 7 9 8 2 6 5 8 2 5 1 9 2 3 2 7 1 6 4

1 5 9 6 7 9 3 2 9 9 3 1 8 1 9 4 1 6 8 2 9

9 2 6 5 8 2 5 2 3 2 3 4 5 6 7 8 9 6 2 7 7 6

3 1 2 5 8 5 7 6 6 1 9 4 3 3 9 8 1 4 3 5 6 3

5 4 3 2 6 9 2 3 2 7 5 1 4 6 2 6 7 5 1 4 7 9

1 3 5 1 8 9 6 1 7 9 9 4 3 1 2 6 9 8 9 2 9 2

8 3 2 4 6 5 5 6 8 7 2 8 5 9 2 6 3 2 7 6 7 6

6 1 3 9 1 4 1 7 2 4 7 6 8 9 5 2 7 3 9 4 9 2

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DIRECTIONS FOR TEST #12

CIRCLING 5's and STRIKING 9's

On the next page you will find numbers. This time, I want you to circle the fives, and cross out the nines. (REPEAT) You may write the directions at the top of the page. Work quickly and accurately. Any questions? Ready, begin. (TIME: 3 minutes.)

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DIRECTIONS FOR TEST #13

SIMPLE LETTER CODING

On the top of the page, you will find a code. Each letter is matched with a number. Take a minute to study the code. (time, one minute.) Now, when I say begin, match each letter below with its appropriate number. Write the number below the letter. Work consecutively (in order, along the page). Work quickly and accurately. Any questions? Ready, begin. (TIME: 3 minutes.)

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a	b	e	g	k	n	d	s	z
4	6	8	7	2	5	9	1	3

g k d s a b e z n d a g e k z s

n b a e k d z b g n s g d a e n

k s b z a g d z b k e s n a d b

e n g z k s z d k e a b g n s n

e a d g k s b z b s k g d a e z

n s g a k a e d b n z s n a g d

c k b n e b d a g z k s s z n b

a d e g k s g a k z d e b n a s

g a n e d k b n e d k b s g a z

n d a z s g k e b b c g n z s a

d k s z a b n e d g k k e b n s

z b d g n e z a s g k d b b d n

g z s a e k z g b d n e k s a b

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DIRECTIONS FOR TEST #14

SIMPLE LETTER CODING - ADDITION

Please fill in you name, age, and the date in the space at the upper right hand corner. At the top of the page you see a code. It reads, a=5, b=4, c=3, d=2, ê=1. Below you see pairs of letters. In your mind, match the letter with its appropriate number in the code, and complete the addition. Do all this work in your head, only writing down the answer to the addition. Now take a look at the examples below the code. The first one reads, e=1 plus d=2; 1+2 = 3, so 3 is the correct answer. The second example reads, d=2 plus c=3; 2+3 = 5, so 5 is the correct answer. Check the rest for yourself. Are there any questions? You will be given three minutes to complete as many as you can. Work quickly and accurately. Ready, begin. (TIME: 3 minutes.)

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NAME _____

AGE _____

DATE _____

CODE

a	b	c	d	e
5	4	3	2	1

EXAMPLES - ADDITION

e	d	b	a	b	c
d	c	e	b	c	c
3	5	5	9	7	6

a	d	b	a	a	c	d	b	c	d	e	e	c	d	e
a	b	b	e	c	a	e	e	b	a	a	b	e	d	d

e	b	d	b	b	a	a	c	e	c	b	d	d	c	e
c	c	e	a	d	b	d	c	e	d	c	b	e	b	b

a	c	e	b	b	c	c	b	a	e	c	d	a	d	b
e	a	c	b	e	c	d	d	b	d	e	e	a	d	a

d	a	a	e	e	d	a	c	b	b	b	e	e	d	a
a	d	c	e	a	e	e	b	a	c	e	a	e	e	b

b	e	a	a	d	b	d	e	c	d	e	c	a	d	b
d	e	c	a	b	b	d	b	d	a	d	a	a	b	b

a	a	c	d	b	c	d	e	e	c	d	e	e	b	d
e	c	a	e	e	b	a	a	b	e	d	d	c	c	e

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DIRECTIONS FOR TEST # 15

SIMPLE SYLLABLE CODING - ADDITION

At the top of the page you see a code. It reads, dit=4, maz=3, tob=2 gex-1. Below you see pairs of these nonsense syllables. In your mind, match the syllable with its appropriate number in the code, and complete the addition. Do all this work in your head, only writing down the answer to the addition. Now take a look at the examples below the code. The first one reads, gex=1, plus tob=2; 1+2 = 3, so 3 is the correct answer. The second example reads, maz=3, plus gex=1; 3+1 = 4, so 4 is the correct answer. Check the rest for yourself. Are there any questions? You will have three minutes to complete as many as you can. Work quickly and accurately. Ready, begin. (TIME: 3 minutes.)

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NAME _____

DATE _____

AGE _____

CODE

DIT	MAZ	TOB	GEX
4	3	2	1

EXAMPLES - ADDITION

GEX	MAZ	TOB	MAZ	GEX
TOB	GEX	DIT	DIT	DIT
3	4	6	7	5

ADDITION

GEX	MAZ	TOB	GEX	DIT	MAZ	TOB	DIT	GEX	MAZ
TOB	DIT	TOB	DIT	MAZ	GEX	MAZ	DIT	GEX	TOB
MAZ	TOB	DIT	GEX	TOB	DIT	DIT	GEX	MAZ	DIT
MAZ	GEX	GEX	MAZ	DIT	TOB	DIT	GEX	GEX	MAZ
DIT	DIT	TOB	MAZ	GEX	MAZ	TOB	TOB	GEX	TOB
TOB	GEX	MAZ	DIT	TOB	MAZ	DIT	GEX	DIT	TOB
MAZ	GEX	GEX	DIT	GEX	DIT	MAZ	TOB	TOB	GEX
TOB	MAZ	GEX	GEX	MAZ	MAZ	MAZ	TOB	DIT	TOB
TOB	DIT	DIT	MAZ	TOB	MAZ	MAZ	GEX	TOB	MAZ
MAZ	DIT	TOB	TOB	GEX	GEX	DIT	DIT	MAZ	DIT
DIT	GEX	MAZ	GEX	GEX	MAZ	DIT	TOB	DIT	TOB
TOB	MAZ	GEX	DIT	GEX	TOB	DIT	GEX	MAZ	DIT
TOB	MAZ	GEX	DIT	DIT	DIT	TOB	GEX	MAZ	GEX
TOB	MAZ	TOB	GEX	GEX	DIT	GEX	MAZ	MAZ	DIT
TOB	GEX	MAZ	MAZ	MAZ	DIT	TOB	TOB	DIT	GEX
DIT	GEX	GEX	TOB	DIT	TOB	MAZ	TOB	MAZ	TOB

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DIRECTIONS FOR TEST #16

WORD FLUENCY

You have three minutes to write as many different words as you can think of. Do not write in sentences, use proper names or foreign words. Any questions? Ready, begin. (TIME: 3 minutes.)

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DIRECTIONS FOR TEST #17

AUDIO LETTER SPAN

Number from 1 to 18 down the side of the blank page. I am going to read some sets of letters. Listen to them carefully, and when I finish, write down the letters in the order I have given them to you. I can only read each set once, so listen carefully. Do not start writing the letters until I say so. (Read "number 1", and then the set, very distinctly.)

KEY FOR AUDITORY SPAN

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

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TEST # 18

(Directions below)

SHORTHAND APTITUDE TEST

prepared by

Research and Guidance Branch,
Department of Public Instruction,
Brisbane, Queensland.

Name.....Age Now.....Year

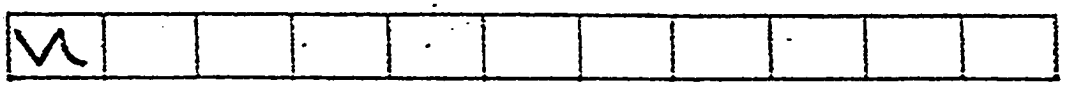
Today's Date.....Birthday.....

School.....Grade.....

TEST 1

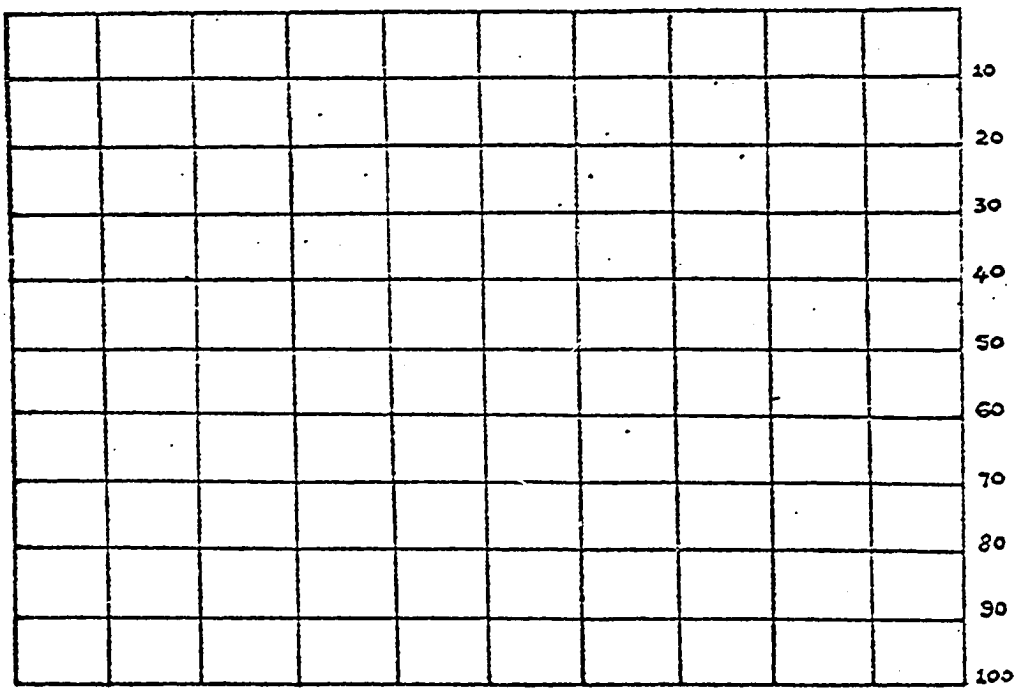
You must copy the symbol shown below as many times as you can in two minutes. The symbol contains two straight lines and a curve. Put one symbol in each block. Make the whole of one symbol before you begin work on another.

Work this line for practice. Copy the symbol accurately.



Work across the page.

WORK QUICKLY. THIS IS A SPEED TEST.



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DIRECTIONS FOR TEST #19

MAKING SQUARES

The tester says:

"You have a blank sheet of paper in front of you. When I say 'start' I want you to begin to make squares like this." Tester demonstrates squares on a blackboard. "You will notice that these squares have four sides, that they are closed, and that no square touches another. This is the pattern that you are to follow. If you should use up all the space on the front of the sheet, you may turn it over and use the back. You will have three minutes in which to make as many squares as you can. Get ready. Start. "

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DIRECTIONS FOR TEST #20

SPELLING

The tester says:

"You have a blank sheet of paper in front of you. I am going to dictate some words for you to spell. You will write down each word after I have dictated it to you. I will say each word twice. If you do not understand the word I have given, please raise your hand and I will make a sentence containing the word.

There will be twenty-five words in all. Please write as rapidly but as clearly as you can. "

The following spelling list was given:

1. road
2. ground
3. know
4. drink
5. turkey
6. elephant
7. different
8. inch
9. strong
10. stamp
11. fair
12. quickly
13. believe
14. handle
15. bridge
16. speed
17. battle
18. cleaned
19. either
20. quarter
21. guard
22. forgotten
23. crawl
24. tongue
25. single

From: The "Word Recognition and Word Analysis" subtest of the Durrell Analysis of Reading Difficulty (1955), page 9, "Grades 2-6 Reading Level--List 1."

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PLEASE NOTE:

Pages 224-225, "Durrell Analysis of Reading Difficulty", ©1955 by Harcourt, Brace & World, Inc. not microfilmed at request of author. Available for consultation at Harvard University Library.

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APPENDIX II

Raw data regarding the Fryeburg experimental group. Designations are self-evident in most cases. The Reading Expectancy is based on the Bond & Tinker (1957) formula: (years in school X I.Q.) plus 1.0 (p. 79).

I.Q. is Full Scale WISC/WAIS.

Many of the students in this group had received intensive remedial work before coming to the summer program. S #60, for example, had spent two years at the Gow School. He had learned to read while there, but had not developed writing skills. S #22 had gained over four years in reading ability during the previous summer at the Institute and private tutoring during the subsequent year. His spelling and composition skills were still showing major deficits.

All Ss had a history of difficulties in the acquisition of decoding skills, and almost all were still disabled spellers and writers.

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Miscellaneous Data, Fryeburg Experimentals

No.	I.Q.	Age	Yrs. Sch.	Rdng. Expt.	Gray Oral	Splg.	2nd Yr.	Durrell		
								Oral	Silent	List.Comp.
1	124	8	3	4.7	0.0	0.0		L1	0	H4
2	131	9	4	6.3	5.1	3.1	X	M4	M4	H5
3	117	9	4	5.9	6.1	2.4	X	L5	H4	M5
4	118	11	6	7.1	4.7	3.4		L4	L4	H5
5	102	11	5	6.1	3.2	2.6		M3	H2	H4
6	112	10	4	5.5	4.2	2.2		L4	H3	L5
7	103	11	5	6.2	4.9	3.1		-	-	-
8	126	9	4	6.0	3.9	3.0		L4	M3	L6
9	142	11	5	8.1	4.7	2.9		M4	L4	M6
10	97	10	4	4.9	2.3	2.2		M2	M2	M4
11	118	09	3	4.5	2.4	2.0		L2	L2	H4
12	101	11	5	6.0	3.6	2.1		H3	L3	H4
13	131	11	5	7.6	2.3	2.2		H1	L2	L5
14	123	11	5	7.1	2.6	2.0		M2	L2	H5
15	121	13	6	8.3	3.2	3.1		L3	H2	L6
16	109	12	6	7.2	4.2	4.0		H3	L4	H5
17	116	12	7	9.1	7.0	4.3		-	-	-
18	125	12	6	8.5	5.1	3.7		M5	L5	M5
19	96	14	8	8.7	3.4	3.0		L3	H2	L4
20	101	14	8	9.0	2.6	2.1		-	-	-

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No.	I.Q.	Age	Yrs. Sch.	Rdng. Expt.	Gray Oral	Splg.	2nd Yr.	Durrell		
								Oral	Silent	List Comp.
21	110	13	7	8.7	4.5	4.4		M4	H4	H5
22	116	14	8	10.1	10.2	5.1	X	-	-	-
23	105	14	8	9.4	8.7	3.7	X	-	-	-
24	123	13	7	9.5	5.7	4.9		-	-	-
25	123	14	8	10.8	8.0	5.3		-	-	-
26	98	13	7	7.9	4.9	2.8		L4	H4	L6
27	100	13	7	8.0	3.4	2.0		L4	L3	L4
28	95	13	8	9.6	7.7	4.8		-	-	-
29	111	13	7	8.8	5.2	5.4		-	-	-
30	99	13	7	7.9	2.4	2.0		L2	L2	H4
31	110	14	8	9.8	6.7	5.4		-	-	-
32	110	14	8	9.8	3.6	3.2		-	-	-
33	108	12	6	7.5	7.3	4.7	X	-	-	-
34	113	14	8	10.0	7.3	6.1		-	-	-
35	126	13	7	9.9	6.7	5.4		-	-	-
36	114	13	7	9.0	5.7	4.2		-	-	-
37	115	13	7	9.1	4.2	3.9		-	-	-
38	110	16	10	12.0	7.7	4.8		-	-	-
39	122	16	10	13.2	7.3	5.1		-	-	-
40	114	15	9	11.3	3.2	2.8		L4	L3	H5
41	118	19	12	13.2	9.7	6.6		-	-	-

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No.	I.Q.	Age	Yrs. Sch.	Rdng. Expt.	Gray Oral	Splg.	2nd Yr.	Durrell Oral	Durrell Silent	Durrell List Comp.
42	104	15	9	10.4	4.0	4.1		L4	L4	L5
43	120	15	9	11.8	3.6	3.3		M4	L3	H5
44	95	15	9	9.6	4.9	4.0		L5	M4	L4
45	130	15	9	11.8	4.9	4.6		M5	L5	M5
46	110	15	9	11.0	4.9	3.8		M4	M4	M6
47	123	15	9	12.1	4.2	4.0		H3	L4	M6
48	116	17	11	12.8	6.7	5.1		-	-	-
49	125	19	13	16.0	12.0	5.4		-	-	-
50	128	15	9	12.5	8.0	4.8		-	-	-
51	104	17	11	12.4	9.3	5.2		-	-	-
52	127	18	12	15.2	10.7	6.6		-	-	-
53	120	17	11	14.2	11.0	7.1		-	-	-
54	128	16	10	13.8	6.7	5.2		-	-	-
55	104	16	10	11.4	4.2	3.7		-	-	-
56	98	16	10	10.8	1.9	1.2		L2	M1	H5
57	117	15	9	11.5	11.3	6.1	X	-	-	-
58	134	15	9	12.3	7.0	5.4		-	-	-
59	98	15	9	9.8	5.1	4.0		_	-	-
60	121	17	11	14.3	12.0	6.6	X	-	-	-
61	132	17	11	15.5	11.3	7.2	X	-	-	-
62	118	16	10	12.8	7.7	5.1		-	-	-

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No.	I.Q.	Age	Yrs. Sch.	Rdng. Expt.	Gray Oral	Splg.	2nd Yr.	Durrell		
								Oral	Silent	List.Comp.
63	91	15	9	9.2	3.9	2.7		H4	M3	M3
64	99	15	9	10.0	6.1	4.3		-	-	-
65	119	15	9	11.7	11.3	6.2	X	-	-	-
66	91	15	9	9.2	5.1	3.3		-	-	-
67	101	15	9	10.1	2.3	2.1		H2	M2	L6

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APPENDIX III

Scores on three subtests of the Durrell Analysis of Reading Difficulty (Oral Reading, Silent Reading, and Listening Comprehension) for 50 subjects chosen at random from the files of the Reading Research Institute.

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Scores on three subtests of the Durrell Analysis of Reading Difficulty (Oral Reading, Silent Reading, and Listening Comprehension) for 50 subjects chosen randomly from the files of the Reading Research Institute, Wellesley, Mass.

IDENT #	SEX	AGE	GRADE	IQ	ORAL	SILENT	COMPR
1	1	8	3	107	2L	1H	5M
3	2	9	2R	107	1M	1L	5M
5	1	12	6	109	3L	3L	6+
9	1	11	5	108	2M	2H	6+
10	1	9	3	113	2M	1H	5M
11	1	8	2R	112	3L	3L	3M
13	1	9	3	118	3H	4M	5M
19	1	9	4	121	1L	2M	5M
23	1	13	8	123	4L	4H	6+
30	1	8	3	104	3L	3L	3M
31	1	8	2	101	1L	1H	3M
35	1	9	4	115	2H	4M	6+
36	1	8	3	115	2H	3L	5M
37	1	9	3	107	1M	1H	2M
40	1	13	7	118	6M	5M	6+
45	1	17	10	118	5L	5L	6+
61	1	9	2R	101	2L	2M	3M
89	1	11	6	137	3H	6H	6+
95	1	6	1	107	2L	1M	4M
104	1	10	5	124	4M	4L	5M
107	1	17	11	102	5L	4H	6M
143	2	8	3	111	3M	3M	4M
156	2	15	10	100	6L	4L	6+
163	1	14	9	113	5M	5M	6M
164	1	10	5	119	5H	6L	6+
173	1	10	3R	108	1H	2L	6+

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IDENT #	SEX	AGE	GRADE	IQ	DURRELL ORAL	DURRELL SILENT	DURRELL COMPR
174	1	14	8	108	4L	4H	6+
178	1	8	3	112	2H	2M	3M
191	1	12	6	104	3L	3H	6M
183	1	13	7	107	6M	4H	6+
185	1	8	2	115	3L	2H	3M
186	1	11	6	104	3L	3L	3M
187	1	9	4	106	3M	3H	3M
201	1	12	7	109	6H	6M	6+
212	1	15	10	104	4H	5L	6+
215	1	9	3	117	3M	3H	4M
217	1	9	3R	125	3M	3L	5M
218	1	17	11	120	6M	6M	6+
229	1	12	6	110	5M	4M	6M
231	1	9	3	101	2M	3M	3M
232	1	10	5	134	6L	6L	6M
234	1	14	9	110	6H	5H	6M
240	1	10	4	116	3H	3L	4M
241	1	9	4	105	3M	3M	3M
244	1	9	3	106	2M	2L	3M
245	1	12	6	123	6M	5H	6+
325	2	7	2	111	2M	1H	3M
1011	1	9	4	114	3L	2H	6M
1096	1	11	5	107	2M	2H	4M
1098	1	10	4	111	3L	3L	4L

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APPENDIX IV

Sample of the Tutor Report Form on which information was elicited regarding the comprehension ability of children. These reports were normally received daily.

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TUTOR REPORT FORM

Date:_____

Student_____

Materials used:

Class session goals:

What happened?:

Diagnostic evaluation: (use back of sheet if necessary)

Reading: 1. Decoding skills

2. Comprehension skills

Spelling:

Composition:

ADDITIONAL INFORMATION:

Tutor_____

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APPENDIX V

Spelling samples from the two-school study. The first part of the protocols consists of samples from poor readers/ poor automatizers, while the second part is made up of samples from poor readers/normal automatizers.

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Spelling samples from third grade pupils who were poor readers and poor automatizers.

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161 | A

road ground ~~mont~~

drink turkey eleplant

~~different~~ inch

strong

stamp

fair

quickly ✗

weleave +

harail +

wige +

spled ✗

watch ✗

cleand

other +

quarter

gard +

fougotten +

chale ✗

tongue

single +

9

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rodex singlx
gondx
ncowx
drink
tunkex
elifntx
drifrnx
inch
stornx
Stamf
Farx
Qurtx
blevex
handle
brigex
Spedex
batalx
clindx
ethex
Qutenx
gurdx
Forgutnx
crolx
hungx

4

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1. road
2. ground
3. know
4. dink X
5. turkey
6. eliphint X
7. difrint X
8. inch
9. [illegible]
10. [illegible]
11. [illegible] X
12. [illegible] X
13. [illegible] X
14. handdil X
15. [illegible] X
16. [illegible]
17. ballil X
18. clean X
19. ether X
20. [illegible]
21. grass X
22. forgotin X
23. crall X
24. lung X
25. single

10

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road ✓
ground ✗
know ✓
drink ✓
turky ✗
Blufent ✗
sipot ✗
inch ✓
ston ✗
stamp ✓
far ✗
gidy ✗
blef ✗
handl ✗
trig ✗
spede ✗
fatel ✗
klend ✗
ether ✗
Quotar ✗
grdi ✗
frgotin ✗
kol ✗
tonn ✗

5

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road round X
know drink trucky X
elafent difint X
inch
strang Qral X
stap X
fair X tung X
sigl X
Qikely X
belaw X
hand X
brig X
sped
batil X
Qlened X
steer X
Qrter X
grard X
forgtin X

5

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297A

road
ground
know
drengk
terch
elefent
difent
inch
strong
stomp
far
quley
blev
harnll
brig
peda
brell
klen
ether
gster
gred
forgten
kral
tugn
singgl

7

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[2 15A]

road
ground
Rope x
dust x
turcky x
elphephent x
diphrent x
inch
storng x
stamp
fair
quickly
belvic x
handle
Brlge x
speed
battle x
cleaned
ether x
quarter x
gard x
forgoten x
crowl x
Tong x
single

10

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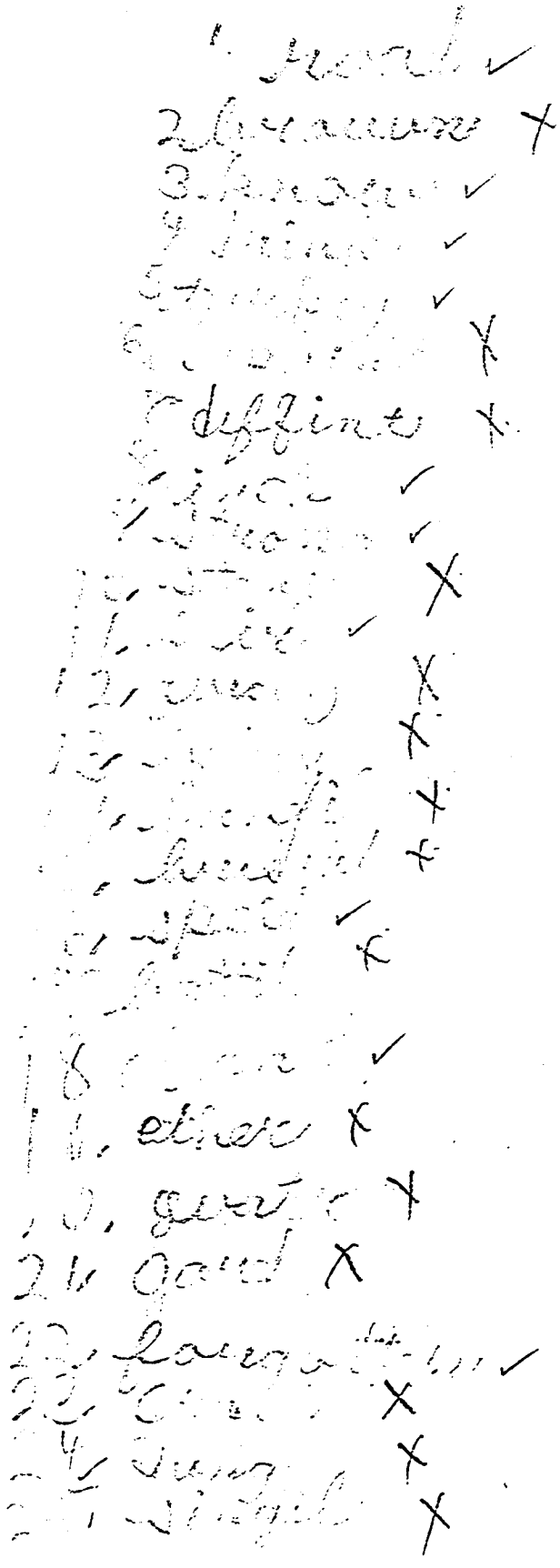

10

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248 A

Duquette

shes 2e q

1. rode X
2. ground.
3. know
4. bunk.
5. turkey
6. diffent. X
7. difrent. X
8. bnch. X
9. strong
10. stamp
11. fare X
12. quickly
13. belive X
14. handle
15. bridge 13
16. speed
17. battle
18. cleaned
19. eather X
20. quarter
21. gard X
22. forgatin X
23. quall X
24. lavng X
25. singgle X

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road
ground
know
drink
turkey
elghlet +
defrent +
inch
strong
stap +
fair
qiqly +
bclive +
handle
bridch +
spec +
batle +
cleaned
ether +
qater +
gardid +
forgoten +

tual + x
Segl + x

10

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Spelling samples from
third grade pupils who
were poor readers but
normal automatizers

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282B

R

A
road ✓
ground ✓
know ✓
drink ✓
turkey ✓
elafent ✓
drift ✓
inchin ✓
trang ✓
stang ✓
fear ✓
gauty ✓
belew ✓
handly ✓
big ✓

6

sped ✓
patly ✓
clean ✓
eathy. ✓
ewarter ✓
gard ✓
forgaten ✓
crale ✓
tang ✓
sening ✓

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road
ground
know
drink
turkey
elephent x
different x
inch
strong
stamp
fair
quickly
beleave x
handle
bridge x
speed
battle

cleaned
either
quater x
gard x
forgoten x
crale x
tang x
single

16

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238B

1. road
2. ground
3. honour
4. drink
5. turkey
6. elephant
7. different
8. inch
9. strong
10. stamp
11. fair
12. quickly
13. deliver X
14. handle X
15. bridge
16. speak
17. bottle
18. cleaned
19. leather X
20. quarter
21. guard
22. forgotten X
23. crawl
24. turn X
25. single

20

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Test B

Road Ground Know drink Turkey elephant different
inch strong stamp Fair Quickly Believe handle
Bridge speed Battle cleaned either Quarter.
Guard Forgotten Crawl Tongue single

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road
ground
know
drink
turkey
elephant
different
inch
strong
stamp
fair
quickly
believe
handle
bridge
speed
little
learned
other X
quarter X
guard
forgotten X
crawl
tongue
single

22

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VITA

1938-1942	Piedmont College, and the University of Georgia	A.B. June 1942
1942-1945	The Union Theological Seminary, New York City	B.D. June 1945
1945-1949	Minister, Community Church Chaplain, Uplands Hospital and Pleasant Hill Academy Pleasant Hill, Tennessee	
1949-1955	Instructor, Old and New Testament, Foundation School, Berea College, Berea, Kentucky	
1955-1956	Fulbright Grantee, Foreign Graduate School, University of Copenhagen, Denmark	
1956-1959	Dean of Men, Foundation School Berea College, Berea, Kentucky	
1959-1970	Graduate School of Education Harvard University	
	Consultant on Language Disabilities, Wayland, Mass., Public Schools, 1959-1963	
	Co-founder, Adult Literacy Program Mass. Council for Public Schools Boston, Mass., 1963-1964	
	Consultant, Office of Economic Opportunity, Washington, D.C., 1964-1965	
	Founder-director, Reading Research Institute, Wellesley, Mass., 1964 to present	

Cont'd.

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Research Associate,
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Co-founder and Educational Director
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1967 to present

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