IDENTIFICATION OF SUBORDINATE SKILLS CONTRIBUTING TO SPELLING FAILURE IN EIGHT YEAR OLD BOYS WITH AVERAGE INTELLIGENCE

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN SPECIAL EDUCATION IN THE GRADUATE SCHOOL OF THE TEXAS WOMAN'S UNIVERSITY COLLEGE OF EDUCATION

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We hereby recommend that the dissertation prepared under our supervision by Reba Katherine Walker

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be accepted as fulfilling this part of the requirements for the Degree of Doctor of Philosophy.

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DEDICATION

This work is dedicated to the children who made it possible and to those whose problems and questions created the need to know and understand more about the processes of human learning. Because of them the effort has been made to expand the boundaries of the known and probe the unknown.

ACKNOWLEDGMENTS

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More directly, there has been the support, guidance, and positive direction provided by the University committee members. Special appreciation is expressed for their willingness to give of their time and talent to guide this study. Dr. Ernest Watkins was especially generous in providing time to answer questions and define problems.

It is hoped that the debts of gratitude may be repayed by providing the same kind of support to students and contemporaries in future research endeavors.

LIST OF TABLES

TABLE OF CONTENTS

IDENTIFICATION OF SUBORDINATE SKILLS CONTRIBUTING TO SPELLING FAILURE IN EIGHT-YEAR-OLD BOYS WITH AVERAGE INTELLIGENCE

CHAPTER 1

Introduction

At every age level boys make more spelling errors than girls and are more variable in their performance in reading, spelling, and handwriting than girls(Anderson, 1963). In part, the lower performance in these academic areas may be attributed to the natural differences in the sexes. McCarthy (1946) referred to the "total sex difference" in language development in favor of girls. McNemar (1942) noted that girls performed better on Stanford-Binet items involving language than did boys. Generally, results of research show girls to be superior to boys in language development at all ages and stages of development (Gesell, 1940; Millard, 1951; Thompson, 1952). Several studies indicate the sex differences may be attributed to fluency on the part of girls rather than any absolute difference in vocabulary or comprehension of the written word (Havighurst & Breese, 1947; Hobson, 1947; Terman & Tyler, 1954).

In the early years, at least, the difference in language development may be attributed to the generally accepted observation that boys develop at a slower rate than girls. The lag in development almost surely results in negative feelings about the self and school tasks in general. Brueckner and Bond (1955) list undesirable attitude and lack of interest as contributing factors to poor spelling. It is reasonable to expect lack of

interest and negative attitude toward any activity which does not enhance the self concept (Kowitz, 1967; Atwell, 1969).

Regardless of the differences between boys and girls in language development there remains the fact that not all boys function below grade placement level expectations in reading and the language arts, spelling included. It is that population of boys which functions below grade placement level in spelling that will be considered in this study. It has been observed that some boys function a year or more below grade placement level though they are of the same age and of the same range of intelligence (WISC Full Scale IQ) as classmates who function at or above grade placement level. Simpson (1967) reported children of average to superior intelligence who failed spelling. Often the boys are of the same race, language and socioeconomic groups also.

Under these conditions, a specific language learning disability may be suspected. Sources of the disability may be various, but certain commonalities might be expected if sufficient information from educational, perceptual, and intellectual tests could be obtained from children demonstrating spelling disability and compared to like data from a control group. Certain patterns should be present in the test profiles of the two groups that would differentiate between them in terms of strengths and weaknesses in subordinate skills and cognitive process development. The deficit skills conceivably could be those usually classified as preacademic, such as perception and discrimination of an elementary nature by means of

the various sense modalities. If this be the case, drill in the global activity of spelling from dictation would not be expected to produce significant or lasting improvement until retraining of the more basic processes occurred.

While most school instruction utilizes the whole class method, it may be that students demonstrating spelling difficulty need highly individualized instructions. With the trend toward emphasizing diagnostic and prescriptive teaching, there must of necessity be analysis of tasks and individual learning strategies, recognition of hierarchies of skills, and sequencing of acquisition of skills subordinate to the final expected performance by the learner. Identification of the deficit subordinate skills is thus an antecedent to relevant training for elevating the level of performance in the most efficient manner.

Problem

The major problem of this research project was to identify those subordinate skills which differentiate between eight and nine year old boys with spelling disability and boys of the same age, IQ, grade placement, race, language and socioeconomic status who function at or above grade level.

Research in spelling disorders as reported and reviewed did not indicate an effort to identify and train (or retrain) the subordinate skills comprising the broad foundation of preacademic learning which serves as the structure upon which all new learning must be built.

English spelling is highly complex, with almost unlimited components. Many of the skills and behaviors may not, upon first consideration, appear to be part of the global task of writing a word from dictation. Yet, if the child has not acquired the prerequisite behaviors, he may not benefit from even intensive training in the global subject area of spelling.

While many children acquire such skills incidentally before entering school, the child with a specific learning disability may not have mastered skills as low on the continuum of learning as Gagné's (1966) stimulus-response level in terms of being able to spell from dictation.

The spelling task itself must be analyzed for component factors and at least a tentative hierarchy recognized or formulated. Gagné has charted such analyses of reading and of acquisition of number concepts. No such analysis for spelling was found in the literature. Review of the literature did give many clues as to what some of the contributing factors might be, however. Different investigators over a period of time have been interested in specific factors. The broad surveys by Spache (1941) reporting the findings of both causal and related factors in spelling failures suggested to the present investigator tests which might be used to identify the factors seen to be of the most primary nature. Since the surveys generalized much information from the field of reading disorders, it seemed necessary to be more specific and to determine whether or not there were tests of

specific factors which differentiate between boys with spelling disability and boys of the same age, race, grade placement, IQ, language, and socioeconomic status who function at or above grade placement level.

Since the investigation focuses on the child with a learning disability in spelling and such disability, according to much of the literature, has been viewed as psychoneurological (Johnson & Myklebust, 1967), the work of Luria (1970) was especially considered as offering direction to the investigation. His description of behaviors observed when known lesions existed in various parts of the brain, suggested that similar behavior might exist in lesser degree if the brain were dysfunctional, even to the most subtle degree. A problem in using information from studies and articles on psychoneurological disorders is that much of the data is gathered from clinical study of adult brain-injured patients. Downward extrapolation of the results or conclusions may not be appropriate for making statements about the behavior of children with cerebral dysfunction.

Much has been written in an effort to define learning disability in specific terms that will allow for educational placement and thus for local funding, since funding varies according to classification of exceptionality. A composite definition is used: the child must have average or above intelligence (WISC FSIQ of 90 or more) and still function one or more years below expectancy in a basic learning area (spelling) even though vision, hearing, gross motor performance, and emotional adjustment are apparently

adequate (Johnson & Myklebust, 1967; Myklebust, 1967; Kass, 1969; Waugh & Bush, 1971). Since IQ, chronological age, grade placement, and spelling achievement will be controlled, the criteria will be comparable to Myklebust's learning quotient (LQ) which is derived by using the following equations.

$$\text{Expectancy Age} = \frac{\text{MA} + \text{CA} + \text{Grade Age}}{3}$$

$$\text{Learning Quotient} = \frac{\text{Achievement Age}}{\text{Expectancy Age}}$$

A learning quotient of 89 or less represents a learning disability.

The value of the proposed study should be that diagnosticians, resource teachers, or others responsible for educational programming and prescriptive teaching could use the same tests or subtests found to differentiate between the two aforementioned groups of boys to identify specific deficits in a particular child and design learning tasks according to his individual needs. The child need not be subjected to an intensive perceptual-motor training program if his relevant deficit is faulty articulation or lack of ability in recognizing letters of the alphabet by sound. Nor does he need to have his entire spelling program changed to emphasize phonics if the deficit is in the motor planning required to make the strokes of a letter even though its sound and name are known to him. A low score on a spelling test may be as inadequate for use in remediation as a Full Scale IQ. Both are deceiving. Carey (1969) suggests that any whole-test score is deceiving and offers the taxonomic type test as a partial solution.

The many excellent spelling texts used in schools incorporate research findings into their study and drill suggestions, increasing the spelling skills of the average and superior speller and widening the range of performance in a classroom which includes children with spelling disability unless special efforts are made to provide a different kind of training for the disabled. It is not that new or different ways are needed to teach spelling to the majority of children. It is rather that skills of the disabled learner must be analyzed more precisely. If the deficit is in the anlage function (Horn, 1968) training must begin in these very elementary capacities of attention, perception, and retention which lie below the simplest cognitive process. The function is closely associated with neural-physiological structures and could thus be expected to be dysfunctional to a degree in the child with psychoneurological disability.

Review of the Literature

Research in the area of spelling generates a low level of interest on the part of educators in general. Horn (1967) reported that of 454 language arts research articles published or in process during 1965, only 14 were on spelling. Of the thirteen spelling studies reviewed by Horn (1967), one was on comparison of methods of teaching spelling while none compared test score profiles. In 1941 Spache reported a survey of research dating back to 1900 and from his survey outlined causal factors in spelling disability. Four major categories were suggested: physical, intellectual and temperamental, subject matter achievement, and miscellaneous.

Physical factors were seen to be visual disorders, disorders in auditory acuity and auditory discrimination, disorders in motor coordination as it influenced both handwriting and speech, poor handwriting (quality and speed), and disorders in speech and pronunciation. In the intellectual and temperamental area, level of intelligence was the most frequently reported factor, though the correlation between spelling and IQ will not be expected to be as great as the correlation between reading and IQ (Bakwin & Bakwin, 1966). Attitudes, interests and emotions were listed as causal in this area also. In the area of subject matter achievement, phonetic skills and knowledges and vocabulary were seen to be major causal factors in spelling disability. Miscellaneous causes were home background, early training, and educational history, among others.

A second article by Spache (1941) outlined factors related to but not causal in spelling disabilities. Among these were various visual disorders, reversals, congenital defects in specific cortical areas, handedness and eyedness, cerebral dominance, age, sex, physical maturation, and birth order. Both surveys by Spache utilized data from the analogous field of reading to formulate the outlines and develop the patterns in relationship to spelling performance.

A series of studies (Hodges, 1964; Rudorf, 1965; Hodges and Rudorf, 1965; Hodges, 1966; Hanna, 1966) centered around the investigation at Stanford of phoneme-grapheme relationships analysis. One result of the studies was the formulation of a phonological system of spelling. It was

found, however, that when a list of 17,000 words was fed into the computer programmed to use the phonological system, fewer than 49% of the words could be correctly spelled from oral-aural cues alone, even though phoneme-grapheme relationships could be predicted better than 89% of the time. Hanna (1953) had earlier emphasized the importance of teaching the child to "hear" and "analyze" his speech in such a way as to facilitate translation of his oral speech to the written form in spelling. Emphasis on phonics and sound-symbol relationships were encouraged. At the same time he reported some fifteen spellings of the /e/ sound in he. Thus the analysis and sound-symbol relationship training would of necessity teach the various spellings of such phonemes. The Gillingham method (1960) does this. The linguistic approach in general emphasizes structural analysis of words into CVC, CVCe, CVVC, patterns (Simpson, 1967). Silberman (1963) reported that first graders who trained in auditory blending of such linguistic patterns (CVC trigrams) were able to decode 75% of such trigrams when they were presented visually. The untrained children could decode none. It would appear then that training one sensory modality in a task transferred to a reverse process in a different modality.

Hahn (1964) studied second graders and found that the results of spelling tests did not bear out the assumption that increasing phonics ability increases spelling ability. Meaningful writing experiences appeared to contribute most to spelling success. This finding would agree

with Hull (1952), who suggested that spelling a word is a heterogeneous response chain with terminal reinforcement. The oftener the response chain is activated and completed, the more automatic it should become. Kinesthetic memory would thus be involved. Visual monitoring would provide a part of the reinforcement for correctly produced specimens. As Hull pointed out, however, the longer the response chain becomes, the lower becomes the probability that all responses will be correct. Sapir (1971) reported that first graders trained in reading and spelling only those words that carried the phoneme-grapheme correspondence did not score higher on the Stanford Achievement Test (Primary II) at the end of the second grade. Many of the spelling errors reported by Kooi, Schutz, and Baker (1965) could be the result of dependency upon phonics.

Spache (1940) developed a system for classifying spelling errors and found, in a study of the errors made by 25 average and 25 poor spellers in the third through the fifth grades, that his classifications were omissions, additions, transpositions, phonetic substitutions, and non-phonetic substitutions. Each class was further sub-classified. Errors were seen to be the result of deficits in: auditory discrimination, phonetic skills, ability to give letter names to letter sounds, sound blending ability, and ability to analyze.

An interesting study by Russell (1955) used fifteen tests (subtests) to compare the performance of 250 students designated as the top 27% and the bottom 27% in spelling achievement in grades five and six. The students

were matched for CA, IQ, and sex. Scores of the good spellers exceeded scores of the poor spellers on 14 of the 15 tests with the difference being significant at the .01 level. The Comprehension and Vocabulary subtests from the reading section of the California Achievement Test; Perception, Reasoning and Space items from SRA Primary Mental Abilities Test; and an experimental form of a visual perceptual test and six experimenter-constructed vocabulary tests made up the battery. Vocabulary and spelling scores were found to have a .60 correlation. Lower spelling scores were more highly related to auditory and visual test scores than were high spelling scores. Fifth and sixth grade children spelling at the seventh and eighth grade level appeared to be using a different set of cues from the ones used by the children performing at the third and fourth grade level in spelling.

Spelling would appear to be a highly complex psycho-motor act comprised of a multiplicity of subordinate or prerequisite skills. Identification of the components involved continues to be the subject of many informal articles, some of which are based on clinical observation (Crawford, 1967; Barsch, 1967). Johnson and Myklebust (1967) state that spelling requires more auditory and visual discrimination, memory, sequentialization, analysis, and synthesis and integration simultaneously than perhaps any other skill.

Luria (1970) analyzed the processes involved in writing a word when the stimulus is auditory according to the area of the brain involved

and the disorders manifested when these areas were damaged. The four major processes discussed by Luria were auditory discrimination (as the child distinguishes between acoustic cues only very slightly different in some cases), articulation (as the child implicitly or explicitly uses oral kinesthetic cues to clarify acoustical structure), translating the phonemes into graphemes (as the child matches the acoustic input to a learned symbol for the sound), and putting the letters in the proper sequence to form a word. For some children the name of the letter representing the sound may be known and oral spelling would be possible. However, forming the written letter (even spatial relationship of its parts) will give difficulty. Stereotyped graphic responses may be given for some letters or words.

Auditory discrimination deficits may be compounded by short term memory errors when phonemes in the same word are similar. Shulman (1971) suggests that similarity in a string of elements decreases the number of elements recalled in correct position. Such similarity contributes more to increase in error than does repetition of the same sound. Such finding agrees with Kooi (1965).

Linn (1967) suggests a battery of tests for diagnosis and remediation of spelling disorder which includes the Frostig Developmental Test of Visual Perception, Illinois Test of Psycholinguistic Abilities, The Wepman Test of Auditory Discrimination, and the Purdue Perceptual Motor Survey. No report of research using such a battery is given. The selection of

tests appears to be arbitrary.

Regardless of the complexity of spelling, it has been suggested that no more than 75 minutes per week be devoted to spelling instruction (Horn, 1967). Piaget has stated that teaching spelling is a "waste of time" and suggests that spelling is learned much better just by reading (Hall, 1970). The solution to the problem of poor spelling may be to identify the component skills and to give specific training in these areas when deficiencies are identified rather than to teach the global operation. Gagné's cumulative model of learning suggests such an approach (Gagné, 1964, 1966, 1967, 1968).

The study being reported differs from those reviewed in its limited age and grade placement of male subjects. While Anderson (1963) compared spelling performance of girls and boys, the study being reported was for boys only. Performance of first graders (Sapir, 1971), second graders (Hahn, 1964) and fifth and sixth graders (Russell, 1955), has been studied. Spache (1940) included third through fifth grade in one of his studies. None of the studies specified limitation to English-speaking subjects with no second language to control for influence of bilingualism. Nor did any specify race of subjects to control for influence of cultural-ethnic factors. No report was made of use of a measure of socioeconomic status in selection of subjects for any of the studies reviewed. The McGuire-White short form would give adequate control of this variable and was used as one instrument to identify students to be

considered in the study.

The studies reviewed did not use an experimental group of children classified as learning disabled by definition. The boy with a specific learning disability in spelling might be expected to demonstrate many test behaviors not observed in boys spelling on the same level for different reasons (mental retardation for example).

Though several studies identify various factors contributing to spelling errors, it is at the level of the global, complex task rather than any attempt to formulate a concept of prerequisite skill training.

Many of the studies treat instructional methodology at the complex global level, curriculum procedure, phonological analysis of the English language (i.e., the subject matter). The purpose of the study being reported is an attempt to isolate factors which suggest deficits in specific cognitive processes at the lowest levels of learning. The child himself would be of central concern, not the subject matter. The fact that most children function adequately under existing curricula and methodology speaks well of educational procedures generally. It is the need for a differential approach for the exceptional child that generates interest in the more basic components of spelling.

Though Spache (1940) listed the inability to give letter names to letter sounds as one of the deficits contributing to spelling error (third through fifth grade) and Luria (1970) lists various mental

manipulations of the alphabet (sound, name, graphic reproduction) as involved in spelling, no specific comparison of various aspects of alphabet knowledge of groups in a controlled study has been found in review of the literature. The proposed study would evaluate the knowledge of the alphabet and compare error scores of the two groups of boys. Grapho-motor reproduction, sequencing, auditory recognition, naming from visual presentation and producing the phonic representation from visual presentation, as well as naming from tactile examination only was involved in the assessment of skills of the students participating in the present study.

The MKM Auditory Letter Recognition Test requires the child to write initial consonants, consonant blends, medial vowels and consonant digraphs when a whole word is verbally presented. Though the task is not as complex as spelling a word from dictation, it does sample the ability to analyze the verbal stimulus which Luria (1970) suggests as being a necessary skill for spelling. Its use in the present study allowed partial evaluation of the ability on the part of the subject to analyze the individual sounds of a word, assign a letter name to the sound, revisualize the letter, make the necessary motorplans for grapho-motor execution of the required letter or letters. Though Silberman (1963) found auditory blending training to aid first graders in sounding out visually presented trigrams, it may or may not be that auditory blending

ability would aid analysis of the same trigram presented as a verbal whole (i.e., synthesis ability may not be related to analysis ability when only the auditory modality is involved).

Purpose and Limitations

The purpose of this investigation was to determine whether or not a battery of tests as is generally administered for pupil appraisal would yield information which would discriminate between third grade boys, age 8-0 to 9-7 inclusive, who were functioning one or more years below grade placement level in spelling and those who were functioning at grade placement level or above in spelling as measured by the Wide Range Achievement Test. The variation in ages allowed for testing throughout the school year and allowed participation in the study of students having birthdays soon after school opened in the fall as well as those having birthdays in late summer.

It was felt that if specific tests and/or subtests were found to be consistently and significantly low, knowledge of factor analysis of the subtests should provide direction for prescriptive teaching and educational programming for individual cases. The child might be helped further to develop strategies for spelling which utilize his strong sensory modalities: auditory, visual, kinesthetic, or any combination thereof.

The study was limited to eight and nine year olds because it is at this age that many teachers and schools refer children for evaluation. It

has been a general policy in most areas to allow the child time to mature, adjust, "catch up" during the primary grades. Developmental charts indicate that by eight years of age the child's auditory discrimination is fully developed (Wepman, 1958, 1960), that articulation of all speech sounds has been mastered (Berry & Eisenson, 1956; Kirk, 1962; Wyatt, 1969; Templin, 1953) and that visual maturity has occurred (Austin, 1961). In addition by age seven 90% of perceptual growth is thought to have occurred with the additional 10% occurring between ages seven and ten (Martin, Gilfoyl, Fisher and Grueter, 1969). Thus maturational readiness of third graders might be assumed to be adequate in the perceptual areas unless a true disability were present. Cohen (1959) suggests different factorial structure of the Wechsler Intelligence Scale for Children at ages 7-6, 10-6, and 13-6. Including several grades and ages in one study might tend to level the differences and disguise components of a problem for a specific age. Also the formal spelling test has become part of the curriculum and children are expected to be able to spell from dictation.

No subject had repeated a grade nor had he ever been assigned to any special education class. The only exception to the class assignment restriction was that a child once assigned to a learning disability class but at the time of the study is assigned to a regular classroom might be considered for the experimental group. Boys with Full Scale IQ

on the Wechsler Intelligence Scale for Children equal to or greater than 90 were used in the study. The restriction was made in order to provide partial control of the effect of intelligence on the spelling scores since spelling scores and general intelligence are expected to be positively correlated in normal children (Horn, 1967; Brueckner & Bond, 1955; Russell, 1955; Spache, 1940). Simpson (1967) noted children of average to superior intelligence who failed in spelling. Boys in the experimental group for this study were in this IQ range but scored at least one year below grade placement level on the WRAT spelling subtest. Boys in the same IQ range but with a WRAT spelling score at or above grade placement level were selected for the control group.

The study was limited to boys only because it is felt that the spelling scores made by boys would vary for reasons different from the reasons causing variations in girls' scores (Sapir, 1966; Critchley, 1971; Kagan, 1969; Prescott, 1955; Anderson, 1963). Other studies are cited in the Introduction.

English-speaking boys were selected with the added restriction that they had no second language in order to minimize effect of confusion in auditory reception of words which might be similar in the two languages (Lester, 1964). Previous study of an assigned list of words, as is used in formal instruction, should facilitate spelling by simple expectancy. The effects of expectancy related to rehearsal should not enter on the Wide Range scores since the list would not

have been studied or rehearsed before testing. Expectancy should then be according to the child's receptive vocabulary or familiarity with words only. Effect of speech and language use on auditory reception was further controlled by selecting white middle class subjects only. The concept of a "standard" pronunciation system presents problems in teaching and testing spelling (Hanna, 1966). If the teacher and the student do not approximate sameness in pronunciation, internalized meanings, and expressive function of words, the differences could produce variable effects on scores. Milner (1951) found the child's language status and socioeconomic status to be correlated .78 or .86 according to the statistical method used. Socioeconomic class is seen to have an effect on vocabulary, general adequacy of speech, articulation, and precision as well as amount of speech (Irwin, 1948). Rate of language development differs with socioeconomic status so that children enter school with different receptive and expressive language levels (Breckenridge, 1955). The McGuire-White short form was used for determining socioeconomic status so that the two groups would be comparable in this respect.

Boys for the experimental and control groups were selected so that the mean Full Scale WISC IQs for the two groups would not differ more than four points. Since study was carried out over a three year period the ages of the boys range from 8 years, 0 months to 9 years, 7 months, with mean ages for the two groups which do not vary more than

four months. The socioeconomic status for subjects was kept within the range of 23 to 56 index points with means between the two groups not to vary more than $\pm$ four index points.

The Wide Range Achievement Test was selected because it would limit the behavior to be analyzed. Being thus limited the term "spelling" will be used in a restricted rather than a general sense.

Definition of Spelling

For this study "spelling" is defined as the ability to write a single word from dictation. It is realized that for spelling to be functional, the student must develop the ability to use the word in composition without aid of either visual or auditory cue. He must be able to retrieve it from a memory store almost automatically so that the flow of thought synchronized with rhythmic motor execution is not interrupted by conscious effort to recall components of the desired word or their sequencing and construction. The curriculum for public schools generally calls for the student to study certain specified lists of words, which are dictated to him by the teacher as she administers the ubiquitous Friday spelling test. It is realistic, then, to identify possible prerequisite skills which need training or retraining if the student is to function adequately in this respect. Higher education continues to rely on the lecture to impart knowledge, requiring adequate ability to translate the spoken

word into decipherable written notes if the student is to have means of reviewing the lecture for study purposes. Consistent correct writing of a word should increase the probability that the response becomes automatic, improving the quality of spelling in composition as well as spelling from dictation.

Test Selection for Profile

Tests used in the investigation were chosen because they are the ones most often used in pupil appraisal and because they measure the factors most often mentioned in studies of factors contributing to spelling errors. Waugh and Bush (1971) suggest a minimum test battery for appraisal of elementary school children:

The Stanford-Binet (L-M) or The WISC

Draw-A-Person

Peabody Picture Vocabulary Test

Purdue Perceptual-Motor Survey

Illinois Test of Psycholinguistic Abilities

Frostig Test of Visual Perception

Bender Gestalt

Memory for Designs

Wepman Auditory Discrimination Test

Wide Range Achievement Test

At the upper elementary level the Hiskey-Nebraska replaces the ITPA and the Frostig is not given. For this study only selected subtests from the ITPA were used. The Benton Visual Retention Test was used to test visual memory when a grapho-motor response is required. The Frostig was not administered, nor was the Purdue. Selected tests from the Detroit Tests of Learning Aptitude were used instead of tests from the Hiskey-Nebraska. An additional cluster of tests pertaining to the alphabet were given as was a developmental articulation test.

As stated previously the WISC was used to establish IQ for selection of subjects. Subjects had Full Scale IQ of 90 or above regardless of spelling performance. The WISC was chosen because of its widespread use in pupil appraisal and in diagnosis and prescription and for the usefulness of subtest scatter to suggest further testing and possible means of remediation (McCarthy & McCarthy, 1969).

Spache (1941) listed home background, early training and educational history as related to spelling performance. The scores on the Information subtest of the WISC should reflect this background of education, cultural milieu, and experience (Gearheart & Willenberg, 1970; Waugh & Bush, 1971).

Comprehension is a factor related to spelling scores (Russell, 1955; Nall & Hoops, 1967; Crawford, 1967). Cohen (1959) suggests that the WISC subtests Information, Comprehension, Similarities, and Vocabulary measure verbal comprehension. Once the word has meaning

for the child, it is hypothesized, he is more likely to be able to spell it, perhaps because a familiar word is better recognized auditorily. Money (1962) suggests that a verbal comprehension score can be determined by adding the scaled scores of the WISC subtests Information, Comprehension, Similarities, and Vocabulary then dividing by four. This technique was used to derive a verbal comprehension score for each subject.

Spache (1941) and Russell (1955) found correlations between vocabulary and spelling scores. The Vocabulary subtest of the WISC was used to evaluate this factor. Vocabulary factor has been found (Sabatino and Hayden, 1970) to be a principal component of general school failure in elementary school failure. The spelling section of the WRAT was not used in the Sabatino study though the other WRAT subtests were used.

As mentioned previously, Myklebust (1967) sees synthesis and integration as factors in spelling performance. Verbal integrative ability is measured by the WISC Similarities subtest (Garmes, 1970).

Sequencing appears to be a major factor in spelling (Hull, 1952; Hanna, 1953; Heckleman, 1966-67; Critchley, 1971). Sequencing of input should be considered as a part of the sequencing factor (Heckleman, 1966-67). Bannatyne (1968) suggests that WISC Digit Span, Coding, and Picture Arrangement all measure sequencing abilities. A derived

sequencing score was obtained by averaging the scaled scores on these three WISC subtests. In addition the Detroit Visual Attention Span for Letters was used. Rupert (1971) suggests that the student with a deficit in visual sequential memory may be able to spell a word correctly if allowed to do so orally. When he is asked to write the word, however, he is not able to sequence the letters properly. He may have included all the letters but have their order jumbled. The Detroit subtest also may estimate accuracy of visualization mentioned by Barsch (1967). It was observed that children who consistently spelled a word incorrectly, later read their misspelled word as the required word. The correct visual image must be acquired if the components are to be properly sequenced in reproduction. In addition the image must be retrievable from memory in order to be expressed. Digit Span subtest of the WISC was considered for measure of auditory-verbal sequencing.

Poor motor coordination (Spache, 1941; Barsch, 1967), poor handwriting in both speed and quality (Spache, 1941; Hanna, 1953; Brueckner & Bond, 1955) have been found to be related factors contributing to low spelling scores. The Coding subtest of the WISC and the Detroit Motor Speed and Accuracy Test was used to measure this area of performance.

Visual perception has been suggested as being a factor in spelling performance (Spache, 1941; Russell, 1955; Crawford, 1967; Myklebust, 1967). From reading reports of various studies, it is concluded that the term <u>perception</u> includes the cognitive process of discrimination also. Since much attention to detail is required in discrimination

between such letters as the printed e and c or n and h, scores on the Picture Completion subtest of the WISC were considered in evaluating this area. The visual perception required will include perceiving the word as it is presented in a form to be studied or learned and perceiving the word after it is written from dictation. Thus a visual monitoring of the grapho-motor response is inferred. Children who have poor motor and kinesthetic cues probably use the visual feedback for self-correcting purposes. Excessive erasing and correcting has been observed clinically in bright children who made incorrect letters or letter parts when writing from dictation, but recognized the error in the visual form. Spatial orientation is at least a contributing factor in this area of spelling performance. Rupert (1971) has stated that perceiving spatial relationships is directly related to spelling skill, especially as it relates to placing letters in their proper positions. Gunderson (1969) defines orientation of single letters (b-d, p-b) as static reversals and movements of letters to other parts of the word (i.e., sequencing errors) as kinetic reversals (e.g., left-felt). The child who writes a "b" when a "d" is required but almost instantly erases the error and corrects it, may not have the kinesthetic image or the motor plan for execution of the letter readily available, but uses visual discrimination in his self-monitoring. Tests for evaluating the visual perception factor, in addition to Picture Completion, were WISC Block Design and Object Assembly. In addition a

Spatial Abilities score was derived from Object Assembly, Block Design, and Picture Completion by using the average of the scaled scores of the three subtests as suggested by Bannatyne (1968).

A further clarification of the effect of comprehension and integration on spelling was sought in comparing scores on the Peabody Picture Vocabulary Test. Comprehension of the auditory stimulus is assumed if the subject is able to integrate the verbal and visual cues in order to make a correct response. Since the PPVT is expected to correlate with the WISC Verbal Scale (Dunn, 1965), the IQ scores on these two measures were compared for both the experimental group and the control group. Analysis of the degree of differences in the two groups was also done.

Integration of visual perception and grapho-motor response was tested by using the Bender Visual-Motor Gestalt Test. The scoring technique used was that of the Watkins Bender-Gestalt Scoring System. A copy of the scoring sheets are included in the Appendix. The manual and report of the research included in standardization are as yet (1974) unpublished. Information, however, is available through the Department of Special Education at Texas Woman's University (Watkins, 1973). Since the score is an error score, the lower the score, the better the performance.

Since the Bender allows a grapho-motor response to occur in the presence of the stimuli, it does not test visual memory. The Detroit

Visual Attention Span for Letters does test visual memory but no grapho-motor response is required. The Benton Visual Retention Test was used to test integration of visual perception-visual memory grapho-motor behavior. Both the number correct score and the error scores were considered. The Benton may be considered a measure of revisualization. In addition, the Benton may be considered to test simultaneous memory for form, attitude, and sequence. It may be that each of these aspects of memory would be intact if tested separately but one or more be dysfunctional or inoperative if the task requires simultaneous processing in all three areas, as in reading, writing, and spelling (Guthrie & Goldberg, 1972).

Spache (1941) found sound blending to be related to spelling ability. Bannatyne and Wichiarajote (1970) reported sound blending to be included in the lower limits of a cluster factor which also included spelling scores, total body balance, balance on one foot, and balance on two feet. Silberman (1963) found sound blending training to facilitate analysis of the printed word. Whether it facilitates phoneme analysis of auditorily presented whole words needs investigation as this analytic process is a major prerequisite to writing a spelling word from dictation (Spache, 1941; Hanna, 1953; Brueckner & Bond, 1955; Gillingham, 1960; Simpson, 1967; Myklebust, 1967;

Luria, 1970; Sapir, 1971). The Sound Blending subtest of the ITPA was used to measure sound blending ability.

Auditory discrimination also appears to be a major component of correct spelling (Spache, 1941; Hanna, 1953; Russell, 1955; Brueckner & Bond, 1955; Crawford, 1967; Myklebust, 1967; Wyatt, 1969; Luria, 1970). Articulation is involved in the spelling process also (Spache, 1941; Horn, 1967; Luria, 1970). The Wepman Auditory Discrimination Test was used to test auditory discrimination. Gearheart and Willenberg (1970) report that studies with the Wepman indicate that children with articulation problems tend to score low on this auditory discrimination test. Morency (1967) suggests that one-third of children with articulation disorders have poor auditory discrimination. This is not surprising when it is considered, for many of the letters which produce auditory confusion (d, t) are produced with the articulators in very similar positions (b, p). On the Wepman test the score is an error score. Thus a higher score will indicate poorer performance. The Developmental Articulation Test (Hejna, 1955) was given since the test samples 27 speech sounds as they appear in initial, medial, and final position. All sounds on the test are expected to be mastered by age seven. A Pearson Product Moment Correlation was planned to evaluate the data from the Wepman and the Developmental Articulation Test to determine

whether or not these two processes are correlated as suggested by Gearheart and Willenberg (1970) in boys of the specified age and IQ. Correlation coefficients for each group could then be compared to determine whether or not they are significantly different. It was seen in the sample studied that articulation was not a problem to be considered. Two boys in each group had minor articulation problems which could be scored. One child substituted the "b" sound for "v" sound in such words as "television", "vacuum", or "stove". The "s" sound was somewhat imprecise in the others. Since the 56 other boys had no articulation problem, the correlation between Wepman scores and articulation scores was not computed.

A cluster of factors included in writing a word from dictation appears to revolve around knowledge of the alphabet. Once the auditory stimulus of the word is translated into phonemes, the phonemes must be translated into graphemes. The several translations result in production of the grapho-motor response of writing letters. To succeed in this complex series of acts, the child must be able to recognize which letters make specific sounds. Auditory discrimination does not guarantee mental translation to a letter name and ultimately a letter form. Lack of ability to break the whole word into its component phonemes is recognized by Spache (1941), Hanna (1953), Brueckner and Bond (1955), Gillingham (1960), Myklebust (1967), Luria (1970), and Sapir (1971) as contributing to spelling errors. Once the phonemes are

identified, the student must assign the letter name to the sound (Spache, 1941; Hanna, 1953; Luria, 1970). Once the letter name is known, its construction must be executed. Importance of the transition of the spoken to the written form is recognized by Hanna (1953), Simpson (1967), Luria (1970), and Sapir (1971).

To test this cluster of abilities, screening type tests were given (Wold, 1970).

Alphabet Writing - Spontaneous

Alphabet Writing - from Dictation (random)

MKM Visual Letter Recognition Test

MKM Auditory Letter Recognition Test

Haptic Letter Recognition Test

The Alphabet Writing Tests are said to test the child in his ability to think in sequence, to visualize the letter and reproduce it in proper form (Michael, King & Moorhead, 1963).

In the Visual Letter Recognition test the child is shown the lower case alphabets in random order and is asked to give the name of each and the sound it makes. Short sounds for vowels are requested. It has been indicated that children learn tasks more efficiently when they have names for the elements of the process (Spiker, 1956). Knowing the names of letters should, according to this reasoning, facilitate spelling.

In the Auditory Letter Recognition test the child writes initial consonants of dictated words, consonant blends, consonant digraphs, and medial vowel sounds as requested for each section.

Performance scores on each test for the experimental group and the control group were compared. All scores were error scores, therefore the lower the score the better the performance.

Design of Study

Each of the 60 subjects were administered the following tests in the indicated order:

I. For subject selection

The Wide Range Achievement Test (Spelling)

The Wechsler Intelligence Scale for Children (including Digit Span, but not the Mazes)

McGuire-White Measurement of Social Status (short form)

II. For comparison of the two groups:

The Bender Gestalt Test

The Peabody Picture Vocabulary Test

The Benton Visual Retention Test

The Wepman Auditory Discrimination Test

The Developmental Articulation Test

The Illinois Test of Psycholinguistic Abilities

Sound Blending

Auditory Closure

The Detroit Tests of Learning Aptitude

Motor Speed and Accuracy

Visual Attention Span for Letters

The Alphabet Writing (Spontaneous) Test

The Alphabet Writing (Dictation) Test

MKM Visual Letter Recognition Test

MKM Auditory Letter Recognition Test

Haptic Letter Recognition Test

All tests were administered by the investigator, qualified counselors, diagnosticians, or a certified speech and hearing therapist under the direct supervision of the investigator. Subjects were enrolled in the public schools of Haskell, Knox, Wise and Tarrant Counties of Texas. All communities were rural-agrarian rather than urban-industrial.

Though formal null hypotheses were stated, it was expected from informal observation that significant differences between the groups would be noted in scores on the cluster of tests pertaining to the alphabet. A second expected difference was in both the Auditory Discrimination Test and the Articulation Test. Sequencing skills, both Auditory (Digit Span) and visual-motor (Detroit Visual Attention Span for Letters, WISC Picture Arrangement and Alphabet Writing, spontaneous) were expected to be lower in the experimental group.

Since the Full Scale IQ on the WISC was controlled, the ranges were not significantly different. It was expected, however, that the test profiles for the two groups would be different. If the subjects in the

experimental group scored lower than the subjects in the control group on some subtests they would, then, score higher on others. Whether or not these subtest scores are significantly different was tested statistically. The global IQ may actually be misleading for educational purposes.

The Benton was expected to correlate better with spelling scores than the Bender.

The following hypotheses were tested using a one-way ANOVA to test each hypotheses. A probability level of .05 was accepted as a minimum criteria for statistical significance.

H_{o_1} : There will be no difference in terms of scaled scores on the Information subtest of the WISC between the experimental group and the control group.

H_{o_2} : There will be no difference in terms of scaled scores on the Comprehension subtest of the WISC between the experimental group and the control group.

H_{o_3} : There will be no difference in terms of scaled scores on the Similarities subtest of the WISC between the experimental group and the control group.

H_{o_4} : There will be no difference in terms of scaled scores on the Vocabulary subtest of the WISC between the experimental group and the control group.

H_{o_5} : There will be no difference in terms of the derived Verbal Comprehension scores between the experimental group and the control group.

H_{o_6} : There will be no difference in terms of scaled scores on the Digit Span subtest of the WISC between the experimental group and the control group.

H_{o_7} : There will be no difference in terms of scaled scores on the Coding subtest of the WISC between the experimental group and the control group.

H_{o_8} : There will be no difference in terms of scaled scores on the Picture Arrangement subtest of the WISC between the experimental group and the control group.

H_{o_9} : There will be no difference in terms of the derived Sequencing Ability scores between the experimental group and the control group.

$H_{o_{10}}$: There will be no difference in terms of the Detroit Visual Attention Span for Letters scores between the experimental group and the control group.

$H_{o_{11}}$: There will be no difference in terms of scores on the Detroit Motor Speed and Accuracy Test between the experimental group and the control group.

$H_{o_{12}}$: There will be no difference in terms of scaled scores on the Picture Completion subtest of the WISC between the experimental and the control groups.

$H_{o_{13}}$: There will be no difference in terms of the scaled scores on the Block Design subtest of the WISC between the experimental group and the control group.

$H_{o_{14}}$: There will be no difference in terms of scaled scores on the Object Assembly subtest of the WISC between the experimental group and the control group.

$H_{o_{15}}$: There will be no difference in terms of the derived Spatial Abilities scores between the experimental group and the control group.

$H_{o_{16}}$: There will be no difference in terms of scores on the Auditory Closure subtest of the ITPA between the experimental group and the control group.

$H_{o_{17}}$: There will be no difference in terms of raw scores on the PPVT between the experimental group and the control group.

$H_{o_{18}}$: There will be no difference in terms of WISC Verbal Scaled Score Total between the experimental group and the control group.

In addition, a correlation coefficient was computed using the PPVT raw scores and the WISC Verbal Scaled Score totals for the

experimental group. In like manner a similar correlation coefficient was computed for the control group. The coefficients for each group were then compared in order to determine if the two groups are significantly different in this respect.

$H_{o_{19}}$: There will be no difference in terms of correlation coefficients for the WISC Verbal Scaled Score Total and the PPVT raw scores between the experimental group and the control group.

The One-Way ANOVA was used to test the following hypotheses. A level of .05 significance was accepted.

$H_{o_{20}}$: There will be no difference in terms of error scores on the Bender between the experimental group and the control group.

$H_{o_{21}}$: There will be no difference in terms of the error scores on the Benton Visual Retention Test between the experimental and the control group.

$H_{o_{22}}$: There will be no difference in terms of the number correct score on the Benton Visual Retention Test between the experimental group and the control group.

$H_{o_{23}}$: There will be no difference in terms of the scores on the ITPA Sound Blending subtest between the experimental group and the control group.

$H_{o_{24}}$: There will be no difference in terms of error score on the Wepman Auditory Discrimination Test between the experimental group and the control group.

$H_{o_{25}}$: There will be no difference in terms of scores on the Developmental Articulation Test between the experimental group and the control group.

A correlation coefficient was not computed for each group using scores on the Wepman Auditory Discrimination Test and the Developmental Articulation Test as planned at the beginning of the study. The reasons for this change have been discussed previously. Thus the null hypothesis Ho 26 as follows was discarded and the statistic not computed.

$H_{o_{26}}$: There will be no difference in terms of correlation coefficients for the Wepman Auditory Discrimination Test and the Developmental Articulation Test between the experimental group and the control group.

The following hypotheses were tested by using a One-Way ANOVA. A significance level of .05 was accepted.

$H_{o_{27}}$: There will be no difference in terms of error scores on the Alphabet Writing-Spontaneous Test between the experimental group and the control group.

$H_{o_{28}}$: There will be no difference in terms of error scores on the Alphabet Writing from Dictation Test between the experimental group and the control group.

$H_{o_{29}}$: There will be no difference in terms of error scores on the MKM Visual Letter Recognition Test between the experimental group and the control group.

$H_{o_{30}}$: There will be no difference in terms of error scores on the MKM Auditory Letter Recognition Test between the experimental and the control group.

$H_{o_{31}}$: There will be no difference in terms of error scores on the Haptic Letter Recognition Test between the experimental and the control group.

$H_{o_{32}}$: There will be no difference, in terms of absolute differences, between WISC Verbal IQ and WISC Performance IQ scores between the experimental group and the control group.

For each subject a mean score was derived using the scaled scores from the eleven subtests of the WISC. The number of subtest scores which fall below the subject's own mean were listed for each subject.

$H_{o_{33}}$: There will be no difference in terms of number of subtests falling below the subject's own mean between the experimental group and the control group.

CHAPTER II

IMPLEMENTING THE DESIGN

Actual screening necessary to identify students to be included in the study began early in the spring semester of the 1971-72 school year. Letters explaining the purpose of the study and asking permission to work in the schools were sent to administrators beforehand. Samples are included in Appendix A. Because the general opinion among educators indicated learning disabilities to be prevalent in the 12 to 20 percent range, it was assumed that students in the 10 schools of the Haskell-Knox Consortium would provide the population for sampling. It was soon determined that when IQ, socioeconomic, cultural-ethnic, and bilingual factors were controlled, the percent of children demonstrating learning disability was extremely small. The finding agreed with that of Koppitz (1971, p.5). In the 13 districts referring students to the LD classes in her study the incidence was seen to be one to one-and-a-half percent of the total school population. When sex was controlled to exclude girls and the disability specified as spelling, the percent in the schools of the Consortium was probably no more than one-half percent. The concentration of Mexican-Americans and black families in the farm and ranch areas lowered the number of children meeting the criteria for subject selection. It was with this finding that similar communities in Wise and Tarrant Counties were included in

the study. In each school, all third grade boys were included in the WRAT Spelling screening. Table 1, placed at the end of this chapter, shows the number of boys screened in each school. It can be noted that in many classrooms more than half the boys were functioning below placement in spelling.

Once the spelling test was scored, birthdates were checked on all Caucasian boys who scored one year or more below placement. School records were checked in order to determine that no child under consideration had repeated a grade. The letters to parents (Appendix A) were attached to information sheets requesting the necessary information as to occupation and education of the head of the household. As was found in the Watkins study (1973) this information was not readily provided by parents. In 125 cases the information was not provided and the children could not be considered for inclusion in the study. In other cases the socioeconomic scores made the children ineligible. As can be seen in Table 1, 660 children were screened in order to identify the 30 experimental subjects. In each case of identification of a child for the experimental group, a child from the same classroom was chosen for the control group. Thus the variables clustering around curriculum, text book, teacher, and teaching method were controlled though these were not specified in subject selection criteria. As testing proceded on an individual

basis, the principal was given a summary sheet of test scores (Appendix A) for placement in the child's folder. The occupation and education information sheets were not given to administrators, though many of the districts had the same information on their enrollment forms. When a principal requested it, a conference was scheduled with the child's teacher or parent for interpretation of the test results and educational recommendations. While such conferences were not planned as part of the study, they were an important outcome and identified children who were then provided special instructional assistance. The tests and conferences provided a basis for educational planning. Though the conferences delayed completion of the study, they gave it practical meaning as well as personal significance.

TABLE 1

Screening Sample

	County	City	Number	Number Below Grade Placement	Grade Equivalent Range in WRAT Spelling Section
1971-72	Haskell	Haskell	40	23	<1.6-6.5
	Haskell	Paint Creek	2	1	2. -5.0
	Haskell	Rule	8	2	3.0-4.7
	Haskell	Rochester	11	6	2.2-5.3
	Knox	Munday	33	11	<1.6-5.3
	Knox	Knox City	20	5	2.7-6.3
	Wise	Boyd	18	7	1.5-5.5
	Wise	Chico	17	11	1.8-4.5
	Wise	Bridgeport	61	25	2.2-6.5
	Wise	Paradise	12	6	2.3-6.3
	Wise	Newark	16	8	1.7-6.3
	Wise	Slidell	3	0	3.9-5.3
	Tarrant	Fort Worth	3	2	2.5-3.9
	Tarrant	Lake Worth	38	20	1.8-6.8
	Tarrant	Azle	84	37	2.2-6.0+
1972-73	Knox	Munday	20	8	1.4-4.5
	Knox	Knox City	10	2	2.0-5.0
	Tarrant	Lake Worth	10	7	2.0-5.7
	Wise	Bridgeport	54	33	1.3-6.3
	Knox	Rochester	8	6	2.6-4.7
	Tarrant	Crowley	87	44	0.0-6.8+

TABLE 1

Screening Sample

	County	City	Number	Number Below Grade Placement	Grade Equivalent Range in WRAT Spelling Section
1973-74	Tarrant	Crowley	46	25	1.8-6.0+
	Tarrant	Crowley (S)	22	10	2.0-5.3
	Wise	Bridgeport	37	10	Nursery-7.2
	Totals		660	309	

CHAPTER III

RESULTS

Scores obtained on the aforementioned tests and subtests were analyzed by computer, using a one-way analysis of variance (ST001, Rev. May 1971) and product-moment correlation coefficient statistics. All analysis was done at the North Texas State University Statistical Library.

A summary of analysis of three of the controlled variables is presented in Table 2. No significant difference in terms of age, socioeconomic status or full scale IQ on the WISC was found to exist between the two groups.

TABLE 2

Means, Standard Deviations (SD), F Ratios, and Probability for Groups on Age, Socioeconomic Status and WISC FSIQ

		$\bar{X}$	SD	F	P
Age in Months	E	106.07	3.78	.4831	.4898
	C	105.33	4.37		
Socioeconomic Status	E	45.37	8.47	.2715	.6043
	C	44.23	8.38		
WISC FSIQ	E	103.87	9.14	1.7705	.1885
	C	106.93	8.71		

Of the first 18 null hypotheses, only three were rejected. A summary of statistical findings on this portion of the study is shown in Table 3. Significant differences in terms of WISC Coding (Ho 7), Derived Sequencing Score (Ho 9), and Detroit Visual Attention Span for Letters (Ho 10) were found to exist between the experimental and control groups. That memory factors were also involved, and probably account for part of the difference between high and low achievers in spelling, was suggested by the .0511 level of significance on WISC Information and the .0614 level of significance on WISC Digit Span.

TABLE 3

Means, Standard Deviations, F Ratios and P Values for Null Hypotheses 1-18

(There will be no difference between the Groups in terms of:)

			$\bar{X}$	SD	F	P
Ho 1	WISC	E	9.50	2.31	3.9671	.0511
	Information	C	10.70	2.35		
Ho 2	WISC	E	10.60	3.05	.0591	.8087
	Comprehension	C	10.40	3.32		
Ho 3	WISC	E	10.67	2.34	3.0678	.0851
	Similarities	C	11.90	3.09		
Ho 4	WISC	E	10.87	2.28	.0123	.9122
	Vocabulary	C	10.93	2.38		
Ho 5	Verbal Compre-	E	10.40	1.64	2.6034	.1120
	hension, Derived	C	11.13	1.83		

TABLE 3

Means, Standard Deviations, F Ratios and P Values for Null Hypotheses 1-18

(There will be no difference between the Groups in terms of:)

			$\bar{X}$	SD	F	P
Ho 6	WISC Digit	E	8.23	2.06	3.6397	.0614
	Span	C	9.27	2.13		
Ho 7	WISC	E	10.63	1.88	15.1461	.0003**
	Coding	C	12.60	2.03		
Ho 8	WISC Picture	E	11.47	2.39	.8911	.3491
	Arrangement	C	10.83	2.79		
Ho 9	Derived Score,	E	10.11	1.24	6.0091	.0173*
	Sequencing	C	10.90	1.26		
Ho 10	Visual	E	107.0	13.64	5.0174	.0289*
	Attention	C	114.7	13.10		
	(M.A.) Detroit/					
	Letters					
Ho 11	Motor Speed	E	101.27	13.96	.7649	.3854
	(M.A.) Detroit	C	105.10	19.53		
Ho 12	WISC Picture	E	10.97	2.74	.1619	.6889
	Completion	C	10.67	3.02		
Ho 13	WISC Block	E	10.40	2.80	.3805	.5393
	Design	C	10.83	2.64		

TABLE 3

Means, Standard Deviations, F Ratios and P Values for Null Hypotheses 1-18

(There will be no difference between the Groups in terms of:)

			$\bar{X}$	SD	F	P
Ho 14	WISC Object	E	10.90	3.48	1.0720	.3048
	Assembly	C	10.10	2.41		
Ho 15	Derived	E	10.75	2.45	.1400	.7097
	Spatial	C	10.53	2.12		
	Abilities					
Ho 16	ITPA Auditory	E	34.07	6.05	.5210	.4733
	Closure	C	35.07	4.59		
Ho 17	PPVT Raw	E	72.83	8.53	.1984	.6577
	Score	C	71.97	6.39		
Ho 18	WISC	E	51.00	7.85	2.7693	.1015
	S.S. Totals	C	54.47	8.28		

Using the PPVT raw scores and the total of Verbal scaled scores, a correlation coefficient of .0939 ($P > .10$) was computed for the experimental group and .4706 ($P < .01$) for controls. When these coefficients were tested in order to determine if they were significantly different, the resultant Z of 1.527 was not as great as the 1.96 required to establish significance at the .05 level.

Hypothesis Ho 20 was tested by using the Watkins Weighted Scoring System and then the Watkins Revised Scoring System. By either method, the difference in terms of scorable errors on the Bender Gestalt between the two groups was not significant at the .05 level. Comparisons of scores using the two Bender scoring systems are shown in Table 4.

TABLE 4

Means, Standard Deviations, F Ratios and P Values for Two Systems of Scoring the Bender Gestalt Test

		$\bar{X}$	SD	F	P
Weighted Scoring	E	10.30	3.94	.1099	$>.05$
	C	9.93	4.60		
Revised Scoring	E	7.633	2.97	.5360	$>.05$
	C	7.000	3.70		

The summary table for Ho 21 - Ho 24 is presented in Table 5. Since there were virtually no errors of articulation in either group, the statistics were not computed for Ho 25 and Ho 26. From Table 5 it can be seen that Ho 24 was rejected and that auditory discrimination errors were significantly greater in number for boys in the experimental group than for controls.

TABLE 5

Means, Standard Deviations (SD), F Ratios and P Values for Ho 21 - Ho 24

(There will be no difference between the Groups in terms of:)

			$\bar{X}$	SD	F	P
Ho 21	Benton	E	9.50	4.08	.0936	.7607
	Error Scores	C	9.20	3.49		
Ho 22	Benton	E	4.40	1.67	0.1867	.6673
	Number Correct	C	4.60	1.90		
Ho 23	ITPA	E	41.43	4.99	0.0528	.8191
	Sound Blending	C	41.73	5.12		
Ho 24	Wepman	E	5.63	2.99	17.9720	.0001***
	X Error Score	C	2.90	1.88		

Hypotheses 27 - 31 treated various tasks related to the child's knowledge of the alphabet. Two of the five null hypotheses were rejected. Summary of the scores are presented in Table 6.

TABLE 6

Means, Standard Deviations (SD), F Ratios and P Values for Ho 27 - Ho 31

(There will be no difference between the two Groups in terms of:)

			$\bar{X}$	SD	F	P
Ho 27	Alphabet	E	2.17	2.56	5.3509	.0243*
	Spontaneous	C	0.90	1.56		

TABLE 6

Means, Standard Deviations (SD), F Ratios and P Values for Ho 27 - Ho 31

(There will be no difference between the two Groups in terms of:)

			$\bar{X}$	SD	F	P
Ho 28	Alphabet from Dictation Random Order	E	1.00	1.51	3.1945	.0791
		C	0.47	0.63		
Ho 29	Visual Letter Recognition	E	2.50	1.76	2.0174	.1608
		C	1.83	1.88		
Ho 30	Auditory Letter Recognition	E	19.33	7.36	33.3889	.00001**
		C	10.03	4.84		
Ho 31	Haptic Letter Recognition	E	6.20	3.84	.0351	.8520
		C	6.37	3.00		

The remaining hypotheses relate to the WISC scores and are presented in summary in Table 7. For this sample, at least, there was no significant difference between groups in absolute difference in Verbal and Performance IQ on the WISC. Nor did the two groups differ significantly in the number of WISC subtest scores falling below the child's own mean.

TABLE 7

Means, Standard Deviations (SD), F Ratios and P Values for Ho 32 - Ho 33

(There will be no difference between the groups in terms of:)

			$\bar{X}$	SD	F	P
Ho 32	Absolute Difference WISC Verbal IQ-Performance IQ	E	12.27	9.48	.4070	.5260
		C	10.80	8.23		
Ho 33	WISC Subtests Below Child's Mean	E	5.47	1.07	.1050	.7474
		C	5.57	1.30		

In addition to the statistical data other observations were recorded. Of the experimental group, 10 boys had 15 or more points between the WISC scales (a standard deviation or more) while nine controls had that amount of spread. Only one child in the study had the same IQ for Verbal and Performance scales.

Though no formal hypothesis was stated concerning differences between the two groups in terms of WISC Verbal IQ, it was considered to be a variable that should be analyzed since learning disabled children, as a group, are generally supposed to have depressed verbal skills. A t test was done (one tail, 58df) with results which supported this general finding. The WISC Verbal IQ scores for the experimental group were found to be significantly lower than those for the control group ($P < .01$).

CHAPTER IV

DISCUSSION AND SUMMARY

Sixty boys matched for age, grade, IQ, socioeconomic background, race, and language were tested over a wide range of skills indicated by research to be related to spelling competency. When assigned to groups according to spelling achievement on the WRAT and compared on thirty-three variables the boys with spelling achievement one or more years below placement were seen to have certain deficits in skill development that were significantly low compared to scores achieved by their controls.

In order of significance the differentiating test areas are listed below with the corresponding levels of significance.

MKM Test of Auditory Letter Recognition	.00001
Wepman Auditory Discrimination Test	.0001
WISC Coding	.0003
Derived Sequencing	.0173
Spontaneous Writing of the Alphabet (No Model)	.0243
Detroit Visual Attention Span for Letters	.0289

Three other tests approached the .05 level considered as acceptable criteria for rejecting a null hypothesis. They were:

WISC Information	.0511
WISC Digit Span	.0614

WISC Verbal IQ .0789

When individual scaled scores were observed, it was found that 13 of the experimental group and 5 of the control group scored three or more scaled score points lower on the Information subtest than on two other Verbal Scale subtests (Digit Span excluded). A difference between two proportions statistic was used to analyze this data. The number of experimental subjects with the above pattern was significantly greater than the number of controls with the pattern ($P < .05$). The two groups were different in terms of the number of subjects scoring three scaled score points or more lower on the Coding subtest of the WISC than on two other Performance subtests (E=9; C=1, with $P < .05$).

It would seem that the most handicapping condition related to spelling achievement is the inability to identify a specified component of a word, assign a grapheme to the required phoneme and write it from an internalized motor plan. The task is one of analysis as the child is not asked to write a whole word but a specified element: initial consonant only, initial consonant blend, initial consonant digraph, single vowel (marked "long" or "short") or dipthongs. In this particular task no sequencing or whole word revisualization is required. Analysis of the whole in order to identify an embedded phoneme which has been blended with other phonemes appears to be the dysfunctional skill. The reverse operation of sound blending phonemes to identify a whole word was adequately developed in the same children who achieved at such a low level on the analysis. The group means

for Sound Blending (ITPA) were E 41.43 and C 41.73 with the level of significance at .8191, or relatively equal development.

The difference of next greatest significance between the groups was shown to be auditory discrimination as measured by the Wepman. Discrimination is certainly one of the subskills comprising the analysis skills required in the auditory recognition of embedded phonemes of the above task. Visual discrimination deficit was not demonstrated on the alphabet tasks, nor was association of visual symbol with letter names or phonemes significantly dysfunctional. If whole words could not be discriminated it would follow that the attempt to analyze them would result in lower scores, as it did in this sample.

The significant difference between groups in terms of WISC Coding scores would support research findings that this subtest score is generally found to be low in a child with a language/learning disability. For this sample, motor speed (as measured by the Detroit) was not the major contributing factor to low scores. Visual memory (as measured by the Benton) was comparable to that of controls. The symbolic nature of the material and motor planning could be interferring with performance on the Coding task. The visual stimuli for coding consist of nonmeaningful symbols which approximate alphabets and numerals, but for which the child has no verbal labels. Without the verbal

labels, the child cannot use verbal mediation to assist visual memory. Most of the forms on the Benton have verbal labels mastered by school aged children. Another major difference in the two tasks is that the Benton figures are reproduced in the same sequence as presented, while the Coding task involves perceptual restructuring of a sequence of numerals which the child has mastered at the automatic level. Thus some rudimentary search behavior is involved before the child can select the nonmeaningful symbol to copy into his next empty "box". Learning disabled children are known for their inability to copy from one surface to another even when sequence and relationships do not have to be restructured. An observer could determine whether the deficit is motor planning for any individual child simply by watching him do spontaneous handwriting. Pencil grasp, direction of strokes, sequence of strokes, integration of strokes, erasures, mark overs, and second attempts all reflect the child's motor planning ability. Memory for the Gestalt, as well as the motor movements, is involved. Other children can copy symbols adequately if the sequence does not require restructuring. Eye-hand coordination is a factor in this task also. The complexity of the coding task is related to the number of cognitive processes and prerequisite skills involved and it is not surprising that it is consistently lower in children with learning problems than in successful achievers.

Derived sequencing scores, averaged from Digit Span, Coding, and

Picture Arrangement, were significantly low even though the experimental group tended to have higher scores on Picture Arrangement than the controls (P=.3491). Sequencing pictorial material to demonstrate comprehension of a depicted story, then, appeared to be unrelated to success in spelling from dictation. The auditory and grapho-motor aspects of sequencing appear to be the components of this derived score related to spelling scores. As has been suggested in the earlier discussion of the Coding task, a multiplicity of factors other than sequencing per se are involved in this cluster of subtests.

Spontaneous writing of the alphabet requires the sequencing skills, visual recall, and grapho-motor planning already demonstrated to be deficits in the experimental sample of third grade boys. Even when the alphabet names were given verbally, these boys scored lower than their controls (P=.0791), emphasizing the possibility that the major deficits are revisualization and motor planning. The sequencing is, for some subjects, as difficult for letter parts as for the alphabet order.

Visual memory was low in the experimental subjects when measured by the Detroit Visual Attention Span for Letters but not when measured by the Benton. Sequencing is required in both tests. Again it appears to be the symbolic level which gives the difficulty. Reversals lower this test score for many children with learning problems (d-b-p-q-g).

There was observed some confusion of i-j in recall. If a particular child can be seen to have a moderate visual recall deficit when symbols are involved, spelling might improve with use of a typewriter. Such an approach would overcome the deficits clustering around grapho-motor dysfunction as well.

Interesting outcomes were the lower (but not significant) scores on Information, Digit Span, and Verbal IQ. Along with the low Coding and depressed Arithmetic scores, they make up a profile of group mean scores comparable to profiles observed on individual test protocols of children with learning disability. The tendency to have lower verbal than performance IQ in the learning disability population was supported in this study. Though the Coding mean did not appear to be lower than other subtest means for the experimental group, it was significantly lower than the high Coding mean of the control group. As expected, Digit Span was lowest of all scores. Arithmetic and Digit Span were somewhat depressed for both groups. Only in Picture Arrangement did the experimental group have a higher mean. Table 8 shows the group mean profiles.

TABLE 8

Group Mean Profiles

Experimentals:	VIQ 101.03 < PIQ 106.10 = 5.07		
Information	9.50	Picture Completion	10.97
Comprehension	10.60	Picture Arrangement	11.47

TABLE 8

Group Mean Profiles

Arithmetic	9.33	Block Design	10.40
Similarities	10.67	Object Assembly	10.90
Vocabulary	10.87	Coding	10.63
Digit Span	8.23		
Controls:	VIQ 105.70 < PIQ 107.10 = 1.40		
Information	10.70	Picture Completion	10.67
Comprehension	10.60	Picture Arrangement	10.83
Arithmetic	9.80	Block Design	10.83
Similarities	10.90	Object Assembly	10.10
Vocabulary	10.93	Coding	12.60
Digit Span	9.27		

Though the scaled score means are not significantly different as observed in individual patterns, the fact that they continue to reflect an expected pattern when full scale IQ is controlled and when averages smooth out differences bringing scores toward the mean of 10, seems to emphasize the learning disability of the experimental group. Even when individual strengths and weaknesses project different profiles for individual subjects, the classical pattern emerges. Low spelling achievement is then the observable manifestation of the

learning disability and for this population, auditory analysis, discrimination, and memory along with visual memory (at the symbolic level), and motor memory, appear to be the processes which are dysfunctional. Memory for sequence appeared to cut across all modalities.

The major purpose of the study was to identify the preacademic skills which might be dysfunctional in the third grade boy experiencing failure in spelling. The skill processes listed above can be measured by use of tests and subtests generally included in the battery for educational appraisal: WISC Coding Subtest; average of WISC Digit Span, Coding, and Picture Arrangement; Detroit Visual Attention Span for Letters, the Wepman Auditory Discrimination Test. The informal test not widely used but extremely diagnostic was the MKM Test of Auditory Letter Recognition and writing the alphabet from memory. Part of the screening preparatory to referral could include the Wepman administered by the person responsible for hearing screening. The MKM tests were designed to be used by classroom teachers as diagnostic tools. Results of these tests could be made a part of teacher referral forms. The diagnostician would need only to include the Detroit subtest at the time of WISC administration if the referral included poor spelling performance.

Many resources are available to the teacher who can identify these areas of deficit in the student who is spelling below expectancy. Remediation in the prerequisite skills would be expected to facilitate mastery in spelling.

Results of the study indicate need for further investigation to determine if educational intervention could remediate the deficits in prerequisite skills to the extent that spelling achievement would be elevated.

Investigation to determine if a low achieving child could improve his WRAT spelling score if allowed to type his responses is a second implication. Such an investigation could be done in a brief period of time by giving a group the WRAT spelling test and allowing the children who scored one year below placement to take individual WRAT tests on the typewriter. A one-way analysis of variance could then be applied to determine whether eliminating the handwriting response and allowing recognition instead of recall would result in better spelling performance. Since the problem of poor spelling is so widespread, it appears that more investigation to identify the deficits and the best means to remediate or compensate could be generated. It does appear that many of the skills required are those requiring development and/or training of the basic psychological

learning processes of auditory, visual, and haptic processing. Systematic identification of the dysfunctional processes and techniques for remediation and/or compensation are already possible with instruments and materials available. The major need appears to be for some systematic evaluation of the efficiency and economy of the processes of appraisal, intervention, and results of intervention.

REFERENCES

Anderson, I.H. Comparisons of the reading and spelling achievement, and the quality of handwriting of groups of English, Scottish, and American children. U.S. Department of Health, Education, and Welfare, Office of Education, Cooperative Research Project No. 1903, Ann Arbor: University of Michigan, 1963 (305 pp).

Atwell, A. The learner's self concept. Children's House, 1969, III(2).

Austin, C. Teaching about vision. National Society for Prevention of Blindness, Eye Health Committee, 1961.

Bakwin, H. & Bakwin, R.M. Clinical Management of Behavioral Disorders in Children, Philadelphia: W.B. Saunders, 1966.

Bannatyne, A.D. Diagnosing learning disabilities and writing remedial prescriptions. Journal of Learning Disabilities, 1968, 1(4), 242-249.

Bannatyne, A.D. & Wichiarajota, M.A. Relationships between written spelling, motor functioning and sequencing. Journal of Learning Disabilities, 1970, 3(5), 14-16.

Berry, M.F., & Eisenson, J. Speech disorders: Principles and practices of therapy. New York: Appleton-Century-Crofts, Inc., 1956.

Breckenridge, M.E., & Wincent, E.L. Child development physical and psychological growth through the school years. (3rd ed.) Philadelphia: W.B. Saunders Company, 1955.

Barsch, R.H. A visual-spatial concept of spelling. Academic Therapy, 1967, 3(1), 5-8.

Brueckner, L.J., & Bond, G.L. Diagnosis and treatment of spelling difficulties. New York: Appleton-Century-Crofts, 1955.

Carey, R.L. Evaluating instructional outcomes in elementary science. Science Education, 1969, 53(5), 403-407.

Cohen, J. Factorial structure of the WISC at ages 7-6, 10-6, and 13-6. Journal of Consulting Psychology, 1959, 23, 285-299.

Crawford, L. The child with learning disabilities in a spelling class. Academic Therapy, 1967, 3(1), 16-20.

Critchley, M. Developmental dyslexia as a specific cognitive disorder. In J. Hellmuth (Ed.), Cognitive studies, Vol. 2, deficits in cognition. New York: Brunner/Mazel, 1971, 47-52.

Fowler, W. Cognitive baselines in early childhood developmental learning and differentiation of competence rule systems. In J. Hellmuth (Ed.), Cognitive studies, Vol. 2, deficits in cognition. New York: Brunner/Mazel, 1971.

Gagné, R.M. The implications of instructional objectives for learning. In C.M. Lindvall (Ed.), Defining educational objectives. Pittsburgh: University of Pittsburgh Press, 1964, 37-46.

Gagné, R.M. The conditions of learning. New York: Holt, Rinehart & Winston, Inc., 1966.

Gagné, R.M. Curriculum research and promotion of learning. In Perspectives of curriculum evaluation AERA Monograph series in curriculum development. Chicago: Rand McNally, 1967, 19-38.

Gagné, R.M. Contribution of learning to human development. Psychological Review, 1968, 75(3), 177-191.

Gearheart, B.R., & Willenberg, E.P. Application of pupil assessment information: For the special education teacher. Denver: Love Publishing Co., 1970.

Gesell, A.L. The first five years of life. New York: Harper and Brothers, 1940.

Gillingham, A., & Stillman, B. Remedial training for children with specific disability in reading, spelling, and penmanship. Cambridge, Mass.: Educators Publishing Service, 1960.

Gunderson, D.B. Reading problems: Glossary of terminology. Reading Research Quarterly, Summer 1969, Vol. IV(4), 534-549.

Guthrie, J.T. & Goldberg, H.K. Visual sequential memory in reading disability. Journal of Learning Disabilities, 1972, 5(1), 41-46.

Hahn, W.P. Phonics: A boon to spelling? Elementary School Journal, 1964, 64, 383-386.

Hall, E. A conversation with Jean Piaget and Barbel Inhelder. Psychology Today, 1970, 3(12), 25-32 and 54-56.

Hanna, P.R. Needed research in spelling. Elementary English, 1966, 43, 60-66, 89.

Hanna, P.R., & Moore, J.T. Spelling--from spoken word to written symbol. Elementary School Journal, 1953, 53, 329-337.

Havighurst, R.J., & Breese, F.H. Relation between ability and social status in a midwestern community II Primary mental abilities. Journal of Educational Psychology, 1947, 38, 241-247.

Hyna, F. Developmental Articulation Test. Denver, Colorado: Communication Foundation Ltd., 1955 (University of Connecticut, Storrs, Connecticut).

Hobson, J.R. Sex differences in primary mental abilities. Journal of Educational Research, 1947, 41, 126-132.

Hodges, R.E. The psychological bases for spelling. Elementary English, 1965, 42, 629-635.

Horn, E. What research says to the teacher teaching spelling. Washington, D.C.: National Education Association of the United States, c1954, 1967.

Horn, J.L. Organization of abilities and the development of intelligence. Psychological Review, 1968, 75, 242-259.

Horn, T.D. Handwriting and spelling. Review of Educational Research, 1967, 37(2), 168-177.

Irwin, O.C. Infant speech: The effect of family occupational status and of age on the use of sound types. Journal of Speech and Hearing Disorders, 1948, 13, 224-226.

Johnson, D.J., & Myklebust, H.R. Learning disabilities: Educational principles and practices. New York: Grune & Stratton, 1967.

Kagan, J. Acquisition and significance of sex typing and sex rate identity. In M.L. Hoffman and L.W. Hoffman (Eds.), Review of child development research, Vol. 1, New York: Russell Sage Foundation, 1964, 137-167.

Kirk, S.A. Educating exceptional children. Boston: Houghton-Mifflin, 1962.

Kooi, B.Y., Schutz, R.E., & Baker, R.L. Spelling errors and the serial-position effect. Journal of Educational Psychology, 1965, 56, 334-336.

Koppitz, E.M. Children with learning disabilities: A five year follow-up study. New York: Grune & Stratton, 1971.

Kowitz, G.T. The management of motivation. Phi Delta Kappan, October, 1967.

Lester, M. Graphemic-phonemic correspondences as the basis for teaching spelling. Elementary English, 1964, 41, 748-752.

Linn, S.H. Spelling problems: Diagnosis and remediation. Academic Therapy, 1967, 3(1), 62-63 and 66.

Luria, A.R. The functional organization of the brain. Scientific American, 1970, 222(3), 66-72, 78.

Martin, H.P., Gilfoyle, E.M., Fisher, H.L., & Grueter, B.B. Assessment of perceptual development. The American Journal of Occupational Therapy, 1969, 23(5), 387-396.

McCarthy, J.J., & McCarthy, J.F. Learning Disabilities. Boston: Allyn and Bacon, Inc., 1969.

Michael, L.D., King, J.W., & Moorhead, A. MKM Manual of Instruction. Rapid City, South Dakota: M.K.M., Inc., 1963.

Millard, C.V. Child growth and development in the elementary school years. Boston: D.C. Heath and Co., 1951.

Milner, E. A study of the relationship between reading readiness in grade-one children and patterns of parent-child interaction. Child Development, 1951, 22, 95-112.

Morency, A.D., Wepman, J.M., & Weiner, P.S. Studies in speech: Developmental articulation inaccuracy. Elementary School Journal, 1967, 67, 329-338.

Prescott, G.A. Sex differences in Metropolitan Readiness Test Results. Journal of Educational Research, 1955, 48, 605-610.

Rupert, H.A., Jr. Visual and auditory learning problems in the disabled learner. Biological Science Curriculum Study Newsletter, 1971, 43, 10.

Sapir, S.G. Sex differences in perceptual-motor development. Perceptual and Motor Skills, 1966, 22, 987-992.

Sapir, S.G. Learning disability and deficit centered classroom training. In J. Hellmuth (Ed.), Cognitive studies, Vol. 2, Deficits in cognition, New York: Brunner/Mazel, 1971.

Shulman, H.G. Similarity effects in short term memory. Psychological Bulletin, 1971, 75(6), 399-415.

Silberman, H.F. Reading and related verbal learnings. System Development Corporation, Santa Monica, California, 1963.

Simpson, B.L. What is meant by a linguistic approach to reading and spelling. Academic Therapy, Fall 1967, 3(1), 13-15.

Spache, G. Spelling disability correlates I: Factors probably sausal in spelling disability. Journal of Educational Research, 1941, 34, 561-586.

Spache, G. Spelling disability correlates II: Factors that may be related to spelling disability. Journal of Educational Research, 1941, 35, 119-137.

Spiker, C.C. Stimulus pretraining and subsequent performance in the delayed action experiment. Journal of Experimental Psychology, 1956, 52, 107-111.

Templin, M.C. Norms on a screening test of articulation for ages three through eight. Journal of Speech and Hearing Disorders, 1953, 18(4), 323-331.

Terman, L.M. & Tyler, L.E. Psychological sex differences. In L. Carmichael (Ed.), Manual of Child Psychology (2nd ed.), New York: John Wiley and Sons, Inc., 1954 (1064-1115).

Thompson, G.C. Child psychology: Growth trends and adjustment. Boston: Houghton Mifflin Co., 1952.

Watkins, E.O. The Watkins Bender-Gestalt Scoring System. Texas Woman's University, Denton, Texas, copyright pending 1973.

Waugh, K.W., & Bush, W.J. Diagnosing learning disorders. Columbus, Ohio: Charles E. Merrill Publishing Company, 1971.

Wepman, J.M. Auditory Discrimination Test. Chicago: Language Research Associates, 1958.

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

Wold, R.M. Screening tests to be used by the classroom teacher, San Rafael, California: Academic Therapy Publications, 1970.

Wyatt, G.L. Language learning and communication disorders in children. New York: The Free Press, 1969.

APPENDIX A

SAMPLE SCORING SHEETS AND LETTERS AND FORMS SENT TO ADMINISTRATORS AND PARENTS

SCORING FORM FOR THE WATKINS BENDER-GESTALT SCORING SYSTEM

Name: _____ Date Tested: _____

C.A.: _____ M.A.: _____ Total Error Score: _____

	(Circle One)			
No. of Errors Compared to C.A.:	Normal	Mild	Moderate	Severe
No. of Errors Compared to M.A.:	Normal	Mild	Moderate	Severe

Figures and Item Numbers	Descriptions of Items
_____ 1.	Total time ____ minutes ____ seconds (score if less than 4 or more than 9 minutes.) (Age 5)

Items Scored on Each Figure

Figure A

_____ 2.	Rotation (Age 6).
_____ 3.	Fail to touch or overlap by 1/8 inch or more (Age 6).
_____ 4.	Missing and/or extra angle(s) in Diamond (Age 5).
_____ 5.	Disproportion of parts, one approximately 1/3 larger or more, than other (Age 6).

Figure 1

_____ 6.	Substitution of 5 or more circles for dots (Age 7).
_____ 7.	Rotation (Age 5).
_____ 8.	Dashes and commas for dots, 3 or more (Age 7).
_____ 9.	Perseveration of two or more dots (Age 6).
_____ 10.	Truncation of two or more dots (Age 5).

Figure 2

_____ 11.	Dashes and commas for circles (Age 7).
_____ 12.	Truncation of one or more columns of circles (Age 6).
_____ 13.	Perseveration of one or more circles in the rows (Age 7).
_____ 14.	One or two rows of circles omitted (Age 5).
_____ 15.	Truncation of one or more circles in the rows (Age 7).
_____ 16.	Perseveration of one or more columns of circles (Age 7).
_____ 17.	Rotation (Age 9).

Figure 3

_____ 18.	Substitution of 5 or more circles for dots (Age 6).
_____ 19.	Substitution of lines for dots (Age 5).
_____ 20.	Dashes and commas for dots, three or more (Age 7).
_____ 21.	Shape of design lost (Age 7).
_____ 22.	Rotation (Age 6).

Figure 4

_____ 23.	Fail to touch, or overlap, by 1/8 inch or more (Age 5).
_____ 24.	Rotation of entire Design or one element (Age 5).

Figures and Item Numbers	Descriptions of Items
Figure 5	
_____ 25.	Substitution of lines for dots (Age 5).
_____ 26.	Rotation (Age 5).
_____ 27.	Dashes or commas for dots, 3 or more (Age 5).
_____ 28.	Perseveration of two or more dots in circle or extension (Age 7).
_____ 29.	Substitution of 5 or more circles for dots (Age 7).
Figure 6	
_____ 30.	Two lines interwoven (Age 5).
_____ 31.	Substitution of two or more angles for curves (Age 6).
_____ 32.	Failure to cross the two lines, or crossing at extreme ends (Age 5).
_____ 33.	Substitution of straight lines for curves (Age 5).
_____ 34.	Perseveration of one or more curves (Age 7).
Figure 7	
_____ 35.	Missing and/or extra angle(s)(Age 7).
_____ 36.	Fail to touch or overlap excessively, by 1/8 inch or more (Age 6).
_____ 37.	Rotation (Age 6).
_____ 38.	Disproportion of the two hexagons, one approximately 1/3 larger than other (Age 9).
Figure 8	
_____ 39.	Rotation (Age 5).
_____ 40.	Missing and/or extra angle(s) (Age 6).
	Items Scored if Present on Any Figure
_____ 41.	Tremor. Score 1 for each figure with significant tremor, in case of doubt don't score (Age 5).
_____ 42.	Collision (the overlapping of two designs, including one design intruding into the open section of another design, or one design colliding with the edge of the page). Score 1 for each two collisions, and score 1 for each two collisions above the initial two. For example, if a child has five collisions, he would get a score of 2. (Age 5).

Directions for Completing Scoring Form:

1. Place a 1 in the blank to the left of each item where an error is made, except for Items 41 and 42 where a score of more than 1 may be recorded.

2. After all items have been scored, sum across all items to obtain the Total Error Score. This score is then used in the Norm Table to determine how the child compares to children of this mental age and chronological age.

3. Ages given in the parentheses after each item indicate chronological ages at which each item becomes significant by discriminating between normal and learning disability children.

4. The above scoring form should be used only if the test was given according to the directions used by Watkins.

NORMS FOR THE WATKINS BENDER-GESTALT SCORING SYSTEM

Number of Errors Necessary at each Age Level to Indicate the Presence of a Mild, Moderate or Severe Visual Perceptual Problem

C.A. or M.A.	Mild	Moderate	Severe
5-0 to 5-5	20	21	22
5-6 to 5-11	18	19	20
6-0 to 6-5	17	18	19
6-6 to 6-11	15	16	17
7-0 to 7-5	14	15	16
7-6 to 7-11	13	14	15
8-0 to 8-5	12	13	14
8-6 to 8-11	11	12	13
9-0 to 9-5	9	10	11
9-6 to 9-11	8	9	10
10-0 to 10-5	7	8	9
10-6 to 10-11	6	7	8
11-0 and up	5	6	7

Use of the Table:

1. In using the above table, use the child's C.A. if his M.A. is above his C.A.; use his M.A. if his M.A. is below his C.A. M.A. must be obtained from an adequate group or individually administered I.Q. test. Do not use short tests such as the PPVT. Compare each child's performance with his chronological age and with his mental age. This is important for developing educational plans.

2. If a child is 11½ months or more into a year, use the bottom of the next highest year. For example, if a child is 5 years 11 months, and 15 days old, use a C.A. of 6-0.

December 5, 1971

Administrators

Knox-Haskell School District

Dear Sirs:

Attached is an abstract of the prospectus for my proposed dissertation, to be done toward fulfilling requirements for a doctoral degree at Texas Woman's University at Denton, Texas.

I am requesting permission to include third grade boys of the Knox-Haskell schools in my study sample. In addition to the help such permission would be for me, I would like to think of the work as making a contribution to the people involved. A summary sheet of test results would be provided for each participant's school folder. The information should be of benefit to the diagnosticians and teachers working with the children in the classrooms. I would be happy to provide a copy of the final results of the study to be kept in some central location if this would be of benefit to the district.

It has been my pleasure to work with members of the Knox-Haskell Staff during the fall semester. I hope it will be possible to continue the association.

Very sincerely,

Reba Walker

Dear Administrator:

Attached is a summary of the dissertation study which I am conducting as part of the requirement for the doctoral degree at Texas Woman's University. I have already screened third grade boys in three Texas counties and am requesting permission to screen third grade boys in your school.

The screening consists of administration of the spelling section of the Wide Range Achievement Test as a group test. The procedure takes approximately twenty minutes. Prospective subjects are then given the attached letters to parents. Those meeting the requirements of these two tests are then tested individually. The battery takes approximately two and one-half hours to administer. The individual testing could be done at the Child Study Center if this seems to be too much time out of the classroom.

I would appreciate any assistance you might be able to give me in carrying out the described study.

Respectfully,

Reba K. Walker
Supervisor of Educational Services
Child Study Center

Summary of Doctoral Dissertation Study

Spelling performance of third grade boys is being analyzed to identify true spelling disability and its possible cause or causes.

Subject selection criteria are:

Boys 8 yrs. 4 mo. to 9 yrs. 4 mo. in age

Race - White to rule out cultural-ethnic factors

English speaking - to rule out second language factor

Average intelligence (90 or above) - to rule out general retardation

Middle class - to rule out socio-economic factor

Wide Range spelling score grade equivalent one year below placement

A control group will meet all above criteria except that they will achieve a spelling grade equivalent score at or above grade placement.

After selection by sex, age, grade, race, language, and spelling score, the McGuire-White scale of socio-economic status will be completed. Final selection will be dependent upon scores on the Wechsler Intelligence Scale for Children.

All subjects will then be administered the following tests:

Bender-Gestalt Test

Peabody Picture Vocabulary Test

Benton Visual Retention Test

Wepman Auditory Discrimination Test

Developmental Articulation Test

Sound Blending (ITPA)

Auditory Closure (ITPA)

Motor Speed and Precision (Detroit)

Visual Attention Span for Letters (Detroit)

MKM - Spontaneous Alphabet Writing

MKM - Alphabet Writing from Dictation

MKM - Auditory Letter Recognition

MKM - Visual Letter Recognition

MKM - Haptic Letter Recognition

A Summary Sheet of all test scores will be provided for the child's school folder.

No teaching or treatment is included in the study. Instead, scores on all tests are compared to determine in which areas the boys with a spelling disability differ from classmates matched for the above mentioned variables.

Knowledge of such difference should assist in individual programming for such students.

Dear Parent:

Spelling performance of third grade boys in three Texas counties is being analyzed in order to obtain information which might contribute to improved means of teaching this complex skill on an individual basis.

Many variables must be controlled in such a study. Education and occupation of the head of the family are two of these variables. The attached forms are requests for such information from you, since you have a third grade son in one of the three counties. No names are used in such scientific investigations. All information from these forms will be kept confidential and will not become a part of your child's school record. You will notice a code number on your forms. This code is known only to the investigator and is used simply to compile data for processing in a computor.

Your prompt return of the forms will be appreciated. I will be in the area of your child's school until _____ and will collect the papers, which you may return sealed in the attached envelope. You may mail them if you prefer.

Your assistance and cooperation are deeply appreciated.

Very sincerely,

Reba K. Walker
Doctoral Candidate
Texas Woman's University
Denton, Texas

Code _____

EDUCATION COMPLETED BY HEAD OF FAMILY

Please check one (highest completed)

_____Completed appropriate graduate work for a recognized profession at highest level; graduate of a generally recognized, high status, four-year college.

_____Graduate from a four-year college, university, or professional school with a recognized bachelor's degree, including four-year teacher colleges.

_____Attended college or university for two or more years; junior college graduate; teacher education from a normal school; R.N. from a nursing school.

_____Graduate from high school or completed equivalent secondary education; includes various kinds of "post-high" business education or trade school study.

_____Attended high school, completed grade nine, but did not graduate from high school; for persons born prior to 1900, grade eight completed.

_____Completed grade eight but did not attend beyond grade nine; for persons born prior to 1900, grades four to seven would be equivalent.

_____Left elementary or junior high school before completing grade eight; for persons born prior to 1900, no education or attendance to grade three.

Code _____

OCCUPATION OF HEAD OF FAMILY

Check one which most nearly describes your occupation.

___Land owner or farmer who does not supervise his property directly.

___Land operators who supervise properties and have an active urban supervisor.

___Farm owners with "hired help".

___Operators of leased property who supervise.

___Small landowner, operator of rented property.

___Tenants on good farms

___Farm foreman

___Owner of farm who "hires out".

___Postal clerk

___RR or telegraph agent or supervisor.

___Bookkeeper

___Stenographer

___Ticket agent

___Police captain

___Railroad conductor

___Tailor

___Watchmaker

___Small contractor who works at or supervises his jobs.

___Foreman

___Master carpenter

___Master electrician

___Railroad engineer

___Apprentice to skill trade

___Repairman

___Skilled worker

___CPA

___Editor

___Executive secretary

___Accountant

___Insurance

___Realestate

___Stock and bond salesman

___Editorial writer

___Bank clerk

___Auto salesman

___Bus boy

___Domestic help

___Sales people in department store

___Dime store clerk

___Grocery clerk

___Telephone operator

___Beauty operator

___High school teacher

___Librarian

___Other 4 year degree profession

___Grade school teacher

___Registered nurse

___Minister (without 4 year degree)

___Lawyer

___Proprietor of business valued at $100,000 or more.

___Business of $50,000 to $100,000 value.

___Business of $10,000 to $50,000 value.

___Business of $5,000 to $10,000 value.

___Business of $2,000 to $5,000 value.

___Business less than $2,000.

___Judge

___Physician

___Engineer

___Professor

___School superintendent

___President, etc. of corporation

___Bank executive

___Public utilities executive

___Assistant office manager

___Department manager

___Department supervisor

___Manufacturer's agent

___Branch manager

___Buyer

___Salesman

___Factory worker

___Production line

___Watchman

___Taxi driver

___Truck driver

___Waiter, waitress

___Gas station attendant

Other: Please specify

_____

_____

Summary Sheet

Code_____

Name_____ Date_____

Grade_____ DOB_____

WRAT Spelling_____ CA_____

WISC FS IQ _____ MA_____

Verbal IQ_____ Performance IQ_____

Inf._____ Pic. Comp._____

Comp._____ Pic. Arr._____

Arith._____ Bl. Des._____

Sim._____ Obj. Assn._____

Vocab._____ Coding_____

(D. Sp._____)

McGuire-White_____

Bender_____

PPVT IQ_____ MA_____

Benton Correct_____ Errors_____

Wepman_____

Developmental Articulation_____

ITPA Sound Blending_____

ITPA Aud. Closure_____

Detroit Motor Speed_____

Visual Attention/Letters_____

MKM Alphabet Spontaneous_____; Dictated_____

Visual Letter Recognition Name_____; Sound_____

Auditory Letter Recognition_____

Haptic Letter Recognition_____

APPENDIX B

TABLES OF RAW DATA WITH MEANS (M)

AND STANDARD DEVIATIONS (SD)

Appendix B

Tables of Raw Data with Means (M) and Standard Deviations (SD)

Ages in Months		McGuire-White Socio-Economic Scores		WISC FSIQ		WISC Verbal Scale IQ	
E	C	E	C	E	C	E	C
111	108	48	33	104	104	100	100
106	112	52	55	107	102	103	96
103	111	36	36	101	123	114	121
110	105	48	48	109	112	110	103
110	110	48	40	104	104	89	113
111	103	52	48	110	112	115	115
111	106	52	33	116	113	116	114
106	108	52	48	99	99	99	85
109	110	36	24	109	109	100	105
105	103	44	27	107	108	116	116
103	108	51	48	106	105	110	108
104	105	36	28	106	103	108	99
102	98	48	40	94	122	86	125
99	103	40	45	92	93	92	96
101	105	48	40	96	98	103	99
104	111	31	48	114	112	101	110
103	112	20	56	126	106	118	99
112	110	40	48	120	101	106	90
112	105	48	48	96	104	96	103
106	109	48	52	91	91	85	103
104	108	40	51	95	94	91	92
100	99	41	48	109	107	103	101
110	99	48	48	97	110	91	103
101	98	33	40	109	112	113	119
107	105	48	48	116	117	101	115
109	101	56	48	95	102	92	104
105	106	55	48	97	117	96	123
106	102	52	55	92	92	91	92
104	99	55	48	107	119	92	119
108	101	55	48	92	117	94	103
M 106.07	M105.33	M 45.37	M 44.23	M 103.87	M 106.93	M 101.03	M 105.70
SD 3.78	SD 4.37	SD 8.47	SD 8.38	SD 9.14	SD 8.71	SD 9.77	SD 10.43

WISC Performance Scale IQ		WISC Information Ho 1		WISC Comprehension Ho 2		WISC Arith	
E	C	E	C	E	C	E	C
107	107	12	11	7	9	10	7
111	108	9	11	12	7	11	8
87	120	11	11	12	16	12	9
106	121	10	12	15	10	11	9
120	93	7	11	10	13	4	11
103	106	11	12	14	14	11	9
113	110	11	15	14	12	13	11
100	114	8	6	8	7	9	11
117	113	10	10	12	11	9	13
94	97	12	14	16	13	11	8
100	101	14	11	7	13	12	13
103	107	12	9	9	8	11	11
104	114	6	11	10	16	6	13
93	92	7	7	8	14	12	8
89	97	8	12	12	8	8	9
125	113	14	14	9	10	8	11
131	113	12	7	12	12	12	7
131	113	12	7	11	11	8	9
96	104	7	9	11	11	8	11
100	80	10	11	5	7	9	9
100	97	6	7	10	7	9	7
110	111	10	11	16	10	6	9
104	117	9	13	11	3	7	11
104	101	8	11	15	15	12	11
129	117	9	10	7	11	9	11
99	100	6	8	12	10	11	10
99	108	7	14	12	17	9	11
94	93	8	11	9	10	6	4
122	115	8	13	6	13	9	13
92	131	11	12	6	6	7	10
M 106.10	M 107.10	M 9.50	M 10.70	M 10.60	M 10.40	M 9.33	M 9.80
SD 12.43	SD 10.58	SD2.31	SD 2.35	SD 3.05	SD 3.32	SD2.25	SD2.09

WISC Similarities Ho 3		WISC Vocabulary Ho 4		Verbal Comprehension Derived Score Ho 5		WISC Digit Span Ho 6	
E	C	E	C	E	C	E	C
12	12	9	11	10.00	10.75	6	8
10	12	10	9	10.25	9.75	7	8
15	17	12	14	12.50	14.50	11	10
10	10	12	11	11.75	10.75	10	11
13	12	7	13	9.25	12.25	6	8
12	3	14	14	12.75	10.75	6	11
12	11	13	12	12.50	12.50	12	9
11	9	13	5	10.00	6.75	7	12
8	10	11	10	10.25	10.25	10	6
12	14	12	14	13.00	13.75	9	9
13	9	12	10	11.50	10.75	7	10
12	11	12	10	11.25	9.50	13	6
9	16	8	14	8.25	14.25	9	6
6	9	11	9	8.00	9.75	9	9
12	11	12	9	11.00	10.00	9	11
7	12	13	11	10.75	11.25	7	10
12	12	16	11	13.00	10.50	6	6
12	9	12	6	11.75	8.25	10	6
11	13	10	8	9.75	10.25	10	11
5	12	9	13	7.25	10.75	7	6
9	12	9	11	8.50	9.25	7	12
14	7	9	14	12.25	10.50	7	9
8	15	8	10	9.00	10.25	5	13
12	14	13	14	12.00	13.50	7	9
12	18	14	12	10.50	12.75	11	11
9	16	6	9	8.25	10.75	10	11
10	14	9	12	9.50	14.25	9	11
9	10	11	9	9.25	10.00	6	7
12	13	9	13	8.75	13.00	6	11
11	14	10	10	9.50	10.50	8	11
M 10.68	M 11.90	M 10.87	M 10.90	M 10.40	M 11.13	M 8.23	M 9.27
SD 2.31	SD 3.09	SD 2.28	SD 2.38	SD 1.64	SD 1.83	SD2.06	SD2.13

WISC Coding Ho 7		WISC Picture Arrangement Ho 8		Sequencing Derived Scores Ho 9		Detroit Visual Attention Span for Letters MA in Months Ho 10	
E	C	E	C	E	C	E	C
5	11	11	15	7.33	11.33	99	122
14	12	11	7	10.66	9.00	133	109
7	12	8	13	8.66	11.66	108	111
13	11	10	13	11.00	11.66	117	133
12	11	14	10	10.66	9.66	81	115
9	14	12	12	9.00	12.33	115	122
12	15	12	9	12.00	11.00	134	114
8	14	15	10	10.00	12.00	99	115
14	19	12	5	12.00	10.00	105	109
10	11	13	9	10.66	9.66	93	94
12	8	13	11	10.66	9.66	108	110
11	12	10	12	11.33	10.00	134	90
10	15	12	12	10.33	11.00	87	114
10	13	10	4	9.66	8.66	108	108
12	10	7	10	9.33	10.33	120	109
11	15	14	13	10.66	12.66	93	120
11	11	16	11	11.00	9.33	126	132
11	14	14	16	11.66	12.00	100	114
12	12	12	8	11.33	10.33	99	114
10	13	11	7	9.33	8.66	99	109
11	13	10	11	9.33	12.00	105	156
9	12	15	13	10.33	11.33	99	108
9	12	10	13	8.00	12.66	114	114
11	13	12	14	10.00	12.00	108	120
12	11	12	10	11.66	10.66	105	138
11	12	7	13	9.33	12.00	120	114
10	13	11	10	10.00	11.33	110	114
10	13	6	10	7.33	10.00	90	110
11	11	12	10	9.66	10.66	93	90
11	15	12	14	10.33	13.33	108	114
M 10.63	M 12.60	M 11.47	M 10.83	M 10.11	M 10.90	M 107.0	M 114.7
SD 1.88	SD 2.03	SD 2.39	SD 2.79	SD 1.24	SD 1.26	SD 13.64	SD 13.10

Detroit Motor Speed MA in Months Ho 11		WISC Picture Completion Ho 12		WISC Block Design Ho 13		WISC Object Assembly Ho 14	
E	C	E	C	E	C	E	C
108	123	16	6	11	12	12	11
108	102	13	14	12	12	8	11
93	93	10	12	8	14	8	13
117	133	6	16	10	13	15	11
105	84	12	9	14	9	12	6
111	122	13	7	7	12	11	9
96	69	13	11	11	10	11	12
99	141	8	9	11	13	8	14
117	147	9	12	13	10	14	13
108	105	8	8	9	11	6	9
120	111	10	12	6	9	9	11
90	63	11	11	8	12	12	8
78	102	12	8	10	15	9	10
72	111	7	11	8	8	10	8
111	111	7	7	7	12	9	9
105	123	13	13	15	7	15	11
96	105	16	14	15	13	15	10
102	111	15	10	16	9	16	10
129	96	9	13	9	8	5	12
99	84	7	5	10	5	12	6
105	120	10	12	8	5	11	7
114	99	14	12	8	11	11	10
81	87	10	11	10	13	14	13
102	84	11	8	10	9	9	7
105	114	13	16	17	12	17	13
75	90	10	7	10	10	11	8
111	123	10	10	10	12	8	11
90	111	11	7	8	10	11	5
81	90	15	15	12	13	16	12
111	99	10	14	9	16	2	13
M 101.27	M 105.10	M 10.97	M 10.67	M 10.40	M 10.83	M 10.90	M 10.10
SD 13.96	SD 19.53	SD 2.74	SD 3.02	SD 2.80	SD 2.64	SD 3.48	SD 2.41

Derived Spatial Abilities Score Ho 15		ITPA Auditory Closure Scaled Scores Ho 16		PPVT Raw Scores Ho 17	
E	C	E	C	E	C
13.00	9.66	28	28	67	67
11.00	12.33	38	37	65	62
8.66	13.00	41	40	68	80
10.33	13.33	36	33	80	72
12.66	8.00	28	38	69	84
10.33	9.33	44	32	74	67
11.66	11.00	45	31	80	75
9.00	12.00	33	36	69	76
12.00	11.66	32	38	85	66
7.66	9.33	38	45	65	79
8.33	10.66	34	36	61	76
10.33	10.33	23	40	65	69
10.33	11.00	32	33	81	73
8.33	9.00	31	37	77	61
7.66	9.33	42	33	82	75
14.33	10.33	38	28	98	72
15.33	12.33	39	37	80	78
15.66	9.66	42	34	76	65
7.66	11.00	29	42	68	70
9.66	5.33	21	32	70	77
9.66	8.00	33	28	65	63
11.00	11.00	28	36	65	70
11.33	12.33	36	33	80	59
10.00	8.00	34	42	71	72
15.66	13.66	38	40	81	77
10.33	8.33	28	37	67	76
9.33	11.00	25	31	63	78
10.00	7.33	35	26	79	64
14.33	13.33	35	33	61	75
7.00	14.33	36	36	73	77
M 10.75	M 10.53	M 34.07	M 35.07	M 72.83	M 71.97
SD 2.45	SD 2.12	SD 6.05	SD 4.59	SD 8.53	SD 6.39

WISC Verbal Scaled Scores Total Ho 18

E	C
50	50
52	47
62	67
58	52
41	60
62	62
63	61
49	38
50	54
63	63
58	56
56	49
39	70
44	47
52	49
51	58
64	49
55	42
47	52
38	52
43	44
55	51
43	52
60	65
51	62
44	53
47	68
43	44
44	65
45	52
M 51.00	M 54.47
SD 7.85	SD 8.28

Correlation WISC Verbal And PPVT Raw Score

Pearson Product Moment
r

Experimentals

WISC Verbal	PPVT
50	67
52	65
62	68
58	80
41	69
62	74
63	80
49	69
50	85
63	65
58	61
56	65
39	81
44	77
52	82
51	98
64	80
55	76
47	68
38	70
43	65
55	65
43	80
60	71
51	81
44	67
47	63
43	79
44	61
45	73
M 51.17	M 72.80
SD 7.87	SD 8.53

Correlation
.0939

Correlation WISC Verbal Scaled Scores and PPVT Raw Score

Pearson Product Moment
r

Controls

WISC	PPVT
50	67
47	62
67	80
52	72
60	84
62	67
61	75
38	76
54	66
63	79
56	76
49	69
70	73
47	61
49	75
58	72
49	78
42	65
52	70
52	77
44	63
51	70
52	59
65	72
62	77
53	76
68	78
44	64
65	75
52	77
M 54.57	M 69.83
SD 8.13	SD 9.11

Correlation
.4706

Bender Weighted Scores (Watkins) Ho 20		Bender Watkins Revised Scoring Ho 20		Benton Ho 21 Error Score		Benton Ho 22 Number Correct	
E	C	E	C	E	C	E	C
5	7	2	4	5	2	6	9
4	11	4	6	6	10	6	5
14	8	10	4	6	13	6	4
12	7	8	5	7	8	6	4
11	15	8	7	2	7	8	5
9	13	6	15	7	6	4	5
9	14	8	14	9	4	4	6
10	15	8	11	8	10	4	5
6	10	4	6	8	6	4	5
9	11	7	9	11	11	3	4
13	5	10	5	15	10	2	3
16	9	12	4	10	8	5	4
9	10	5	7	8	6	5	6
11	5	6	3	15	13	3	2
9	1	7	1	14	6	3	7
6	8	3	6	6	5	6	6
11	6	6	5	5	11	6	4
6	7	5	5	3	6	7	6
15	12	10	7	14	8	3	5
7	20	6	14	7	13	5	2
11	16	7	11	8	9	5	3
7	14	5	9	11	10	3	4
10	11	9	7	11	3	3	9
12	8	8	5	6	12	7	3
22	12	16	9	12	10	4	5
11	13	8	11	13	10	3	3
11	17	9	11	19	15	2	2
11	7	9	5	12	17	4	1
14	4	11	3	11	12	1	4
15	1	12	1	16	5	4	7
M 10.30	M 9.93	M 7.63	M 7.00	M 9.50	M 4.08	M 4.40	M 4.60
SD 3.94	SD 4.60	SD 2.97	SD 3.70	SD 9.20	SD 3.49	SD 1.67	SD 1.90

ITPA Sound Blend Scaled Scores Ho 23		Wepman X Errors Scores Ho 24		Hejna Developmental Articulation Error Score Ho 25	
E	C	E	C	E	C
39	35	3	2	0	0
44	39	10	6	0	0
41	46	5	0	0	0
44	43	7	2	0	0
26	33	14	2	0	0
42	33	9	2	0	0
44	36	5	2	0	0
43	31	4	8	0	0
39	44	3	4	0	0
44	42	7	1	0	0
43	47	6	1	0	0
45	38	8	4	0	0
38	46	6	0	2	0
44	40	2	3	0	0
43	48	4	2	0	0
39	42	5	5	0	0
46	47	4	2	0	0
44	46	5	5	0	0
39	47	4	2	0	1
26	35	12	5	0	0
43	39	11	2	0	1
39	48	4	5	0	0
43	44	2	3	0	0
44	43	5	3	0	0
47	45	4	2	0	0
36	46	3	3	0	0
44	44	5	2	0	0
47	35	6	6	1	0
42	47	3	1	0	0
45	43	3	2	0	0
M 41.43	M 4.99	M 5.63	M 2.90		
SD 41.73	SD 5.12	SD 2.99	SD 1.88		

Spontaneous Writing of the Alphabet Error Score Ho 27		Writing the Alphabet from Dictation Error Score Ho 28		Visual Recog. Alphabet Name + Sound Error Score Ho 29	
E	C	E	C	E	C
5	0	0	0	4	0
3	1	2	0	0	2
2	0	0	0	1	0
0	0	1	2	1	0
1	7	0	1	5	3
0	0	0	0	1	4
1	0	2	1	0	1
0	1	2	1	0	6
0	0	0	0	2	2
9	1	0	0	2	0
2	0	0	1	5	0
3	3	3	1	3	4
7	1	0	0	4	1
2	0	3	1	4	2
1	0	0	1	3	0
2	0	7	0	2	5
1	0	1	1	4	6
2	0	0	2	1	2
1	1	2	0	5	0
1	0	0	0	1	1
2	0	2	0	3	2
0	3	0	0	5	0
0	1	0	0	1	2
0	0	0	0	1	4
1	2	1	0	1	3
8	1	0	1	6	0
0	0	1	0	2	0
3	4	0	0	1	3
0	0	2	0	4	0
3	1	1	1	3	2
M 2.17	M 0.90	M 1.00	M 0.47	M 2.50	M 1.83
SD 2.57	SD 1.56	SD 1.51	SD 0.63	SD 1.76	SD 1.88

MKM Auditory Letter Recognition Error Score Ho 30		Haptic Letter Recognition Error Score Ho 31		Absolute Difference Between Verbal & Performance WISC IQ's Ho 32		Number of WISC Subtest (SS) Falling Below S own mean Ho 33	
E	C	E	C	E	C	E	C
21	13	7	12	7	7	5	4
24	6	6	9	8	12	4	5
20	2	2	3	27	1	5	7
11	6	3	12	4	18	7	7
34	13	2	4	31	20	5	5
15	7	7	7	12	9	6	4
7	7	1	4	3	4	7	6
18	15	14	3	1	29	7	5
17	6	3	5	17	8	6	7
18	10	7	2	22	19	5	6
17	3	12	9	10	7	5	5
20	9	4	6	5	8	3	5
38	10	10	4	18	11	6	5
29	8	7	8	1	4	5	8
20	6	10	6	14	2	6	5
22	3	4	4	24	3	5	6
19	7	2	4	13	14	6	4
10	10	1	7	25	23	7	8
14	12	10	9	0	1	5	4
21	23	7	8	15	23	4	6
21	19	8	8	9	5	6	5
19	8	4	5	7	10	7	5
8	9	2	6	13	14	6	4
14	10	8	11	9	18	6	6
15	10	3	6	28	2	7	8
35	12	9	7	7	4	4	7
23	18	11	3	3	15	5	7
22	16	2	12	3	1	5	4
12	9	6	1	30	4	5	4
16	14	14	6	2	28	4	5
M 19.33	M 10.03	M 6.20	M 6.37	M 12.27	M 10.80	M 5.47	M 5.57
SD 7.36	SD 4.84	SD 3.84	SD 3.00	SD 9.48	SD 8.23	SD 1.07	SD 1.30