CONCURRENT ACADEMIC PREDICTORS OF SPELLING PERFORMANCE OF THIRD GRADE CHILDREN

By

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To

Linda

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The focus of the present study was to identify a set of prerequisite tasks, modality relevant to spelling performance, that when based on accuracy and speed as performance measures, would discriminate between good spellers and poor spellers. A review of related literature suggested that (a) tasks used to date have represented more than one basic behavior per task; (b) tasks that have been used are related to, but are not direct replications of the modality input and output structure of spelling behavior; (c) tasks used have not represented the most basic skills assumed by curriculum hierarchies to be prerequisite to spelling competence; and (d) tasks have been assessed by accuracy alone, without referring to speed (fluency) as a viable performance measure.

A spelling test was administered to a group of third graders in Alachua County, Florida. From these results, the top and bottom

25.9 percent (good and poor spellers) were chosen (N=35 per group). Each of these subjects was then assessed on each of eight tasks on three consecutive days. Accuracy and speed scores were obtained for each subject on each task. Discriminant analysis and multiple regression procedures were used to analyze the data.

The results of the study indicated that two of the eight tasks used, See CVC trigram/Say nonsense word and Hear two letter blends and digraphs/Write letters, were the best tasks with which to discriminate groups of good and poor third grade spellers. Speed and accuracy scores on the two tasks were found to be nearly equivalent discriminators between the two groups of spellers. The findings of this study indicated that the use of speed and accuracy as performance measures may serve two useful functions. First, speed and accuracy scores discriminate between good and poor spellers. Second, speed and accuracy scores reduce possible misclassifications that may interfere with a child's curricular program. The overall and additional findings have suggested possible alternative research efforts that may help solve the problem of presenting classroom instruction that could promote better spelling achievement.

CHAPTER I

INTRODUCTION

Spelling is one criterion by which school achievement is measured. Allen and Ager (1965) state that "spelling is an independent skill and should receive specific attention . . . in the school curriculum" (p. 159). There are many characteristics that contribute to spelling performance in children, e.g., intelligence, visual perception. There may be certain prerequisite academic skills, that if known early, could serve to discriminate between good and poor spellers. Such a discrimination could also be helpful in planning remedial and developmental curricular programs.

The concern for correctness in spelling and effective instructional methods is not new. Cook and O'Shea (1914) stated, "There is . . . a wide-spread belief that graduates of the elementary schools can not spell so well now as they did in earlier times." T. D. Horn (1969) related even earlier reports of such dissatisfaction from the thirteenth century. Many teachers are aware of children who are poor spellers but the reason for their spelling difficulties remains a concern. Although educators are cognizant of correlates related to poor spelling (Russell, 1937; Spache, 1940a; 1940b; 1941a; 1941b) they may

be unsure of those specific behavioral elements functionally related to spelling.

To date, the research on spelling suffers from numerous limitations. Among these are (a) the lack of replicable procedures (T. D. Horn, 1967); and (b) the use of tasks that do not directly replicate spelling behavior (Westermann, 1971). An example of the latter is the use of tasks to assess spelling which have generally been used to assess reading. The characteristic behaviors specific to spelling and reading are different. Whereas in reading the input modality is visual (See), in spelling the input modality is auditory (Hear) (Fries, 1963; Lerner, 1971). It does not necessarily stand that a See consonant/Say consonant name task provides information which is as relevant to actual spelling behavior as a Hear consonant sound/Say consonant name task. The latter is a direct replication of the modalities used in spelling behavior, while the former can only approximate the spelling behavior by content alone.

Emerging from the above limitations in the existing literature is the need for clearly defined and replicable procedures (T. D. Horn, 1967) that make use of modality relevant tasks dealing directly with spelling (Bannatyne & Wichiarajote, 1969; Hanna & Hanna, 1966).

Purpose of the Study

The present study was designed to discriminate between good and poor spelling performance in third grade children. It was based on a combination of unique theoretical and methodological parameters that have not been used in spelling research prior to this study. The unique factors are:

(1) the use of tasks that appear to be prerequisite of spelling behavior;

(2) the use of accuracy and speed measures as performance descriptors of the tasks;

(3) the use of tasks that make use of modality input and output directly related to spelling performance;

(4) the use of multiple measures consisting of three samples of each child's performance on each task; and

(5) the use of a new scoring procedure for the spelling task itself.

The problem, then, was to identify a set of prerequisite tasks, modality relevant to spelling performance, that when based on accuracy and speed as performance measures would discriminate between good spellers and poor spellers. The specific questions asked were:

(1) Which tasks, with respect to accuracy, discriminated between good spellers and poor spellers?

(2) Which tasks, with respect to speed, discriminated between good spellers and poor spellers?

(3) Which tasks, with respect to both accuracy and speed, discriminated between good spellers and poor spellers?

Justification of the Study

Among the reasons indicated as possible evidence of low spelling achievement in the United States are (a) a decline in the systematic teaching of spelling resulting from erroneous interpretations of incidental findings and (b) confusion resulting from grapheme and phoneme relationships (E. Horn, 1960). Prediction studies have not been done in the area of spelling that would help to clarify these issues. What exists in the literature on spelling, however, are concurrent correlational studies that have related various characteristics (e.g., intelligence, demographic information) to spelling competence.

The intent of this study was to use tasks that appear to be hierarchical prerequisites of spelling competence using the same input and output modalities as actual spelling performance (Hear input rather than See input). Traditionally, See or reading type tasks have been used. Hear tasks were chosen because their topographical relation to spelling behavior may provide better predictors.

Findings from this study may provide educators with a new knowledge base upon which to (a) identify good spellers and poor spellers early; (b) focus on curricular variables related to remediating poor spelling; (c) focus on these curricular variables in accordance with performance measures (i.e., accuracy

and speed) found to be relevant; and (d) provide information about the utility of an input and output modality structure that is relevant to spelling performance. Whether or not remediation of related deficit skills will directly result in the improvement of poor spelling is subject to empirical research. It is not included within the scope of the present study.

Limitations

Threats to Internal Validity

The internal validity of this study may have been weakened by the instrumentation procedures used (Campbell & Stanley, 1966). This refers to possible scoring errors due to individual data recorder error. Chapter III discusses the procedures used to protect the internal validity of this study.

Threats to External Validity

The generalizability of this study may have been threatened by the lack of total randomization in the selection of the subjects. The reader is cautioned in generalizing the results presented beyond the geographical area in which the study was done.

Definitions of Terms

Good Speller: The top 25.9 percent (N=35) of the original group (N=135) based on the spelling test score.

Poor Speller: The bottom 25.9 percent (N=35) of the original group (N=135) based on the spelling test score.

Accuracy: A percentage score based on the number of correct responses divided by the total number of responses made.

Speed: The total number of responses made, correct and error, per minute.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Traditional Variables

Spelling research has traditionally been divided into three areas. These areas are (a) learner variables, (b) curricular variables, and (c) word variables (Cahen, Craun, & Johnson, 1971). The knowledge of learner variables has not proven to be clearly related to remediating poor spelling or to facilitating good spelling (T. D. Horn, 1967). The majority of research on spelling has dealt with curricular variables, e.g., methods and materials (Blair, 1975; T. D. Horn, 1969). There is no teaching approach that appears to best facilitate good spelling. Research on word variables has been concerned with such issues as error analysis, regularity versus irregularity of orthography, and high frequency versus low frequency of word occurrence.

Parameters of the Present Study

The present study has five parameters. These parameters have generated a new perspective for looking at learner performance on relevant tasks. The literature reviewed will be considered under the rubric of:

(1) learning hierarchies, as they contribute to task selection;

(2) academic predictors and their contribution to (a) the selected tasks and (b) the input and output modality of the selected tasks;

(3) a new procedure for scoring spelling tasks;

(4) accuracy and speed as separate performance measures of the selected tasks; and

(5) repeated measures of predictor tasks.

These parameters may permit more precision in the discrimination between good and poor spellers. Learning hierarchies is a theoretical parameter. The new scoring procedure and multiple measurement of tasks are methodological parameters. Performance measures and the contribution of academic predictors are both theoretical and methodological in nature.

Learning Hierarchies

Definition and Characteristics

Learning hierarchies are "descriptions of the relationships of positive transfer among intellectual skills" (Gagné, 1968, p. 4). What they are not, however, are statements of how an individual acquires the knowledge contained in the hierarchy. Each level of the hierarchy generates some quantity and quality that positively transfers to the learning of a "not-previously-acquired, higher-order capability" (p. 5).

Learning hierarchies, then, represent the effects of cummulative learning with the greatest amount of positive transfer among elements. Gagné (1968) makes the point that learning hierarchies represent the most effective direction of learning for the entire population of learners, and do not represent strategies unique to individual learners.

Origins of Learning Hierarchies

This study has as one of its parameters the issue of curriculum and is concerned with the selection of tasks that may be sequentially ordered. Gagné (1970) has stated that content in any one area of learning (e.g., spelling) should be hierarchically ordered so that those simpler concepts and abilities upon which later learning is based be mastered first. Instructional design, or management, can then be based on those conditions of learning (curriculum) that are requisite to each of the hierarchical components.

Learning hierarchies represent priority ordered skill sequences. That is to say, based on skill analysis, experience, and the use of other persons' lists, skills are ordered, in many instances, post hoc. One should not infer that this method is in error. However, effort needs to be expended to determine

empirically whether or not these ordered skills transfer positively in a vertical fashion or are independent (Gagné, 1968).

Validation of Learning Hierarchies

Investigations of the validity of learning hierarchies have yielded inconclusive results (White, 1973). Based on Gagné's (1962) validation model, research efforts reviewed fell short of being validated. Reasons indicated by White included methodological weaknesses and the lack of the Gagné model to provide a test of hierarchical dependence.

White (1973) then discussed a different method for validating hierarchies. The model proved useful with one major limitation. Large numbers of hierarchical elements (k) prohibit the use of the model. This is due to the number of groups of subjects needed to complete the validation procedure which can be arrived at by using k! groups for maximum control or 2(k-1) groups for minimum control.

White (1973) concluded his remarks by presenting some modifications of Gagné's (1962) original design. He stated that "it would be a pity if further effort is expended on the production of unreliable or ambiguous data in this [learning hierarchies] area of learning when much more precise work is possible" (p. 374).

Task Selection in the Present Study

In light of the comments of White (1973) and Gagné (1963; 1970) and the lack of validation of current hierarchies, one is

left with a choice of combining what is already in existence or deriving a new hierarchy that may not fit those already in use.

Specific behaviors assumed to be prerequisite to spelling have appeared on curriculum hierarchies (Random House, 1972; Starlin & Starlin, 1972) and in task analyses of spelling (Westermann, 1971). These behaviors have been accepted as necessary for spelling performance. It is from these hierarchies that the tasks used in the present study were selected.

Task Selection and Hierarchy Validation

In lieu of a validated hierarchy in spelling, tasks were chosen from already published hierarchies. The tasks selected represent a basic core of skills found at the beginning of each of these published hierarchies. That is not to say because they are in agreement with each other they are valid, but because they are in agreement they represent a consensus of the field at present. The tasks in use in this study afford one a beginning point which needs further work toward empirical validation.

Related Academic Predictor Variables

This study has used concurrent prediction, with third graders, in an effort to determine a set of tasks, not used to date, that attempts to explain the nature of the relationship of this set of tasks to spelling performance.

The following section of the review is limited in scope to those areas of academic concern that are relevant to the selec-

tion of tasks used in the present study. Of concern are tasks that are topographically relevant to spelling and tasks related to speed of manuscript handwriting.

Reading

Hughes (1953) has stated that "the correlation [+.53] between reading and spelling indicates that . . . they may have some skills in common, but are, to a considerable degree, discrete" (p. 348). Reading and spelling skills, although topographically similar, make use of different input and output modalities. Reading is a See/Say task and spelling is a Hear/Say or Hear/Write task. Therefore, reading represents a grapheme-phoneme relationship and spelling represents a phonome-grapheme relationship.

Skills related to spelling need to be assessed with the modality structure relevant to actual spelling behavior. The utility of such a modality structure will allow one to place particular emphasis not only on the content of related tasks, but to ascertain the importance of the modality structure in predicting spelling performance.

Phonics. Studies by Spache (1940a), Russell (1937), Bond (1935), and Monroe (1932) assessed word attack skills related to spelling. Their results indicated that poor spellers were inferior to good spellers on these tasks (i.e., blending letters to form words). Two limitations of these studies that are relevant to the present study were (a) the tasks involved visual

input rather than auditory input; and (b) the tasks encompassed different levels of the same topographic task (i.e., CVC words, CVCV words, CCVC words). Monroe (1932) in her assessment of vowel or consonant difficulties that might have contributed to spelling difficulty, based her conclusions on words read by her subjects. If a child read "these" instead of "those", the error was vowels. If a child read "then" instead of "them" the error was consonants.

Templin (1954) found phonics based on visual recognition tasks to be correlated +.54 to +.57 with spelling. She did use one recall task, Hear consonant sound and sound combinations/ Write letter(s). This task correlated +.34 with spelling. Although Templin used a Hear task, the task included more than one basic behavior (single sounds and sound combinations).

Summary. The selection of tasks for use in the present study were modality relevant to spelling as well as representing one basic behavior per task. These tasks were selected because they represent basic skills agreed to be prerequisite to spelling competence.

Speed of Manuscript Handwriting

The issue of speed in handwriting has been considered as early as 1914, when Freeman found that increasing speed does not necessarily sacrifice the quality of handwriting. The slower the child writes, the slower the language forms are emitted from him. As a child is able to write more automatically

(proficiently), the easier it is for him to communicate with others in written form. Early speed studies have not shown significant differences between poor and good spellers (Cobb, Kincaid, & Washburn, 1918; Russell, 1937).

Speed data on third graders suggests that they can write random letters at a mean rate of 41 letters per minute (Stiles, 1974). In another study, Wolking (1973) found that third graders can write numbers randomly at a rate of 62 numbers per minute and that by the sixth grade at a rate of 116 numbers per minute. With an increased emphasis on proficiency as a function of accuracy and time, perhaps the issue of speed can be a more clearly defined component of educational designs. The use of speed data in the present study may yield information that will further substantiate its inclusion as a performance measure of academic competence.

Spelling Test Scoring Procedure

Scoring Units

Whole Word. Spelling tests have traditionally been scored using a words correct, as the scoring unit, procedure. Use of this method does not allow for the varying length of each word. Individuals may be penalized for misspelling an entire word, when they may have, in fact, only misspelled an affix. Further analysis for instructional purposes is limited.

Syllable. The use of syllables as a scoring unit accounts neither for the varying length of words nor for the monosyllabism of some words. Use of this method of scoring subsumes an a priori knowledge of the rules of syllabication by the speller. This is not to infer that spellers do not need to be aware of these rules, but in the early grades (1-3) the more complex rules of syllabication are not stressed (Griffith, Bishop, Brown, Cohen, Islar, Pinder, & Steen, 1971).

Sound cluster. Sound clusters have been called phonemes by some authors (Bannatyne, 1973; White & Haring, 1976). Bannatyne makes a distinction between phonemes in the word "cough" (/k/ /ou/ /f/) and optemes and graphemes (/c/ /ou/ /gh/). Despite the nomenclature used, sound clusters may present some problem in that the child may have some of the letters correct but may miss others. In the above example, "c" and "k" are interchangeable phonemically, as are "ou" and "aw" and "f", "gh", or "ph". Use of this method does not give an individual credit for parts of the word he has written correctly, because the whole word procedure is still a factor.

Letter. White and Haring (1976) suggest that "the letter is the basic unit of spelling behavior" (p. 29). The following example will illustrate the scoring procedure. The word "often" has five letters, thereby having six possible units. The child is given credit for knowing how to start and knowing how to stop the word. Carets are used to indicate the flow of the spelling of the word. "Often," when spelled correctly, looks like

^o^f^t^e^n^ (six units), but when spelled without the "t" would look like ^o^f e^n^ (four units). This scoring procedure allows one to look not only at the whole word, syllables, and sound clusters, but at letter sequencing, where many errors seem to be prevalent. Evidence from pilot data not only substantiated this contention, but allowed the investigator to look at initial, medial, and final consonant placement, vowel placement and letter sequencing. Although this information was not used for purposes of this study, valuable information for teaching considerations is made available.

Performance Descriptors

Accuracy

Performance analysis can only be described as accurately as is allowed for by the performance measures used. Presumably more precise measures permit finer discriminations to be made. Traditional measurement provides one with an accuracy score, be it percent correct of the material presented or percent correct of the material attempted. Accuracy, therefore, is only representative of count, or comparison on an interval scale.

Speed

Speed allows one to look at the number of behaviors (count) emitted per unit of time. Skinner, in 1932, introduced the concept of speed (count/time) "as a basic unit of direct behavioral measurement" (Pennypacker, 1972).

Speed is a valuable measure because all behavior occurs in a time dimension. Speed, in combination with accuracy, allows for more precise information than is yielded by accuracy alone. Two children may each read the same material with the same accuracy. However, the addition of speed as a performance measure allows one to notice that one child takes two minutes and the other child takes five minutes. Educationally, one cannot, with this added information, state that both children read equally as well.

Haughton (1972) has discussed the importance of speed to education. He stated that it is fluency (speed) that allows a child to perform functionally, not accuracy. It must be remembered, however, that the acquisition of functional speed follows the acquisition of accuracy on the same task.

This study has made use of both accuracy and speed scores per task, in an effort to assess the unique contribution each may make to the same set of predictor tasks and to assess the joint contribution each may make when used to describe the same tasks.

Repeated Measures of Predictor Tasks

Norm-referenced tests are administered once per child. The score yielded represents that child's functioning level at the time of testing. To accomodate for errors in measurement related to such factors as scoring error, illness of the child, and lack of rapport with the examiner, these tests have included in their

manuals formulae from which may be derived a standard error of measurement ($SE_m = \sigma_x\sqrt{1-r_{xx}}$), where σ_x = the standard deviation of the test and r_{xx} = the reliability coefficient of the test.

It has been suggested by researchers (i.e., Stiles, 1974; White & Haring, 1976) that administration of tasks over a three day period will yield a more reliable measure. In an effort to obtain a more reliable measure from each subject, data was collected on the same tasks for three consecutive days.

Summary

The literature reviewed suggests that (a) tasks used to date have not been comprised of one basic behavior per task; (b) tasks that have been used are related to, but are not direct replications of the modality input and output structure of spelling behavior; (c) tasks used have not represented the most basic skills assumed by curriculum hierarchies to be prerequisite to spelling competence; and (d) tasks have been assessed by accuracy alone, without referring to speed (fluency) as a viable performance measure that may yield useful information for teaching. The present study has used these parameters in a unique combination that may describe more accurately predictor variables associated with spelling performance.

CHAPTER III

PROCEDURES

The focus of this study was to examine a set of concurrent academic predictors of spelling performance. A group of third graders was administered a spelling test. From these results, the top and bottom 25.9 percent (good and poor spellers) were chosen. Each of these subjects was then assessed on each of eight predictor tasks on three consecutive days. Accuracy and speed scores were obtained for each subject on each task. These scores were used as the independent variables in the statistical analysis. The dependent measure was group membership, e.g., good or poor spellers.

Specific Questions

Question One

Which tasks, with respect to accuracy, discriminated between good spellers and poor spellers?

Question Two

Whick tasks, with respect to speed, discriminated between good spellers and poor spellers?

Question Three

Which tasks, with respect to both accuracy and speed, discriminated between good spellers and poor spellers?

Subjects

One hundred thirty-five third graders were administered a spelling test (see Appendix A). The subjects for the study were drawn from three public schools in Alachua County, Florida. The sample initially comprised third graders in attendance at these schools. The schools were selected on the basis of availability. An upper and lower group (N=35 per group) were selected from the original group. Each group, therefore, was comprised of approximately 25% of the original group. These two groups were used for the remainder of the study.

The following tables report demographic information about the subjects in the two groups. Table 1 shows the sex ratio for each group. Table 2 shows the school breakdown for each group. Table 3 shows the parents' index of social position for each group (Hollingshead & Redlich, 1958). It may be noted that there is a disproportionate amount of children from groups five, six, and seven. The distribution of children in this sample, based on parents' index of social position, does not approximate a normal population distribution. This information is included to further describe the characteristics of the sample, however, it was not used in the data analysis of the present study.

Table 1

Sex Ratio Per Group

	Good		Poor		Total	
Sex	N	% of Good Group	N	% of Poor Group	N	% of Total
Male	16	.46	21	.60	37	.53
Female	19	.54	14	.40	33	.47
Total	35		35		70	

Table 2

School Breakdown Per Group

	Good		Poor		Total	
School	N	% of Good Group	N	% of Poor Group	N	% of Total
A	17	.49	10	.29	27	.39
B	7	.20	12	.34	19	.27
C	11	.31	13	.37	24	.34
Total	35		35		70	

Table 3

Parents' Index of Social Position Per Group

Group	Index 1	2	3	4	5	6	7	Not Available
Good	5	6	1	6	6	4	4	3
Poor	0	0	1	4	5	10	11	4
Totals	5	6	2	10	11	14	15	7

1 = Higher executives, proprietors of large concerns, and major professionals.

2 = Business managers, proprietors of medium-sized business, and lesser professionals.

3 = Administrative personnel, small independent businesses, and minor professionals.

4 = Clerical and sales workers, technicians, and owners of little businesses.

5 = Skilled manual employees.

6 = Machine operators and semi-skilled employees.

7 = Unskilled employees (and unemployed).

Instrumentation

All tasks for all subjects were the same. The tasks used as the predictor variables were assumed to be representative of classroom behaviors needed to promote skill attainment in the area of spelling.

The spelling task used to obtain the dependent, or criterion, measure included 48 words randomly selected from the Spelling Errors Test II-IV (Spache, 1955). The test has twelve sections of ten words each. Each section represents a specific error type. Although error types were not analyzed for this study, four words were included from each of the twelve error type groups. In this way, no subject was penalized if, for example, he were to be deficient in one error type.

This study has made use of tasks drawn from the Starlin and Starlin (1972) and Random House (1972) curriculum hierarchies and from Westermann's (1971) task analysis of spelling. Selected for presentation in a random order, the predictor tasks used were:

(1) See CVC trigram/Say nonsense word;

(2) Hear consonant sound/Say consonant name;

(3) Hear short vowel sound/Write vowel;

(4) See one place addition fact/Say answer;

(5) Hear two letter blends and digraphs/Write letters;

(6) Hear consonant sound/Write consonant;

(7) Hear short vowel sound/Say vowel name; and

(8) Hear instruction/Write letters of the alphabet.

Tasks 2, 3, 5, 6, and 7 were employed because (a) they are representative of prerequisite skills assumed to be necessary for spelling competence and (b) they follow the Hear/Say or Hear/Write modality structure of spelling behavior. These tasks, neglected in previous research, needed to be studied so as to assess their relevance to spelling and to the teaching of spelling.

Tasks 1, 4, and 8 were included because of the unique information each might contribute to a more definitive understanding of spelling. If the math task (#4) were to predict or correlate highly with the ability to spell, one might be able to infer that the prerequisite skills for spelling are not specific to the domain of spelling.

Inclusion of the alphabet writing task (#8) serves a unique function. As one assesses short vowel and consonant skills, the output is to be obtained in two modes, one oral and the other written. If a child were to have a high rate of oral responding on these tasks, but were to have a low rate of written responding, one might assume that the writing of the response interfers with the performance. This would indicate a performance ceiling on these tasks placed by the child's writing ability. If, on the other hand, a child were to have a higher rate of written responding on these tasks, one might infer that his writing-motor ability is better than his vocal-motor ability.

Task #1, a See/Say (reading) task, is included as it is purported to assess the ability to blend basic sounds (Personke, 1972). Assessing the ability to use phonics generalizations becomes somewhat of a problem. Some words which are phonetically regular, such as "red," may already have been learned as a sight word. Therefore, CVC nonsense trigrams were used.

Method

Administration of the Spelling Test

All subjects were administered a spelling test (Spache, 1955). Use of a spelling test that had words for second, third, and fourth graders allowed for a broader range of words. The range of words encompassed (a) a base for poorer spellers to respond, and (b) a high enough ceiling for better spellers. The spelling test was administered to each class as a group task. Record forms were provided for each subject on which the subject's answers were written. Each word was presented individually, used contextually in a sentence, and then repeated. For each corresponding number on the answer sheet, a card was held up with that number so that each child was able to mark the answer in the appropriate space. Sufficient time was allowed for each child to finish the word called.

Directions for the spelling task were:

"I am going to give you a spelling test. There will be 48 words in all. There may be a few words that you haven't studied before, but I want you to try to spell these new words the best you can. This is not one of your regular spelling tests. What you do on this test will not affect your spelling grade. Let's start now and see how well you can do.

I will read the word, then use it in a sentence, and then say the word again. Wait until I say the word the last time after the sentence before you begin to

write. As we move to each new word, I will hold up a card with the number on your paper so that you can make sure you are writing the word in the correct space. Are there any questions?"

An example was used to assist the child to find the appropriate writing space on the paper.

Scoring of the spelling test. Scoring of the spelling test words was based on a procedure suggested by White and Haring (1976). Using this procedure, each word was analyzed for the number of units correct. Each word had one more possible unit than the number of letters in the word itself. By using this procedure, units were awarded for beginning the word on the correct letter and for finishing the word with the correct letter.

Forty-eight words were selected from the Spache Errors Test (Spache, 1955). There were a total of 224 letters for the 48 words plus 48 additional units according to the White and Haring (1976) scoring procedure. Using this procedure 272 was the highest spelling score attainable.

Administration of the Predictor Tasks

On three consecutive days, each subject was tested individually in a place designated by the school principal. There were two recorders, the investigator and a graduate assistant, working at all times to facilitate the procedure with as little time interruption as possible for each cooperating teacher. Each task was a thirty-second sample of academic behavior. The obtained scores

were multiplied by two so that the standard measure of behavior, movements per minute, could be used (Lindsley, 1972). Writing paper and stimulus sheets (see Appendix C) were supplied for each task for which it was required. Pencils were also supplied. All subjects used one-quarter inch (.635 cm.) lined paper. All stimulus sheets read by the subjects were presented on eight and one-half by eleven inch (21.59x27.94 cm.) unlined paper and were typed with primary size type. All data recorders had appropriate record sheets on which to record the subjects' responses. All data recorders had a prior training and practice session.

For all Hear/Say tasks the directions were:

"Listen as I say each vowel (or consonant) sound. As I say each sound, I want you to tell me the name of the letter. Are you ready?"

Each Hear/Write task was administered in the same manner except that the responses were written. Short vowel sounds were "a" as in apple, "e" as in elephant, "i" as in indian, "o" as in ox, and "u" as in umbrella.

For the two See/Say tasks the instructions were:

"I want you to look carefully at each nonsense word (or addition fact). When I say go, I want you to start here (point) and tell me what the word is (or what the answer is). I want you to go across the paper (point to the arrow at the top of the sheet and follow it across the paper with your finger). Are you ready?"

The instruction for the task of writing letters of the alphabet was:

> "On this sheet of paper I want you to write all the letters of the alphabet from 'a' to 'z'. If you should finish before I say stop, go back to 'a' and try and write as many more letters as you can. I would like you to print the letters (manuscript). Are you ready?"

Scoring the Predictor Tasks. Each of the eight predictor tasks was administered on three consecutive days. Each recorder was responsible for scoring all oral response tasks. The investigator scored all written tasks. Pilot data collected showed that it was easier to correct the written tasks after the task administration.

Each task presented two mean scores. The accuracy score was a mean score based on the number of responses correct divided by the total number of responses per task attempted. The second score was a speed score. A mean speed score represented the average of the total number of responses, correct and error, attempted per subject on each task.

Data Analysis

The Biomedical Computer Programs BMD 07M (Dixon, 1973) was accessed for a stepwise discriminant analysis procedure. The program allowed for the use of a linear combination of measures from which those measures contributing most to the variance of

the dependent measure were kept in the prediction equation. The use of a two group discriminant analysis allowed for the dependent variable to be dichotomous, in other words, to represent group membership. The two-group discriminant analysis procedure provided a classification schema by which an individual, based on predictor variable scores, was assigned membership into that group whose mean score he most closely approximated.

Three free-entry subproblem routines were performed. The first routine was an analysis using both accuracy and speed measures of the eight tasks. The second analysis used only accuracy scores and the third analysis used speed scores.

Additional Analyses

A second program (BMD 07M, Dixon, 1973) was accessed based upon the results of the first analysis. This second program, also with three subproblem routines, used only those tasks from the first program that were found to be the most reliable discriminators. Three prediction equations were obtained from the three subproblem routines of the second program. The results of these equations, with a child's score placed in the formulae, compared to the cut-off score, represent an individual's predicted group membership, as a function of accuracy scores, speed scores, and both accuracy and speed scores. Constants and coefficients for each equation are different due to the contribution of the specific performance measures used.

Additional information yielded by the BMD 07M and BMD 02R programs (Dixon, 1973) will be discussed in Chapter IV. This information includes variance accounted for in the dependent measure, e.g., group membership, by all of the predictor variables (see page 23) and possible misclassification of individuals to each group.

The BMD 02R program (Dixon, 1973) was accessed a second time. The variables included were (a) Hear consonant sound/Say consonant name (CONS H/S); (b) Hear consonant sound/Write consonant (CONS H/W); (c) Hear short vowel sound/Say vowel name (SHVL H/S); and (d) Hear short vowel sound/Write vowel (SHVL H/W). The math and alphabet writing tasks were not included. Two other tasks were not included. They were: See CVC trigram/Say nonsense word (CVC) and Hear two letter blends and digraphs/Write letters (BLDI). Therefore, the four single component, auditory input tasks (consonant or short vowel; Hear/Say and Hear/Write) were entered in the program. The use of only these four tasks was for the purpose of analyzing their contribution as discriminating variables separate from (a) more complex tasks (CVC and BLDI) and (b) tasks not directly relevant to the development of spelling behavior. Three free-entry subproblem routines were accessed. Accuracy scores were used in the first subproblem. Speed scores were used in the second subproblem. Accuracy and speed scores in combination were used in the third subproblem.

Average accuracy and speed improvements were calculated for each subject. This was done by subtracting the day one accuracy or speed score from the day two score. The day two score was then

subtracted from the day three score. These two results were then added together. The sum was divided by two. The resultant score was the average accuracy or speed improvement per subject per task. These scores were pooled to calculate the mean improvement per group per task.

CHAPTER IV

RESULTS

The present study was conducted to generate a set of predictor tasks that would discriminate between a group of good spellers and a group of poor spellers. This set of tasks was based on accuracy, speed, and accuracy and speed scores in combination.

Specific questions asked were:

(1) Which tasks, with respect to accuracy, would discriminate between good spellers and poor spellers?

(2) Which tasks, with respect to speed, would discriminate between good spellers and poor spellers?

(3) Which tasks, with respect to both accuracy and speed, would discriminate between good spellers and poor spellers?

Question One

Results from the discriminant analysis procedure using accuracy scores showed that two variables, (1) See CVC trigram/ Say nonsense word (CVC-A) and (2) Hear two letter blends and

digraphs/Write letters (BLDI-A) were reliable predictors significant at the .01 level. The following discriminant prediction equation resulted:

$$Y = -15.7142 + 0.1805\ (CVC\text{-}A) + 0.0768\ (BLDI\text{-}A)$$

By inserting a child's CVC-A and BLDI-A scores in the above equation the resultant score can be compared to the cut-off score of +0.0034, above which a child would be predicted to be a good speller and below which a child would be predicted to be a poor speller.

Question Two

Results from the discriminant analysis procedure using speed scores showed the two variables, (1) See CVC trigram/Say nonsense word (CVC-S) and (2) Hear two letter blends and digraphs/Write letters (BLDI-S) were reliable predictors significant at the .01 level. The following discriminant prediction equation resulted:

$$Y = -16.7490 + 0.2553\ (CVC\text{-}S) + 0.3354\ (BLDI\text{-}S)$$

By inserting a child's CVC-S and BLDI-S scores in the above equation, the resultant score can be compared to the cut-off score of +0.0002, above which a child would be predicted to be a good speller and below which a child would be predicted to be a poor speller.

Question Three

When the eight tasks were entered into the discriminant analysis using both accuracy and speed scores for each task, four tasks were found to be reliable predictors. Significant at the .01 level were,

(1) See CVC trigram/Say nonsense word (CVC-S) and (2) See CVC trigram/Say nonsense word (CVC-A). Significant at the .05 level were (1) Hear two letter blends and digraphs/Write letters (BLDI-S) and (2) Hear two letter blends and digraphs/Write letters (BLDI-A). The following discriminant prediction equation resulted:

$$Y = 23.6238 + 0.1818\ (CVC\text{-}S) + 0.1329\ (CVC\text{-}A) + 0.2560\ (BLDI\text{-}S) + 0.0532\ (BLDI\text{-}A)$$

By inserting a child's CVC-S, CVC-A, BLDI-S, and BLDI-A scores in the above equation the resultant score can be compared to the cut-off score of -0.0032, above which a child would be predicted to be a good speller and below which a child would be predicted to be a poor speller.

Additional Findings

Contribution of Predictor Variables in Accounting for Variance in the Dependent Measure

Additional information yielded by accessing the BMD 02R stepwise regression program (Dixon, 1973) is presented in Table 4.

Table 4

Predictor Variable Contributions

Performance Measure	Variables in Order of Entrance in the Program	Variance Accounted for in the Dependent Measure
Accuracy	CVC-A(76.3%),BLDI-A(3%)	79.3%
	Remaining 6 Variables	1.2%
Speed	CVC-S(76.6%),BLDI-S(2.7%)	79.3%
	Remaining 6 Variables	1.6%
Accuracy and Speed	CVC-S(76.6%),CVC-A(6.5%), BLDI-S(0.9%),BLDI-A(0.7%)	84.7%
	Remaining 12 Variables	2.2%

Due to the use of free-entry subproblem routines, the first variable entered accounted for unique and overlapping variance. Each subsequent variable entered represented an incremental amount of unique and overlapping variance not already accounted for by a previously entered variable.

The results presented in Table 4 for accuracy alone and for speed alone show that the CVC task was the major contributor to variance accounted for in the dependent measure by each performance descriptor. The CVC-S score accounted for 76.6% of the variance, which was slightly more, .3%, than the CVC-A score (76.3%). Therefore, when accuracy and speed scores were entered into the stepwise regression program simultaneously, the CVC-S score entered first, showing both unique and overlapping variance attributable to the CVC-S score. The decrease in variance accounted for in the dependent measure by the CVC-A score from 76.3%, when entered with accuracy scores, to 6.5%, when entered with both accuracy and speed scores, is reflective of the overlapping amount of variance shared by the CVC-S and CVC-A scores.

Initial and Predicted Group Assignment

Each subject was assigned initially to either the good spellers group or the poor spellers group based on his/her spelling test score. The range of scores for the good spellers group was from 85.3% to 99.6% correct. The range of scores for the poor spellers group was from 7.7% to 49.5% correct. Results of the analysis indicate that on the basis of the best predictor variable scores, certain individuals would have been misclassified with respect to their initial group assignment. Tables 5, 6, and 7 are shown in terms of initial assignment and predictor variable assignment.

Table 5

Accuracy and Speed as Performance Measures

		Predicted Assignment	
		Good	Poor
Initial Assignment	Good	34	1
	Poor	0	35

Thirty-four of the 35 subjects initially assigned to the good spellers group were also assigned to this group based on predictor variable scores. One subject classified initially as a good speller was classified as a poor speller on the basis of his/her predictor variable scores. All 35 of those assigned initially as poor spellers were predicted to be poor spellers on the basis of their predictor varibale scores.

Table 6

Accuracy as a Performance Measure

		Predicted Assignment	
		Good	Poor
Initial Assignment	Good	35	0
	Poor	2	33

The entire group initially assigned as good spellers was predicted to be good spellers. Thirty-three of the 35 subjects assigned initially to the poor spellers group were also assigned to this group based on predictor variable scores. Two subjects classified initially as poor spellers were misclassified as good spellers on the basis of their predictor variable scores.

Table 7

Speed as a Performance Measure

		Predicted Assignment	
		Good	Poor
Initial Assignment	Good	33	2
	Poor	0	35

Thirty-three of the 35 subjects assigned initially to the good spellers group were also assigned to this group based on their predictor variable scores. Two subjects classified initially as good spellers, were classified as poor spellers based on their predictor variable scores. The entire group (n = 35) of initially assigned poor spellers were classified as poor spellers based on their predictor variable scores.

Use of the discriminant prediction equation misclassified 3% of the good spellers group as poor spellers and 0.0% of the poor spellers group, based on accuracy and speed scores. Six percent of poor spellers group and 0.0% of the good spellers group were misclassified based on accuracy scores. Six percent of the good spellers group and 0.0% of the poor spellers group were misclassified based on speed scores.

Scatter plots are reported in Appendix G. Each scatter plot represents one task and one performance measure of that task and its relationship to the spelling test score (percent correct). Means and standard deviations for the good spellers group and for the poor spellers group on each task are reported in Appendix E. Raw score data are reported in Appendix F.

Analysis of Single Component, Auditory Input Tasks

A supplementary analysis was conducted which included the four single component, auditory input tasks (CONS H/S, CONS H/W, SHVL H/S, and SHVL H/W). The CVC and BLDI tasks that were found to be the best predictors in the original analysis were not included. The reason for not including the CVC and BLDI tasks was that their relationship to spelling performance was already known to be significant. The See one place addition fact/Say answer (MATH) and Hear instruction/Write letters of the alphabet (ALPH) tasks were also not included in the present analysis. This was done for two reasons. First, the MATH and ALPH tasks were found not to be related to spelling performance in the overall analysis. Second, the MATH and ALPH tasks are not curriculum tasks directly relevant to the development of spelling behavior.

In order to ascertain the relationship of single component, auditory input tasks (CONS H/S, CONS H/W, SHVL H/S, and SHVL H/W) to spelling performance, a separate analysis was performed. The results are indicated in Table 8.

Table 8

The Relationship of Single Component, Auditory Input Tasks to Spelling Performance

Performance Measure	Variables in Order of Entrance in the Program	Variance Accounted for in the Dependent Measure
Accuracy	SHVL H/W (31.5%)	31.5%
Speed	SHVL H/W (52.1%) CONS H/W (5.4%) SHVL H/S (2.2%)	59.7%
Accuracy and Speed	SHVL H/W-S (52.1%) SHVL H/W-A (5.7%) CONS H/W-S (6.2%)	64.0%

All variables except one were significant at the .01 level. The SHVL H/S tasks with speed as a performance measure was significant at the .05 level.

Accuracy and Speed Change

Each of the eight tasks was administered on each of three consecutive days. The group means presented in Table 9 represent each groups average change over the three day period. Both groups showed an increase in speed scores. The good spellers group showed a decrease in accuracy on the ALPH task. The poor spellers group showed a decrease in accuracy on the CVC and SHVL H/S tasks.

Table 9

Mean Change Per Task Per Group

TASK	GOOD GROUP MEAN ACCURACY (% Correct)	GOOD GROUP MEAN SPEED (Response/Min.)	POOR GROUP MEAN ACCURACY (% Correct)	POOR GROUP MEAN SPEED (Response/Min.)
CVC	1.11	10.94	-1.47	2.94
CONS H/S	0.39	4.94	1.00	3.23
SHVL H/W	1.19	4.00	-0.63	4.63
MATH	0.09	4.91	0.17	1.97
BLDI	3.61	2.71	3.26	1.57
CONS H/W	0.56	2.99	0.77	2.26
SHVL H/S	1.30	1.43	1.11	1.46
ALPH	-0.04	4.37	0.10	2.31
MEAN CHANGE	+1.02	+4.53	+0.54	+2.55

CHAPTER V

DISCUSSION

The focus of the present study was to identify a set of prerequisite tasks, modality relevant to spelling performance, that when based on accuracy and speed as performance measures, would discriminate between good spellers and poor spellers. A review of related literature suggested that (a) tasks used to date have represented more than one basic behavior per task; (b) tasks that have been used are related to, but are not direct replications of the input and output modality structure of spelling behavior; (c) tasks used have not represented the most basic skills assumed by curriculum hierarchies to be prerequisite to spelling competence; and (d) tasks have been assessed by accuracy alone, without referring to speed (fluency) as a viable performance measure.

A spelling test was administered to a group of third graders in Alachua County, Florida. From these results the top 25.9 percent (good and poor spellers) were chosen (N=35 subjects per group). Each of these subjects was then assessed on each of eight tasks on three consecutive days. Accuracy and speed scores were obtained for each subject on each task.

Two of the eight tasks used, See CVC trigram/Say nonsense word and Hear two letter blends and digraphs/Write letters, were the two tasks with which to discriminate groups of good and poor third grade spellers. The use of accuracy and speed scores in combination revealed that speed was the better performance measure for discriminating between the two groups of spellers.

The results will be discussed under the following headings:

(1) Task complexity and learning hierarchies;

(2) Input and output modality structure of the task;

(3) Spelling test scoring procedure;

(4) Performance measures;

(5) Repeated measures of predictor tasks;

(6) Conclusions; and

(7) Recommendations for future research.

Task Complexity and Learning Hierarchies

The tasks used in the present study were selected from spelling skill hierarchies and task analyses. The content of six of the tasks followed the developmental progression of skills found in the hierarchies. Two tasks were single component tasks (CONS and SHVL). The findings indicated that at the third grade level, the more complex skills are better at discriminating between good and poor spellers than the single component tasks.

Gagné (1965) suggested an order assigned to skills within a hierarchical structure (simple responses, chains or multiple discriminations, classifying, use of principles or rules, and problem solving). The CONS and SHVL tasks seem to be an example of chains or multiple discriminations. The CVC task seems to be an example of the use of principles or rules. For the third grade subjects included in this study, simple response tasks (CONS, SHVL) were not found to discriminate reliably between good and poor spellers. One may conclude, then, that the simple tasks do not account for a significant amount of the variance in the spelling task itself. The CVC and BLDI tasks, or the more complex tasks, were the tasks that were found to discriminate reliably between the groups of good and poor spellers.

An additional analysis that included the four single component tasks (CONS H/S, CONS H/W, SHVL H/S, and SHVL H/W) lends support to this line of reasoning. The SHVL tasks were the best discriminators, regardless of performance measure.

The overall analysis indicated that the four tasks, with content relevant to spelling behavior (CVC, BLDI, SHVL, and CONS), followed a descending order from complex to simple. The order was CVC, BLDI, SHVL, and CONS.

Although this study was not designed to validate any one learning hierarchy, the results may be serendipitous in their outcome. Of the four tasks based on spelling curriculum hierarchies, the CONS tasks were least successful in dis-

criminating between good and poor spellers. The SHVL tasks were slightly more successful. The BLDI task was more successful yet. The CVC task, the more complex task according to the hierarchies, was the most successful task to discriminate between good and poor spellers.

Input and Output Modality Structure of the Task

One of the two tasks found to be the best discriminators of third grade spelling performance, Hear two letter blends and digraphs/Write letters was a direct replication of the modality structure of actual spelling behavior. The CVC task had the modality structure of a reading task (See/Say). The contribution of the BLDI task to the variance of the dependent measure ranged from 0.7% to 3.0% depending on the performance measure(s) used (See Table 4). The results indicated that although its contribution was statistically significant, the practical significance of its contribution in explaining variance accounted for in the dependent measure, is clearly limited.

Previous studies in the spelling literature have not made use of a direct replication of the modality structure of actual spelling behavior (Bond, 1935; Monroe, 1932; Russell, 1937; Spache, 1940a; Wallace, Klein, & Schneider, 1968). An attempt was made to ascertain whether or not auditory input tasks may have been more related to spelling behavior than visual input tasks. However, the CVC task, a reading task, was found to be

the task that best discriminated between the good spellers and poor spellers. On the basis of the results of this study, one must agree with Monroe's (1932) statement that

> The correlation [between reading and spelling is] so high . . . we must be measuring an achievement which is greatly dependent either upon reading or upon the same factors which underlie the ability to read. (p. 13)

Spelling Test Scoring Procedure

A new procedure for scoring the spelling test (White & Haring, 1976) was used in this study. In a post hoc analysis, the spelling tests were rescored using the more traditional words correct procedure. A Pearson Product Moment Correlation was performed between units correct (White & Haring) and words correct. A correlation of +.97 was obtained.

The results of the correlation procedure indicated that either scoring procedure could have been used in this study. The preference of using the White and Haring (1976) scoring procedure would be to learn more about a child's spelling behavior because of the extensive word analysis that would be obtained. The whole word procedure would be preferable where scoring time was a primary consideration.

Performance Measures

The results of this study were obtained by considering the original set of eight tasks in three ways. Accuracy scores were used in the first subproblem. Speed scores were used in the second subproblem, accuracy and speed scores in combination were used in the third subproblem. Regardless of the performance measure used, the CVC and BLDI tasks were found to be the best discriminating tasks

in the same order (CVC, BLDI). However, when accuracy and speed scores were used in combination in a free-entry subproblem routine, the speed scores on each task (CVC, BLDI) accounted for more variance in the dependent measure than the accuracy scores (See Table 4).

Accuracy scores are not to be interpreted as less powerful than speed scores but as representing incremental variance attributed uniquely to each of the successive variables entered into the prediction equation. The near equivalence of accuracy and speed scores entered by discrete performance descriptors disappears when the two are entered simultaneously. This phenomenon is evidenced as the stepwise regression program selects the variable that is most highly correlated with the dependent variable. This first variable, and each successive variable, enters showing unique and overlapping variance accounted for in the dependent measure. Each successive variable, then, is selected to enter on its contribution of variance in the dependent measure. An analysis of single component, auditory input tasks (CONS, SHVL) indicated that speed scores were again slightly more powerful in their ability to discriminate between good and poor spellers than were accuracy scores (See Table 8).

Speed and accuracy scores on the tasks were found to be equivalent discriminators between the two groups of spellers. An indication that remediation or development of the skills on these tasks needs to include both accuracy and speed before final proficiency can be noted. This indication is suggested by the fact that speed and accuracy were equivalent performance measures. Based on a mean score of the good spellers group (N=35) on each task, the following accuracy and speed scores may be helpful in determining proficiency levels of the tasks.

Table 10

Proficiency Levels Per Task

TASKS	MEAN SCORE
CVC (accuracy)	91.6% correct
CVC (speed)	63.2 responses per minute
BLDI (accuracy)	86.5% correct
BLDI (speed)	24.0 responses per minute

Speed and accuracy scores are also relevant to the issue of possible misclassifications. Children predicted to be good or poor spellers and who are indeed good or poor spellers will receive appropriate curricular instruction. Children predicted to be poor spellers who are indeed good spellers will certainly not suffer from extra curricular intervention. However, children predicted to be good spellers who are indeed poor spellers may suffer from lack of instruction. The lack of instruction for any child that needs it may cause teacher and learner frustration. The misclassification of this last group of children, those predicted to be good spellers but who are not good spellers, needs to be minimized.

The results of this study indicated that when accuracy and speed scores in combination or speed scores alone are used as performance measures, no children are misclassified by being predicted as good spellers when they are indeed poor spellers (See Tables 5 and 7). The small percentage of misclassifications

by accuracy scores appears to be a reflection of the N used in this study. Therefore, speed, accuracy, or a combination of speed and accuracy could be used to reduce misclassifications that could be harmful to the learner.

Group standard deviations on each task presented an interesting descriptive finding. On four of the tasks included in this study (CVC, MATH, BLDI, and ALPH) the poor spellers group displayed more variability with respect to accuracy than did the good spellers group. However, on these same four tasks, the good spellers group displayed more variability with respect to speed than did the poor spellers group. Although standard deviations for each group on each task are presented in Appendix E, Table 11 presents that standard deviation data relevant to the CVC, MATH, BLDI, and ALPH tasks.

Table 11

Standard Deviations on the CVC, MATH, BLDI, and ALPH Tasks

TASK	STANDARD DEVIATION GOOD GROUP	STANDARD DEVIATION POOR GROUP
CVC (accuracy)	10.0	22.0*
CVC (speed)	16.1*	7.4
MATH (accuracy)	4.8	23.0*
MATH (speed)	12.6*	8.7
BLDI (accuracy)	11.3	27.4*
BLDI (speed)	5.6*	3.2
ALPH (accuracy)	1.0	2.9*
ALPH (speed)	14.0*	7.8

*more variability

One may infer from these findings that the poor spellers group, with a wider dispersion of accuracy scores and less variability in speed scores, has not completed the basic stage of acquiring accurate responses. The good spellers group, however, was less variable on accuracy scores. Their accuracy scores may indicate mastery of the tasks included for this study. However, the variability in their speed scores leads one to believe that they have not, as a group, reached a fluent level of performance on these four tasks.

It has been suggested (Haughton, 1972; Starlin, 1972) that although the final proficiency aim for any child on any task is accurate responding at an acceptable speed, accurate responding needs to be in a child's repertoire before accurate responding at an acceptable speed can be obtained. In this study, the poor spellers, as a group, were responding neither accurately nor fluently. The lack of variability in their low speed scores suggests that as a group their speed scores may be rather consistent because they have not yet mastered the stage of accurate responding. This would account for an overall slow speed of responding on these tasks. The good spellers group, because of the lack of variability in their high accuracy scores, seems to have mastered the stage of responding accurately. However, the variability in their speed scores leads one to believe that as a group they are not yet fluent on these four tasks.

In summary, the findings of this study indicated that the use of speed and accuracy as performance measures may serve two

useful functions. First, speed and accuracy scores discriminate between good and poor spellers. Second, speed and accuracy scores reduce misclassifications that may interfere with a child's curricular program.

Repeated Measures of the Tasks

Repeated measures over three days for each task were obtained to represent a more reliable measure for each subject's performance on each task. Group means are reported in Table 9.

Both groups of spellers increased their speed scores over the three day period. The good spellers, as a group, did not improve their accuracy scores on the ALPH task, due to the ceiling effects of the task. The poor spellers, as a group, did not improve their accuracy scores on the CVC and SHVL H/W tasks.

Low increases in accuracy scores for the subjects involved may have been due to four reasons. First, some subjects maintained 100% accuracy over the three day period. Therefore, due to ceiling effects, their accuracy scores could not increase, while their speed scores may have increased. On the CVC task, subject #103 remained at 100% accuracy for the three days while the subject's speed score change was +20.9 responses per minute over the three days.

Second, some subjects maintained a 0.0% accuracy score over the three day period. Subject #230 maintained a 0.0% accuracy for three days on the BLDI task while the subject's speed score changed by one incorrect response per minute.

Third, some subjects, while increasing their speed scores, lowered their accuracy scores. For example, on the CVC task, subject #116 had speed scores of 48, 60, and 85.8 responses per minute for the three days. This subject's accuracy scores were 100, 100, and 97 percent correct for the three days. As the subject's speed increased the chance for error increased. Therefore, due to a single error on day three, this subject's average accuracy change was -1.5% while the average speed change was +18.9 responses per minute.

Fourth, some subjects who may have had an increase from day one to day two may have had a decrease from day two to day three or vice versa. Depending on the differences between the days, some subjects may have shown no change and others an increase or decrease. Subject #117 had a -6 speed increase from day one to day two and a +12 speed increase from day two to day three, with an overall speed change of +3 (CVC task). On the BLDI task, subject #225 had a speed change of +8 from day one to day two and a speed change of -8 from day two to day three. This subject's overall change in speed on the BLDI task was zero.

The results of these findings indicated a positive change in speed on all tasks for both groups. The good spellers group exhibited a positive change in accuracy scores on seven of the tasks. The poor spellers group exhibited a positive change in speed on six of the tasks. Each group exhibited change on each task over the three day period. Although the changes were generally not large, it was evident that two or three samples

of each task was a closer approximation of each child's maximum capability on each task. Therefore, the contention that three days of data collection as a more reliable measure of a subject's performance than one day of data collection was upheld.

Conclusions

The focus of this study and the specific questions asked were stated in terms of identifying a set of prerequisite tasks that would best discriminate between good spellers and poor spellers. The set of tasks used in this study was discussed in terms of accuracy and speed as performance measures both separate and in combination. The results of the data analysis indicated that when accuracy and speed were used as separate performance measures, the same two tasks were found to be the best discriminators between the groups of good and poor spellers. The two tasks were See CVC trigram/Say nonsense word and Hear two letter blends and digraphs/ Write letters. When accuracy and speed scores were used in combination as performance measures, the CVC and BLDI tasks again were found to be the best discriminators between the two groups of spellers. However, when used in combination, the speed score for each task was a slightly more powerful discriminator than was the accuracy score due to the free-entry variable selection (See previous discussion).

Five of the tasks selected for inclusion in this study were direct replications of the input and output modality structure of spelling behavior. One task was a reading task; the other two tasks were a math task and an alphabet writing task. Although

the BLDI task, a Hear/Write task, was one of the two best tasks in discriminating between groups of good and poor spellers, it's contribution to the variance accounted for in the dependent measure was extremely small (See Table 4). The CVC task, a reading task, was the best discriminating task. Therefore, the use of tasks involving the input-output modality structure that directly replicates spelling behavior was less reliable than the reading task in discriminating between the two groups of spellers.

Supplementary analyses of the data indicated that the use of speed, as a performance measure, classified children for curricular programming with slightly less liability than the use of accuracy. Speed was also the performance measure that showed the greatest change over the three days of data collection. The spelling test scoring procedure used in this study was found not to be time saving. However, it presented a more extensive analysis of a child's spelling performance than the words correct procedure. Although this study did not attempt to validate any one spelling skill hierarchy, the findings supported a sequence of the tasks used, from simple to complex.

Recommendations for Future Research

The present study has included multiple regression and discriminant analysis procedures. Through the use of these procedures, this investigator has obtained information that is useful in (a) discriminating between groups of good and poor spellers and (b) discussing the most reliable discriminating tasks. The findings

have been focused on issues such as (a) task complexity and learning hierarchies; (b) the input and output modality structure relevant to spelling behavior; and (c) the utility of accuracy and speed as performance measures. The resultant information from this study provides one with a basis upon which a second stage of more functionally oriented research may be based. This second stage of research, then, should consist of studies that are concerned with the functional relationship of the present findings to classroom spelling curricula.

This task (BLDI) had the modality structure that directly replicated spelling behavior. The BLDI task was less reliable as a discriminator than the reading task. It would be interesting to include the Hear/Say and Hear/Write modality structure as a unique experimental variable. Efforts could then be made to determine if curricular instruction, with an emphasis on these modality structures (Hear/Say or Hear/Write), would enhance the ability to spell. The curricular emphasis in many classrooms is on reading. There are those children, however, that even with reading instruction are poor spellers. Perhaps an emphasis on related content material, with the modality structure directly replicate of spelling behavior, would improve this poor spellers group's ability to achieve competence in spelling.

The present findings have demonstrated the utility of speed (fluency) as a viable performance measure that needs to be emphasized equally with accuracy in classroom instruction. The results, using speed and accuracy, were similar. Speed, as a

performance measure, has not been used before and may be a novel means by which variance in performance can be explained. Research efforts are needed that will use speed as an aim for skill mastery. These research efforts need to consider the efficacy of remediating deficit skills (i.e., CVC, BLDI) to a level of fluent mastery. Once these skills have been mastered, a determination of their effectiveness in improving spelling performance may be conducted.

It is indicated from the findings that for the third graders included in this study, the more complex tasks (CVC, BLDI) discriminated best between the two groups of spellers. Further research efforts at different grade levels (i.e., one, five) may demonstrate that different skills discriminate at different grade levels or that by a certain grade level, the same tasks can be used as discriminators. This may well serve to provide a developmental sequence of skills. Performance on this sequence could alert teachers to possible concomitant performance in spelling. As stated earlier, if other research efforts suggest that mastery of deficit skills is effective in improving spelling, a criterion performance sequence may have excellent curricular merit.

The present study has answered the specific questions for which it was designed. The overall findings as well as the additional findings have suggested possible alternative research efforts that may help solve the problem of presenting classroom instruction that could promote better spelling achievement.

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APPENDIX A

SPELLING TEST

SPELLING TEST

NAME: _____ SCHOOL: _____

1. bite _____
2. and _____
3. dark _____
4. bush _____
5. bags _____
6. bottom _____
7. asleep _____
8. ate _____
9. bull _____
10. four _____
11. fasten _____
12. later _____
13. cotton _____
14. cave _____
15. did _____
16. hatch _____
17. rent _____
18. giant _____
19. laughing _____
20. am _____
21. broom _____
22. melon _____
23. dollars _____
24. deer _____
25. cookies _____
26. march _____
27. books _____
28. mice _____
29. her _____
30. rich _____
31. glass _____
32. field _____
33. though _____
34. bake _____
35. alone _____
36. lily _____
37. obey _____
38. pony _____
39. hot _____
40. street _____
41. an _____
42. patch _____
43. parties _____
44. seem _____
45. bonnet _____
46. already _____
47. heap _____
48. pear _____

APPENDIX B

ACADEMIC TASKS

I. SEE CVC TRIGRAM/SAY NONSENSE WORD

meb wid kum vak rop het div len jad nup _____ # correct

zik fap rud tek yab vit suf pid rab nen _____ # attempted

ket tav dak fot lub das pif niv dup maf _____ accuracy

Speed_____/1 minute

II. HEAR CONSONANT SOUND/SAY CONSONANT NAME

c f h n q t v k y b g m p s j w z d x _____ # correct

r l n k h f c b y v t q s p m j l r g _____ # attempted

x d z w c q g w l f t j z h v m d n s _____ accuracy

Speed_____/1 minute

III. HEAR SHORT VOWEL SOUND/WRITE VOWEL

e o a i u o e u i a i u _____ # correct

e o u i a o e i a u o e _____ # attempted

a i u i e o a u e i o a _____ accuracy

Speed_____/1 minute

IV. SEE ONE PLACE ADDITION FACT/SAY ANSWER

1+1=2	2+0=2	5+4=9	6+2=8	8+1=9
0+6=6	5+3=8	2+4=6	7+0=7	2+5=7
1+5=6	0+3=3	6+3=9	6+1=7	2+8=10
4+1=5	3+7=10	3+2=5	4+5=9	1+0=1
0+2=2	2+6=8	2+3=5	1+4=5	7+2=9
3+6=9	2+7=9	4+3=7	4+2=6	1+8=9
4+6=10	7+3=10	9+1=10	3+0=3	5+0=5
1+9=10	6+4=10	8+2=10	5+1=6	0+9=9

_____ # correct

_____ # attempted

_____ accuracy

Speed_____/1 minute

V. HEAR TWO LETTER BLENDS AND DIGRAPHS/WRITE LETTERS

br	th	sk	ch	cr	bl	sm	sh	cl
tr	tw	fl	dr	sn	gl	fr	sp	pl
gr	sl	pr	st	sw	tr	ch	dr	br

_____ # correct

_____ # attempted

_____ accuracy

Speed_____/1 minute

VI. HEAR CONSONANT SOUND/WRITE CONSONANT

c	f	h	n	q	t	v	k	y	b	g	m	p	s	j	w	z	d	x
r	l	n	k	h	f	c	b	y	v	t	q	s	p	m	j	l	r	g
x	d	z	w	c	q	g	w	l	f	t	j	z	h	v	m	d	n	s

_____ # correct

_____ # attempted

_____ accuracy

Speed_____/1 minute

VII. HEAR SHORT VOWEL SOUND/SAY VOWEL

e	o	a	i	u	o	e	u	i	a	i	u
e	o	u	i	a	o	e	i	a	u	o	e
a	i	u	i	e	o	a	u	e	i	o	a

_____ # correct

_____ # attempted

_____ accuracy

Speed_____/1 minute

VIII. HEAR INSTRUCTION/WRITE LETTERS OF THE ALPHABET

A B C D E F G H I J K L M

N O P Q R S T U V W X Y Z

_____ # correct

_____ # attempted

_____ accuracy

Speed_____/1 minute

APPENDIX C

SEE CVC TRIGRAM/SAY NONSENSE WORD STIMULUS SHEET

MEB	WID	KUM	VAK	ROP
HET	DIV	LEN	JAD	NUP
ZIK	FAP	RUD	TEK	YAB
VIT	SUF	PID	RAB	NEN
KET	TAV	DAK	FOT	LUB
DAS	PIF	NIV	DUP	MAF

APPENDIX D

SEE ONE PLACE ADDITION FACT/SAY ANSWER

STIMULUS SHEET

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

APPENDIX E

GROUP MEANS AND STANDARD DEVIATIONS

Table E-1

Group Means and Standard Deviations

Variable	Good Group Mean	Good Group Standard Deviation	Poor Group Mean	Poor Group Standard Deviation
See CVC trigram/Say nonsense word - Accuracy	91.6	10.0	31.2	22.0
See CVC trigram/Say nonsense word - Speed	63.2	16.1	18.6	7.4
Hear consonant sound/Say letter name - Accuracy	93.0	5.0	88.5	6.3
Hear consonant sound/Say letter name - Speed	39.5	5.1	31.5	5.4
Hear short vowel sound/Say vowel name - Accuracy	58.7	19.9	32.8	19.0
Hear short vowel sound/Say vowel name - Speed	30.3	5.9	18.8	5.2
See one place addition fact/Say answer - Accuracy	97.5	4.9	86.0	23.0
See one place addition fact/Say answer - Speed	44.2	12.6	29.1	8.7
Hear two letter blends and digraphs/ Write letters - Accuracy	86.5	11.3	34.3	27.4
Hear two letter blends and digraphs/ Write letters - Speed	24.0	5.6	13.6	3.2
Hear consonant sound/Write letter - Accuracy	92.5	4.9	86.8	8.7
Hear consonant sound/Write letter - Speed	34.7	5.7	23.8	5.1
Hear short vowel sound/Write vowel - Accuracy	58.9	20.8	36.5	18.2
Hear short vowel sound/Write vowel - Speed	32.2	3.5	23.9	5.0
Hear instruction/Write letters of the alphabet - Accuracy	99.5	1.0	97.9	2.9
Hear instruction/Write letters of the alphabet - Speed	57.9	14.0	35.1	7.8

APPENDIX F

RAW SCORE DATA

Raw Score Data

The first column (S's) consists of each subjects number within the good spellers group (100's) or the poor spellers group (200's). The DEP column is each subjects spelling test score in percent correct. The three numbers are read as a one place decimal number (e.g., 99.6).

The last eight columns are the raw scores per subject on each of the eight tasks. The tasks are:

Code	Task
CVC H/S	See CVC trigram/Say nonsense word
CONS H/S	Hear consonant sound/Say consonant name
SHVL H/W	Hear short vowel sound/Write vowel
MATH S/S	See one place addition fact/Say answer
BLDI H/W	Hear two letter blends and digraphs/Write letters
CONS H/W	Hear consonant sound/Write consonant
SHVL H/S	Hear short vowel sound/Say vowel name
ALPH H/W	Hear instruction/Write letters of the alphabet.

The eight numbers for each task are read as two four digit numbers with a one place decimal (e.g., 09900774 = 99.0 and 77.4). A zero was used in the hundred's column when a subject's score was less than 100. The first number in each column is the accuracy score for the task. The last number in each column is the speed score for the task.

S'S	DEP	CVC	S/S	CONS	H/S	SHVL	H/W	MATH	S/S	BLDI	H/W	CONS	H/W	SHVL	H/S	ALPH	H/W
101	996	09900774		08530413		04770307		10000553		09200260		09270367		05570347		10000573	
102	993	09630747		10000427		05900373		09600333		09700400		10000473		05700327		10000787	
103	989	10000860		09530420		06330300		10000513		09730233		09500427		06570320		10000680	
104	982	09900837		09830427		06730307		10000821		08870247		09270380		06630340		10000700	
105	978	09100657		09830367		05000333		10000480		10000260		09470340		06400313		10000807	
106	974	09470727		08830387		05370353		10000367		09070293		09100380		05570333		10000607	
107	963	09230586		09830327		09530260		09630540		08130207		09370300		08130327		10000807	
108	967	10000607		09670393		05000307		10000420		08630300		08730380		04670300		09900720	
109	967	09100821		09270367		05970273		10000560		10000180		09600340		07630367		09770533	
110	967	08470660		08000380		06100340		09170393		04930227		09000340		05430367		10000507	
111	960	10000551		10000367		07000313		10000420		09130233		10000307		07230293		10000547	
112	960	09670707		09530453		04100407		09770420		09400360		09370500		03500360		09900567	
113	952	09470456		09200407		05670207		10000360		10000220		09500360		07470253		10000707	
114	945	09270540		09000347		08370360		09800340		08900260		09000340		06670320		10000527	
115	938	09100877		09270453		01700360		09900527		08770340		08830413		01730347		09900693	
116	934	09900646		09630300		09170307		09430400		08400173		09070307		09100340		10000447	
117	930	10000940		10000347		09400307		10000353		07730180		09300293		09730267		10000487	
118	923	09070353		08800413		04300407		09870447		06270293		08070373		04630373		10000560	
119	923	09570534		09500393		08770260		09630387		10000213		10000280		09200347		09600533	
120	912	08830393		09200427		07270273		09630400		08730227		09000407		06370327		10000640	
121	912	08530600		08900407		03530300		09900487		07230240		08830353		03630327		09770580	
122	912	09900595		09800433		06500387		10000353		09470240		10000373		07570333		09870313	
123	893	07900564		08770387		03770320		10000804		08130193		09530300		03600306		09930860	
124	893	10000635		09700500		08630393		09870453		08870280		09670407		09800340		09870580	
125	886	07130858		09230453		05730227		10000493		08730207		08800333		05800360		10000607	
126	886	09230705		08970473		02630207		10000407		07700260		09070367		03700287		10000673	
127	882	09100636		09500393		04900287		09670360		08770173		09300300		04500287		10000407	
128	875	09570763		09400500		04600380		09830440		09370313		09130367		03330340		10000673	
129	871	09830733		09670427		07030300		10000500		08170227		09030347		07370373		09770573	
130	868	07970539		09230360		04800320		08970340		09370220		09770327		04200287		09870447	
131	868	09200347		08570340		03170247		09500293		08870160		09170247		02330227		10000360	
132	868	07200433		09400320		05970207		07400160		06230207		08900300		06370267		10000533	
133	868	09700453		09830353		06930213		09600320		09370187		10000260		05670293		10000253	
134	860	10000657		08300347		07730247		10000467		08500180		07930273		07270327		10000420	
135	853	05470320		09070313		03170220		10000547		08300213		09000293		03100333		10000553	

S'S	DEP	CVC	S/S	CONS H/S	SHVL H/W	MATH S/S	BLDI H/W	CONS H/W	SHVL H/S	ALPH H/W
201	496	03730180	09070247	07200213	07270260	05000127	09030207	06370233	09670353	
202	496	05470427	09530300	01130127	10000273	05900167	09270273	04800253	09730480	
203	493	02800193	08670267	05000207	09830426	08370120	08130213	05500280	10000373	
204	493	07390247	09300287	08300253	10000333	07770133	09100240	08570300	09600353	
205	489	02770227	08930393	03030267	09570273	06700173	07730306	04300327	09630426	
206	482	06570187	08500300	04470247	09500420	04030160	09100253	02770213	09870413	
207	478	03390200	09230333	03100153	09400473	04600133	09000220	01870220	09730473	
208	471	02230187	08400300	02900127	09630180	06570120	09200173	05000167	10000367	
209	434	05730280	08570367	02370307	09470260	05530173	08600280	02530347	09800333	
210	430	03530167	08730373	04330233	10000300	06000167	06000307	05330253	10000360	
211	415	07930260	09670373	07600220	09800293	02230133	10000207	06330293	09500300	
212	400	04370293	09300300	04970233	09670233	01670187	08500293	06600213	10000440	
213	397	03030153	08900367	03630120	07670200	00000193	08570287	02330200	09500400	
214	386	00430167	09300287	03900200	08900273	04430120	09030260	04100227	10000433	
215	364	04030247	10000307	04670140	10000393	01900113	10000247	05830207	10000327	
216	349	03600173	09170327	01500227	07930160	03330133	09200213	02000253	09770360	
217	335	02700227	09230367	03870173	09270260	07300127	08970260	04470220	09870453	
218	327	00670247	08600373	03030273	08900247	03800180	08870353	03000333	10000300	
219	320	01770107	09300280	01300200	00000273	03930173	08400253	02070227	10000367	
220	305	04830207	08600233	03700167	08730167	05870160	08700207	03830167	09830273	
221	301	01970187	08930400	03230247	09670420	07400180	09200333	05030333	10000420	
222	298	03000247	08300273	03630113	10000387	06330093	08430193	03000220	09270247	
223	290	05670107	08400327	04600253	10000400	00000167	07830247	04300293	10000400	
224	287	01670133	08970340	03230193	08030393	00330160	09000320	02900247	10000333	
225	279	00000073	09170340	01300213	10000280	00000127	08100227	01430187	09870460	
226	276	01000133	08930400	02300193	02730100	02930113	09730213	03630260	09670173	
227	261	05130147	09070300	03000147	08300227	04170087	08230227	03470227	10000413	
228	250	06330100	08970393	00370140	09600333	00670133	09130260	01800267	10000273	
229	239	00000120	07500240	00470140	09400313	00000120	06200167	03030213	08670260	
230	235	00000067	09470360	04270140	09670200	00000100	10000147	02930233	10000247	
231	195	02900267	09170247	02670140	06870267	01500093	09730193	02030187	10000273	
232	189	01930180	09330300	01270147	09830380	00000087	09200253	00000160	10000367	
233	121	02370160	08330240	01100127	09270200	00670107	08800173	03130207	09730353	
234	080	00000073	07570307	01930160	02670280	01230113	08000180	01830220	09730200	
235	077	00470140	06800187	01330153	09370320	00000093	07970160	01570167	09170273	

APPENDIX G

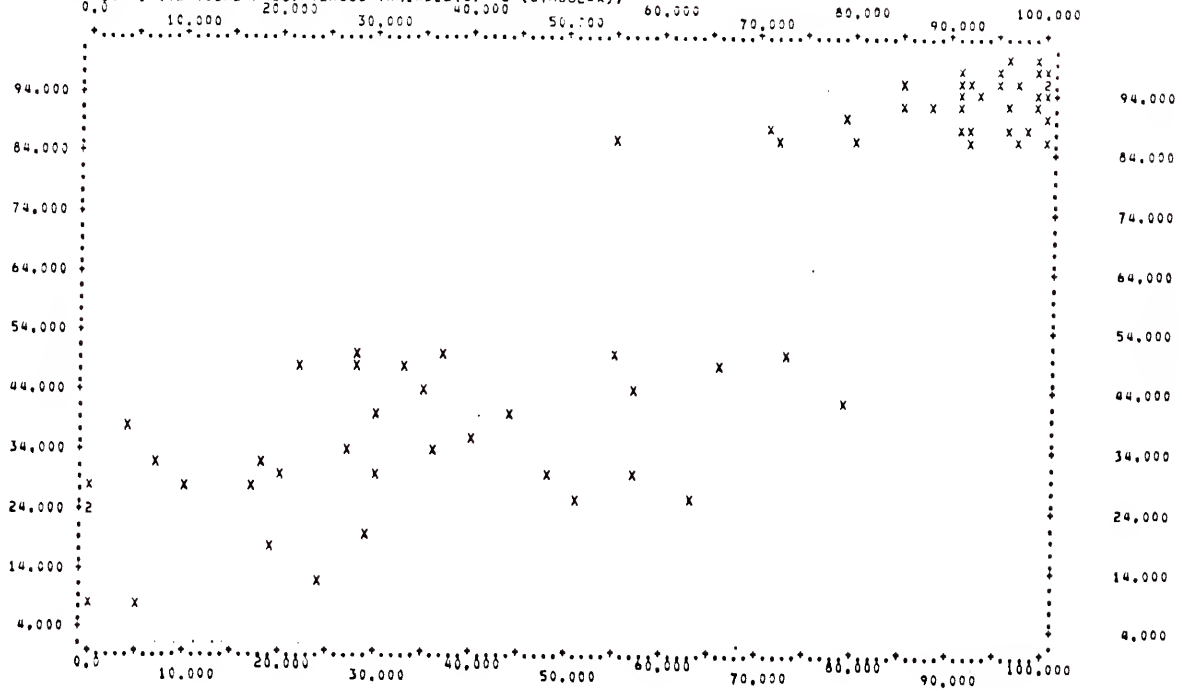
SCATTER PLOTS

The following are scatter plots representing each task, based on accuracy or speed, and its relationship to the spelling test score (percent correct). Two correlations are reported. The first correlation is a pooled correlation. Each group's scores (N=35 per group) are correlated independently and then pooled for an average correlation. The second correlation is based on the total sample (N=70).

BMD05D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

SPELLING AGAINST CVC TRIGRAMS ACCURACY

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 2 (SYMBOL=X),

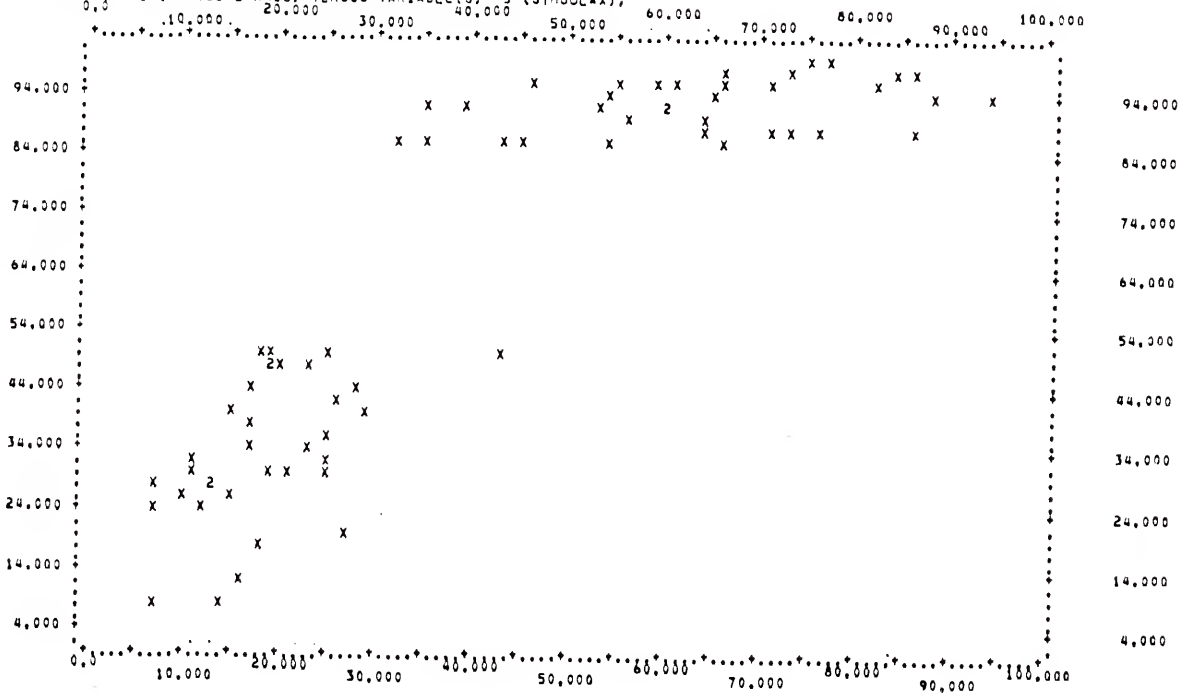


Correlation: r = +0.48

Correlation: r = +0.87

BMDP2D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 3 (SYMBOL=X), SPELLING AGAINST CVC TRIGRAMS SPEED



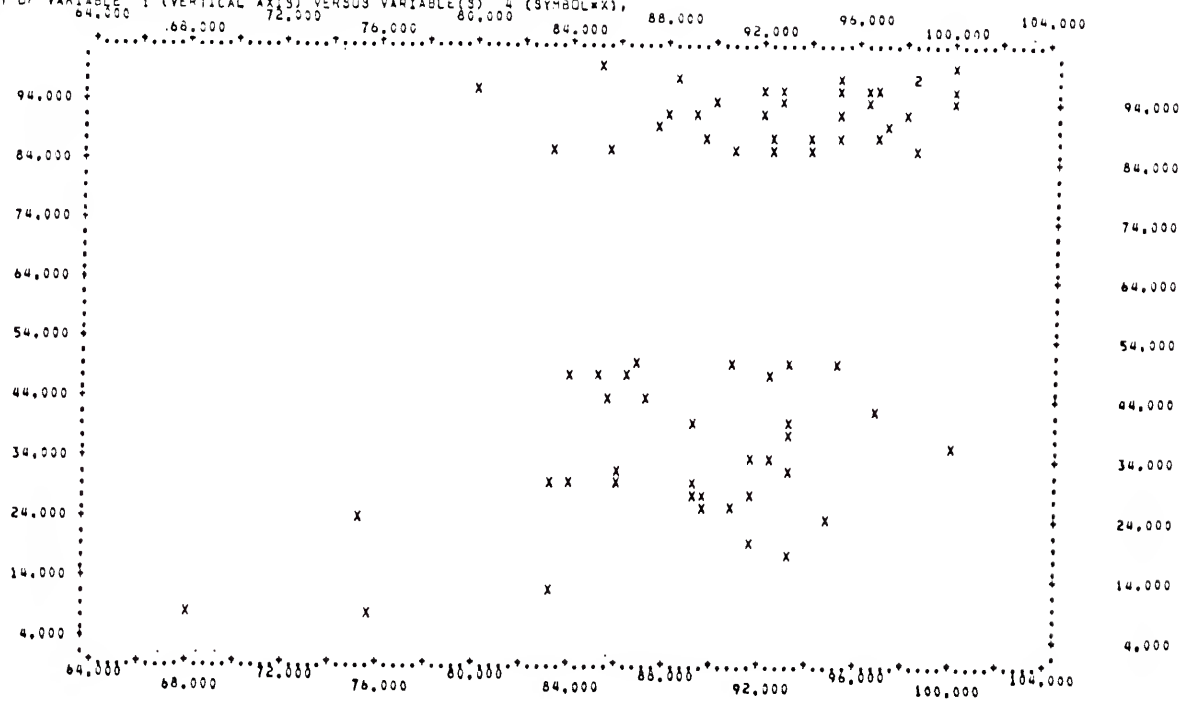
Correlation: r = +0.33

Correlation: r = +0.88

BMDP3D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

SPELLING AGAINST CONSONANT HEAR/SAY ACCURACY

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 4 (SYMBOL=X),

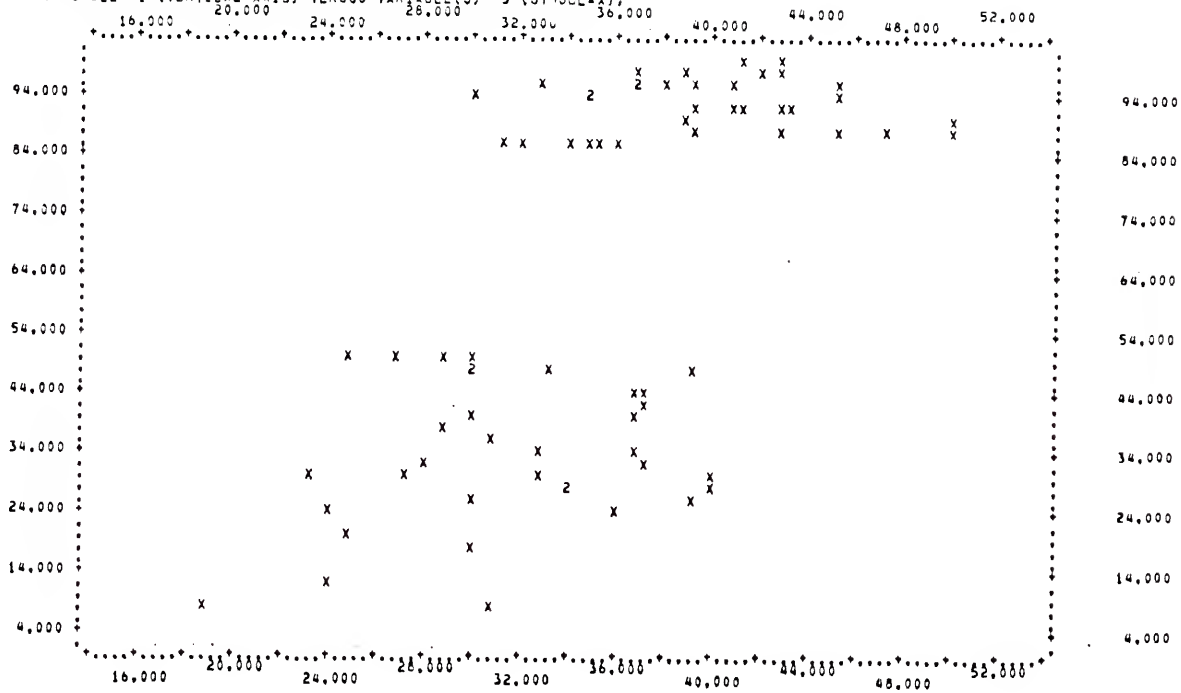


Correlation: r = +0.35

Correlation: r = +0.38

BMDP3D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

SPELLING AGAINST CONSONANT HEAR/SAY SPEED
PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 5 (SYMBOL=X),

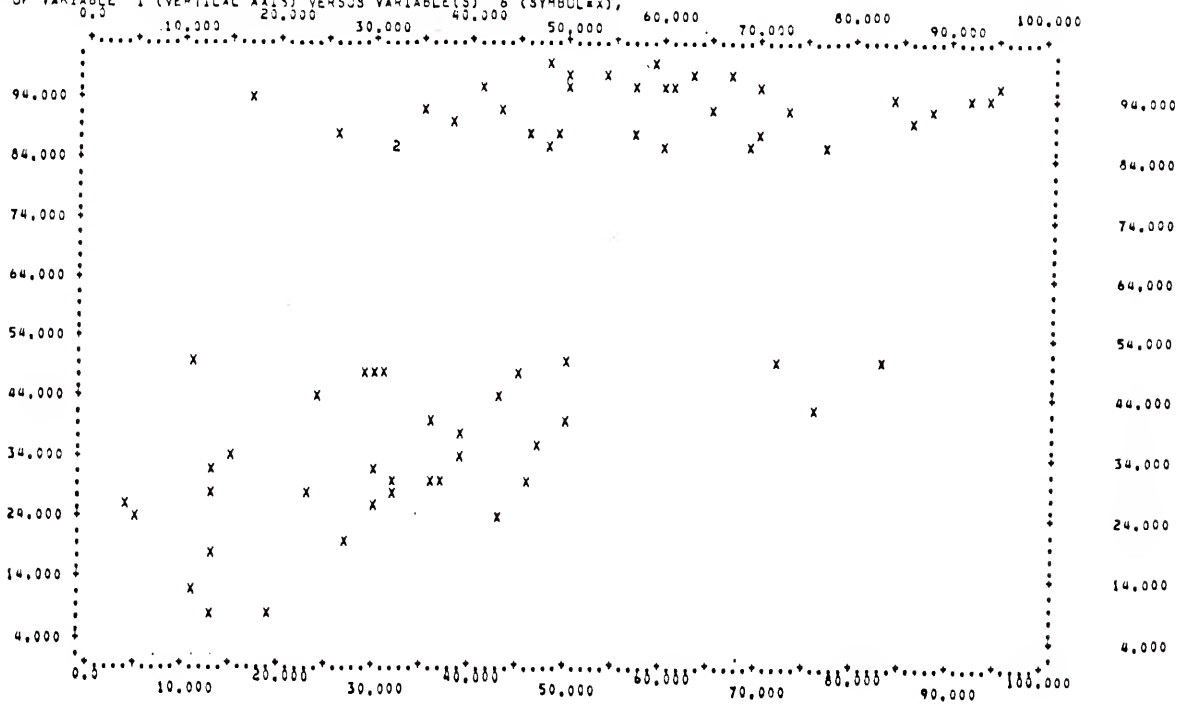


Correlation: r = +0.18

Correlation: r = +0.61

BMDP3D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 6 (SYMBOL=X), SPELLING AGAINST SHORT VOWEL HEAR/WRITE ACCURACY



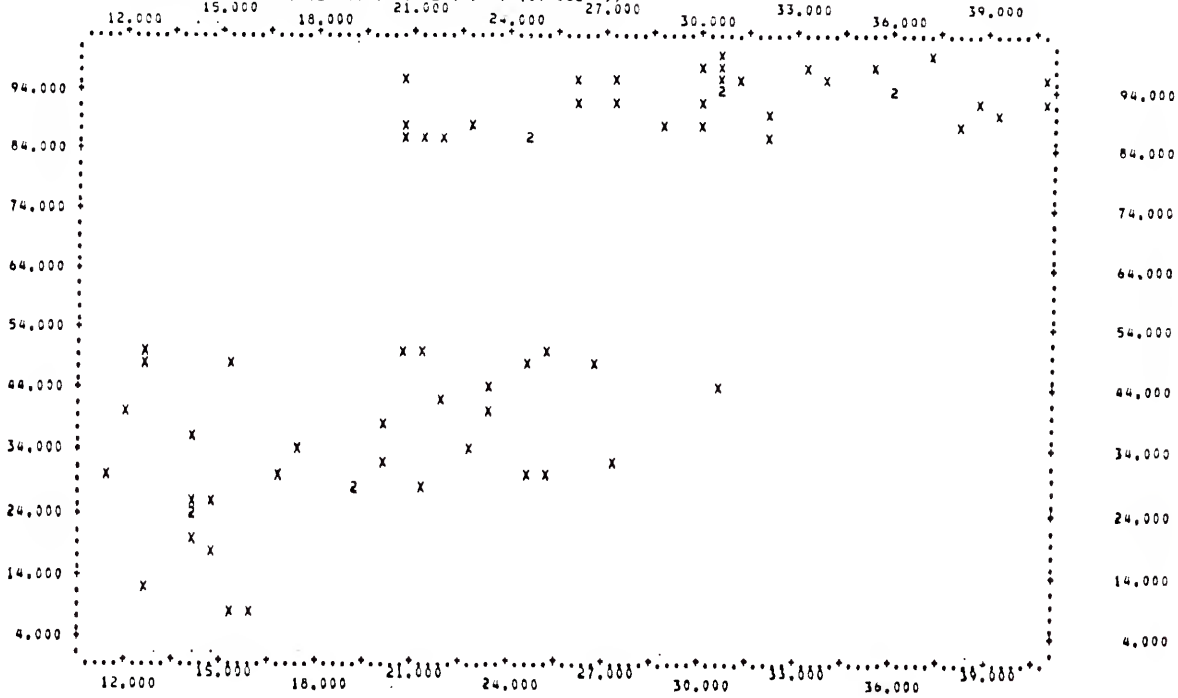
Correlation: r = +0.39

Correlation: r = +0.56

BMD05D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

SPELLING AGAINST SHORT VOWEL HEAR/WRITE SPEED

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 7 (SYMBOLEX),



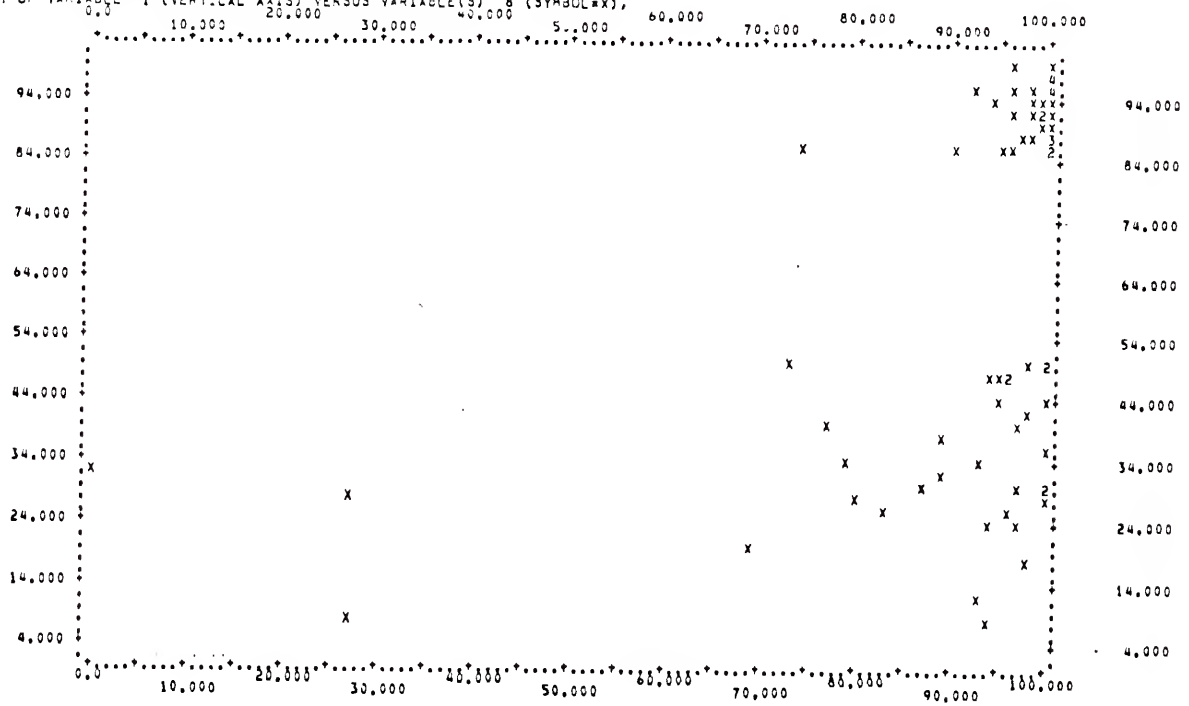
Correlation: r = +0.35

Correlation: r = +0.72

BMDP3D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

SPELLING AGAINST MATH ACCURACY

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 8 (SYMBOL=X),

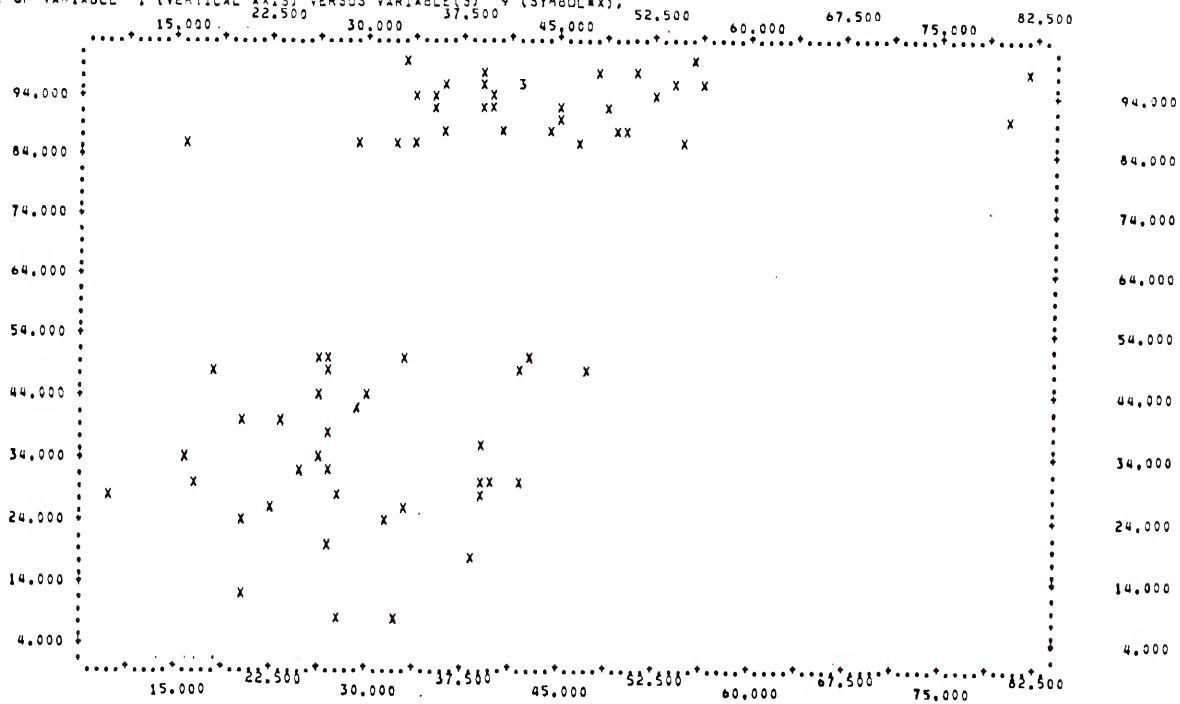


Correlation: r = +0.27

Correlation: r = +0.33

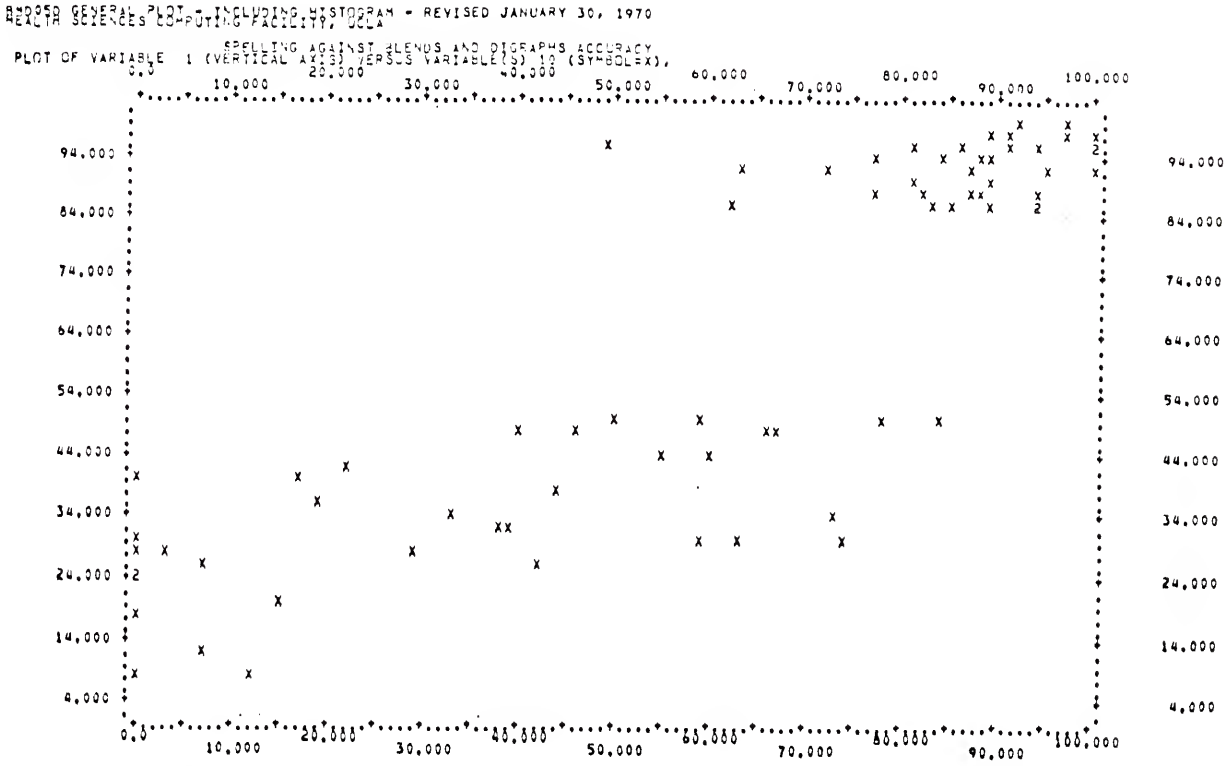
BMDO2D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PLOT OF VARIABLE 1 (VERTICAL AXIS) SPELLING AGAINST MATH SPEED VERSUS VARIABLE(3) 9 (SYMBOL=X),



Correlation: r = +0.14

Correlation: r = +0.58



Correlation: r = +0.59

Correlation: r = +o.78

BMDP5D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

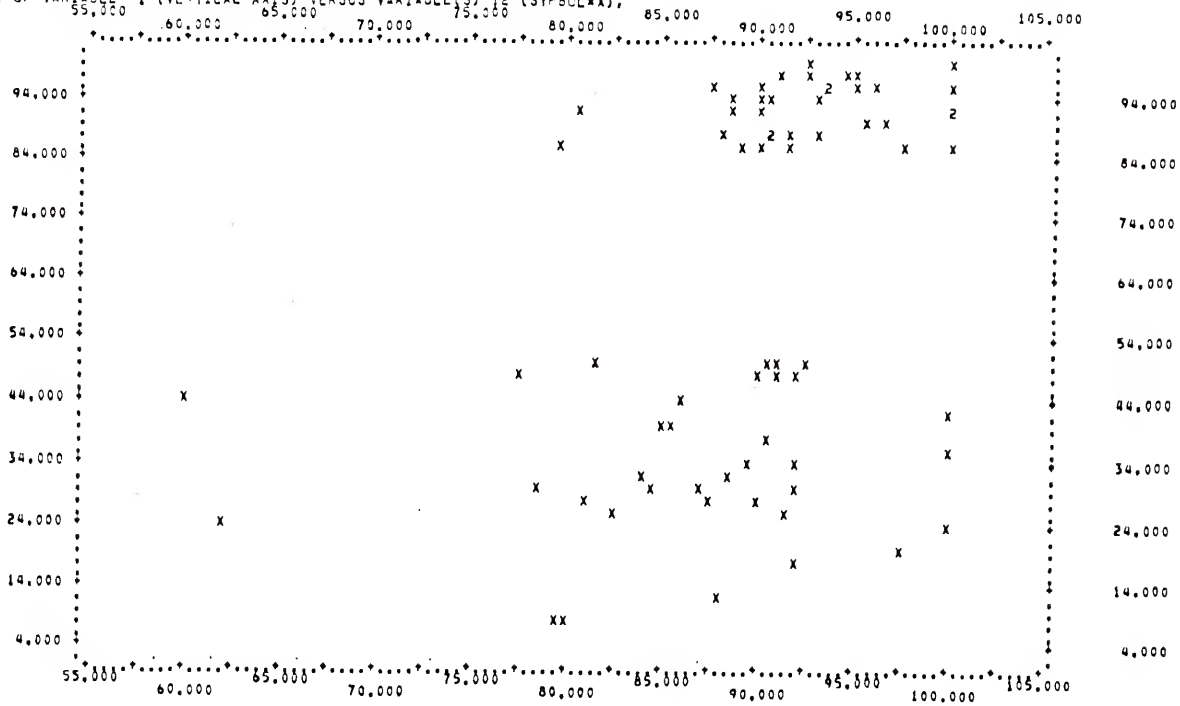
PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 11 (SYMBOL=X).
SPELLING AGAINST BLENDS AND DIGRAPHS SPEED

Correlation: r = +0.35

Correlation: r = +0.76

BMD05B GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 12 (SYMBOL=X), SPELLING AGAINST CONSONANT HEAR/WRITE ACCURACY

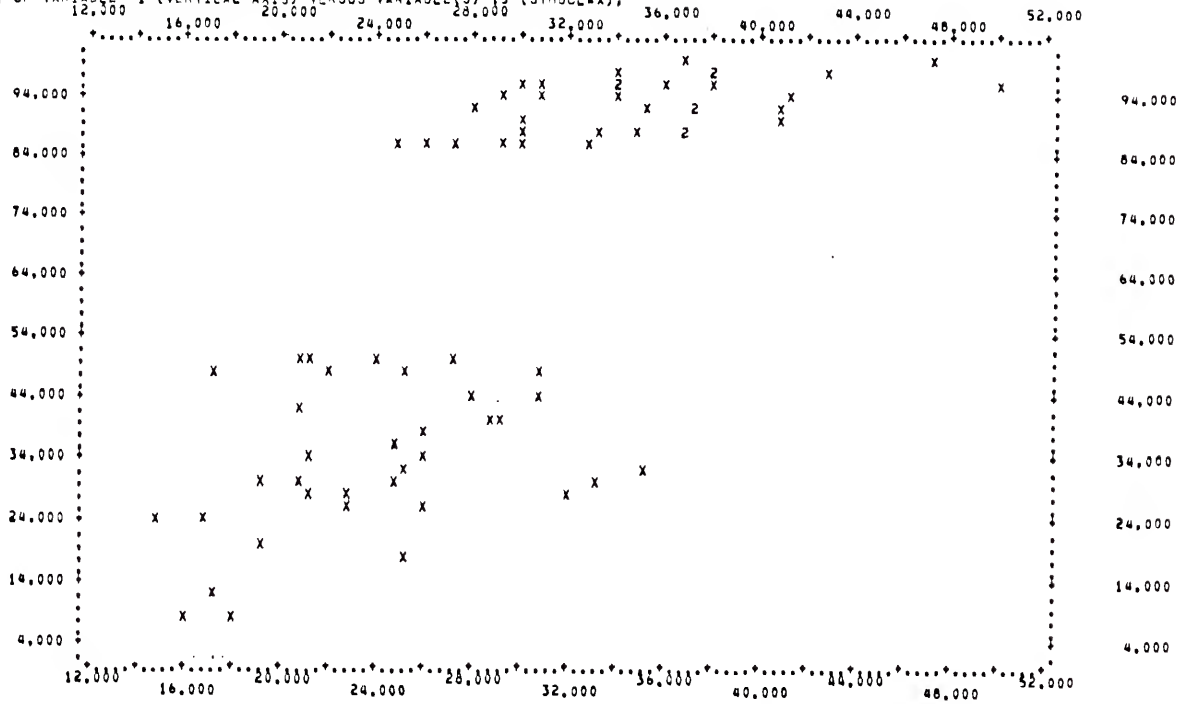


Correlation: r = +0.11

Correlation: r = +0.37

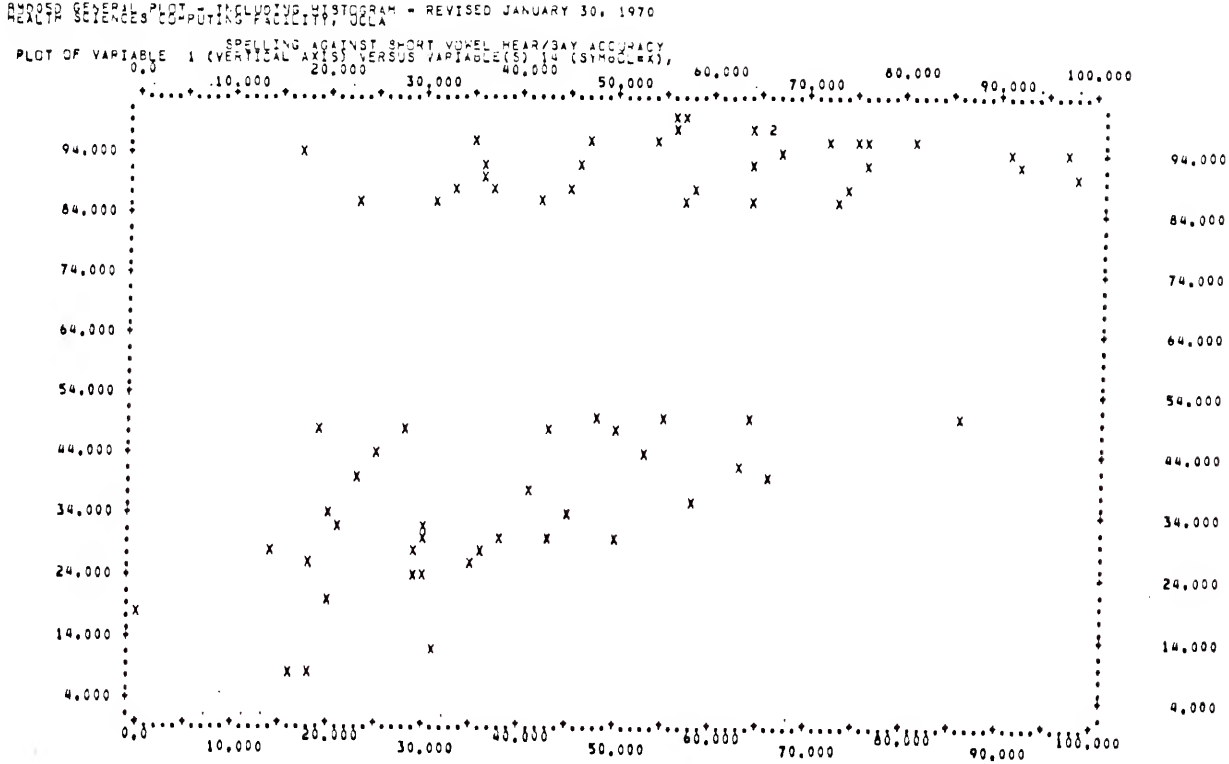
BMD05S GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 13 (SYMBOL=X), SPELLING AGAINST CONSONANT HEAR/WRITE SPEED



Correlation: r = +0.37

Correlation: r = +0.71

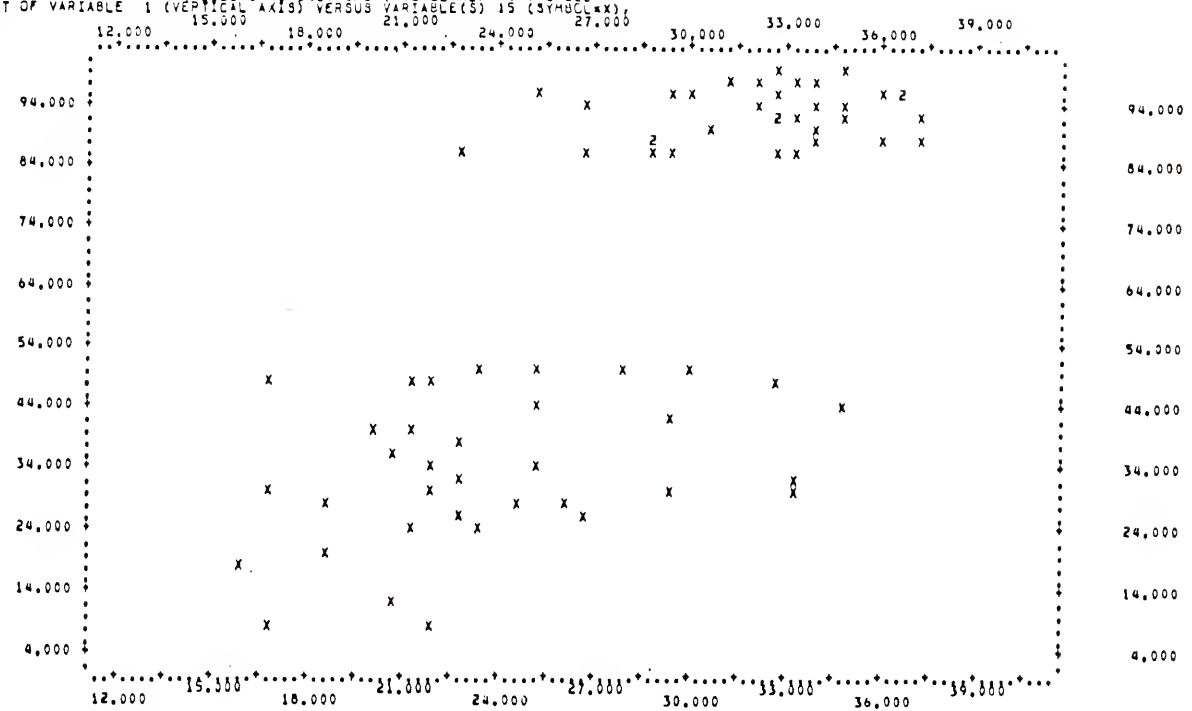


Correlation: r = +0.42

Correlation: r = +0.50

BMDO5R GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 15 (SYMBOL=X), SPELLING AGAINST SHORT VOWEL HEAR/SAY SPEED

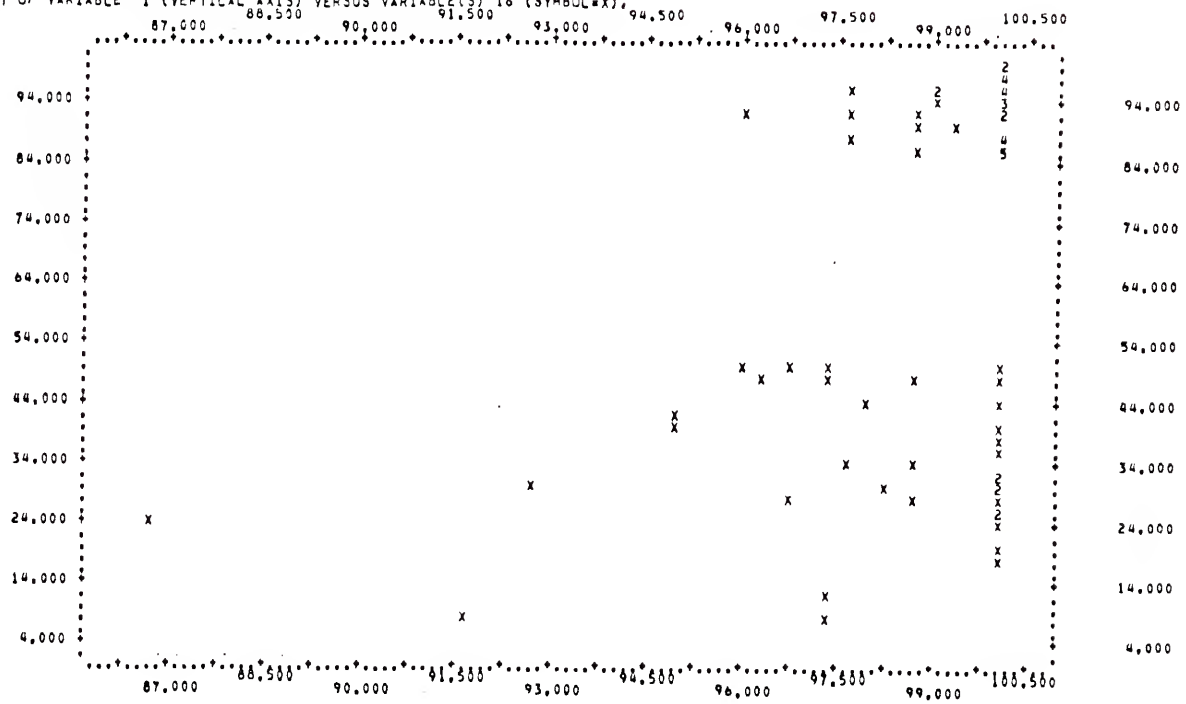


Correlation: r = +0.33

Correlation: r = +0.70

BMDP3D GENERAL PLOT, INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

SPELLING AGAINST ALPHABET ACCURACY
PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 16 (SYMBOL=X).

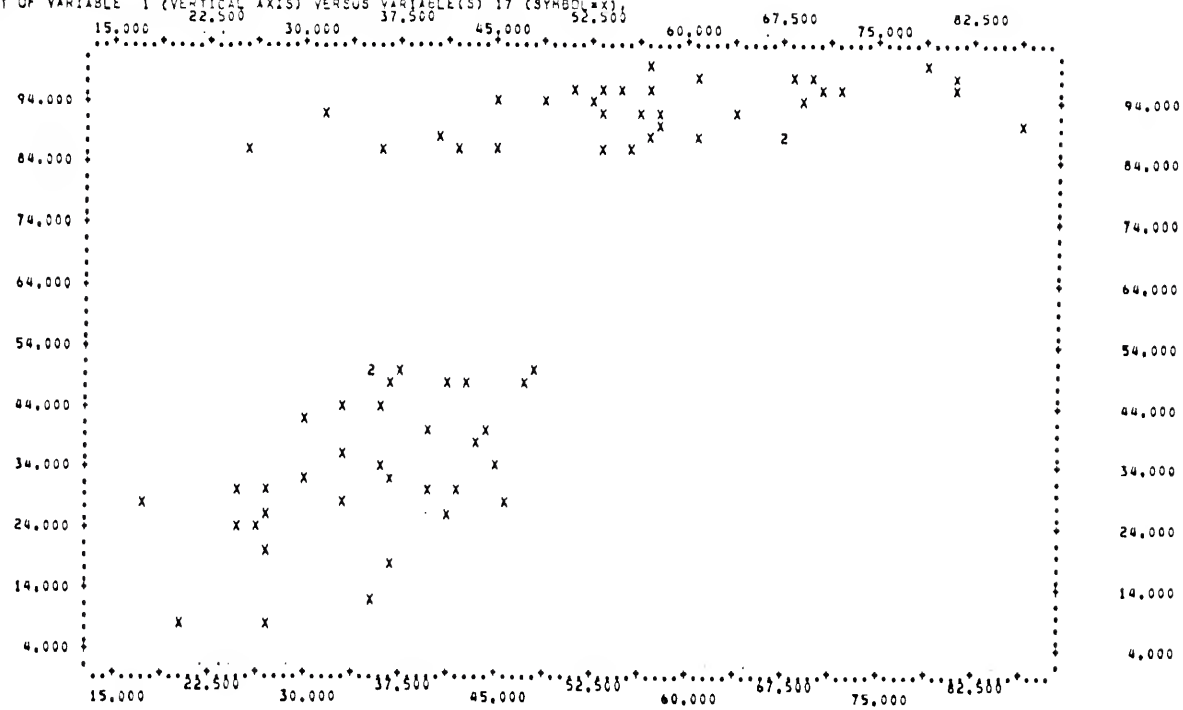


Correlation: r = +0.13

Correlation: r = +0.35

BMD09D GENERAL PLOT - INCLUDING HISTOGRAM - REVISED JANUARY 30, 1970
REXCTA SCIENCES COMPUTING FACILITY, UCLA

PLOT OF VARIABLE 1 (VERTICAL AXIS) VERSUS VARIABLE(S) 17 (SYMBOL=X)
SPELLING AGAINST ALPHABET SPEED



Correlation: r = +0.38

Correlation: r = +0.72

BIOGRAPHICAL SKETCH

Elliott I. Lessen was born in Syracuse, New York, on February 10, 1947. He was graduated from the Syracuse City Schools in 1964. Mr. Lessen received a B.A. from Syracuse University in 1968 with a major in Art History.

Mr. Lessen was a third grade teacher with the Chicago Public Schools for the 1968-1969 school year during which time he pursued graduate coursework in elementary education at Loyola University. From June, 1969, through August, 1970, Mr. Lessen taught HeadStart/Experimental Pre-Kindergarten and Pre-first grade in Syracuse, New York. He did further graduate work in early childhood and special education at Syracuse University.

From September, 1970, to June, 1973, Mr. Lessen was employed by the Adams School, a private school for brain-injured and emotionally disturbed children in New York City. He was awarded his M.S. from Hunter College in June, 1973, with a major in special education (emotional disturbance).

Mr. Lessen was a specific learning disabilities resource teacher during the 1973-1974 school year in Gainesville, Florida. He started his doctoral program in September, 1973. Concurrently, Mr. Lessen was a graduate teaching assistant with the Department of Special

Education and the National Teacher Corps. He was also an administrative assistant with the Career Associate in Special Education program at Santa Fe Community College. Mr. Lessen will receive a Ph.D. from the University of Florida in December, 1976. His area of specialization is special education (learning disabilities).

Mr. Lessen has accepted a position as an Assistant Professor of Special Education at the University of Northern Iowa, Cedar Falls, Iowa, beginning August, 1976. Mr. Lessen and his wife, Linda, are happily married.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

William D. Wolking, Chairperson
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Thomas B. Abbott
Professor of Speech

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Charles Forgnone
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Cecil D. Mercer
Assistant Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Paul Satz
Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

William B. Ware
Professor of Foundations of Education

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

~~December, 1976~~
MAR. 1977

Dean, College of Education

Dean, Graduate School