DOCUMENT RESUME

ED 089 362 CS 201 192

AUTHOR	Horn, Thomas D., Ed.
TITLE	Research on Handwriting and Spelling.
INSTITUTION	National Conference on Research in English.
PUB DATE	66
NOTE	83p.; Articles reprinted from the December 1964 and various 1965 and 1966 issues of "Elementary English"; This document previously announced as ED 026 361
AVAILABLE FROM	National Council of Teachers of English, 1111 Kenyon Road, Urbana, Illinois 61801 (Stock No. 14200, $1.10 non-member, $1.00 member)
EDRS PRICE	MF-$0.75 HC-$4.20 PLUS POSTAGE
DESCRIPTORS	Applied Linguistics; Cursive Writing; *Educational Research; English Curriculum; *English Instruction; *Handwriting; Handwriting Skills; *Language Arts; Linguistics; Psychology; *Spelling; Spelling Instruction; Writing

ABSTRACT

In this collection of articles, the results of recent research in handwriting and spelling are reported and evaluated in the perspective of studies done over the past 50 years. The articles included are "Handwriting and Spelling: Their Current Status in the Language Arts Curriculum," "Handwriting Research" ("Movement and Quality" and "Style and Practice"), "Searching Linguistics for Cues for the Teaching of Spelling," "The Psychological Bases of Spelling," "Applications of Linguistics and Psychological Cues to the Spelling Course of Study," "Measurement of Spelling Ability," "Need Research in Spelling," "The Generalization Controversy on Spelling Instruction," and "A Model for the Analysis of Spelling Behavior." Contributors of articles are Walter T. Petty, Dan W. Andersen, Richard E. Hodges, E. Hugh Rudorf, Paul R. Hanna, Jean S. Hanna, Sidney R. Bergquist, Albert H. Yee, and Carl Personke. (JS)

Research on Handwriting and Spelling

A Research Bulletin
Prepared by a Committee
of the

National Conference on Research in English

THOMAS D. HORN
University of Texas
Editorial Chairman

Published for the NCRE
by the
National Council of Teachers of English
508 South Sixth Street, Champaign, Illinois 61820

THE NATIONAL CONFERENCE ON RESEARCH IN ENGLISH

is an organization of one hundred active members qualified to conduct scientific research in English

The purpose of the organization is to stimulate and encourage research in the teaching of English and to publish results of significant investigations and of and scientific experimentation

1966 President

MARY C. AUSTIN
Western Reserve University
Cleveland, Ohio

The articles in this bulletin were originally published in the December, 1964, and various 1965 and 1966 issues of

ELEMENTARY ENGLISH

Contents

PREFACE

During the past decade interest in the applications of linguistics to educational curricula and the utilization of computer science in educational research has resulted in a number of significant studies which highlight some of the issues involved in the language arts area, particularly spelling. The purpose of this research bulletin is to pull together recent research studies, particularly those available which involve computerization, and to evaluate them in the perspective of studies done over the past half century. A model for projecting research activities is discussed in the final chapter.

Despite the fact that a number of naive educators have concluded that spelling and handwriting have been "researched out," it will be obvious to the reader of the bulletin that such is not the case. The authors of the various sections of the bulletin have made a conscientious attempt to report defensible research and to avoid the "sound and fury" of educational evangelism. It is our hope that researchers in the language arts will find the bulletin a useful reference source.

The complete Stanford Spelling Project report is made available within the pages of this research bulletin as well as a critical examination of the report. Researchers interested in pursuing some of the issues raised in the bulletin concerning the Stanford Project will be interested in a "parting shot" by Richard E. Hodges in his article, "The Case for Teaching Sound-to-Letter Correspondence in Spelling," in the March, 1966, issue of *The Elementary School Journal*. The editor has no doubt but what more will be heard from the various protagonists of differing views.

Thomas D. Horn
The University of Texas
1966

WALTER T. PETTY

Handwriting and Spelling: Their Current Status in the Language Arts Curriculum

Spelling and handwriting have traditionally been important elements of the elementary school curriculum. As measured by the amount of time devoted to their teaching and by teacher effort, the importance of their roles has ranged from very considerable to only moderate. Since the impact of Sputnik, a greater emphasis has been placed on the three R's. Thus, both spelling and handwriting are again receiving greater teaching attention than was the case only a few years ago.

While it may be generally agreed that these subjects are currently receiving more curricular emphasis, this does not necessarily mean that they are being better taught than formerly. Disturbing as it may be, there appears to be evidence that teaching practice has tended to remain influenced far more by habit than by research evidence. For example, Groff (20) reported that a survey of opinions of directors of elementary education in seventy-two metropolitan areas showed that the teaching of handwriting is based on public opinion rather than on research evidence. A similar conclusion regarding spelling was reached by Richmond (45) as a result of a detailed study of forty-one sixth-grade children.

This report is a summary of the status of handwriting and spelling teaching today with particular reference to established findings of research and to research recently concluded. Brief consideration is also given to the relationships between handwriting and spelling as facets of the total language arts. This report is not intended as a comprehensive one of the research in these areas, nor are the references cited the only ones which could be cited. Reference is made in many instances only to well-documented research summaries. The report is simply one which sets the stage for somewhat more detailed summaries which will follow.

Spelling programs today.

Actual procedures followed in the teaching of spelling throughout the country are considerably influenced by the commercial materials used. Since teacher practices may have considerable bearing upon what appears in a textbook, traditional procedures may receive reinforcement with the result that a cycle of practices with little research validity is operating. That this supposition has considerable observational validity is

Dr. Petty is an Associate Professor of Education at Sacramento State College, California.
Elementary English, XXXXI (December 1964), 839-843, 959.

testified to by Horn's (29) statement that ". . . the chief problem today [in teaching spelling] appears to be a more critical and universal application of the [research] evidence now available."

Spelling programs generally give at least some consideration to vocabulary studies which show the words written most frequently (4). Spelling lists published in recent years have tended to include fewer than 4,000 words, thus reflecting this consideration. However, the actual words in such lists and the grade levels suggested for teaching particular words varies considerably from list to list (29). This variance is often the result of improper attention to the existing evidence on which words should be included and when the teaching of a particular word should occur, as well as the treatment given phonic or linguistic rules and generalizations (24). Treatment which gives undue stress to rules having limited application results in the selection of words for which the rules apply and fails to choose words of greater social utility (46, 50).

Teaching spelling.

The superiority of the test-study approach over the study-test approach in teaching words has long been established (17, 31). The test-study procedure calls for beginning the unit of instruction with a test which identifies for each pupil the words he does not know how to spell. This procedure is efficient and helps to build favorable attitudes toward spelling (13, 30). Another help for building favorable attitudes is a procedure known as the corrected test, which focuses upon specific spelling problems through having each pupil check his own test. This has been shown to be the most efficient single procedure for learning to spell (30, 31).

The test-study approach and the corrected-test are basic elements of method identified by research to be essential which are ignored by many teachers. Another inferior procedure in widespread use is the contextual presentation of the spelling words. This presentation presumably develops the meaning of the words; however, since most such presentations simply use the words rather than develop their meanings, and since carefully selected spelling words have ordinarily been in the pupils' speaking, understanding, and reading vocabularies, any so-called development of meaning is largely a waste of pupil time. The list presentation of words is more efficient and fosters a more favorable learning attitude (8, 30, 31).

Early studies pointed out the faulty reasoning in expecting improved spelling ability to result from increasing the time devoted to spelling instruction (14), yet time allotments have recently been increased. In most instances not more than seventy-five minutes per week should be devoted to spelling instruction, and there is evidence that even less time accomplishes equal achievement (29). In most schools, spelling is taught five periods per week, principally because of the ease in the administration of such a program. However, there is considerable evidence which suggests that fewer periods may be satisfactory (29), particularly if the corrected test technique is used (32).

One of the most common causes of low spelling achievement is poor study habits (18, 48). Many children do not follow the study "steps" suggested in most commercial spelling materials and generally known to teachers. Although these steps focus upon sensory impression and attempted recall, use of the corrected test enhances the steps' effectiveness as study procedures (29, 30).

How well a pupil learns to spell depends largely upon his interest. The pupil's interest in and his attitude toward spelling determines what he will do toward at-

tempting to learn, how hard he will work, and how persistent he will be in his learning effort. The development of the desired interest and attitude may be accomplished by: (1) selecting genuinely useful words; (2) limiting study to those words which tests have shown the pupil unable to spell; (3) fostering definite and efficient study habits; (4) showing pupils that they are achieving and progressing; and (5) using materials which have inherent appeal (29, 30).

Recent research in spelling.

As has been stated previously, an apparent need in spelling instruction is the application of the evidence regarding its teaching that has been produced by research. By and large this application has not been made. Further, there has been a disappointing amount of significant and new research in recent years (37), with the paucity probably due both to the difficulty of attacking some problems and to the financial encouragement given to investigating other curricular areas.

The value of the corrected test was borne out in Schoephoerster's study (52), though application of this procedure probably has still gained little teacher acceptance. The instructional possibilities of individualized spelling plans were shown in Eisman's study and the suggestion made that variation in study plans may be needed for pupils with different perceptive abilities (9). The question of identifying image types still remains mute, though training in visual imagery showed an effectiveness in learning spelling (36, 44). The precise kind of imagery training and the value for all pupils remains unsettled.

Programmed instruction received research attention (2, 6, 19). While spelling would appear to lend itself to such instruction, results of the research did not clearly bear out this view. Undoubtedly this is an area which will and should receive more research attention.

Identifying and classifying spelling errors has continued to interest researchers (33, 43), with some clarification of the attention which needs to be given to letter positions and to meanings of homonyms. The controversy over the value of phonics in teaching spelling has also continued, with extensive claims being reported concerning the "regular" representation of *phonemes* (24). Several recent studies (22, 42, 49) indicate that phonetic rules do not apply to a substantial percentage of *words* pupils are called upon to spell. The position is still prevalent that some teaching of sound-to-letter and letter-to-sound relationships may prove of value (29).

Handwriting programs today.

Recent surveys of the status of handwriting instruction indicate that handwriting programs are also largely tied to commercial handwriting systems (34, 40). As many as sixteen commercial programs are in use, with another ten commercial systems being used which emphasize other facets of the language arts. These latter ten, therefore, are classified as only partial handwriting programs (26, 40). The various handwriting programs show considerable divergence in letter forms, sequence in the introduction of letters, and recommended teaching practices (26).

Evidence has also been presented that as high as 30 percent of all school systems have no handwriting program and as many as 50 percent of all schools have no separate handwriting period (34). Teachers in these school systems undoubtedly make at least some incidental effort to improve handwriting, though the surveys generally fail to establish the extent of this.

The absence of handwriting programs in many school systems may result from the lack of attention often given handwriting in teacher education programs (7). Also, of

course, the social valuing of other curricular areas over that of handwriting has had its effect. In a crowded school curriculum something has to go; for a teacher with little ability himself to write well, with handwriting ranking low in popularity with him and with his fellow teachers (25), and with little societal pressure, an easy area to eliminate or denigrate is the handwriting program.

Handwriting instruction.

The most recent survey of handwriting instruction of an extensive nature was that made in Wisconsin in 1951 (23). Studies in Texas (41) and in Monmouth County, New Jersey (25), though more recent, were less extensive. However, they both substantiated the findings of the Wisconsin study. These studies showed a number of factors as basic to handwriting instruction: (1) legibility is considered the most important objective in programs, with slant, letter formation, and spacing of next importance. Speed of writing should receive the least stress; (2) practice periods of about ten minutes' duration each, either daily or on alternate days, are generally favored; (3) the introduction of manuscript writing is made in the first grade, with transition to cursive usually occurring in the early third grade; and (4) teachers, in general, are aware of the importance of the proper handwriting position, adjustments necessary for the left-handed child, and of the paper and writing instruments to use.

The handwriting position in general acceptance in practice and supported by research (15, 38) is to use the pen or pencil as essentially an extension of the forearm, with the movement combining vertical and side strokes to produce a moderately slanted letter formation. The body, of course, must be in a position for the forearm to move freely and without strain. The principal adjustment to be made for the left-handed pupil is one of reversing the slant of the paper, though a slightly more pronounced slant is preferred by the left-handed pupil writing cursive form than by the right-handed pupil (10).

Copying to learn the formation of letters is favored over other methods; most commercial handwriting programs recognize this (40). Handwriting paper generally used recognizes the need to reduce the space between the lines as pupils advance in age and in writing skill. Pupils also prefer to use conventional writing instruments, since these seem to work as well as specialized ones for different grade levels. Research on such instruments is continuing and instruments designed from research evidence may ultimately result (28).

Handwriting issues and recent research.

Analyses of adult handwriting reported in 1960 have shown the need for handwriting instruction with much of the instructional emphasis being upon the maintenance of earlier learned skills (55). The fact that adults' handwriting departs from many of the forms as originally learned led to the suggestion that some letter forms in current use should be modified (51).

Issues in the teaching of handwriting which have been of concern for some years continue to be unsettled. These include: (1) whether or not both manuscript and cursive forms should be taught; (2) whether or not practice on letter forms and handwriting movements should occur isolated from meaningful writing; (3) how handwriting should be evaluated; and (4) how instruction may be individualized to care for differences in pupil abilities.

Most schools teach both manuscript and cursive forms so this issue is largely one of appraising the consideration which should be given to custom in the continuance of

teaching cursive writing. The extent to which manuscript writing may be done with comparable speed remains controversial (12, 21). There is a trend toward the maintenance of skill in manuscript form throughout the grades, even after cursive has been introduced. Tradition and society's feelings concerning the esthetic qualities of cursive writing will probably mean continued teaching of both forms.

Using a functional approach exclusively versus giving some attention to training in motor skills may be an issue only to the extent that some schools have no handwriting periods and may, thus, do little formal handwriting teaching. The role of motor learning will be discussed in a later chapter in this bulletin, but evidence to date appears to recognize the need for practice of a motor-drill nature (16, 38, 54). There is evidence that some letters are more difficult to form than others, which led to the opinion that there should be direct teaching of letter forms and continued practice on them (39). However, the nature and condition of the practice which would achieve the handwriting objectives has only recently begun to receive the experimental attention needed to settle the issue.

Evaluation of children's handwriting is simply nonexistent or is quite informal. Few schools evaluate in the formal sense through the use of commercial scales. One reason for this may be that such evaluation possibly would show relatively low scale scores (3), though a more important social reason may be that regular use of a standard scale may destroy the individuality of handwriting (25). Handwriting scales are increasingly being mentioned in reports of research, but in order for scales to be used properly teachers need training in their use (11). The evaluation needed may not occur until new scales are developed which reflect current handwriting standards and which provide for self-diagnosis (1, 27). Also, further clarification is needed as to just what constitutes handwriting quality and handwriting legibility before more usable scales can be developed (47).

Some commercial handwriting materials may not foster the individualized instruction generally needed. This is particularly true with respect to the emphasis given rhythmic count in forming letters (27). A teacher may allow variance, however, in such count for different pupils and, if he has a program of diagnosis and evaluation, may possibly approach an individualized handwriting program. Taking into consideration (1) the objective of legibility, (2) the recognition of pupil differences in abilities, and (3) the awareness that pupils actually develop personalized forms of writing (51, 53), programs which provide for instruction which recognize handwriting individuality would seem to be imperative. Since an increasing number of commercial systems make such provision, more individualized handwriting instruction should appear (40).

Handwriting and spelling in the language arts program.

Spelling and handwriting competencies are influenced by reading, listening, and written and oral composition, just as skills in these latter areas are influenced by spelling and handwriting abilities. Studies have shown positive correlations between abilities in the various language arts (5, 35), but not as high as might be expected (17). The extent to which these correlations increase or decrease as pupils mature is a matter not clearly established (35, 56).

Many of the interrelationships that are present are very likely due to the presence of common elements in each facet and to the fact that an experience affecting one cannot be isolated from the others. For instance, pupils certainly do learn to spell many words as a result of reading and

other activities. Spelling pretests regularly show that pupils know how to spell many of the words on such tests (32). Too, a number of researchers have reported that mispronunciations and speech articulatory defects are often related to spelling disabilities (29) and, of course, illegible handwriting at least leads one to question the spelling accuracy of the words written. Copying words as a part of handwriting instruction may account for learning the spelling of some words since the motor-mental effort made is a type of sensory impression basic to learning spelling.

Certainly, as handwriting improves, all written work is facilitated with the result of increased benefits to spelling (29). Likewise, pronunciation and articulation which give due recognition to letters representing sounds means that these letters and perhaps their order in words are seen and may be recalled when spelling is attempted. It would seem, though, that learning in one language arts area that has carryover to another takes place in a larger context than just relating one aspect to another. That is, genuine interrelated learning would seem to result best from an instructional program which teaches all of the language arts in a communication framework (5).

Recognition of the interrelationships of the language arts, however, should not be interpreted as support for an incidental approach to the teaching of the various facets as opposed to systematic programs. Neither should systematic attention preclude correlating the language arts with other curricular areas not integrating related skills. A genuine communication program acknowledges the interrelatedness of all of the language arts as well as the need for specific teaching attention to specific skills.

References

1. Bezzi, Rocky, "A Standardized Manuscript Scale for Grades 1, 2, and 3," *The Journal of Educational Research*, 55 (April, 1962), 339-340.
2. Buzby, John J., and Lester Mann, "The TMI Self-Tutoring Program Compared with Teacher and Flash Card Taught Programs," *The Journal of Educational Research*, 55 (August, 1962), 585-586.
3. Covert, Sidney, *An Evaluation of Handwriting in Certain Iowa Schools*. Doctor's thesis. State University of Iowa, 1953.
4. Davis, Bennie Joe, *A Study of the Vocabulary Overlap Between Words Written by Children and Words Written by Adults*. Master's thesis. The University of Texas, 1954.
5. Early, Margaret J., "Communication Arts," *Encyclopedia of Educational Research*. Chester W. Harris, (ed.). New York: Macmillan, 1960.
6. Edgerton, Alice K., and Ruth W. Twombly, "A Programmed Course in Spelling," *The Elementary School Journal*, 62 (April, 1962), 380-386.
7. "Educators Enthused over Handwriting Instruction Programs," *Handwriting Foundation Newsletter*, 143 (February 6, 1962).
8. Edwards, Mary Ann Rigsby, *An Evaluation of the Casis School Instructional Program in Spelling*. Master's thesis. The University of Texas, 1953.
9. Eisman, Edward, "Individualized Spelling," *Elementary English*, 39 (May, 1962), 478-480.
10. Enstrom, E. A., "The Relative Efficiency of the Various Approaches to Writing with the Left Hand," *The Journal of Educational Research*, 55 (August, 1962), 573-577.
11. Feldt, Leonard S., "The Reliability of Measures of Handwriting Ability," *Journal of Educational Psychology*, 53 (December, 1962), 288-292.
12. Fitzgerald, James A., "Research in Spelling and Handwriting," *Review of Educational Research*, 22 (April, 1952), 89-95.
13. _____, *The Teaching of Spelling*. Milwaukee: Bruce Publishing Company, 1951.
14. Foran, Thomas G., *The Psychology and Teaching of Spelling*. Washington, D.C.: Catholic Education Press, 1934.
15. Freeman, Frank, *The Handwriting Movement*. Chicago: The University of Chicago, 1918.
16. Gates, A. I., and G. A. Taylor, "Acquisition of Motor Control in Writing by Pre-School Children," *Teachers College Record*, 24 (1924), 459-468.
17. Gates, A. I., "An Experimental Comparison of the Study-Test and Test-Study Methods in Spelling," *Journal of Educational Psychology*, 22 (January, 1931), 1-19.
18. _____, *The Psychology of Reading and*

Spelling with Special Reference to Disability. Contributions to Education, Number 129. New York: Teachers College, Columbia University, 1922.

19. Gibson, Mrs. R. E., "Final Report on the Westside High School Teaching-by-Tape Project," *Bulletin of the National Association of Secondary School Principals*, 44 (January, 1960), 56-62.
20. Groff, Patrick J., "From Manuscript to Cursive —Why?" *Elementary School Journal*, 61 (November, 1960), 55-62.
21. ———, "New Speeds of Handwriting," *Elementary English*, 38 (December, 1961), 564-565.
22. ———, "The New Iowa Spelling Scale: How Phonic Is It?" *The Elementary School Journal*, 62 (October, 1961), 46-49.
23. *Handwriting in Wisconsin*. University of Wisconsin, Department of Education Committee for Research in Handwriting. Madison: University of Wisconsin, 1951.
24. Hanna, Paul R., and James T. Moore, Jr., "Spelling – From Spoken Word to Written Symbol," *Elementary School Journal*, 53 (February, 1953), 329-337.
25. Harris, Theodore L., "Handwriting," *Encyclopedia of Educational Research*. Chester W. Harris, (ed.). New York: Macmillan, 1960.
26. Herrick, Virgil E., *Comparison of Practices in Handwriting Advocated by Nineteen Commercial Systems of Handwriting Instruction*. Madison: Committee on Research in Basic Skills, University of Wisconsin, 1960.
27. ———, (ed.), *New Horizons for Research in Handwriting*. Report of the Invitational Conference on Research in Handwriting. Madison: University of Wisconsin Press, 1963.
28. ———, "What Research Says about Writing Tools for Children," *NEA Journal*, 50 (February, 1961), 49-50.
29. Horn, Ernest, "Spelling," *Encyclopedia of Educational Research*. Chester W. Harris, (ed.). New York: Macmillan, 1960.
30. ———, *Teaching Spelling: What Research Says to the Teacher*. Washington, D.C.: Department of Classroom Teachers and American Educational Research Association, 1954.
31. Horn, Thomas D., "Research in Spelling," *Elementary English*, 37 (March, 1960), 174-177.
32. ———, and Henry J. Otto, *Spelling Instruction: A Curriculum-Wide Approach*. Bureau of Laboratory School Publications Number 2. Austin: The University of Texas, 1954.
33. Jensen, Arthur R., "Spelling Errors and the Serial-Position Effect," *The Journal of Educational Psychology*, 53 (June, 1962), 105-109.
34. King, Fred M., "Handwriting Practices in Our Schools Today," *Elementary English*, 38 (November, 1961), 483-486.
35. Loban, Walter D., *The Language of Elementary School Children*. NCTE Research Report No. 1. Champaign, Illinois: National Council of Teachers of English, 1963.
36. Mason, Geoffrey P., "Word Discrimination Drills," *Journal of Educational Research*, 55 (September, 1961), 39-40.
37. Michael, William B., "A Short Evaluation of the Research Reviewed in Language Arts and Fine Arts," *Review of Educational Research*, 34 (April, 1964), 249-256.
38. Myers, Emma, *A General Review of Handwriting Instruction*. Master's thesis. State University of Iowa, 1954.
39. Newland, T. Ernest, "An Analytical Study of the Development of Illegibilities in Handwriting from Lower Grades to Adulthood," *Journal of Educational Research*, 26 (December, 1932), 249-258.
40. Noble, J. Kendrick, Jr., "Handwriting Programs in Today's Schools," *Elementary English*, 40 (May, 1963), 506-512.
41. Owen, Mary E. (ed.), "Just Where Do We Stand in Handwriting?" *Instructor*, 63 (1954), 57.
42. Petty, Walter T., "Phonetic Elements as Factors in Spelling Difficulty," *Journal of Educational Research*, 51 (November, 1958), 209-214.
43. Plessas, Gus P., "Children's Errors in Spelling Homonyms," *The Elementary School Journal*, 64 (December, 1963), 163-168.
44. Radaker, Leon D., "The Effect of Visual Imagery upon Spelling Performance," *Journal of Educational Research*, 56 (March, 1963), 370-372.
45. Richmond, Arnie E., "Children's Spelling Needs and the Implications of Research," *Journal of Experimental Education*, 29 (September, 1960), 3-21.
46. Rogness, Alton S., *Grouping Spelling Words According to the Rule*. Doctor's thesis. Colorado State College of Education, 1953.
47. Rondinella, Oreste R., "An Evaluation of Subjectivity of Elementary School Teachers in Grading Handwriting," *Elementary English*, 40 (May, 1963), 531-532.
48. Russell, David H., *Characteristics of Good and Poor Spellers*. Contributions to Education, Number 727. New York: Teachers College, Columbia University, 1937.
49. Sah, Loretta J., *A Study of Spelling Performances*. Master's thesis. Sacramento State College, 1964.
50. Sartorius, Ina C., *Generalizations in Spelling*. Contributions to Education, Number 472. New York: Teachers College, Columbia University, 1931.

51. Schell, Leo M. and Paul C. Burns, "Retention and Changes by College Students of Certain Upper-Case Cursive Letter Forms," *Elementary English*, 40 (May, 1963), 513-517.
52. Schoephoerster, Hugh, "Research into Variations of the Test-Study Plan of Teaching Spelling," *Elementary English*, 39 (May, 1962), 460-462.
53. Seifert, Eloise P., *Personal Styles of Handwriting in Grades Six, Seven, Eight, and Nine*. Doctor's thesis. Boston University, 1959.
54. Shane, Harold G., *Research Helps in Teaching the Language Arts*. Washington, D.C.: Association for Supervision and Curriculum Development, 1955.
55. Templin, Elaine M., "How Important Is Handwriting Today?" *The Elementary School Journal*, 61 (December, 1960), 158-164.
56. Templin, Mildred C., "Phonic Knowledge and Its Relation to the Spelling and Reading Achievement of Fourth Grade Pupils," *Journal of Educational Research*, 47 (February, 1954), 441-454.
57. Winter, Clotilda, "Interrelationships among Language Variables in Children of the First and Second Grades," *Elementary English*, 34 (February, 1957), 108-113.

DAN W. ANDERSEN

Handwriting Research: Movement and Quality

Introduction

"The moving finger writes and having writ moves on"—and on, and on. The history of handwriting is as old as the history of man, *i.e.*, the *recorded* history of man. Though alphabets have undergone great changes down through the ages and though a variety of alphabets have caused great differences in the way we put our letters together, the fact remains handwriting is, and always has been, a major preoccupation of civilized man.

There are those who would argue that 'Ritin' has been the neglected "R" in the trilogy (36), but historically the emphasis on handwriting has had an esteemed position in the evolution of the American schools (4).

With the advent of automation, electric typewriters, computers, electric dictating machines, telephonic devices, there are those who would question the continued need for handwriting practice. Freeman (13) discussed the role of handwriting in the 1930's, prior to the electronic boom. He pointed out that the *Statistical Abstract of the United States* for 1930 showed that the sale of handwriting materials increased at about the same rate as the increase in the sale of typewriters. He argued that people were doing more handwriting rather than less and that the use of the typewriter increased the total volume of writing but did not displace it.

More recently Templin (35, 36) surveyed 454 adults as to their normal writing behavior. After recording weekly handwriting activity as to socio-economic group, type of handwriting instrument used, amount of writing done, she concluded: (1) the typewriter has not replaced the pencil; (2) the ball point pen seemed to have wide acceptance; and (3) handwriting legibility is still paramount to efficiency in the business and the social world.

It seems reasonably certain that it will still be some time in the future before our technology will be able to mass produce instrumentation that will replace the need for college class note taking and scribbling the weekly shopping list on the back of a three-by-five card.

This general concern shown for handwriting has not always been accompanied by a comparable research concern. The history of handwriting research has not been even. There have been periods of maximum effort and other periods when very little was done. In describing handwriting research of the first three decades of the 1900's, Freeman (13) points to the second decade as the popular period and the other periods as relatively quiet. Herrick (25) generally agrees with this and adds the fourth decade to this slumber period, claiming that World War II oc-

Dr. Andersen is an Assistant Professor of Education at the University of Wisconsin, Madison.
Elementary English, XXXXII (January 1965), 45-53.

cupied the attention of many individuals who would otherwise have been studying educational problems. Herrick would suggest that since 1950 there has been a significant increase in research activity in this phase of the language arts.

In a critical review by West of handwriting studies reported during the period of 1940-1950 two different types of material may be identified—the descriptive, and the research oriented (39).

> The lack of constructive basic research in the field of handwriting still continues. Most articles are in the nature of general discussion, suggestions, and aids to teachers or experts of local modification.

An analysis of Herrick's comprehensive bibliography "Handwriting and Related Factors 1890-1960," (23) would show that of 1,754 entries, 450 are placed in the category "Brief Non-technical Discussions." When such other bibliographical categories as "History of Writing and of Educative Writing," "Bibliographies," "Reviews of Summaries of Research," "Recommended Courses of Study," and "Description of Instructional Materials," are added to the 450 non-technical discussions, it becomes evident that over 70 percent of the handwriting articles reported in this bibliography are of a non-technical, descriptive nature.

That there is no lack of problems in the area of handwriting research is emphasized by Horn (27). He lists some five problems of general design in handwriting research and suggests twenty-one possible problems of a more specific nature dealing with handwriting.

For purposes of this review, the research in handwriting will be centered around four major areas: (1) the handwriting movement; (2) the measurement of quality in handwriting; (3) the concern for handwriting style—manuscript and cursive; and (4) instructional practices in handwriting.

In all, 104 studies are included in this review. The primary intent was to select studies that reflected the most recent research, notably since 1960, but to include also those handwriting studies that have made a significant contribution to handwriting research, irrespective of date.

Handwriting Movement

That the handwriting act is a complex psychomotor process has been attested to by various researchers (15, 22). The complexity of this handwriting act has caused the investigators to look for certain dimensions that might better describe what actually takes place when a person writes. It seems apparent from the literature that the dimensions of the handwriting act most commonly considered are (1) the hand movement, (2) velocity and rhythm, and (3) the pressure phenomenon.

Hand Movement

Freeman (12) suggested fifty years ago that the writing movement could be analyzed in two ways: (1) the number of component movements—finger, hand, arm, and so on, may be determined and their nature investigated; or (2) the characteristics of the total resultant movement may be investigated. Freeman used the second approach to demonstrate that the elements in the writing process came to be treated not as individual strokes or movements, but rather as stages in the progress of the organized whole. In comparing the handwriting movement of children with adults, he concluded that children's writing was less rhythmical, less organized, and less automatized. This and subsequent research led Freeman (14) to experimentation and development of a handwriting movement that combined both finger and arm movement rather than exclusive finger or arm control.

Judd's (29) work had also demonstrated that only through an appropriate combina-

tion of finger and arm control could adequate handwriting style be carried out over long periods of time. Since the work of Judd and Freeman, this combination method has been the predominant hand movement. In this movement the hand is not turned over on the side but only about halfway over. It rests on the third and fourth fingers, not on the side. It is not planted in one place, but slides across the page while the letters are being formed. The arm and hand may have a share in the formation of the letters. The fingers, relaxed, grasp the pen lightly in completing the letters (15).

An alternative to this method has been recently suggested by Callewaert (3). With palm facing down, one places the barrel of the pen on the web between the index and middle finger, bends the hand slightly backward and gently grasps the barrel of the pen with the distal end of the thumb, index finger, and lateral portion of the middle finger. Callewaert contends that this "round" method of handwriting is more physiologically sound than the usual method. Most of Callewaert's studies have been clinical rather than experimental.

Velocity and Rhythm

It is evident from an analysis of present day handwriting practices that there is no longer the emphasis placed on speed and rhythm that was witnessed earlier (25). Some years ago Gates (16) developed a formula for rating handwriting that utilized the function of speed as part of the legibility rating. A number of earlier studies investigated the phenomenon of speed in handwriting.

Freeman (15) discusses the variation of handwriting speed among individuals and groups of individuals and proposes some representative norms for the various grade levels that seem to be indicated by the different investigations of the speed phenomenon. He concludes from the research that an adult may easily reach one hundred thirty letters per minute, and that speed of writing may be stepped up a good deal without sacrificing a reasonable degree of legibility.

Groff (17) recently compared the speed norms developed by Ayres (where the subjects copied "familiar" sentences), with Groff's method where the subjects did not have a "set" for the sentences. A comparison of the speeds of handwriting in letters per minute of pupils by the two methods indicated lower grade-level expectancies in the speed of handwriting by the Groff approach than are the speed norms set by the older study. Groff contends that the more recent approach serves as a better indicator of speed of handwriting.

Groff (18) also investigated the matter of who writes faster—boys or girls, left-handed or right-handed children? Using a population of 4,834 fourth-, fifth-, and sixth-grade students in copying for two minutes the beginning passage of Lincoln's Gettysburg Address, his results showed that: (1) the girls wrote significantly more rapidly than the boys; and (2) the difference in speed of writing between the left-handed and right-handed writers was not significant.

There have been a number of studies which explored the notion of rhythm in handwriting. The evidence is unclear from the research as to precisely what part rhythm plays in the handwriting act. This is partly due to lack of an acceptable definition of rhythm. Drever's work (6) suggests that rhythms are absent from the child's early writing and makes their appearance at about the age of eleven; he confirmed that the rhythm in adults was extremely regular. West (40) and Nutt (30) both conducted studies that gave further indication that there was a rhythm in handwriting. Irish (28) selected rhythm as a problem for study and measured the

actual writing time of each letter, as well as the most frequently used letter combinations in order to discover whether a rhythm would emerge from this timing. Irish hypothesized that if handwriting is rhythmical then the time recorded for single letters would vary definitely from letter to letter in accordance with the length of the strokes, the direction of the strokes, and the number of the strokes. Irish concluded that since the time for writing any single letter is very close to the time for writing any other, the notion of a rhythmic pattern or timing in handwriting was not supported. The apparent discrepancy in whether there is a rhythm in writing and if so whether rhythm should be considered in instructional procedure is a problem that could benefit from further clarification and study.

Pressure Phenomenon

The pressure phenomenon in handwriting has not fared well as a subject for investigation. The difficult problem a researcher encounters when he attempts to measure or control the pressure points in the handwriting acts is due cause for this paucity of research. Actually two different approaches to the pressure phenomenon have been undertaken. One line of investigation is based upon the assumption that such data reflect certain aspects of the psychological functioning of the individual and hence are useful in personality analysis. This graphological emphasis has been much more popular in Europe than in the United States. However, Downey (5) and Pascal (31) have both contributed studies in the United States that attempt to relate particular pressure patterns to certain personality correlates.

More recently, the work of the Handwriting Institute, Inc., a privately supported research organization formed to investigate graphological and graphomotor variables, has been active in this field. From this Institute, Fluckiger *et al* (9) have completed a review of the experimental research in graphology from 1933 to 1960. From this review they make the following observations: (1) some of the best methods for measuring handwriting and testing graphological hypotheses are relatively new and remain to be exploited by those who do fundamental research in the field; (2) although rigorous methodology has begun to make clear-cut findings possible in this area, the relevance of the hypotheses typically chosen to be tested is still within range of graphological criticism. Where graphological theory makes its most sweeping commitments, it is least discreetly atomistic, dealing with variables which are combined, interdependent or qualitatively described. These are variables and hypotheses of handwriting theory which still await sophisticated research.

The handwriting pressure phenomenon has also been studied in relation to the educationally important task of producing legible and efficient handwriting. It has been pointed out that there are actually three different measures of pressure (26). One may note the pressure of the fingers on the barrel of the pen, the pressure of the pen upon the writing surface, and the attendant pressure of the hand resting upon the writing surface. Harris and Rarick (20, 21, 22) have been active in researching the point pressure upon the writing surface. Their findings (21) would seem to indicate that force variation was more closely related to legibility and speed in handwriting then was absolute point pressure. Another study (22) investigating the relationship of handwriting pressure and legibility in children reinforced their earlier findings. They concluded that if speed is increased, variability in application of force is likewise increased, motor set is disturbed, and the handwriting legibility is adversely affected.

Herrick and Otto's study (26) was concerned with the pressure exerted upon the barrel of the writing instrument. Making use of a specially designed grip pressure transducer pen, they were able to examine possible interrelationships between point and barrel pressure from a population drawn from grade four, grade six, and college. Their data seemed to show that high point pressure goes with high grip pressure and that low point pressure goes with low grip pressure.

Implications

The hand movement suggested by Callewaert has some very interesting research possibilities. Callewaert's work has been directed toward subjects suffering from the age-old student's disease, "writer's cramp." His "round" method suggested minimizing pressure, and could be researched in any laboratory equipped to assess the pressure exerted on the writing instrument. A prolonged writing period could test for consistency in the writing and fatigue factors which the "round" method attempts to ameliorate. It is conceivable that writing efficiency could better be maintained through a balance of the "round" method and the combination method suggested by Judd and Freeman.

Velocity is a factor that has not been given appropriate research attention. Handwriting legibility is a function of speed. Research has supported evidence that legibility deteriorates under extreme speeds, and yet many times the requirements of the task are for extreme speed. It would appear that one of the questions to be answered is to investigate at what point speed causes deterioration, and to examine the condition under which this deterioration takes place. Handwriting is a tool subject; it should be done as efficiently as possible.

It would seem from the studies of Harris and Rarick that handwriting practices which are adjusted to individual differences in motor control and which allow each child to develop his own optimum rate of writing and level of writing pressure should be encouraged. Conversely, those practices which initiate handwriting instruction regardless of coordination ability or emphasize drill on uniformity of pressure should not be fostered. Since a substantial body of research indicates that children's rate of motor development shows great individual differences, the practice of introducing children to handwriting instruction at a uniform age or grade level needs re-examination.

The Measurement of Quality in Handwriting

An estimation of handwriting quality requires both a definition and a standard of measurement of that quality. This problem of defining and measuring handwriting quality has been a primary concern of handwriting researchers for many years. Whereas earlier handwriting was valued for its beauty and esthetic qualities, more recently quality has been denoted by its legibility and readability.

Development of Handwriting Scales

With the intent of measuring quality, many instruments and devices have been produced by researchers interested in the field of handwriting. The Thorndike (37) handwriting scale was produced in 1910 and actually marked the beginning of the development of scales in America. The criterion used for judgment was "general merit"—this recognized the artistic quality of the writing in addition to clarity and uniformity of line.

Ayres (1) produced and published his first handwriting scale in 1912. He revised it in 1917 (Gettysburg edition), providing a convenient, useful reference based on

readability as the criterion rather than the "general merit" concept. Ayres contended that since handwriting is produced for others to read and understand what is written, the quality criterion should be *how quickly the specimen can be read.* Several of the commercial systems in handwriting today employ the Ayres scale in their respective programs of evaluation.

In 1915 Freeman (11) developed his first scale and recognized general excellence as a sum of five specific factors: letter form, uniformity of slant, uniformity of alignment of letters, quality of line, and spacing between letters and words. A revision (10) of this scale (1959) used general excellence as the criterion and did not consider the evaluation of specific factors, *i.e.*, "specimens selected should show a balance among all the elements of form, spacing, alignment, letter formation, and uniformity in size and slant."

The West scale (38) developed in 1956-57 included the criterion of speed along with the criterion of quality-legibility, indicating a direct relation between the two factors.

Recently there have been other attempts at scale development (2, 24). Bezzi (2) has developed a series of manuscript scales for grades one, two, and three. Sampling from one hundred thirty schools throughout the United States, 7,212 handwriting specimens were analyzed and judged in preparation for a five-step quality scale for each of the three grades. This is one of the few manuscript rating scales available.

Herrick (24) rejected the attempt to obtain a scale with five to seven levels of legibility with one sample representing each level. He proposed the development of a whole population of writing samples as a set of scaled items with known characteristics of legibility, size, and slant. This set would constitute a master scale defining a given continuum of writing quality. From this master scale any number of sub-scales could be drawn for a variety of evaluation and research purposes. From a handwriting population of 2,844 fourth-, fifth-, and sixth-grade students, six hundred samples were selected and rated for general readability by seventy-six judges. Each of the six hundred items were scaled by Attneave's method of graded dichotomies with a known legibility rating of from 1.0 to 5.0. Each sample was measured for size, 1.00 mm to 7.00 mm, and for slant, 20° to left of perpendicular to 40° to the right of perpendicular. This categorization of each sample by size, slant, and legibility rating permitted the development of a variety of scales utilizing various size, slant, and legibility combinations.

Reliability

The question of whether handwriting scales can increase reliability in the judgment of handwriting samples is one that has merited attention.

Evidence from at least three sources sheds some light on this question. Freeman (13) points out that even though two persons rating the same specimens of writing will not always agree in the quality values assigned, it has been shown that the use of an appropriate scale results in more reliable measures than teachers assign without a scale, and that training in the use of a scale increases the reliability of the scores.

Feldt's concern (8) was with establishing reliability between judges for a particular set of scales used in grades one and two. His findings suggested that reliability can be raised by analyzing the scores from several independent sessions and by providing additional training materials for teachers.

Rondinella's study (33), employing two hundred ten grade school teachers to rate handwriting samples of two hundred thirty-

nine fourth-, fifth-, and sixth-grade children, gave evidence that these teacher raters were subjective in rating the handwriting specimens and that many were unaware of the criteria shown on handwriting scales for the rating or grading of handwriting. These judges mentioned fourteen different characteristics for the handwriting specimens that accounted for their rating. Contrast this with the five suggested by Freeman or by the single notion of readability suggested by most of the scale developers.

Utilization of Scales

In the light of what has been said about the increased reliability of judgment when handwriting scales are used, it would seem important to investigate the present practice in making use of scales in the school program. Six hundred of the 6,639 county and independent urban systems were randomly selected for a survey of handwriting practices (25) in the United States. Of those systems answering the questionnaire, only one-third of the schools used some scale in evaluating children's writing. The Freeman scale is the one most commonly used, followed by scales developed by local school systems. The West and Ayres scales, with the ones mentioned above, account for ninety-five percent of the scales used in programs of handwriting instruction. The use of a scale to evaluate handwriting seems to be tied to the use of a corresponding commercial system.

Comparing Quality

The intent of handwriting measurement is to be able to differentiate the good from the not-so-good, and to permit an individual to be able to gauge his progress in the skill more efficiently than if he did not have a scale. Measurement also permits an analysis of how well one population fared using one method as contrasted to another population using another method. Measurement also permits asking the question as to whether handwriting is done better or poorer today than at succeeding times in our history. In an attempt to ascertain the difference in handwriting quality today and an earlier period, Erlebacher and Herrick (7) compared the quality of handwriting in 1959 with samples of script prevalent in 1912. Using Ayres' 1912 handwriting scale, the present day samples of handwriting were compared with those from the earlier era. Since students in the 1912 study were in the upper elementary school, samples of six hundred seventy-seven sixth-grade students were gathered in twenty Wisconsin schools for purposes of comparison. Erlebacher and Herrick concluded that: (1) there is a strong indication that the 1912 and 1959 samples did not differ meaningfully in median legibility; and (2) if the populations were representative, there is little reason to make the general claim that handwriting of today's children has deteriorated.

Implications

The criterion now considered most important in the estimation of handwriting quality is legibility, *i.e.*, the ease with which something can be read. In ascertaining the quality level of the specimens there is little emphasis on special form, style, or speed with which the specimen was written. It is interesting in the light of this to see authors of major summaries of handwriting research separated by two decades voice practically identical propositions.

Freeman (13) suggested in 1940,

> Statements are sometimes made as to the elements on which the scale is based, such as legibility, beauty, and character in the case of the Thorndike scale and legibility in the case of the Ayres scale. There is no evidence, however, as to what elements actually determine the judgments of persons who use the scales.

Harris (19), following up in a companion volume, stated in 1960:

> Although the development of handwriting scales necessitates attempts to define the characteristics of the qualities being measured, surprisingly little basic research has been done to rigorously define and analyze the qualities presumably being measured.

Quant's study (32) is one of the few research studies that attempts to single out and evaluate the various factors that might account for legibility. Legibility is not a unitary characteristic but is a composite of simpler elements, and it is an investigation of these simpler elements that holds promise of a more thorough understanding of legibility.

Of additional concern is the knowledge that evaluation can be improved by the use of handwriting scales and the accompanying evidence that very few teachers make use of scales. With few exceptions, programs of handwriting in the public schools have been designed to instruct but not to measure the growth of that instruction. Perhaps the fault lies in the scales. There is apparently little effort going into the development of better evaluation procedures in this field. Herrick's proposal for a scaling procedure that provides for a variety of scales utilizing various size, slant, and legibility combinations needs additional thoughtful consideration.

Bibliography

1. Ayers, Leonard P., *A Scale for Measuring the Quality of Handwriting of School Children*. New York: Russell Sage Foundation, 1912.
2. Bezzi, R., "A Standardized Manuscript Scale for Grades 1, 2, and 3." *Journal of Educational Research*, 55 (April, 1962), 339-40.
3. Callewaert, H., "For Easy and Legibile Handwriting," (V. Herrick, ed.), *New Horizons for Research in Handwriting*. Madison, Wisconsin: The University of Wisconsin Press (1963), Chapter 2.
4. Dougherty, Mary L., "History of the Teaching of Handwriting in America," *Elementary School Journal*, 18 (1917), 280-86.
5. Downey, June E., "Graphology and the Psychology of Handwriting," *Educational Psychological Monographs*, No. 24. Baltimore: Warwick and York, Inc., 1919.
6. Drever, James, "Experimental Study of the Mechanism of Writing," *Nature*, 95 (April, 1915).
7. Erlebacher, A. and V. Herrick, "Quality of Handwiting Today and Yesterday," *Elementary School Journal*, 62 (November, 1961), 89-93.
8. Feldt, Leonard S., "Reliability of Measures of Handwriting Quality," *Journal of Educational Psychology*, 53 (December, 1962), 288-92.
9. Fluckiger, F. A. and Georga H. Welnberg, "A Review of Experimental Research in Graphology, 1933-1960," *Perceptual and Motor Skills*, Monograph Supplement 1-V12, 1961.
10. Freeman, Frank N., "A New Handwriting Scale," *Elementary School Journal*, 59 (January, 1959), 218-21.
11. Freeman, Frank N., "An Analytical Scale for Judging Handwriting," *Elementary School Journal*, 15 (1915), 432-41.
12. Freeman, Frank N., "An Experimental Analysis of the Writing Movement," Psychological Monographs 17, No. 4 (1914), 1-46.
13. Freeman, Frank N., "Handwriting," in Walter S. Monroe (ed.), *Encyclopedia of Educational Research*. New York: Macmillan (1941), 555-61.
14. Freeman, Frank N., "The Handwriting Movement," *Supplementary Educational Monograph*, No. 9. University of Chicago (1918), 169.
15. Freeman, Frank N., "Teaching Handwriting," *What Research Says to the Teacher*, No. 4. NEA (1954), 33 pp.
16. Gates, Arthur I., "Relation of Quality and Speed of Performance: A Formula for Combining the Two in the Case of Handwriting," *Journal of Educational Psychology*, 15 (1924), 129-44.
17. Groff, Patrick J., "New Speeds of Handwriting," *Elementary English*, 38 (December, 1961), 564-5.
18. Groff, Patrick J., "Who Writes Faster?" *Education*, 83 (February, 1963), 367-69.
19. Harris, Theodore, "Handwriting" in Chester Harris (ed.) *Encyclopedia of Educational Research*, 3rd Edition. New York: Macmillan Co. (1960).
20. Harris, Theodore L. and G. Lawrence Rarick, "Psychological and Motor Correlates of Handwriting Legibility," *New Horizons for Research in Handwriting*, (V. Herrick, ed.). Madison, Wisconsin: The University of Wisconsin Press (1963), Chapter 3.
21. Harris, Theodore L. and G. Lawrence Rarick, "Problem of Pressure in Handwriting," *Journal of Experimental Education*, 26 (December, 1957), 151-78.

22. Harris, T. L. and G. L. Rarick, "Relationship Between Handwriting Pressure and Legibility of Handwriting in Children and Adolescents," *Journal of Experimental Education*, 28 (September, 1959), 65-84.
23. Herrick, Virgil E., *Handwriting and Related Factors 1890-1960*. Washington, D. C.: Handwriting Foundation.
24. Herrick, Virgil E. and A. Erlebacher, "The Evaluation of Legibility in Handwriting," *New Horizons for Research in Handwriting* (V. Herrick, ed.) Madison, Wisconsin: The University of Wisconsin Press, 1963, Chapter 8.
25. Herrick, Virgil E. and Nora Okada, "The Present Scene: Practices in the Teaching of Handwriting in the United States–1960," *New Horizons for Research in Handwriting* (V. Herrick, ed.). Madison, Wisconsin: The University of Wisconsin Press, 1963, Chapter 1.
26. Herrick, V. E. and W. Otto, "Pressure on Point and Barrel of a Writing Instrument," *Journal of Experimental Education*, 30 (December, 1961), 215-30.
27. Horn, Ernest, "Questions for Research on Handwriting," *Elementary School Journal*, 62 (March, 1962), 304-12.
28. Irish, Elizabeth H., "*The Principles of Time and Motion Applied to the Teaching of Handwriting*," unpublished Ph.D. dissertation, Stanford University, 1948.
29. Judd, C. H., *Genetic Psychology for Teachers*, Appleton (1911), 329 pp.
30. Nutt, H. W., "Rhythm in Handwriting," *Elementary School Journal*, 19 (March, 1919), 532-40.
31. Pascal, G. R., "Handwriting Pressure: Its Measurement and Significance," *Character and Personality*, 11 (1943), 234-54.
32. Quant, Leslie, "Factors Affecting the Legibility of Handwriting," *Journal of Experimental Education*, 14 (1946), 297-316.
33. Rondinella, Oreste, R., "An Evaluation of Subjectivity of Elementary School Teachers Grading Handwriting," *Elementary English*, 40 (May, 1963), 531-2.
34. Templin, Elaine, "*A Comparative Study of the Legibility of Handwriting of 454 Adults Trained in Three Handwriting Styles: All Cursive, All Manuscript, or Manuscript-Cursive*," unpublished doctoral dissertation, New York University, 1959.
35. Templin, E. M., "How Important Is Handwriting Today?" *Elementary School Journal*, 61 (December, 1960), 158-64.
36. Templin, E. M., "Research and Comment: Handwriting, the Neglected R," *Elementary English*, 37 (October, 1960), 386-9.
37. Thorndike, Edward L., "Handwriting," *Teachers College Rec.*, 11 (1910), 83-175.
38. West, Paul V., *American Handwriting Scale*. New York: A. N. Palmer Co., 1957.
39. West, Paul V., "Handwriting," in Walter S. Monroe (ed.), *Encyclopedia of Educational Research*, Rev. Ed. Macmillan (1950), 524-29.
40. West, Paul V., "The Relation of Rhythm to the Handwriting Movement," *Journal of Educational Psychology*, 13 (October, 1922), 438-44.

DAN W. ANDERSEN

Handwriting Research: Style and Practice

The Concern for Handwriting Style: Manuscript and Cursive

Freeman (23) has pointed out that the questions regarding style of writing categorize under two main issues: vertical *vs.* slanted writing, and manuscript *vs.* cursive. The issue concerning vertical writing has been pretty well settled in favor of writing with a moderate slant as the most widely approved style. That leaves the manuscript-cursive issue, about which opinion and practice is not nearly so unanimous. The presence of two different handwriting styles in the schools has been the subject of a great deal of interest and considerable research.

Current practices in teaching manuscript-cursive.

In two national surveys of handwriting practices, similar findings were reported. Freeman's (22) analysis of information from 727 schools representing forty-eight states indicated that manuscript writing was used in 84.3 percent of the schools with the style being limited mostly to the primary grades. By grade four, however, only 4.4 percent of those sampled were employing the manuscript style. Thus the transition from manuscript to cursive was fairly complete by the end of the third grade. Requesting that respondents to the survey indicate reasons for the practice of manuscript in the lower grades, they checked as advantages "ease of learning, aid to the learning of reading, and aid to spelling."

Polkinghorne's (53) national sample of laboratory schools, private schools, and public schools indicated that 66.4 percent of the sampled schools switch to cursive from manuscript in grade three or above. The survey further indicated that 17.6 percent of the schools used manuscript writing all through the grades—a fact not evidenced in the Freeman survey and a fact probably identified because of Polkinghorne's sampling in laboratory and private schools.

Herrick (35), reporting on national practices as of 1960, indicated that 79 percent of those surveyed taught both manuscript and cursive, while 14 percent taught only cursive and the remaining 7 percent taught only manuscript. His findings indicated that over 70 percent of the schools make the transition from manuscript to cursive somewhere between the last half of the second grade and the first half of the fourth grade.

Though showing minor differences, these surveys all attest to the predominant practice of manuscript use in the primary grades, then giving way to cursive instruction in the middle and upper grades.

The manuscript-cursive handwriting controversy.

Though manuscript writing is a relatively recent innovation [the advent of manuscript writing on the American scene dates

Dr. Andersen is an Assistant Professor of Education at the University of Wisconsin, Madison.
Elementary English, XXXXII (February 1965), 115-125.

only back to the 1920's, but its proponents trace its origin back to the 15th century scribes (8, 41, 70)] and predominantly practiced in the primary grades, its contribution to efficient and effective handwriting style has caused many to advocate its general use in the schools. The manuscript-cursive controversy for the most part has centered around the following factors: (1) legibility, (2) speed, and (3) ease of learning (34).

Legibility: Turner's study (64), employing judges who viewed mirror images of cursive and manuscript samples, concluded that because of independence of the letters, spacing of the words, and economy in line space, manuscript writing was significantly more legible than cursive writing. Freeman's data (19) suggest that manuscript's clearcut angular letter form in contrast to cursive's blending letter form into one another, made manuscript the more legible. Freeman points out, rather interestingly, that the use of vertical handwriting and later manuscript writing may have been brought about because of the fact that physicians and students of school hygiene brought evidence to support the contention that cursive writing caused eye strain.

Foster (18), in a study comparing the use by intermediate-grade children of manuscript and cursive writing, concludes from his data that (1) manuscript is only slightly more legible than is cursive, and (2) children who tend to write one style legibly also tend to write the other style legibly.

There are a number of researchers who have studied the possible effects of early manuscript training on later cursive writing and vice versa. In separate studies Goetsch (25) and Heese (30) both concluded that early manuscript training did not have any detrimental effects on later cursive writing. Heese's data suggested that pupils who were exposed to manuscript writing in the early grades actually demonstrated better cursive writing ability than those who never had manuscript training.

Speed: Though the argument of legibility seems to favor the manuscript style, the issue of speed is as yet unresolved. Showing a difference in adult writing between 2.14 letters per second for manuscript as compared to 2.59 letters per second for cursive, Gray (26) concluded that the differences favoring cursive are chiefly in the speed changes which take place within the writing and are largely due to differences in the form of the letters. He noted also that there is an increase in speed with age for the two types of writing but the increase is less in the case of manuscript writing than it is in the case of cursive. Gates and Brown (24), using a first-grade and sixth-grade population, showed faster writing for the manuscript group in the first grade and faster writing for the cursive group in the sixth grade. They further noted that in grades four through six, manuscript shows an advantage when high quality or legibility is required, whereas cursive writing is superior when the demand is for speed.

Conard and Offerman (9) suggested that the factor making manuscript writing slower was the number of pauses. They were able to show that increased speed in manuscript was accomplished by cutting down the time of pauses between strokes. Hildreth (38), studying the speed of joined and unjoined writing strokes, reported from the findings of an eighth-grade population that students copied the unjoined strokes faster than they copied the joined. She concluded that manuscript writing (unjoined strokes) can be as fast or faster than cursive (joined letter writing). Washburne and Morphett (67) suggest that Hildreth's findings would also be true for the older students. They conclude from

their findings that secondary school students can write faster with the manuscript style than with the cursive. Thus, on the basis of the cited research on comparative speed of the two handwriting styles, the results are inconclusive.

Ease of learning: Along with the factors of legibility and speed, an area of research has been devoted to investigating the ease with which the two handwriting styles may be learned, both physiologically and psychologically. Herrick (33) suggests that the straight line, the circle and spacing forms are more in line with the motor and eye-hand-arm coordinations of the young child than are the complex movements and formations of the cursive system. Freeman's (19) estimation of the two handwriting styles indicates that manuscript is easier to learn for early grade children because the letters are separate and thus the unit of movement is shorter. He reported (19) that supervisors of handwriting reacted more favorably toward manuscript because it was easier to learn and less fatiguing than cursive writing.

A study by Hildreth (39) was designed to look at the facility with which young children of kindergarten age (none of whom had received any formal writing practice) could copy manuscript and cursive form. In testing the children's facility with suitable materials in both styles of writing, it was found that the children copied six times more manuscript style *letters* correctly than cursive style letters. Ten times more manuscript style *words* were correctly copied than cursive style words.

Other research in the area of ease of learning bears on the relationship between the particular handwriting style and other subjects in the curriculum, mainly reading and spelling. Cutright (11), citing studies done in the primary grades, showed higher scores in the areas of reading, written expression, and spelling for manuscript writers. Voorhis (66) investigated first-grade classes grouped by manuscript and cursive style methods and found that the distribution of reading scores of pupils for each group pointed to a decided superiority of manuscript over cursive in its influence on beginning reading. Hildreth (40) in a recent report on early writing as an aid to reading pointed out the interrelationship of manuscript writing and beginning reading, suggesting that these two areas should not be separated but are in fact mutually reinforcing.

Two studies investigating the relationship of handwriting to spelling report similar findings. Varty (65), in comparing second- and third-grade pupils using manuscript and cursive methods, discovered the spelling achievement differences were so small as to offer little evidence in favor of either group. A recent study by Byers (3), in which she had each of the pupils in twenty-four third-grade classrooms write a paragraph using either the cursive or manuscript form, and then, after ten days, write the same paragraph using the alternate form, found that relatively the same total number of errors were made by the pupils in either form. She reported, however, that more letters were omitted, more substitutions made, and more words omitted when the cursive form of writing was used.

Manuscript-cursive transition.

Regardless of what research indicates as to the relative advantages of one style of handwriting over another, the predominant practice in the schools is to introduce manuscript in the primary grades, then (sometime between the second and fourth grade) move into the cursive style. As to when or how this transition should be made has been an interest of various researchers. Washburne and Morphett (67) suggest that when children try to change from

manuscript to cursive writing before they have become competent in manuscript, the cursive writing tends to be poor. They agree with the earlier studies of Goetsch (25) and Crider (10) that children can easily make the shift from either cursive to manuscript or vice versa. Conard and Offerman's study (9) was an attempt with an adult population to find out how quickly manuscript writing could be acquired without loss of speed and quality. They concluded that manuscript writing is a type of writing which can be acquired easily and quickly and that the learning of manuscript writing tends to improve the legibility of the original form of writing, when the original form of writing was cursive.

On the basis of handwriting specimens collected over a six year period, Arnold (1) concluded that the transition from manuscript to cursive should be effected in the fourth grade. She noted that "manuscript meets the needs of young primary pupils, but it becomes illegible when the children grow older and wish to write rapidly."

Templin (61) and Hildreth (42, 43) both refute the need for a transition. Hildreth (43) argues that the child is never ready to learn a new motor habit and that the change over from manuscript to cursive is both wasteful and unnecessary. Templin (61) in arguing for a single style of writing points out that:

> . . . such a duality of learning and performance is almost unknown in the areas of reading and arithmetic where the first learnings are simply reinforced and broadened through subsequent training rather than altered and changed as in this area.

Enstrom (12) also dislikes the manuscript-cursive transition period because he contends it only confuses the child. He argues, however, that the child should master and use both types of writing throughout life. He would teach manuscript in the first grade and start cursive mid-year in the second grade.

Groff's survey (27) of reasons for the manuscript-cursive transition presents some interesting data. After querying directors of elementary education in metropolitan areas, he concluded from these responses that the transition decisions are based mainly on tradition and wide usage--not on research findings. He believes that "despite the evidence of the advantages of this form of writing (manuscript)," there seems little likelihood that school systems will risk disturbing public opinion by switching away from cursive to manuscript.

Though the style of writing employed in the schools has been primarily a question between manuscript or cursive or some combination of these two styles, there have been suggestions and rationales for other styles; one of these is italic handwriting. Freeman (21) describes this form of writing as a slight modification of minuscule script, a style used for writing manuscripts before the age of printing. Freeman, in evaluating the italic style of handwriting, is cautious about accepting its claims and suggests that acceptance of this style of handwriting comes only after careful study and experimentation. Berry (2), in a study employing italic writing with students in grades one through eight, reported that papers improved in legibility and appearance using this method. She contends that italic writing is practical, sensible, and basic to both cursive and manuscript writing. The evidence on italic writing in this country is scant and will require the careful study and experimentation suggested by Freeman before its claims can be validated or disproven.

Implications.

It would appear from the evidence that if we question the presence of two different handwriting styles in the schools the bur-

den of proof lies with the cursive method. The proponents of the cursive method argue from an historical point of view, and on this basis their argument, that the cursive form of writing has been traditionally the socially acceptable form of handwriting, is sound. We must remember, however, that manuscript writing has only been practiced in the public schools for about three decades. Seldom has a curriculum method had such a meteoric rise. From no usage to practically universal usage (in the primary grades) in the short span of thirty years is practically an unheard of curricular application.

Most evidence would indicate that manuscript is more legible than cursive, that it can be written as fast or possibly faster than cursive, that it can be learned more easily by both children and adults than cursive. Then why the reticence in adopting the manuscript style? It would seem that an appropriate research question should be directed at examining the perceptions that go into the handwriting style. Have we made cursive the only "acceptable" style for the young adolescent and adult? Could Groff's notion on "disturbing public opinion" be examined to see what the public expectations are for the teaching of handwriting? With public consent, it is possible that a few rather comprehensive longitudinal studies could supply the evidence as to the merits of the manuscript style. For the most part the evidence now present is from a few, small population studies that are hardly generalizable. The concern should be for the acceptance of the most efficient method.

On the matter of transition, until better evidence is marshalled, the best time is probably determined by the nature of the instructional program, the convenience of teachers, the conviction of the teaching staff and community, as well as factors in the development and learning of children.

Instructional Practices in Handwriting

Surveys of practices.

In order to obtain accurate and valid data about the nature, scope, and success of handwriting instructional practices and programs, a number of surveys have been carried out. Studies have been at the city (57), county (59), state (51), and national (22, 35, 44, 53) level. Conclusions drawn from these surveys naturally reflect the sample used and the type of questions asked, but an analysis of these data permits a picture of the representative instructional practices in handwriting.

King's recent survey (44) of six hundred eighty school systems in four midwestern states showed that: (1) 70 percent of all surveyed had a formal handwriting program; (2) fourteen commercial handwriting systems are being used in these four states—two companies account for 89 percent of the total being used; (3) 59 percent of the respondents indicated a minimum of fifty minutes per week were used in formal handwriting instruction; (4) 9 percent of the school systems require some kind of handwriting training for elementary teachers.

Herrick's national survey (35) of handwriting practices reported in 1962 indicated that: (1) 98 percent of all teachers reporting stated that they do teach handwriting; (2) most schools teach handwriting five times a week in grades one through four and three times a week in grades five through eight with a fifteen- to twenty-minute class period as the favored time at all grade levels; (3) 79 percent of the schools teach both manuscript and cursive and of this number over 70 percent make the transition from manuscript to cursive

writing between the second half of the second grade and the first half of the third grade; (4) schools generally favor a separate handwriting class period in addition to teaching handwriting in some meaningful context in all subject matter areas.

Teaching techniques.

While a great deal has been written on the pedagogical techniques of handwriting, there has been relatively little actual experimentation on how children best learn handwriting. An early study by Hertzberg (37), in which he investigated the effectiveness of four different methods in teaching beginners to write, concluded that children improved most by the method of "direct learning by means of a model which the children attempt to copy." He demonstrated that "training in transparent paper tracing" and "groove tracing" showed no appreciable transfer to writing. Other studies have substantiated the advantage of copying over tracing in learning the handwriting symbols. Townsend's study (62) of the copying skill indicated that there is rapid improvement to about year seven and that thereafter the development continues irregularly and at a slower rate. An interesting finding of the study was that copying correlates more highly with mental age than with chronological age, raising a question concerning our present practice of starting all children in handwriting at the same time.

In a state survey of instructional practices (35), teachers were asked to respond in order of preference to those techniques most useful in teaching handwriting. The order of preference of teachers for the five large categories of devices and procedures were (1) copying, (2) exercises and drills, (3) tracing, (4) rhythm, (5) manual guidance.

As mentioned earlier, a good many published reports (4, 16, 23, 47, 52, 55) have indicated ways and means of teaching and improving legibility. For the most part, these reports are concerned with motivation, attention to accurate letter formation, emphasis on particular letters accounting for the most illegibility, and position of materials and position of the individual writer.

Two recent studies have focused upon the effects of early school handwriting instruction on later handwriting practice. Schell and Burns (56) investigated the handwriting samples of sixty-seven college seniors, all of whom had received elementary school handwriting instruction based upon the same commercial handwriting program. Variations between the uppercase cursive forms taught in the elementary school and those presently used in the college writing were analyzed. On the basis of their findings, noting certain deviant practices from early training, they proposed that certain forms of letters be simplified from the way they are ordinarily taught in the elementary schools and made to conform more closely to the forms actually used by adults in their everyday writing. Epstein *et al* (17), did a similar study in viewing the relationship of certain letter form variants taught in elementary grades to education, I.Q., and age of a female population. They conclude that:

> ... the female adult who continues to write in the fashion that would have pleased her elementary school teacher, is less likely to be as well educated, as bright, or as mature as the adult who has worked her way out of the school-copy rut and has evolved a more efficient and original way of writing.

These studies, though concerned with teaching practices in the elementary grades, seem more concerned with the particular letter models advocated in the elementary grades. Herrick's recent comparison (31, 36) of the letter form models advocated by commercial handwriting systems points

up that there is no commonly used cursive alphabet in the teaching of handwriting in the public school. Differences in the letter forms suggested by the nineteen companies are illustrated and analyzed in his report. Herrick's stated implication of these letter form differences is the need for additional research in the area. Also, the need for simplicity of letter form is sounded both by consumer and producer.

Provisions for individual differences.

That great individual differences exist in many aspects of writing is shown by a number of the studies that have been reported. Provisions for these differences are not so evident. In a recent national survey (35) which examined the extent to which a planned program for diagnosis and remediation of handwriting difficulties is conducted in the schools, only 7 percent of the respondents reported such programs. This would seem to be somewhat below the attention given to remedial programs conducted in other areas of the curriculum.

Early classical studies by Newland (48), Pressey and Pressey (54), and Lehmann and Pressey (46), pointed up two interesting notions: (1) an analysis of handwriting illegibilities would show that a few ill-formed letters (a, r, e, t) contribute to about 50 percent of all the illegibilities recorded at any grade level; and (2) by directing teaching effort to these specific faults of illegibility, both speed and quality of handwriting were definitely increased.

Cole's work (5, 6) in individualizing instruction for the correction of specific illegibilities demonstrated that the main cause of difficulty was due to illegibility of letter forms rather than factors of spacing, slant, or alignment. Utilizing techniques where pupils worked on only the letters that gave them trouble, she conducted two studies that argued strongly for the individualized technique.

There have been recent attempts to provide for individualized and group instruction in handwriting through different organizational arrangements in the classroom (13, 45). One of these plans (45) used a special teacher to present handwriting instruction to about one hundred fifty students at one time. This was followed by group sessions in which skills were developed by classroom teachers, and further followed up through individualized activities on the particular handwriting problems facing the children.

The one form of individual differences that naturally gets the most attention is left-handedness. The phenomenon of the left-handed writer and how to provide for him is still a question confronting handwriting researchers. Freeman's (20) analysis of the research available up to 1940 on the effects of requiring a left-handed child to write with his right hand indicated inconclusive findings. Trankell's (63) data showed that no significant difference was found between the quality of the handwriting of the consistent left-handed writers and the left-handers who consistently use the right hand for writing. On the basis of this evidence (if the concern is for legibility), it seems immaterial as to which hand a lefthander uses.

As to whether left or righthanders write best, Guilford (28), in a study of fifth and sixth graders, reported that right-handed writers matched with left-handed writers in respect to I.Q., age, grade, and sex were consistently better and faster writers.

Smith and Reed (58), using a population of seventy boys and seventy girls, age eight through fourteen, and about equally divided as to handedness, employed a simple repetition writing test and two other skill tests to compare the speed of left- and right-handed writers. While the results showed a tendency for the right-handed subjects to write more rapidly than

the left-handed, the difference was not statistically significant.

On the subject of the problems facing the left-handed writer, a number of people have written suggestions based on their analysis of the problem (7, 15, 23).

Enstrom's comprehensive study (14), based on an analysis of 1,103 left-handed writers in grades five through eight, concluded that rate and success in handwriting was more closely related to the technique used in writing with the left hand than to hand preference. He discussed and analyzed the various postural adjustments indicating a positive relationship between certain of these positions and rate and quality of handwriting. This study presents objective evidence on the nature of desirable positions for the left-handed writer and should have implications for the classroom teacher in making special provisions for the left-handed writer.

Handwriting instruments and materials.

As pointed out by Harris (29), investigations, other than survey studies, are relatively lacking in this area. Herrick's conclusion (35) from the national survey of handwriting practices suggested that the greatest single factor in determining the nature of the instructional program in handwriting in a given school is the commercial system of handwriting instruction being used. Eighty-two percent of all the school systems reporting indicated that they used a commercial system of handwriting as a basis for their program of handwriting instruction. The survey indicates that the three most commonly used resources for teachers are alphabet display cards, a handwriting book for each child, and a teacher's guide accompanying a commercial system. Noble (49) presents a survey of the commercial handwriting systems and discusses possible trends that may be forthcoming.

Along with handwriting materials, the subject of handwriting instruments has been looked at by certain researchers. Whittaker (68) and Otto (50) investigated the use of and preference for fountain pens over steel pens. A more recent study (32) indicated that fountain pens are still favored instruments in grades five through eight but give way to the popularity of the ball point as the most preferred instrument.

Wiles' study (69) indicated no evidence to support the use of the beginner's pencil instead of the adult pencil as an initial writing instrument for children. Herrick's report (32) confirmed Wiles' finding and pointed out that both children and adults preferred a round instrument; slightly less than a half an inch in diameter, a weight of approximately 18.5 grams, and the center of gravity between two to three inches from the writing tip; point of grip averaged 1.22 inches from point of instrument. There was little or no difference in preference of the writing instrument by sex.

Implications.

Much attention in instructional practices is given to correctness of letter formation, and yet it appears that few studies are concerned with the nature of the letter form which is most efficiently and legibly produced. Schell and Burns' study was one of the few directed to this problem. The solution of this problem will require not only the efforts of the classroom teacher but the producer of commercial handwriting materials as well. Herrick's comparison of letter form models advocated by commercial handwriting style point up the need to examine the possibility of agreement on the way letter forms should be made and the further need for simplified letter forms.

Evidence would seem to indicate that there is little being done in the individualization of handwriting instruction. Yet

those studies that have been concerned with examining the effects of individualized techniques show excellent results. The fact that only 7 percent of those schools surveyed indicated a planned program for diagnosis and remediation of handwriting difficulties raises some real questions. There is a need to consider the nature of the developmental and diagnostic help given children to improve their handwriting if a formal program of skill training desires to help children assume major responsibility for the maintenance and development of their own writing skills.

On the matter of handedness, Enstrom's conclusion that rate and success in handwriting is more closely related to the technique used in writing with the left hand than to hand preference suggests some long, hard looks at the kind of provisions —postural adjustment and instructional technique—we might make for the left-handed writer.

Our handwriting instruments are the product of manufacturing precision. Yet, few studies have been made regarding their design either from the point of view of the person using them or from the point of view of the writing task to be performed. Those studies concerned with instrumentation for the most part have been preference studies. It would seem important that, since the writing tool enhances the writing product, there should be concern for investigating what might be an optimum writing instrument.

Bibliography

1. Arnold, Esther Whitacre, "The Transfer from Manuscript to Cursive Writing," *Elementary School Journal*, 33 (April, 1933), 616-20.
2. Berry, Winifred, "Italic Writing," *Education Digest*, 26 (April, 1961) 50-1.
3. Byers, L., "Relationship of Manuscript and Cursive Handwriting to Accuracy in Spelling," *Journal of Educational Research*, 57 (October, 1963), 87-9.
4. Clark, E. C., "Legible Handwriting—Here's How," *Education*, 80 (March, 1960), 396-9.
5. Cole, Luella W., "A Successful Experiment in the Teaching of Handwriting by Analytic Methods," *Journal of Psychology*, 1 (1935-36), 209-22.
6. Cole, Luella W., "Developing and Appraising a Diagnostic System of Instruction in Handwriting," *Language Arts in the Elementary School*, 20th Yearbook, Department of Elementary School Principals. NEA (1941), 450-68.
7. Cole, Luella W., "Instruction in Penmanship for the Left-Handed Child," *Elementary School Journal*, 39 (February, 1939), 436-48.
8. Conard, Edith U., "The Growth of Manuscript Writing in the U. S.," *Childhood Education*, 11-12 (January, 1935), 170-4.
9. Conard, Edith U. and Elizabeth J. Offerman, "A Test of Speed and Quality in Manuscript Writing as Learned by Adults," *Teachers College Record*, 31 (1930), 449-67.
10. Crider, Blake, "The Adaptability of Pupils to Manuscript Writing," *Elementary School Journal*, 32 (April, 1932), 617-22.
11. Cutright, Prudence, "Script-Print and Beginning Reading and Spelling," *Elementary English*, 13 (1936), 139-41.
12. Enstrom, E. A., "After Manuscript Writing—When Shall We Begin Cursive?" *Elementary School Journal*, 61 (October, 1960), 24-7.
13. Enstrom, E. A., "Individualize Your Group Teaching of Handwriting," *Grade Teacher*, 79 (May, 1962), 48+.
14. Enstrom, E. A., "The Extent of the Use of the Left Hand in Handwriting and the Determination of the Relative Efficiency of the Various Hand-Wrist-Arm-Paper Adjustments," unpublished doctoral dissertation. University of Pittsburg, 1957.
15. Enstrom, E. A., "The Relative Efficiency of the Various Approaches to Writing with the Left Hand," *Journal of Educational Research*, 55(10) (August, 1962), 573-7.
16. Enstrom, E. A., "Teaching Legible Handwriting," *Education*, 84 (October, 1963), 114-5.
17. Epstein, L., H. Hartford, and I. Tumarkin, "The Relationship of Certain Letter Form Variants in the Handwriting of Female Subjects to Their Education, IQ and Age," *Journal of Experimental Education*, 29 (June, 1961), 385-92.
18. Foster, Emmet M., "A Comparison of Intermediate Grade Manuscript and Cursive Handwriting in Two Typical Elementary School Programs," unpublished doctoral dissertation. State University of Iowa, 1957.
19. Freeman, Frank N., "An Evaluation of Manuscript Writing," *Elementary School Journal*, 36 (February, 1936), 446-55.

20. Freeman, Frank N., "Handwriting," in Walter S. Monroe (ed.) *Encyclopedia of Educational Research*. New York: Macmillan, 1941, 555-61.
21. Freeman, Frank N., "On Italic Handwriting," *Elementary School Journal*, 60, (February, 1960), 258-64.
22. Freeman, Frank N., "Survey of Manuscript Writing in the Public Schools," *Elementary School Journal*, 46 (1946), 375-80.
23. Freeman, Frank N., "Teaching Handwriting," *What Research Says to the Teacher*, No. 4. NEA (1954), 33 pp.
24. Gates, Arthur I. and Helen Brown, "Experimental Comparisons of Print-Script and Cursive Writing," *Journal of Educational Research*, 20 (June, 1929), 1-14.
25. Goetsch, Walter R., "The Effect of Early Training in Handwriting on Later Writing and on Composition," unpublished masters thesis. University of Chicago, 1934.
26. Gray, William H., "Experimental Comparison of the Movements in Manuscript Writing and Cursive Writing," *Journal of Educational Psychology*, 21 (April, 1930), 259-72.
27. Groff, Patrick J., "From Manuscript to Cursive—Why?" *Elementary School Journal*, 61 (November 1960), 97-101.
28. Guilford, W. H., "Left-Handedness: Its Effect Upon the Quality and Speed of Writing of Pupils in the Fifth and Sixth Grades," unpublished masters thesis. College of Puget Sound, 1936.
29. Harris, Theodore, "Handwriting," in Chester Harris (ed.) *Encyclopedia of Educational Research*, 3rd Ed. New York: Macmillan, 1960.
30. Heese, J. DeVilliers, "The Use of Manuscript Writing in South African Schools," *Journal of Educational Research*, 40 (1946), 161-77.
31. Herrick, Virgil E., *Comparisons of Practices in Handwriting*. Madison, Wisconsin: University of Wisconsin, 1960.
32. Herrick, Virgil E., *The Design of Handwriting Instruments*, unpublished research report. University of Wisconsin, 1954.
33. Herrick, V. E., "Handwriting and Children's Writing," *Elementary English*, 37 (April, 1960), 248-58.
34. Herrick, V. E., "Manuscript and Cursive Writing," *Childhood Education*, 37 (February, 1961), 264-7.
35. Herrick, Virgil E. and Nora Okada, "The Present Scene: Practices in the Teaching of Handwriting in the United States—1960," *New Horizons for Research in Handwriting* (V. Herrick, ed.). Madison, Wisconsin: The University of Wisconsin Press (1963), chapter 1.
36. Herrick, Virgil E. and Wayne Otto, *Letter Form Models Advocated by Commercial Handwriting Systems*. Madison, Wisconsin: University of Wisconsin, 1961.
37. Hertzberg, O. E., "A Comparative Study of Different Methods Used in Teaching Beginners to Write," *Contributions to Education*, 214, Teachers College (1926), 61 pp.
38. Hildreth, Gertrude, "Comparative Speed of Joined and Unjoined Writing Strokes," *Journal of Educational Psychology*, 36 (1945), 91-102.
39. Hildreth, Gertrude, "Copying Manuscript and Cursive Writing," *Childhood Education*, 13 (November, 1936), 127-8.
40. Hildreth, G., "Early Writing as an Aid to Reading," *Elementary English*, 40 (January, 1963), 15-20.
41. Hildreth, G., "Manuscript Writing after 60 Years," *Elementary English*, 37 (January, 1960), 3-13.
42. Hildreth, Gertrude H., "Should Manuscript Writing Be Continued in the Upper Grades?" *Elementary School Journal*, 45 (October, 1944), 85-93.
43. Hildreth, G., "Simplified Handwriting for Today," *Journal of Education Research*, 56 (February, 1963), 330-3.
44. King, Fred M., "Handwriting Practices in Our Schools Today," *Elementary English*, 38 (November, 1961), 483-6.
45. Larison, J., "We Combined Group and Individual Instruction in Handwriting," *Instructor*, 73 (January, 1964), 31.
46. Lehman, Hilda and Luella C. Pressey, "The Effectiveness of Drill in Handwriting to Remove Specific Illegibilities," *School and Society*, 27 (1928), 548-8.
47. Miller, Ethel, "The S-Sense of Good Handwriting," *Grade Teacher*, 79 (February, 1962), 48.
48. Newland, T. Ernest, "An Analytical Study of the Development of Illegibilities in Handwriting from the Lower Grades to Adulthood," *Journal of Educational Research*, 26 (1932), 249-58.
49. Noble, J. Kendrick Jr., "Handwriting Programs in Today's Schools," *Elementary English*, 40 (May, 1963), 506-12+.
50. Otto, Henry J., "Use of Ink and Fountain Pens in the Elementary School," *Elementary School Journal*, 98 (March, 1948), 379-84.
51. Owen, Mary E., "Just Where Do We Stand in Handwriting?" *Instructor*, 63 (1954), 57.
52. Parke, M. P., "How to Teach Cursive Writing," *Grade Teacher*, 77 (February, 1960), 54+.
53. Polkinghorn, Ada R., "Current Practices in Teaching Handwriting," *Elementary School Journal*, 47 (1946), 218-24.
54. Pressey, Sidney L. and Luella C. Pressey, "Analysis of 3,000 Illegibilities in the Hand-

writing of Children and Adults," *Education Research Bulletin*, 6 (1927), 270-3, 5.
55. Rosenhaus, M., "You Can Teach Manuscript Writing with Six Rules," *Instructor*, 67 (September, 1957), 52-3.
56. Schell, L. M. and P. C. Burns, "Retention and Changes by College Students of Certain Upper-Case Cursive Letter Forms," *Elementary English*, 40 (May, 1963), 513-7.
57. Scott, W. E., "Handwriting in Philadelphia's Secondary Schools," *Education*, 80 (March, 1960), 993-5.
58. Smith, A. C. and G. F. Reed, "An Experimental Investigation of the Relative Speeds of Left-and-Right-Handed Writers," *Journal of Genetic Psychology*, 94 (March, 1959), 67-76.
59. Soltis, Rose Mary, "Handwriting—The Middle R," *Elementary English*, 40 (October, 1963), 605-7.
60. Templin, Elaine, "A Comparative Study of the Legibility of Handwriting of 454 Adults Trained in Three Handwriting Styles: All Cursive, All Manuscript, or Manuscript-Cursive," unpublished doctoral dissertation. New York University, 1959.
61. Templin, E. M., "Research and Comment: Handwriting, the Neglected R," *Elementary English*, 37 (October, 1960), 386-9.
62. Townsend, Edward A., "A Study of Copying Ability in Children," *Genetic Psychology Monographs*, 43 (1951), 3-51.
63. Trankell, Arne, "Influence of the Choice of Writing Hand on the Handwriting," *British Journal of Psychology*, 22 (June, 1956), 94-103.
64. Turner, Olive Grace, "The Comparative Legibility and Speed of Manuscript and Cursive Handwriting," *Elementary School Journal*, 30 (June, 1930), 780-6.
65. Varty, Jonathan W., *Manuscript Writing and Spelling Achievement*. Teachers College Contributions to Education No. 749. New York: Teachers College, Columbia University, 1938.
66. Voorhis, T. C., *The Relative Merits of Cursive and Manuscript Writing*. New York: Bureau of Publications, Teachers College, Columbia University, 1931.
67. Washburne, Carleton and Mable Vogel Morphett, "Manuscript Writing—Some Recent Investigations," *Elementary School Journal*, 37 (1937), 517-29.
68. Whittaker, Forrest Marion, "An Experimental Study of the Relative Efficiency of Steel Pens and Fountain Pens in Teaching Penmanship," unpublished masters thesis. University of Southern California, 1934.
69. Wiles, M. E., "Effect of Different Size of Tools on the Handwriting of Beginners," *Elementary School Journal*, 43 (1943), 412-3.
70. Wise, Marjorie, *On the Technique of Manuscript Writing*. New York: Charles Scribner's Sons, 1924.

RICHARD E. HODGES and
E. HUGH RUDORF

Searching Linguistics for Cues for the Teaching of Spelling

(The following article states the overall design for the research approach on spelling improvement reported in this series of five articles. The first article in this series by Hodges and Rudorf reports the research phases on phoneme-grapheme correspondences completed in December, 1964. Other phases of the overall research design herein discussed are underway or are being planned for extensive field testing.)

The relationship of linguistics to spelling instruction.

Linguistic approaches to spelling instruction can be traced back well over a quarter of a century (1); however, the general introduction of linguistic principles into the school spelling curriculum has not been widespread in the English-speaking world. Typically, the teaching of spelling has been predicated on the assumption that there is little relationship between the way words are said and how they are spelled so that each spelling word requires a separate act of learning. Consequently, lists of spelling words for class study have been selected largely on the basis of the utility of these words in children's and adults' writings (3, 11).

Statistical analysis of phoneme-grapheme correspondences, on the other hand, suggests a considerably different rationale for spelling instruction. An early research into the consistency with which the 3,000 most frequently used words in children's writing are spelled was initiated by Paul R. Hanna of Stanford University in 1950. This research revealed that the phonemes (sounds) of the 3,000 words are regularly represented by certain graphemes (letters) approximately 80 percent of the time (12). More recently, with the advent of computer technology, other investigators have attempted to analyze the orthography by linguistic techniques for their own particular purposes; and these studies, too, have indicated that large numbers of words have relatively consistent phoneme-grapheme (sound-to-letter) relationships (4, 8).

What are some of the linguistic assumptions which underlie these kinds of investigations, and what do these investigations imply for the teaching and learning of American-English spelling?

First of all, the American-English orthography is an *alphabetically* constructed sys-

Dr. Hodges is an Assistant Professor of Education in the Graduate School of Education at the University of Chicago. Dr. Rudorf is an Assistant Professor of Education at the University of Delaware, Newark.
Elementary English, XXXXII (May 1965), 527-533.

tem for the writing of spoken words. Many languages use this type of orthography in which each of the phonemes (sounds) of the spoken code has from one to several graphemes (letter symbols) which represent it when spoken words are encoded (translated) into written forms. Ideally, an alphabetic orthography would have one, and only one, grapheme to represent each phoneme. Thus, if a spoken language used forty different phonemes, the written code would also have exactly forty different graphemes. Some languages (*e.g.*, Hawaiian, Finnish, and Italian) come close to achieving this ideal. The American-English language, however, does not attain this criterion (10).* Through the processes of borrowing words (including their spellings) from other languages, through changes in the way sounds are pronounced without changing the way they are spelled, and through historical accidents of printers' preferences or dictionary-makers' errors, the orthography has acquired many more letter representations for phonemes than are necessary.

The problem of learning to spell in most spelling classes centers on the assumption that there are very few useful rules to determine which graphemes do in fact represent the sounds of spoken words. Thus, a child learning to spell cannot with certainty predict how a particular sound will be spelled when it occurs in a specific word; hence, he needs to be helped to learn the spellings of words largely by principles other than the basic principles of sound-to-letter correspondences (6).**

These assumptions have been widely held, largely because there was no massive evidence to support the contention that most American-English phonemes are spelled with reasonable consistency. The Hanna-Moore study of 3,000 words seemed too narrow a sample of the American-English lexicon (the total stock of words existing in the language) (7). Examining more closely additional thousands of words, it was suggested, would verify that the orthography was inconsistent to the point that the Hanna-Moore findings would be deemed unreliable. Other investigators offered findings which were disparate with the conclusions of Hanna and Moore. Bost, for example, applied Moore's phoneme data to 1,148 representative words from Books 3 and 6 of the Horn-Ashbaugh series and found lower percentages of consistency, *e.g.*, 45.7 percent for vowels and 35.7 percent for all phonemes (2).

A study of phonological relationships between sound and letter.

To clarify this and related issues, an intensive study was launched in 1962 at Stanford University of the relationships between phonemes and graphemes in over 17,000 different words (13). Under the direction of Hanna, and with the collaboration of the authors, this research sought not only to examine the degree of consistency of phoneme-grapheme relationships in these 17,000 words, but to analyze the structure of the American-English orthography in general. Using modern computer technology, it became possible to examine the structure of the orthography to a degree never before attempted nor possible

*For a further discussion of past and current efforts to revise the orthography so that there is a more consistent "fit" between the phonemes of speech and the graphemes of writing, see: Richard E. Hodges, "A Short History of Spelling Reform in the United States," *Phi Delta Kappan*, 7 (April, 1964), 330-332.

**See Jean S. and Paul R. Hanna, "Spelling as a School Subject: A Brief History," *The National Elementary Principal*, 38 (May, 1959), 8-23, for an elaboration of various ways in which weekly spelling lists have been developed in order to stress similarities among words other than phoneme-grapheme correspondences.

by the hand-analysis methods of previous studies of the orthography.

What kinds of insights into the American-English orthography were found? Most important, perhaps, it was demonstrated in Phase I (9)* that the orthography is actually a far more consistent reflection of spoken language than had been assumed, particularly when the several components of the phonology (sound system) underlying the orthography are examined. It is true that most phonemes have more than one way of being represented in writing. And it is equally true that, taking into account the way phonemes are spelled in large numbers of *different* words, it is difficult to sort out measures of consistency. But phonemes occupy *positions* in syllables and in monosyllabic words, and when phoneme-grapheme correspondences are tabulated in terms of their occurrences in these positions, a remarkable amount of consistency is found. Furthermore, when the amount of stress given to syllables in these 17,000 words is considered, even more consistency between phonemes and their graphemic representations is evident.

This statistical examination of the orthography, Phase I, does not necessarily presume that the results obtained are in themselves adequate to justify a firm claim for a linguistic approach to spelling instruction. In the first place, the fact that a phoneme is represented by a given grapheme over 80 percent of the time in some position in stressed and unstressed syllables does not tell how useful this information may be in the spelling of *words*. Secondly, increasingly restricting the tabulations of phoneme-grapheme correspondences to particular positions in stressed and unstressed syllables means that the obtained results are generalizable to fewer numbers of words.

Beyond these restrictions, the statistical examination made in the course of the study ascertained that the great majority of phonemes in spoken American-English are indeed consistently represented in writing when the main phonological factors underlying the orthography are taken into consideration: 1) position in syllables, 2) syllabic stress, and 3) internal constraints. In addition, this thorough analysis of the relationship between phonemes and graphemes indicates that other kinds of linguistic factors are determinants of the ways in which some words are spelled. And further, the evidence obtained from the Phase I investigation made it possible to design a second computer program which takes the findings of this first study and uses them to *predict* the spellings of some 17,000 different words.

Predicting the spelling of American-English words.

This second computer program, Phase II (14),** it should be emphasized, relies upon phonological factors alone for its spelling "rules." Three factors which determine the choice of a graphemic option are: 1) the simple phoneme-grapheme relationships, 2) the effect of position of a phoneme in a syllable, and 3) the effect of syllabic stress upon choice of graphemic option. A fourth phonological factor is utilized, a factor designated "internal constraints" or "environmental factors." For example, while the spelling of the phoneme /f/*** can be

*This dissertation, referred to in this article as Phase I, is the first of a series of studies to be completed as part of a continuing research project in spelling initiated at Stanford University; it will be available from USOE as part of the Project 1991 report.

**This dissertation, referred to in this article as Phase II, is the second of a series of studies to be completed as part of a continuing research project in spelling initiated at Stanford University; it will be available from USOE as part of the Project 1991 report.

*** // indicates a phoneme (sound); < > indicates a grapheme (letter).

predicted only some 74 percent of the time on the basis of the first three factors, it is seen from the data in the Hodges study that when this phoneme follows the phoneme /s/, it is *always* spelled <ph> rather than <f> (e.g., *sphere, sphinx*). Thus, the immediate environment of the phoneme limits the choice of graphemic options which may represent it.

An algorithm (a set of rules or symbols defining a process) was therefore developed which utilizes the data from the Hodges study and adds observable factors of internal constraints. For each phoneme a set of rules was constructed which indicated which spelling of that phoneme should be used under various conditions of position, stress, and environment.

The algorithm was then utilized to process the 17,000 words from their phonemicization to their graphemic representation. This processing was expected to show: 1) how many and which words in the corpus could be spelled accurately by the use of oral-aural cues alone; and 2) how many of the words could not be so spelled. Further, the program was constructed to list these words according to the number of spelling errors made and to identify the particular phonemes producing the misspellings.

What are some of the results obtained from this computer run? Of the total number of words, 8,346 (49 percent) were spelled correctly. An additional 6,332 (37.2 percent) of the words were spelled with only one error, 1,941 (11.4 percent) with two errors, and 390 (2.3 percent) with three or more errors.

Morphological and syntactical elements of spelling.

The power of the algorithm, and the phonological approach to spelling, is strengthened when the error list is examined. A glance at these words and types of errors involved indicates that many of these errors may not constitute a serious spelling problem. Many of them could be obviated with the mastery of simple morphological rules (morphology is the study of word formation—the combination of phonemes into meaningful units: roots, affixes, and inflection). For example, the factor of compounding in the formation of words obscures certain rules with regard to position. One rule which this study confirms states that when the long /a/ sound occurs in final position in a word, it is in almost all cases spelled <ay>. But in spelling the word *playground* on phonological cues alone, we obtained the spelling *plaground. Play,* however, was spelled correctly, as was *ground.* Because it can be assumed that a child who can spell both of these words can also spell the compound word *playground,* this type of error in the phonological spelling may be discounted. However, field tests of such assumptions which involve children have not yet been reported. Other morphological factors such as affixation and assimilation can also be taught as additional spelling cues which, when combined with a sense of the phonological base of the orthography, should help the child to spell correctly many hundreds, if not thousands, of the words contained in the printout of error lists.

One further morphological factor which may be utilized in producing correct spelling can also be identified from preliminary scanning of the error lists. Misspellings of certain phonemes can be seen which form a pattern, and these patterns can often be related to the origin of the root word. Families of words from French, Spanish, Italian, or Greek and Latin can be identified.

The teaching of etymology has been generally omitted in the elementary school spelling program. The research here re-

ported lends weight to the suggestion that it might well be a fruitful area of investigation. The evidence indicates that the bulk of the words in a typical elementary school program can be spelled on a phonological basis and a smaller, but still significant, number of words can be spelled correctly by combining phonological and morphological factors such as compounding and affixation. It seems a reasonable hypothesis that an analysis of the relatively few words remaining to be learned by reliance upon other cues might indicate that knowledge of a few important roots from various foreign languages could be a significant factor to enable the child to spell additional numbers of words. For example, a child who learns the spellings and meanings of *phono, photo,* and *graph* can spell additional numbers of words in which these root forms are included.

Finally, of course, as was expected, there does remain a residue of words that must simply be mastered by eye and hand learning methods. These words fall into two broad categories: 1) certain words, a limited number, whose graphemic correspondence to the phonemes is so irregular that they cannot be attacked by phonological or morphological means—words such as *one, acre, iron,* and some of the nautical terms like *forecastle;* and 2) the homonyms or homophones such as *bear* and *bare*. Quite obviously, there is nothing in either phonology or morphology which can help one to distinguish between the spellings of two different words with the same pronunciation. Here we must proceed to a third primary source of information, the syntactic or semantic level of language.

A model of American-English orthography.

Thus, out of this Stanford research project there begins to appear a basis for analyzing the structure of the orthography of the American-English language. We see how such a structure emerges on empirical grounds; it is also quite defensible upon a logical basis. Linguists have long emphasized the fact that what we refer to as a *language* is a system of *oral* symbols. Writing, the orthography, is a surrogate for the oral language; it is, in effect, a symbol for a symbol. Therefore, the structure of the oral language should be reflected in the orthography.

Linguists typically analyze the structure of language on three levels: phonology, morphology, and syntax. Thus, an orthography will reflect phonological, morphological, and syntactical components. The influence of each of these components will depend upon the nature of the written form of the language; that is, whether it is logographic (word) writing, syllabic (syllable) writing, or alphabetic (sound-to-letter) writing. A word-writing system (such as the Chinese) would depend primarily upon morphological and syntactical factors, while an alphabetic writing system would, by definition, be determined primarily at the phonological level. Thus, we can give a definitional model for the spelling of American-English: *The orthography of American-English is determined by a set of rules for unit phoneme-grapheme relationships based, with decreasing productivity, upon three levels of analysis—phonological, morphological, and syntactical.* The phonological level can be further divided into the components of position, stress, and environmental factors; the morphological level can be subdivided into components of compounding, affixation, and word families. This model may be summarized in tabular form as follows:

Phoneme-grapheme relationships determined by:

1. Phonological factors
   1.1 Position

1.2 Stress
1.3 Environmental factors
2. Morphological factors
2.1 Compounding
2.2 Affixation
2.3 Word families
3. Syntax

That the assumptions upon which this model is based are sound has been demonstrated by the Stanford spelling research project (13). Individual phoneme-grapheme relationships, though not in terms of whole *words*, can be predicted with an accuracy of 89.6 percent by use of the phonological cues contained in the algorithm. Equally interesting is the statistical evidence that eight phonemes (/â/ as in *care*, /ē/ as in *here*, /o͞o/ as in *food*, /o͝o/ as in *foot*, /û/ as in *urn*, /ə/ as in *circus*, syllabic /'n/ as in *button* and /z/ as in *zebra* can be identified, which cause a large majority of the spelling problems. When these are considered separately, the percentage of predictability of the remainder rises to over 91 percent. The implication of this for development of a spelling curriculum is obvious.

It must be emphasized that neither the definitional model nor the algorithm is intended to be solely prescriptive of a spelling curriculum. What has been demonstrated at this stage of the research is that the orthography reflects the structure of the oral language upon which it is based. It suggests that regularities exist in the relationship between phonological elements in the oral language and their graphemic representations in the orthography, and that a pedagogical method based upon oral-aural cues to spelling may well prove to be more efficient and powerful than present methods which rely primarily upon visual and hand learning approaches. The next stage of research is to compare the effect of a linguistic approach on learning to spell with other methods.

Summary and implications.

We have seen that by relying upon phonological cues alone we can spell over 8,300 words correctly from the research list of 17,000 words. Consider this in relation to the typical spelling program for the elementary school which contains in a series of textbooks from grade two through grade eight some 3,000 words which are in the main taught as separate learning acts.

Greene and Petty in the 1963 edition of their *Developing Language Skills in the Elementary School* state that "... the ability to spell one word is distinct from the ability to spell other words ..." (5). From these Stanford research studies, one evidently can hypothesize that even a limited knowledge of the phonological relationships between the sounds and the letters of the orthography can provide the power to spell literally thousands of words and that other abilities relating to morphology and syntax may give pupils the ability to spell the vast majority of the words in their oral vocabularies.

Much work yet needs to be done. The algorithm must be examined to determine how words should be selected to help the pupil to arrive inductively at the generalizations that would help him to translate oral cues into writing.

The error lists need to be examined to determine what morphological and morphophonemic factors can be utilized in a spelling curriculum to add to the pupil's ability to combine meaningful units into words for his writing needs.

Finally, the words which the pupil needs that depart markedly from the basic alphabetic nature of the orthography need to be identified and introduced into the curriculum at appropriate points with a heavy reliance upon visual and haptical learning techniques.

These new insights into the nature of the

American-English orthography are currently being matched by increasing insights into the nature of the language learning process. Developers of spelling programs will need to take into account the best available generalizations regarding both the content of the curriculum and appropriate instructional processes; that is, the selection of words which best exemplify the alphabetic principles underlying the orthography and methods of teaching-learning which most effectively help children to apply their learnings to their writings.

In addition, material changes in the conventional means of evaluating children's spelling abilities will undoubtedly need to be made, because both what is learned and how this learning is accomplished may be quite different in a linguistically-oriented spelling program.

Bibliography

1. Bloomfield, Leonard, *Language*. New York: Henry Holt and Co., 1933. 564 pp.
2. Bost, Theda, "An Application of Moore's Phoneme Data to the Spelling of 1,148 Words," unpublished study. Austin: The University of Texas, 1952 (unpaged).
3. Fitzgerald, James A., *A Basic Life Spelling Vocabulary*. Milwaukee: The Bruce Publishing Company, 1951. 161 pp.
4. Garvin, Paul L. and Edith C. Trager, "The Conversion of Phonetic into Orthographic English: A Machine Translation Approach to the Problem," *Phonetica* (to be published).
5. Greene, Harry A. and Walter T. Petty, *Developing Language Skills in the Elementary School*. Second edition. Boston: Allyn and Bacon, Inc., 1963. 572 pp.
6. Hanna, Jean S. and Paul R. Hanna, "Spelling as a School Subject: A Brief History," *The National Elementary Principal*, 38 (May, 1959), 8-23.
7. Hanna, Paul R. and James T. Moore, Jr., "Spelling – From Spoken Word to Written Symbol," *Elementary School Journal*, 53 (February, 1953), 329-37.
8. Higginbottom, Eleanor, "A Study of the Representations of English Vowel Phonemes in the Orthography," *Language and Speech*, 5 (1962), 67-117.
9. Hodges, Richard E., "An Analysis of the Phonological Structure of American-English Orthography," unpublished doctoral dissertation. Stanford, California: Stanford University, 1964. 625 pp.
10. _____, "A Short History of Spelling Reform in the United States," *Phi Delta Kappan*, 7 (April, 1964), 330-32.
11. Horn, Ernest, *A Basic Writing Vocabulary*. Iowa City: University of Iowa Monographs in Education, First Series, No. 4, 1926.
12. Moore, James T., Jr., "Phonetic Elements Appearing in a Three Thousand Word Spelling Vocabulary," unpublished doctoral dissertation. Stanford, California: Stanford University, 1951. 69 pp., plus appendices.
13. *Phoneme-Grapheme Relationships Basic to Cues for Improvement of Spelling*. USOE Cooperative Research Project No. 1991. Stanford, California: Stanford University (to be available from the United States Office of Education).
14. Rudorf, E. Hugh, "The Development of an Algorithm for American-English Spelling," unpublished doctoral dissertation. Stanford, California: Stanford University, 1964. 974 pp.

RICHARD E. HODGES

The Psychological Bases of Spelling

It was six men of Indostan
To learning much inclined,
Who went to see the Elephant
(Though all of them were blind),
That each by observation
Might satisfy his mind. . . . (13)

As John Godfrey Saxe's poem continues, it is learned that each of the six blind men arrived at different conclusions regarding what an elephant looked like as they touched different parts of the animal's body, associating that which they touched with some other object they had experienced.

So it was that one man touched the elephant's ear and concluded that the animal was "very like a fan." Another man touched the beast's tail and determined that an elephant was "very like a rope." The others, in turn, concluded that an elephant was similar to a wall, a spear, a snake, and a tree. Thus, in the end, these six men of Indostan:

. . . Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right,
And all were in the wrong! (13)

Saxe's poem appears to draw a moral which is analogous to the way in which spelling instruction typically has been devised.

Dr. Hodges is an Assistant Professor of Education at the University of Chicago.
Elementary English, XXXXII (October 1965), 629-635.

An effective program of spelling needs to consider three factors: 1) the subject matter involved; that is, the American-English language, how it is represented in writing, and the bases for selecting the words to be learned; 2) the nature of the learner; that is, how the child learns to spell; and 3) the kinds of instructional practices which can effectively help the pupil to acquire understandings of his language and to develop competencies in using it. The second of these three components—the nature of the learning process as it is related to spelling—will be examined although we shall look briefly at the other factors since all three are integrally related.

The American-English spelling system, the orthography, traditionally has been assumed to be so inconsistent that each spelling word to be learned requires in the main a separate learning act. Given a twenty-word list for a spelling lesson based upon this assumption, the child is required to perform twenty separate acts of memorization. In an effort to make the process of spelling less difficult, various attempts have been made to organize weekly spelling lessons around some pattern which would help the child remember his spelling words more easily and would motivate him to undertake the intellectual effort required to learn each word. Typical spelling programs of the recent past have been predicated upon several rationales, including:

(1) Grouping words according to their utility in children's writing.
(2) Grouping words around some central theme (*e.g.*, Colonial Life).
(3) Grouping words by their visual similarities (*e.g.*, *nation*, *function*, *invitation*).
(4) Grouping words around some spelling rule (*e.g.*, for words ending in *y*, change the *y* to *i* before adding suffixes or the *es* of plural forms).
(5) Simply grouping words largely at random (*e.g.*, *tree*, *fine*, *sick*) (6).

Despite such efforts to make spelling instruction more effective, these schemes still require children to study each word in spelling lists largely as individual acts of learning. Because any structural properties that words might have in common have not been widely utilized, the child must acquire as many visual memories as there are words in the spelling list and then practice writing these words to reinforce his haptical memory of them.

Consider, however, the pattern of spelling instruction which is based upon the fact that many American-English words *do* possess basic structural similarities. This instructional program assumes that the orthography is basically a written surrogate of spoken language, even though it is an imperfect reflection of all the components of the oral language system. In such a program, the task of learning to spell involves relating the structure of the written code to the structure of the oral code wherever these two structures match.

The structure of the American-English language and its relationships to spelling instruction.

The American-English language may be described as a coding system by means of which the members of our culture communicate with each other. In an advanced culture such as ours, this code has two parts: 1) a *phonemic* system (an arbitrarily selected set of speech sounds) which in certain sequential patterns comprises the oral language code; and 2) a *graphemic* system (an arbitrarily selected set of graphic symbols) which makes possible a visualization of oral language and comprises the written language code. A moment's reflection makes evident that the spoken language requires only that its users be adept in oral (speaking) and aural (listening) skills while the written code necessitates that its users be facile with aural-oral skills and with visual skills as well. Historically, and in terms of the processes of language learning, spoken language is primal to written language.

Further, oral and written language both require that their users possess two discrete though related abilities: (1) speakers and writers of American-English must be able to *encode* correctly; that is, they must be able to select the appropriate phonemes to produce intelligible speech or be able to select the appropriate graphemes to produce intelligible writing, and (2) they must be able to *decode* correctly the spoken and written messages of others if they are to get meaning from them.

These two distinctions are most important in considering how effective programs of spelling might be fashioned. *The act of spelling is one of encoding the phonemes of speech into the graphemes of the writing system.* Reading, on the other hand, is a task of *decoding*, of translating the written code back into its spoken form. The fact that traditional spelling programs have emphasized visual processes in learning to spell indicates that the encoding and decoding acts have not been fully understood by spelling curriculum specialists. When these two acts are kept distinct, it can be seen that aural-oral processes initiate the individual's act of spelling, with subsequent visual reinforcement of what is writ-

ten; visual processes initiate the act of reading, with subsequent aural-oral reinforcement. In short, spelling and reading are inversely related aspects of the complex process of human communication through language.

Because the oral code is primal to the written code, this system is learned first by users of American-English or any native language. Through a process of imitating older children and adult language models and habituating these learnings, young children normally have attained a functional understanding of oral language by the time they enter into formal schooling experiences (2). The fact that most children speak intelligibly and react to the speech of others is vivid testimony that the structure of oral language is at least intuitively known before formal educative experiences are undertaken.

What the child entering school does not possess, however, is the ability to make explicit his knowledge of the oral code; nor does he typically have much understanding of the written code. These learnings are the central purposes of formal language instruction and are attained through experiences with the oral code in *speaking and listening* and with the written code in *writing and reading*. Spelling instruction proceeds from speaking-listening experiences toward writing-reading experiences.

The structure of knowledge and its relationships to spelling instruction.

Because both oral and written American-English have basically similar structures, there is need to examine briefly the concept of "structure" and its relationship to spelling instruction. Actually, a description of the structure of any field of study is simply a description of a conceptual framework employed by scholars in the field which helps them to make meaningful the facts they find (14). It was in an effort to lay bare the structure of the American-English orthography in order to identify and relate its parts that the recent study of phoneme-grapheme relationships in some 17,000 different words was conducted at Stanford University (10).

The investigation determined that the structure of the American-English orthography closely approximates the structure of the oral code. Further, this study disclosed that, when phoneme-grapheme correspondences are examined in terms of each structural component of oral language, these correspondences appear much more consistent than had previously been thought. It is feasible to speculate that individuals who are proficient spellers intuitively recognize and apply these relationships in their spelling of many words, even though they have not formally been exposed to the structural relationships between the oral and written codes.

Helping children to discover the structural similarities of oral and written American-English takes advantage of the cognitive processes. Acquiring knowledge concerning the underlying principles of spoken and written language promotes the transfer of this knowledge to the spelling of many words. Consequently, remembering the way many words are spelled is enhanced because a knowledge of the relationships between oral and written American-English makes it easier to remember certain facts indicating how these relationships apply to the spelling of words.

The processes of cognition and their relationships to spelling instruction.

A useful way of describing intellectual activities is to assume that these activities are concerned with the *processing of information*. The information (stimuli) to be processed is initially gathered by the sen-

sory mechanisms. This information subsequently is stored within the human cortex, from which it is then selected and processed through a series of complex cognitive functions. The result of this processing is human behavior.

The act of spelling may also be described as one kind of information processing. Words to be spelled are assimilated through the sensory modes of hearing and vision, while the writing of them (the behavior which is sought) represents the results of many complex cognitive processes in which what the ears hear and the eyes see is reinforced by the haptical senses of touch and kinesthetics. Clearly, sensory and motor processes are a part of the act of spelling, but the intervening cognitive processes lie at the heart of effective spelling ability.

The role of the intervening cognitive processes has often been overlooked in efforts to develop spelling programs. Two lines of evidence indicate the importance of taking into account these intellectual processes in fashioning programs of spelling instruction: (1) neurophysiological research clarifies the structure of the human brain in which (2) basic psychological processes take place. Both fields of study—neurophysiology and psychology—clarify how information is processed within the human brain, a matter of fundamental concern to spelling instruction.

Neurophysiology and its relationships to spelling instruction.

Neurophysiological research indicates that human intellectual processes are basically series of *programs,* or plans of action, for responding to situations. These programs develop from the individual's interaction with his environment and are made up of those elements of the situation that are found to be important in guiding behavior when the individual must respond to subsequent situations of a similar nature (12). These experiences, assimilated through the sensory modes, are probably stored in the form of neural traces. Networks of neural "memories" develop and are further added to and modified by each subsequent situation which requires their use. This neural modification and adaptation is what, psychologically, would be called learning. The responses which the individual makes are overt testimony of the kinds of intellectual programs he has devised or learned.

How effective these programs or plans for behavior are in achieving satisfactory responses to situations is dependent upon two factors which have important consequences for spelling instruction. First, *multiple* sensory experiences in learning have the advantage of "triggering" appropriate responses to situations because they enable the individual to select various responses upon the basis of one or more sensory stimulations (5). Consequently, a child who has learned to spell a word by the use of the senses of hearing, sight, and touch is in a good position to recall the spelling of that word when he needs it in his writing because any or all the sensory modes can elicit his memory of it.

Second, the development of effective programs for processing information is more a matter of how *much* information is contained in each element of the program than in the number of elements which are contained in it (11). Thus, the content of spelling programs should include information regarding the basic structural principles underlying the orthography that apply to many words. Such principles, when *inductively learned,* enable the pupil to develop a relatively small set of effective strategies for spelling instead of having to develop nearly as many strategies as there are words to be learned.

These and other neurophysiological in-

sights into intellectual processes indicate that the process of spelling is very much an intellectual process. Consequently, at least in early stages of instruction, children need to be helped to make conscious use of sensory information in developing effective strategies for spelling, even though the ultimate aim of spelling instruction is to reduce the spelling process as much as possible to a reflexive sensori-motor form of behavior.

The means to this goal, however, involve among other things, the deliberate development of basic understandings of the structure of the American-English orthography and the ways in which the sensory modes contribute to spelling power. The pattern of spelling and writing is in the head and not in the hand. In order to accomplish the spelling act effectively, many basic concepts concerning the structure and function of the orthography must be available to the individual in order to guide his spelling and writing of words (9).

Psychology and its relationships to spelling instruction.

Evidence that intellectual activity is a form of information processing is also found in recent significant psychological researches which have important implications for spelling instruction. These studies indicate that effective learning is in large part dependent upon how adequately basic intellectual processes are structured (1).

Intellectual development requires continuous conceptual reorganization in which new information is related to concepts that already have been developed (3). How effectively individuals adapt their patterns of intellectual behavior in the light of additional information is a function of the degree to which they have learned systematically to solve various problems (4). Systematic orderings of information are, in short, *strategies for learning.*

Efficient learning strategies are workable rules for the processing of information (8). These strategies develop from: (1) contiguous experiences with similar kinds of information; (2) assimilating these experiences to form conceptualizations of the situation; (3) frequent opportunities to apply these conceptualizations to the solving of problems; and (4) opportunities to use them in a variety of learning situations (15).

Jean Piaget's basic studies of the development of children's intellectual abilities further indicate the significant role that multisensory learning plays in conceptual development (7). These investigations, which have considerable neurophysiological support, indicate that frequent and early multisensory experiences are necessary if subsequent intellectual abilities are to be developed.

Complex, abstract understandings require a great deal of previous concrete, multisensory learning. Similarly, in the development of children's spelling abilities, experiences should proceed from the concrete to the abstract—from initial multisensory experiences with the sounds, sights, and feeling of words as they are spoken and written, toward the development of conceptual strategies for the study and the writing of words.

Summary and implications.

Available evidence from linguistic studies of the orthography, from neurophysiological research, and from psychological investigations, suggests a rather drastic revision of current instructional practices in the teaching of spelling. Because there is ample linguistic evidence to support the position that oral language is primal to written language and that the written code is in large part a reflection of the oral

code, it becomes clear that aural-oral abilities have the highest priority in the spelling process. The development of these abilities suggests that initial spelling instruction might emphasize children's analysis of the written code in relation to their previously established phonemic habits. In accompaniment with the development of strategies of an aural-oral analysis of words to be spelled, there might also be developed important strategies in recognizing basic visual patterns among words so that children can recognize how words "look" after they have written them, as well as calling attention to the way these words "feel" as they are being written. In combination, these multisensory experiences establish a neural reservoir that permits the pupil to develop effective strategies for learning how to spell.

Furthermore, the lines of evidence that have been presented here suggest that the encoding process of spelling possibly can be learned more readily when children are given the opportunity to discover for themselves that basic structural properties underlie the spellings of many words. Further, children should be given numerous opportunities to apply this knowledge in their writing. The introduction of this kind of instructional program into the spelling curriculum should reduce considerably the necessity to treat each spelling word as a separate learning act in which "excessive overlearning" is required if the words that are learned by memorization are not soon to be forgotten. Obviously, these implications for the spelling curriculum and instruction are in need of extensive field testing.

Clearly, however, all children will not be able to take full advantage of multisensory experiences in learning to spell, particularly those children who are physiologically limited in one or more of the sensory mechanisms. These pupils need to be helped to develop strategies for spelling that are based upon those sensory modes which are readily available to them.

The oral foundation upon which the American-English orthography rests indicates the need for children to develop effective aural-oral abilities if they are to take advantage of the consistency with which the orthography approximates the oral code. Sequential training in helping children to listen for phonemes in relation to their placement in words, to the way in which they are enunciated, and to the basic regularity with which they are represented by graphemes in writing creates a basis for effective spelling power.

The spelling act is much like playing a game of golf. Both acts require the availability of certain basic equipment. For spelling, the individual needs the fundamental sensory modes of hearing, sight, and touch. For golf, the player needs woods, irons, and a putter.

Imagine, then, that a player sets out to play a round of golf having available to him only a putter for making all the shots he will have to attempt. It is unlikely that his final score will be the best that he might attain had he been able to use additional equipment designed expressly for accomplishing certain shots. Such a player is severely handicapped. In order to play the game of golf with proficiency, an individual should have access to many kinds of equipment and know how and when to use them. Furthermore, having a good understanding of the terrain of the course upon which he plays and knowing which clubs can best be used for such a terrain helps him to avoid unnecessary shots.

The act of spelling is similarly demanding of its "players." But the penalties for poor spelling are more severe than are those for poor golfing. Our culture places high value on proficient spelling ability. Yet, much spelling instruction has handi-

capped pupils by forcing them to "play the game" without helping them to develop skills in the use of all the sensory equipment available to them. In addition, children often have not been helped to map out the terrain of the orthography, its structure, so that they will know when to use sensory equipment most effectively. The act of spelling requires basic abilities and effective strategies.

Emerging insights into the learning processes generally, and into the spelling act particularly, in combination with available knowledge of the structure of the American-English orthography, indicate that fundamental revisions should be made and tested in both the content and the instructional practices of spelling programs.

Bibliography

1. Ausubel, David P., "Cognitive Structure and the Facilitation of Meaningful Verbal Learning," *Journal of Teacher Education*, 14 (June, 1963), 217-22.
2. Berko, Jean, "The Child's Learning of English Morphology," *Word*, 14 (August-December, 1958), 150-77.
3. Bruner, Jerome S., "Individual and Collective Problems in the Study of Thinking," *Fundamentals of Psychology: The Psychology of Thinking*. New York: New York Academy of Sciences, 91 (December 23, 1960), 22-37.
4. Bruner, Jerome S., Jacqueline J. Goodnow, and George A. Austin, *A Study of Thinking*. New York: John Wiley & Sons, Inc., 1956. 330 pp.
5. Bullock, Theodore H., "The Problem of Recognition in an Analyzer Made of Neurons," *Sensory Communication*, pp. 717-24. Walter A. Rosenblith (ed.). New York and Boston: John Wiley and Sons, Inc., and M. I. T. Press, 1961. 644 pp.
6. Hanna, Jean S. and Paul R. Hanna, "Spelling as a School Subject: A Brief History," *The National Elementary Principal*, 33 (May, 1959), 8-23.
7. Hunt, J. McV., *Intelligence and Experience*. New York: The Ronald Press, Co., 1961. 416 pp.
8. Miller, George A., "Information and Memory," *Contemporary Readings in General Psychology*, pp. 104-09. Robert S. Daniel (ed.). Boston: Houghton Mifflin Co., 1959. 383 pp.
9. Penfield, Wilder and Lamar Roberts, *Speech and Brain Mechanisms*. Princeton, New Jersey: Princeton University Press, 1959. 286 pp.
10. *Phoneme-Grapheme Relationships Basic to Cues for Improvement of Spelling*. USOE Cooperative Research Project No. 1991. Stanford, California: Stanford University (to be available from the United States Office of Education).
11. Pollack, Irwin, "Selected Developments in Psychophysic, with Implications for Sensory Organization," *Sensory Communication*, pp. 89-98. Walter A. Rosenblith (ed.). New York and Boston: John Wiley and Sons, Inc., and M. I. T. Press, 1961. 844 pp.
12. Pribram, Karl H., "Neurological Notes on the Art of Educating," *Theories of Learning and Instruction*, The Sixty-third Yearbook of the National Society for the Study of Education, pp. 78-110. Ernest R. Hilgard (ed.). Chicago: The University of Chicago Press, 1964. 430 pp.
13. Saxe, John Godfrey, "The Blind Men and the Elephant," *The Poems of John Godfrey Saxe*, p. 135. Boston: Houghton Mifflin and Co., 1884. 301 pp.
14. Schwab, Joseph J., "The Concept of the Structure of a Discipline," *The Educational Record*, (July, 1962), 197-205.
15. Vinacke, W. Edgar, *The Psychology of Thinking*, p. 45. New York: McGraw-Hill Book Co., Inc., 1952. 392 pp.

PAUL R. HANNA AND JEAN S. HANNA

Applications of Linguistics and Psychological Cues to the Spelling Course of Study

[Editor's Note: The following article states the overall design for the research approach on spelling improvement reported in this series of five articles on spelling. The first article in this series (Hodges and Rudorf) reported the research phases on phoneme-grapheme correspondences completed in December, 1964. Other phases of the overall research design herein discussed are either under way or are being planned for extensive field testing.]

The spelling program in schools is currently facing a transformation similar to course content improvement in the other strands of the curriculum. In mathematics, the sciences, the foreign languages, the social sciences and history, and in other aspects of the language arts program, there are powerful movements to root school content and instruction in the fertile soils of the scholarly disciplines in the humanities and the sciences. The several national task forces at work during this decade have already deeply affected the selection of content and the teaching-learning strategies in the pre-collegiate years.

Paul R. Hanna is the Lee L. Jacks Professor of Child Education at Stanford University. Mrs. Jean S. Hanna is a writer and a former teacher.
Elementary English, XXXXII (November 1965), 753-759.

Two important fields are furnishing most promising nutrients for this reform of the spelling program: (1) the discipline of linguistics; and (2) the medical sciences within which are a particular few fields of study that contribute to improved learning theory.

We propose to suggest how these two sources (linguistics and psychology) might furnish insights and cues for the teaching and learning of spelling, the application of which logically would contribute to reforms in the spelling course of study. This article will discuss five aspects of the spelling program:

- selecting the more fruitful spelling generalizations to be drawn from the structure and processes of linguistic studies;
- programing the spelling sequence from beginning primary through upper school grades;
- selecting words for spelling instruction;
- constructing teaching-learning strategies consistent with linguistic and psychological principles;
- mutually reinforcing the related but opposite skills of spelling and reading.

Selecting important spelling insights and cues from linguistics.

We believe the most important insight from linguistics is the fact that our American-English language is primarily an aural-oral system of communication. The child of beginning school age has previously mastered* a set of speech habits through which most of life's activities are conducted. The school should help the child discover the relative "simplicity" of our language's sound system (phonemes with which his spoken words are constructed).

Next, the pupil should be helped to discover that it is useful and possible to make graphic marks on paper (letters which we call graphemes) to represent each of the phonemes he hears and says—that it is desirable to *encode* what he says with combinations of graphemes (whole written words) so that he and/or others may later *decode* these marks and understand what the writer originally intended to convey. The pupil needs to develop the simple and elemental notion that the spoken language is basic and original; the written language, secondary and derived.

The modern spelling program thus builds on these two primal discoveries to be made by each pupil. But these insights are only the beginning. The pupil must go on to discover and generalize the more complex sets of phoneme-grapheme correspondences that are peculiar to our American-English language.

The problem for the curriculum maker is that of selecting from among the several hundred rules identified by Hodges and Rudorf those that are sufficiently important in spelling the corpus of the average individual's speaking vocabulary to warrant time and effort in the spelling program. The statistical evidence generated by the research undertaken at Stanford University gives us a priority ranking among those phonological generalizations of position and stress that will predict the spelling of phonemes at a level of about 84% accuracy. When environmental factors are added to those of phoneme position and stress, the accuracy increases by several percentage points to 89.6%.

We know further that 8 out of the 52 phonemes in the language, *according to the phonemicization used in the Stanford research project,* are those that cause a large majority of the problems in spelling and should therefore receive more teaching-learning time and attention than those that are relatively free of difficult choices among the graphemic options. When these 8 phonemes are considered separately in the statistical analysis, the percentage of predictability of the remaining 44 from phonological factors rises to over 91%. Thus are left 9% of the phoneme-grapheme correspondences in the selected vocabulary that remain spelling problems beyond analysis at the phonological level.

The reader is cautioned, however, from drawing a false conclusion that we contend that whole words can be spelled with a correspondingly high predictability.

Those relatively few words in the 17,000+ selected vocabulary of the project that have no phonological or morphological cues for spelling must be learned the hard way, from the first letter to the last, by drill, pure visual and haptical repetition, until the cell assemblies of the brain are well established.

What we are saying in essence is that

* It must be acknowledged that few if any children have "mastered" an acceptable aural-oral speech behavior if the standards of the cultured adult are the reference point. But few will deny that the basic habits of speech are present in the child beginning school. To the extent that speech patterns are subject to modification, the school has a continuing obligation to guide and encourage the child in improving his speaking skills.

there is now available statistical evidence of the predictability of the ways phonemes are spelled in standard American-English. This evidence now becomes an important guide to the choice of those principles that yield the greatest predictability and therefore are of greatest utility in the spelling program. Careful analysis of the structure of our orthography makes it possible and desirable to design a spelling program that will aid the pupil to examine these phoneme-to-grapheme correspondences and induce rules that will elevate the task of spelling to one of rational behavior in contrast to possibly less effective rote memorization.

Programing a spelling curriculum.

First grade is none too early to expect children to make initial examination of the code by which they carry on intercommunication. The average child enters first grade with an understanding and speaking vocabulary of from 5,000 to 10,000 words. If his communication were to be confined to aural-oral (listening-speaking), he would develop his communicative facility by imitating the speech he hears from his family and friends, his teachers, his peers, and the radio and television programs to which he listens.

But a literate person needs also to communicate by writing. Just as the infant's first speaking syllables are sounds most easily enunciated, so the first writing efforts should be based on those graphemes that most regularly represent the phonemes of his language. The first-grade spelling program ought, if the above speech phenomena are applied to writing, to start with a presentation of the beginning and ending consonant sounds, and the "short" vowel sounds, both regularly exemplified in appropriate monosyllabic words in his oral vocabulary. Communication *needs*, of course, do not always fit such patterns for determining the presentation of sounds. The pupil should also be taught to form carefully the upper and lower case alphabetical letters that represent the phonemes he is learning to identify in words.

Once a child has acquired a measure of confidence in his ability to select and write the appropriate grapheme for the sound he says and hears, he may be introduced to somewhat more challenging correspondences such as: (1) single sounds spelled with two different letters; (2) consonant beginning and ending blends; and (3) other correspondences of increasing complexity.

The second-grade spelling program ought to begin the presentation of the essence of a spelling curriculum: the discovery by the pupil of rules and generalizations which help explain both consistencies and peculiarities of phoneme-grapheme behavior as illustrated in various spellings of "long" vowel sounds; formation of plurals and third person singular; irregular spellings of "short" vowel sounds; and the beginning concept of syllabication. Further, the second-grade pupil should be introduced to the importance of alphabetical order and its value in relation to dictionary usage.

The spelling program in subsequent grades would continue to expand the pupil's knowledge of the orthography of his language and be concerned with increasing emphasis upon examination of factors that influence the correct choice of graphemic representation in increasingly complicated words. Both phonological and morphological bases for mastery of phoneme-grapheme correspondences will become part of his program of study as he becomes more sophisticated in his analysis of the relationships between spoken and written American-English.

The overall spelling program should pro-

vide material suitable for initiating pupil-discovery and application of important and helpful generalizations, and should offer suggestions to the teacher who has responsibility for guiding and encouraging the pupil in his efforts to build spelling power.

The instructional area most neglected in the spelling programs is that of *pupil-discovery* of the behavior of phoneme-grapheme correspondences in his language and the rules and generalizations upon which the orthography is based. The inductive approach should be given the importance it deserves, and the teacher, rather than initiating the rule or principle to be learned, should encourage the pupil to extract it from close examination of words which illustrate the generalization being presented in a particular lesson.

How should one plan a lesson to take full advantage of the best teaching-learning strategies? The lesson might be divided into five parts, as follows:

1. Introducing the particular phoneme-grapheme correspondence to be studied.
   a. Identifying a picture symbol of a word containing these correspondences.
   b. Listening to the sounds in the name of the picture symbol.
   c. Observing the graphemes used to represent those sounds.
2. Studying a list of words whose orthographic representations contain the correspondence being studied.
   a. Observing the regularities as well as the irregularities of the orthography in these words.
   b. Discovering a principle or generalization applicable to the correspondence being studied in the lesson (*e.g.*, when the long *a* sound comes last in a word, it is usually spelled *ay*).
3. Preliminary testing of the pupil's grasp of the principle being taught and his ability to apply it to a specific list of study words.
4. Enlarging and increasing the pupil's spelling vocabulary by means of enrichment exercises appropriate to the lesson.
5. Testing the pupil's mastery of both principles and word list presented in the lesson.

Selecting words for spelling instruction.

The selection of a vocabulary for a modern spelling curriculum should not be primarily a casual compilation of words considered important in children's writing, or a basal list drawn from adult usage. True, children must learn to spell the words they need to write, and there must be a selection of words which are appropriate representations of the particular phoneme-grapheme correspondences being taught in a lesson. But the spelling word vocabulary should *not* be considered the most important component of a spelling program. Arranging a predetermined basal list of words in phonemic-graphemic categories as an aid to building spelling power was an important initial step in modernizing the spelling program.

Where, then, does one start to build a modern spelling vocabulary? We ought to begin with a linguistic analysis of American-English, select those correspondences we wish to present for study, and then prepare a group of study words that illustrate the principle, generalization, or correspondences being taught. To select a list of "important" words first is to elevate the word list to a position of more importance than it deserves. While it is interesting and useful to know which words most children are likely to write in a given grade in school, we must beware lest such a list be responsible for limiting a child's spelling

vocabulary to those words children supposedly need to write. Spelling is not only a process of mastering the orthography of the spoken vocabulary a child possesses at a certain age; it is at the same time an exercise for continuously expanding both his speaking and his writing vocabularies. His "creativity" in composition should be in direct ratio to his command of a rich and (for him) mature vocabulary.

Today, thanks to the interest of linguists and to the research potentialities of computer technology, we are able to enlarge and deepen the scope of our spelling programs. We can expect children to be able to spell, in the elementary grades, a vocabulary of not 3,000 words but from 6,000 to 12,000 or more depending upon the size of his usable oral vocabulary. We anticipate that by building into the child the analytic power that comes from a knowledge of the structure of the American-English orthography, there will be almost no limit to the eventual size of his spelling vocabulary—except the size of his aural-oral vocabulary itself.

To attempt to accomplish such an ambitious program on the basis of "each word a separate learning," would be folly; relatively few people are likely to possess that kind of total visual and haptical recall. A truly effective and practical spelling program must make use of the resources of linguistic analysis made available by the latest research projects.

Constructing teaching-learning strategies.

Learning to write words correctly is a complicated operation that requires the use of three of the five senses: hearing, feeling, and seeing. These three senses, together with the act of speaking and the process of reasoning, constitute the resources by which one develops strategies of learning to enable him to communicate through the written word.

People do not all "learn" in precisely the same way. Some may be essentially visually minded, some haptically minded, and some aural-oral minded. But no one dominant sensorimotor accomplishment should exclude the use of the others. The visual approach reinforces the sense of hearing and is not only useful but even essential as an image-fixer of those correspondences whose behavior cannot be explained by any rule, generalization, or pattern. The haptical approach provides further reinforcement via the tactile (sense of touch) and kinesthetic (complete motor response in arm, hand, and fingers). The teacher should encourage the pupils to take full advantage of all the sensorimotor equipment they have available and bring it to bear on analysis and study of their spelling words. It is the programmer's responsibility to provide within the spelling lessons, materials and exercises which utilize the aural-oral, the visual, and the haptical approaches to spelling.

Equally important with and supportive of the neural-physical resources employed by the pupil to encode his language are the analytic processes by means of which he is able to discover characteristics of orthographic behavior. Both phonological factors (position, stress, environment) and morphological factors (compounding, affixations, and word "families") will become increasingly important in his study as the pupil matures and acquires greater sophistication in his attack upon spelling problems. The teacher must lead the child in a pattern of development which proceeds step by step from awareness of the sounds in the spoken word and their graphemic representation to the filling in of the interstices of the alphabetical system of orthography. The spelling programmers must build on and on until

the pupil has acquired sufficient command of the structure of his language to be able to continue on his own initiative.

A discussion of teaching-learning strategies is incomplete without some reference to regional dialects and their relation to spelling problems. American-English is a living, changing, and expanding communication medium, and we must face three facts: 1) there is no longer one single acceptable pronunciation for a given word; 2) the orthography very often does not conform to the speech habits of large numbers of cultivated people; and 3) there is little likelihood that American-English orthography will be altered to conform to each new change in pronunciation.

While the teacher has a responsibility to provide for his pupils a standard of acceptable pronunciation of a word, he does not have the prerogative of insisting that they change their (acceptable) pronunciation to conform to that which the teacher presumes to be standard in American-English.

The teacher ought to be aware that pronouncing words (for spelling purposes) as nearly as possible in conformity to the orthography may be a great aid to the pupil in his effort to relate phoneme to grapheme. But he will be fighting a losing battle if he attempts to insist that the pupil carry over his oral precision in *writing* words to *speaking* words.

The present-day tendency to slur and abbreviate oral language places an extra burden on the teacher to help the pupil differentiate between oral and written communication. Orthography is like the law of the land; as long as it exists, it must be observed. We can hardly teach or expect the pupil to write exactly what he says in such slovenly speech as: *Aintcha gonna eacher canny?*

Unless and until the orthography changes to correspond with changes in the sounds of the oral code, the teacher must help the pupils bridge the gap between oral and written speech, using whatever strategies are most effective.

Mutually reinforcing skills of spelling and reading.

Although it is generally assumed that good readers tend to be good spellers, the acts of reading and spelling have important differences that must be carefully considered in determining the best teaching approach to each. In unlocking a strange word in his reading, the reader does not ordinarily have to sound out the entire word or, perhaps, any portion of it. He can use the context of the sentence in which the word appears as a powerful clue to identifying the word. Frequently, the context plus a sound association for just the beginning letter or blend will suggest the word. Example: *I will p - - - - the chair red.*

Spelling, on the other hand, requires a thorough job of word analysis. The context in which a pupil wishes to write a word will give him little help with its spelling. He must write the correct letters to represent the sounds in the spoken word and he must write these in a left to right sequence that corresponds to the same sequence in which the phonemes in the spoken word are uttered. Spelling requires a considerable muscular response. A person spelling a word must write letters to stand for sounds which he hears in his mind. The good speller is one whose response mechanism to such mental sound stimuli has become almost an automatic one.

It is important to remember also that the act of spelling involves going from sound to letter (encoding), not from letter to sound (decoding) as in reading. In spelling, the child begins with sounds he hears and says. He translates these sounds into the letters he has learned are appropriate

graphemic representations. These letters, written in correct order, spell words that convey the writer's thoughts.

Once the child has acquired a measure of confidence in his ability to encode (spell) his language, the act of reading (decoding) should be far less mysterious, frustrating, and time consuming than it appears to be under current indefinite language arts programs. The normal progression from listening to reading would appear to be most productively achieved by pursuing the following course:

1. Becoming aware of the existence of sounds.
2. Imitating vocal sounds.
3. Recognizing sounds as basic components of words.
4. Combining sounds in recognizable words.
5. Discovering that letters may be used to record words.
6. Writing words he hears and says.
7. Reading words he and others have written.

Emphasis on step seven before a minimal mastery of or even an acquaintance with steps five and six would appear to the authors to be an unnecessary hardship in the child's effort to master all interrelated aspects of a complete communications system.

In summary

A modern spelling program is possible today as a result of new research into linguistics and into teaching-learning theories. Such a modern spelling program will 1) start from the child's possession of a large aural-oral vocabulary; 2) teach him how to break these words into component sounds; 3) lead him to discover the correspondences between the phonemes and the alphabetical letters that have come to represent these sounds in standard American-English spelling; 4) help him discover the influence that position, stress, and context have in the choice of a particular grapheme from among the several options; 5) guide him to go beyond the phonological analysis to examine the morphological elements such as compounding, affixation, or word families; 6) teach him how to use all his sensorimotor equipment of ear-voice-eye-hand to reinforce each other in fixing the standard spelling in his neural system; and 7) help him to build a spelling power that should make possible a writing vocabulary "unlimited" or limited only by the size of his spoken vocabulary.

E. Hugh Rudorf

Measurement of Spelling Ability

What is spelling ability?

In the final analysis, of course, spelling ability may be defined as the ability to spell those specific words needed for written communication. This definition has the advantage of simplicity, clarity, and economy, and illustrates the principle of writing needs. It suggests, however, nothing about what we can do to strengthen this ability nor does it say anything about what factors underlie the ability. We can, to be sure, using this definition, measure the present state of ability of a child to spell specific words. We can also use this definition as a criterion to measure growth in spelling ability: if a child upon his first testing can spell x number of words; and if, after a given period of study and/or instruction, he can then spell x + y number of words, we can assume an increase in spelling ability commensurate with y. But using only such a limited criterion we have no way of knowing what brought about this increase (or conceivably, decrease) of x; we have no way of determining whether y is adequate; nor can we make any predictions about possible future increase using similar or other methods. These questions offer fruitful fields for educational research. An examination of the literature suggests that the above definition of spelling ability underlies most, if not all, of the present standardized scales and achievement tests relating to spelling.

Were this article merely to review the tests and scales that exist for measuring spelling ability it would be a work of supererogation. This task has been admirably done by other authors in several sources: Horn's article on "Spelling" in the 1960 *Encyclopedia of Educational Research*[1] is an extremely thorough and detailed coverage of the field; Greene and Petty give an excellent summary of measurement of spelling ability in their textbook.[2] The reader may also refer to Buros' *Mental Measurements Yearbook*, both the fourth and fifth editions, where individual spelling tests and scales are described and reviewed. Of those listed therein, only the Lincoln Diagnostic Spelling Test and the Gates-Russell Spelling Diagnostic Test attempt to measure factors underlying spelling ability as discussed in this article. The limitations of these two tests are adequately discussed in this article.

It is suggested, however, that the existing tests and scales for measurement of spelling ability may not adequately reflect the newer insights from research in linguistics and from psychology that have been presented earlier in this bulletin. As a somewhat different point of departure, a new definition of spelling ability is proposed which re-

Dr. Rudorf is an Assistant Professor of Education at the University of Delaware, Newark.
Elementary English, XXXXII (December 1965) 889-894.

[1] Ernest Horn, "Spelling," *Encyclopedia of Educational Research*, Walter S. Monroe (ed.). New York: Macmillan, 1960, pp. 1247-1264.
[2] Harry A. Greene and Walter Petty, *Developing Language Skills in the Elementary School*. Boston: Allyn and Bacon, 1963.

quires an identification of the factors that underlie this ability and which is consonant with a new conception of the purposes of the spelling curriculum in the schools.

Why measure spelling ability?

Horn cites four functions of spelling tests:

> a) to show individual differences in spelling ability in the class and hence to enable the teacher to make proper adjustment to these differences; b) to show which words each pupil needs to study; c) to guide learning by depicting its successes and failures; and d) to show what progress has been made during a term or year.[3]

The *key* purpose seems to be the second mentioned above: that a spelling test should "show which words each pupil needs to study." This statement is typical of the usual approach to the spelling problem. Greene and Petty state explicitly that ". . . the ability to spell one word is distinct from the ability to spell others."[4] In other words, each word requires a separate learning act and the purpose of the spelling lesson is to present *words* (selected according to children's needs or interests) for memorization in a series of weekly lessons. Success of a particular week's lesson is determined by the children's demonstrated knowledge or ability to spell *those words* which they have been given to learn for that week. This rationale (widely held today) determines the content of the spelling curriculum, its methodology (the test-study method has been demonstrated by research to be most effective for memorizing a specific word list), and evaluation—according to the traditional approach.

But when Greene and Petty state that "the ability to spell one word is distinct from the ability to spell another" they certainly do not mean that the ability to spell *hate* is unrelated to the ability to spell *mate*. Or that the ability to spell *nation* is distinct from the ability to spell *national*. Or that learning to spell *photograph* provides no ability which can transfer to the spelling of *phonograph*. It would seem more reasonable that learning to spell each word in the foregoing examples may well require a different constellation of factors underlying spelling ability, but these constellations are certainly very closely related, and the term "distinct" used to describe them might be misleading.

The crucial problem then, in measurement of spelling ability, is the identification of the factors that underlie this ability. Horn recognized this in his article on "Spelling" in the 1950 edition of the *Encyclopedia of Educational Research* although this statement does not appear in the latest edition. In 1950 he made the perceptive remark that "It is now commonly recognized, however, that the measurement of spelling ability requires attention to the basic factors that determine this ability."

Factors underlying spelling ability.

Attempts to define the various factors underlying spelling ability date back at least half a century. One of the more recent (and one with the best research to substantiate it) is reported by Hunt, Hadsell, Hannum, and Johnson. They state:

> Previous workers in the field of spelling instruction seem to have identified four factors, besides general intelligence, that affect the ability to spell English words. These factors are:
>
> The ability to spell words that are phonetic
>
> The ability to spell words that involve roots, prefixes, suffixes, and the rules for combining them

[3] Horn, *op. cit.*
[4] Greene and Petty, *op. cit.*

> The ability to look at a word and reproduce it later, and
> The ability to spell the demons.[6]

Readers of the previous three sections of this series will recognize the relationship of these four factors to the linguistic data presented and to the statements concerning the psychology of spelling made by Hodges.

Linguistically, the first two of these factors represent the phonological and morphological components of the orthography that were identified in the Stanford research project and presented in the model for the orthography. The last ability relates somewhat imperfectly to the "word families" category and to the syntactic level of the model.

The third ability listed relates to the visual sensory input discussed by Hodges and later by the Hannas. The fact that Hunt, *et. al.* relegate this ability to third position in their hierarchy is consonant with the position taken by Hodges that while a multi-sensory approach is recommended, the aural-oral is primary in developing spelling ability.

Aaron has offered evidence to support the primacy of the phonological factors in learning to spell. He reports that

> The fact that spelling of phonetic syllables was the largest contributor to the estimate of the spelling of non-phonetic words as well as those which were phonetic indicates that phonetic skills may be important in the spelling of all types of words. . . . Another important predictor of spelling success was that of visual analysis of words. This latter test may be referred to as one of structural analysis.
>
> This study would lend support to those who favor a varied approach to the teaching of spelling.[4]

Holmes offers further evidence to support the importance of the aural-oral or phonological approach to the learning of spelling. He finds that

> Spelling ability at the high school and university level depends to a large extent upon ability to handle phonetic associations. For the educator, the inference would seem to be that training in at least the listed elements of auditory images might be a fruitful avenue by which to attack the problem of teaching spelling readiness, especially to remedial cases which have failed to learn by *the usual word-form method of teaching*.[5] (Italics added.)

Holmes offers as a hypothesis rising out of his study the suggestion that "auditory images play a greater role in determining spelling ability at the elementary school level than they do at either high school or university level."

David Russell, in an early study, found that

> On the pronunciation test a reliably higher percentage of the normal group were good at blending and analyzed words by syllables than did the retarded group. . . . Ability to blend word parts and to syllabicate seems to be positively associated with spelling.[6]

It is not intended to give the impression that the evidence is all one-sided in favor of phonological factors as the prime de-

[6]Barbara Hunt, Alice Hadsell, Jon Hannum, and Harry W. Johnson, "The Elements of Spelling Ability," *Elementary School Journal* 63 (March 1963) 342-349.

[4]I. E. Aaron, "The Relationship of Selected Measures to Spelling Achievement at the Fourth and Eighth Grade Levels," *Journal of Educational Research*, 53 (December, 1959), 138-143.

[5]Jack A. Holmes, "A Substrata Analysis of Spelling Ability for Elements of Auditory Images," *Journal of Experimental Education*, 22 (June, 1954), 329-349.

[6]David Russell, *Characteristics of Good and Poor Spellers*, p. 81. (Teachers College, Columbia University Contributions to Education, No. 727) New York: Bureau of Publications, TCCU, 1937.

terminants of spelling ability. Were this the case the traditional spelling curriculum would not have developed along the lines stressing the visual approach and would not be based upon the assumption that each word must be treated as a separate learning act. Nevertheless there is a growing body of evidence, as indicated by the authorities here cited, to support this newer position. The following appears to be a reasonable hypothesis and one that should be tested: if the phonological structure underlying the orthography were expressly taught in the schools (rather than ignored or relegated to a secondary position as in the traditional curriculum), these abilities might well be strengthened in elementary school children and research would then even more strongly identify these abilities as of paramount importance in learning to spell. With pupils who have been taught to spell by relying almost exclusively upon visual methods it should not be surprising that their ability to use aural-oral cues has not been developed significantly. Yet the studies cited above have identified phonological factors as important contributors to spelling ability.

Summary

We cannot, of course, measure directly the ability to spell; we can only observe and measure behavior and behavior change and from these observations infer ability to spell. For example, if one asks a child to spell a list of ten words and he spells seven of them according to the accepted spelling, we can say that he has the "ability" to spell 70 percent of those ten words. Giving him the same ten words one week later, we find perhaps that he can spell nine of them correctly. We can infer a 20 percent increase in ability to spell—*those ten words*. But we really don't know this. Perhaps his spelling is pure random. In some instances, results that we obtained in this particular case could occur by chance—the probability is slight, of course, but it is possible. It is not so improbable that the correct spelling of the two words that gave him the 20 percent increase in "ability" was the result of chance. If all that we measure is the objective product, the assumption that correct spelling is an indication or proof of ability to spell in any meaningful sense is just that —an assumption.

Let us, for a minute, consider an ideal language with an ideal alphabetical orthography: one grapheme (letter) to represent each phoneme (unit of sound). Imagine that there are 40 phonemes in the language and there are also 40 graphemes. Each grapheme represents one and only one phoneme. What, in such a language, would constitute ability to spell? Quite obviously, knowledge of the phoneme-grapheme correspondences would enable anyone to spell any word in that language which he could pronounce or which he had heard pronounced distinctly enough so that he could discriminate between the unit sounds or phonemes which made up the word. There would thus be two factors underlying spelling ability in our hypothetical language: auditory discrimination and knowledge of phoneme-grapheme correspondences.

American-English is not such an ideal alphabetical language. It *is*, however, an alphabetical language. The Stanford research project in spelling has presented statistical evidence that the unit phoneme-grapheme correspondences can be predicted upon phonological (sound) bases alone approximately 90 percent of the time. Using only phonological factors, a computer program was constructed which correctly spelled approximately 50 percent of a 17,000 word corpus and spelled an additional 36 percent with only one error. These phonological factors are, to be sure, more

complex than the simple phoneme-grapheme correspondences of our previous ideal language. The ability to use these factors to predict graphemic options 90 percent of the time would require that the individual have a knowledge of the phonemes and a variety of graphemic options for each phoneme; that he be able to recognize syllables in spoken words and the position of a phoneme in the syllable; that he be able to differentiate between stressed (accented) and unstressed (unaccented) syllables; and finally that he be able to predict the correct graphemic option for a given phoneme in some cases by understanding limitations imposed upon these options by the phoneme immediately preceding or immediately following. This may sound complex and rather formidable, but the extent to which these factors can be developed in children by specific instructional methods has been demonstrated to a point where we can proceed with a massive nationwide testing program. But all these factors are phonological; that is, they depend upon auditory stimuli alone.

The evidence by Aaron, Holmes, and Russell cited above, suggests that good spellers do *in fact* utilize many of these phonological cues in their spelling. It certainly seems worth the effort to see how many of the other cues that have been identified as bearing on correct phoneme-grapheme correspondences can be efficiently taught to school children.

Implications for measurement of spelling ability.

As suggested by Paul and Jean Hanna in the previous article, the implications of the data from the Stanford research project are such that the prime objective of a spelling curriculum is not the teaching of x number of specific words, but the teaching of the generalizations underlying the structure of the language and the relationship of this structure to the orthography. Quite obviously if this be the goal of the curriculum, then the abilities we are striving to develop are something more rational and advanced than "the ability to spell specific words."

Factors underlying spelling ability might well be classified under the model presented earlier: phonological factors, morphological factors, and syntactical factors.

Specifically, the abilities we would then be trying to develop (and consequently to measure and evaluate) would include:

1. The ability to discriminate between the phonemes of the language.
2. The ability to identify graphemic options of each of the phonemes.
3. The ability to identify syllables in oral speech.
4. The ability to recognize stress when present.
5. The ability to relate phonemes to their immediate environment.
6. The ability to recognize morphemes (meaningful units of phoneme combinations) such as roots, affixes, and inflections.
7. The ability to utilize certain principles of morphophonemics (how morphemes change in combination to form words; for example, the processes of assimilation and synthesis).
8. The ability to relate meaning (as determined by snytax) to spelling (the homonym problem).

Thus a program of spelling instruction such as that envisaged by the authors of this series of articles would require a redefinition of spelling ability, and a consequent redevelopment of the tests and scales by which we measure this ability and the factors underlying it and evaluate our progress in instruction. There would, of course, then be a need for testing various instructional approaches as to their effectiveness in developing factors that really

make a difference to spelling ability. Excellent beginnings in this area have been made by Hunt, *et. al.*[5] and the other researchers quoted in this manuscript. Much remains to be done, however, to develop adequate, easily used, and valid tests and scales to measure and evaluate spelling ability in a modern, linguistically-based, psychologically-sound spelling curriculum.

Bibliography

1. Aaron, I. E., "The Relationship of Selected Measures to Spelling Achievement at the Fourth and Eighth Grade Levels," *Journal of Educational Research*, 53 (December, 1959), 138-143.
2. Greene, Harry A. and Walter Petty, *Developing Language Skills in the Elementary School.*
3. Holmes, Jack A., "A Substrata Analysis of Spelling Ability for Elements of Auditory Images," *Journal of Experimental Education*, 22 (June, 1954), 329-349.
4. Horn, Ernest, "Spelling," *Encyclopedia of Educational Research*, Walter S. Monroe, (ed.). New York: Macmillan, 1960, pp. 1247-1264.
5. Hunt, Barbara, Alice Hadsell, Jon Hannum, and Harry W. Johnson. "The Elements of Spelling Ability," *Elementary School Journal*, 63 (March 1963), 342-349.
6. Russell, David, *Characteristics of Good and Poor Spellers.* Teachers College, Columbia University Contributions to Education, No. 727). New York: Bureau of Publications, TCCU, 1937.

[5] Loc. cit.

PAUL R. HANNA, JEAN S. HANNA, SIDNEY R. BERGQUIST,
RICHARD E. HODGES, AND E. HUGH RUDORF

Needed Research in Spelling

Early spelling research

During the past half century a great deal of human effort has been expended on research with the hope of improving the curriculum and instruction in the school subject of spelling. Some of the great names in American professional education—Thorndike, Horn, Gates, Dolch, Fitzgerald, McKee, Rinsland, Hildreth—have contributed to the theory and practice in the field of spelling. For their contributions the profession of education is indebted.

This earlier research, however, lacked access to three elements that distinguish today's spelling research: (1) the content and techniques of descriptive linguistics; (2) the benefits of computer-based data processing; and (3) the modern views of "structured learning."

During the first quarter of this century the field of descriptive linguistics was so undeveloped in this nation that it had little to offer to the school curriculum maker. In the second quarter of this century, the linguistics field grew enormously, but its impact on the school curriculum is only now beginning to be felt. Because of a lack of infusion of knowledge about the nature and linguistic structure of American-English into the spelling program, much of the research on spelling done during the first half century is incomplete insofar as linguistics is concerned.

Further, for almost the last fifty years, the leaders of educational research have had to tabulate their data largely by hand or with little more than a desk calculator to lighten the work. Today, the miracle of the electronic computer, coupled with the sophistication of a linguistically oriented programmer, makes possible studies that would have been highly impractical a decade ago. Where once a hand analysis of simple sound-to-letter correspondences in 3,000 words seemed a large task,[1] present-day computers, given a program and several hours of running time, can analyze an entire dictionary in many dimensions. As a result, we now are able to study in depth and in quantity the multiple relationships among structural properties underlying the orthography of our language.

Finally, beginning in the early 1940's, modern theories of learning stressed the importance of guiding the learner to "discover" the structure of a discipline. In spell-

Paul R. Hanna is the Lee Jacks Professor of Child Education at Stanford University; Mrs. Jean S. Hanna is a writer and former teacher; Richard E. Hodges is an Assistant Professor of Education at the University of Chicago; Sidney R. Bergquist is an Assistant Professor of Education at Northwestern University and E. Hugh Rudorf is an Assistant Professor of Education at the University of Delaware.
Elementary English, XXXXIII (January 1966), 60-66, 89.

[1] Paul R. Hanna and James T. Moore, Jr., "Spelling—From Spoken Word to Written Symbol," *Elementary School Journal*, 53 (May, 1959), 329-337.

ing this means assisting the pupil to grasp the rules and techniques by which the process of encoding (writing the letters that stand for the sounds of our spoken language) takes place. No longer need each spelling word be taught as a separate and independent learning act.[2] Current spelling theory suggests that once a child discovers the basic patterns of correspondence and linguistic principles for encoding his speech, he can learn to spell almost as many words as he uses in his spoken vocabulary.

Current spelling research

Today's approach to research in spelling thus has a new frame of reference (linguistics), has a new research tool (electronic data processing), and is predicated on a learning theory that utilizes the plans and structures of a discipline as significant components of teaching and learning in that discipline.

Several linguistics-based studies of elementary school language arts are under way with financial support from private foundations and from the federal government. One such study, sponsored by the Bureau of Cooperative Research of the USOE and carried out at Stanford University, has studied a sample of 17,000 words selected to represent a variety of American-English spelling patterns. The words were subjected to a computer-based analysis that accurately describes the phoneme-to-grapheme (sound-to-letter) matching under various conditions of (1) position, and (2) stress. The computations derived from this analysis showed that individual phonemes are represented by predictable grapheme options more than 80 percent of the time when these two conditions of position and stress were taken into account.

A second phase of the Stanford University project then directed a computer to spell from phonemic cues all 17,000 words in the selected sample on the basis of rules derived from the first analysis with the added factor of including the effects of surrounding phoneme-grapheme correspondences upon how particular phonemes are spelled in standard practice. The results: 89.6 percent of the individual phonemes in the sample were correctly spelled. However, only 49 percent of the words in the sample were correctly spelled.

On the basis of these studies, it is possible to conclude that the spelling of the phonemes of the American-English language is much more highly consistent than heretofore believed by spelling researchers. Furthermore, these results suggest that much of the spelling of American-English can be taught by developing the pupil's understanding of the structural principles underlying the orthography.

But these promising first steps in research toward improving the spelling curriculum also underscore the need for more knowledge about the orthography itself and how it is learned and used. The availability of new analytical tools has opened up new vistas for future research of these aspects of the curriculum. There is now occurring a change in emphasis from concern with spelling methods to investigations into the linguistic backgrounds of spelling content, with the result that spelling curriculum and instruction is moving toward a more solid theoretical base. In a like manner, contemporary theories emanating from research in neurology and psychology are beginning to give a better understanding of the structure and the processes of teaching-learning in spelling. This confrontation between scientific theory and educational practice can concurrently be found throughout the language arts field.

This linguistically based research to date

[2] Ruth G. Strickland, "The Contribution of Structural Linguistics to the Teaching of Reading, Writing, and Grammar in the Elementary School," *Bulletin of the School of Education, Indiana University*, 40 (January, 1964), 1-44.

is promising primarily in terms of the extent to which it has opened up such possibilities, although there are many shortcomings. To give some feeling for the range and nature of research that needs yet to be done, the remainder of this article will explore briefly some of the general concerns in each of four spelling areas: content, process, programs, and performance. Some of the unfilled research needs in each area will be pointed out.

The content of spelling: linguistic analysis

We do not maintain that the research described above is purely linguistic. Rather, we have adapted the concepts and categories on which linguistic research is based from the theories and studies of Greenberg,[3] Hall,[4] and many others. Moreover, the rigor and methodology of the science of linguistics suggest the patterns upon which further studies in spelling can be based.

The general movement of research in the content of spelling programs is an expansion of all basic linguistic investigations: selecting word samples, devising appropriate methodology, and extracting relevant generalizations. The word sample must be extended to validate previous findings and to come closer to the actual language (speech) behavior represented by the spelling act. Linguistic methodology should be extended to include concepts of word form, grammar, and history of language so that spellings of more words in the sample can be explained on linguistic grounds. Finally, the masses of data obtained to date must be brought together into a more productive set of linguistic generalizations and with more efficient means of demonstrating those generalizations.

[3]Joseph H. Greenberg, *Essays in Linguistics*. Chicago: The University of Chicago Press, 1957.
[4]Robert A. Hall, Jr., *Sound and Spelling in English*. Philadelphia: Chilton Co., 1961.

Some of the unfilled needs which suggest research in the area of spelling content follow:

Expansion of the sample

- From the linguist's point of view, a fuller description of spelling patterns would result from analyses based on different kinds of samples. For example, it could be argued that words selected from a dictionary list (representing a number of different words) presents a stylized view of the patterns while a sample based on running text (representing frequency of word usage) would be linguistically more accurate and exhaustive.
- The choice of phonemic code used in the Stanford project could be equated with other phonemic systems. Such a comparison might make the data available to larger numbers of researchers, particularly professional linguists who are interested in an analysis of American-English orthography.
- The phonemic system as it applies to spelling patterns should be the subject of cross-dialect studies to determine what differences in sound-to-letter correspondences are shown by social and geographical variations in speech, and if such variations affect spelling-learning.
- Recent Stanford spelling research is limited to an analysis of three phonological features and how they influence graphemic options. More extensive study of the phonological, morphological, and semantic influences on the patterns of American-English spelling needs to be undertaken.
- Additional studies are needed for determining the interrelationships among the above-named linguistic features and their relative effectiveness as predictors of standardized spellings.
- A particularly fruitful study would deal with the extended environments of sound-to-letter correspondences, categorizing

the types of phonemic and graphemic syllables in which given spelling correspondences occur.

- An analysis of the historical backgrounds of certain words might profitably be carried out. The purpose of such a study would be to describe the effects on American-English spelling patterns of (1) regular sound changes; (2) irregular sound and letter changes; (3) word borrowings (and their spellings); and (4) other historical features such as word coinages and folk etymologies.

Extension of linguistic generalizations

- The masses of data obtained from the Stanford University project and from other research proposed in this article should be brought together to form the bases for relevant linguistic generalizations about spelling. The generalizations thus produced could serve as guides to curriculum designers and teachers in their task of teaching pupils the patterns of American-English spelling.
- There is a particular need for a system of categorizing and indexing important linguistic information about spelling for each word in the lexicon. In this way comparisons and groupings of words may be made on the basis of a linguistic description of their spelling patterns.

Research needs from neurology and psychology

The data provided by the Stanford spelling research project have indicated important elements of current spelling programs, which are in need of substantial revision. Not only the content of spelling programs—the generalizations about the nature of phoneme-grapheme correspondences to be taught and learned and the order in which they are presented to pupils—but also the processes of learning to spell in light of revised content need further examination. The findings of basic research into the American-English orthography imply that curriculum planners need to concern themselves not only with *what* is to be taught but *how* it should be taught.

If the assumption is correct that spelling is a matter of *encoding* the sounds of spoken language into the graphic symbols of written language, then aural-oral cues to spelling are basic. Yet visual and haptical mechanisms are certainly involved in the act of encoding and in fact become dominant over the aural-oral approach when the word to be spelled has little identifiable relation to its phonological structure.

More fundamental, however, is the observation that many individuals are not able to use all the multisensory cues to spelling. This observation indicates the need for a substantial amount of seminal research into the neurological bases of learning in general and learning to spell in particular. Several such investigations are advisable:

Sensorimotor acuity

- Joint investigations by researchers in the medical sciences and in education are needed to determine the extent to which sensorimotor acuity is related to the ability to spell. Such studies would attempt to discover how deaf-mutes, aphasics, spastics, and the blind learn how to spell. Further studies should seek to determine the variations in multisensory "mixes" in individual children's spelling performance that are attributable to their sensorimotor acuity.
- A study of the variations in multisensory learning as related to spelling should investigate not only possible causes of poor spelling ability, including such factors as neurological and physiological limitations, but particularly earlier stimulus deprivation. Such research should also investigate the possible effects of preschool

training in multisensory experiences, on later spelling learning.

- In addition, important insights into the developmental stages of children's learning processes suggest that a careful study needs to be made of the relationship between language-learning development and the school program for the teaching-learning of spelling. This relationship should be made explicit in order to obviate the danger that spelling instruction will include teaching-learning strategies which are beyond or below neurological, physiological, and psychological capabilities of children at particular levels of maturation.

Learning strategies

- Studies of the correlations between findings concerning the structure of the American-English orthography and theories of the structure of learning might do much to assure that the design of spelling lessons agrees with the way pupils learn.
- Equally necessary are comparative studies of the relative merits of inductive and deductive methods for arriving at a knowledge of basic phoneme-grapheme generalizations needed to convert speech into writing. Such studies would help to determine the most efficient use of either method alone or both methods in alternation in spelling programs.

The spelling program: part of the language arts

There is no question that pupils will need directed study in a carefully designed spelling program. Nevertheless, spelling cannot be considered as a skill in isolation from the totality of language learning.

One way of viewing this skill is in relation to the four vocabularies employed by a literate adult for listening, speaking, writing, and reading. When the child enters school, however, he typically has only two of these: a listening (or understanding) vocabulary and a speaking vocabulary. The school's task is to build upon these two, and eventually place all four of the language arts skills at the child's command. From a linguistic point of view, spelling is the bridge between the speaking and the reading vocabularies, and it is on this basis that spelling relates to the language arts as a whole.

A general need for research in the spelling program, then, is one of correlation and consolidation. There is need for developing programs in spelling instruction that reflect the backgrounds of linguistics and learning theory. This, in turn, implies the need for teachers knowledgeable in linguistics and learning—theory and materials with which to focus, direct, and carry out the spelling programs. There is equally a need to develop inter-relationships among all the areas of the language arts. The more specific suggestions that follow stress both the development of spelling programs and the relationship of spelling to the larger framework of the language arts.

Relationships among the four language arts

- A study of the most appropriate place of spelling in the language arts curriculum is needed to indicate how this ability can be related theoretically and in practice to the skills of writing and reading as taught from structured, linguistic premises.
- The analysis of morphological influences on spelling patterns promises to be a useful approach to many words that display phonologically irregular spellings. An aid to the integration of the language arts program may be found in the comparison between these morphological influences on spelling and the larger area of morphological study called "grammar."

Encoding vs. decoding

- Spelling is an encoding process in the use of language, while reading is a decoding process. The two are interrelated, though not as inversions of each other. Two well-known linguists have already produced analyses of relatively small samples of American-English prose.[5,6] A study of comparable scope to the Stanford project, but on the basis of reading (grapheme-to-phoneme) relationships, is not yet available. Such a study might be particularly productive.

Teacher Preparation

- The keystone of any good school program is the teacher who has thorough control of his subject-matter and instructional techniques. Because a linguistically oriented spelling program suggests the advisability of some acquaintance with the formal discipline of linguistics, it is necessary to know through research what training and experience in this discipline will improve the performance of prospective and practicing teachers.

Program aids

- The rapid development of educational aids and materials of all kinds makes it desirable to study the effects on a modern spelling program of all possible combinations of textbooks, teaching machines, computer-based learning centers, audio-visual aids, teacher-prepared materials, and teacher-directed instruction.

Spelling performance: a guide for future development

Research in spelling performance has appeared in considerable quantity in the past, but as stated earlier, such studies lacked the information now available from recent research and developments that are linguistic, computational, and psychological in origin. As Carroll has indicated, earlier studies have overemphasized "the learning of visual, printed stimuli."[7] There is a need for basic information about spelling performance, both auditory *and* visual, so that methods may be compared and modifications proposed on a firm basis. The studies suggested below are, we believe, representative of the types of validation and even speculation that will develop from the current research at Stanford University.

Vocabulary measurement

- A spelling program stressing the linguistic principles that account for basic sound-to-spelling relationships depends upon well developed listening and speaking vocabularies of the primary school child. No accurate, exhaustive, and current descriptions of these two vocabularies for young children are available in published form. Proper design of modern spelling programs and indeed programs for all the language arts will depend more and more heavily upon such measurements.
- Research by Thomas Horn[8] and others indicates that the central core vocabulary of writers of American-English has remained quite constant over the past few years, despite the appearance of many new words in the language. A similar large scale study of the vocabulary needs of speakers is desirable so that the two vocabularies, *speaking* and *writing*, may

[5] Charles C. Fries, *Linguistics and Reading*. New York: Holt, Rinehart, and Winston, Inc., 1963. 265 pp.
[6] Charles F. Hockett, "Analysis of English Spelling. Part I; Analysis of Graphic Monosyllables." Ithaca, New York: Cornell University, Department of Modern Languages, Jan., 1960. (Mimeographed).
[7] John B. Carroll, "Linguistics and the Psychology of Language," *Review of Educational Research*, 34 (April, 1964) 119-124.
[8] Thomas D. Horn, "Extent and Mobility of Adult Writing Vocabularies," unpublished abstract of an address before the American Educational Research Association, Atlantic City, N. J., 1956.

be compared and their joint influence on spelling performance may be measured.

- Early research on word and sound frequencies by Godfrey Dewey[9] has indicated that 19 sounds and 700 words accounted for 75 percent of a 100,000-word sample of running speech. These sounds and words might be compared with the findings of the Stanford University project to determine whether the most consistently spelled sounds and words are also the most common ones.
- The current research in spelling at Stanford University was based upon a phonemic dialect characterized as middle class, "Mid-western American."[10] Accurate measurements of the effects of other dialect patterns upon the findings of the Stanford spelling research will indicate to what degree and in what manner a spelling program ought to reflect the social and geographical backgrounds of the pupils.

Comparison of methods

- A comparison between existing spelling error lists[11] and linguistically defined patterns in the orthography may indicate ways in which a linguistic orientation would be useful in improving spelling performance.
- An extensive, long-term trial of a linguistically-oriented spelling program in comparison with the traditional program is needed to provide a longitudinal assessment of the relative worth of each.
- Implied in the previous suggestions are numbers of other studies to be carried out separately or as part of a large-scale experiment. These would include (1) an evaluation of the effects of teaching the new approaches to spelling on performance in the other language arts, particularly on reading; (2) measuring the ability of pupils taught under linguistic approaches to spell traditional lists of "spelling demons"; and (3) a comparison of the types of errors pupils made when taught under new approaches and when taught by means of "standard" lists.

Reorganization of orthography

- Assuming that research into the patterns of American-English orthography produces workable generalizations for spelling much of the language, a study is needed to determine the best strategies for regularizing the spelling of the remainder of words so that imaginable devices such as the voice-typewriter may become practical realities.
- Another research effort might explore the possible pedagogical repercussions of a substantial commercial success for the voice-typewriter and other voice-response machines such as electronic computers. We might speculate particularly on how a wide use of such machines with modified spelling patterns would affect the "standard" spelling curriculum.

It is obvious that the possible research problems suggested encompass a wide spectrum of possible investigations. We have by no means exhausted the list nor have we tried to be detailed in what we have suggested. Our objectives in this article have been contrasts between most previous spelling research and a linguistic-based approach to spelling, and to outline the major areas of promising research in (1) the linguistic descriptions of the orthography, (2) the neurological and psychological foundations of human learning, (3) the

[9] Godfrey Dewey, *Relative Frequency of English Speech Sounds*. Cambridge: Harvard University Press, 1923, p. 133.

[10] John S. Kenyon, "A Guide to Pronunciation," *Webster's New International Dictionary of the English Language*. Second Edition. Pp. xxii-lxxx. New York: G. and C. Merriam Co., 1960.

[11] Arthur Gates, *A List of Spelling Difficulties in 3816 Words*. New York: Teachers College, Columbia University, 1937.

spelling program in relation to the more inclusive language arts curriculum, and (4) the measurement and evaluation of the new approaches to spelling which the Stanford research suggests. And finally, we suggest the possibility of studies and analyses of the American-English orthography that might spark new interest in spelling reform.

Bibliography

1. Carroll, John B., "Linguistics and the Psychology of Language," *Review of Educational Research*, 34 (April, 1964) 119-24.
2. Dewey, Godfrey, *Relative Frequency of English Speech Sounds*. Cambridge: Harvard University Press, 1923.
3. Fries, Charles C., *Linguistics and Reading*. New York: Holt, Rinehart, and Winston, Inc., 1963.
4. Gates, Arthur, *A List of Spelling Difficulties in 3876 Words*. New York: Teachers College, Columbia University, 1937.
5. Greenberg, Joseph H., *Essays in Linguistics*. Chicago: The University of Chicago Press, 1957.
6. Hall, Robert A., Jr., *Sound and Spelling in English*. Philadelphia: Chilton Co., 1961.
7. Hanna, Paul R. and James T. Moore, Jr., "Spelling—From Spoken Word to Written Symbol," *Elementary School Journal*, 53 (May, 1959) 329-37.
8. Hockett, Charles F., "Analysis of English Spelling. Part I: Analysis of Graphic Monosyllables." Ithaca, New York: Cornell University, Department of Modern Languages, Jan., 1960. (Mimeographed).
9. Horn, Thomas D., "Extent and Mobility of Adult Writing Vocabularies," unpublished abstract of an address before the American Educational Research Association, Atlantic City, N. J., 1956.
10. Kenyon, John S., "A Guide to Pronunciation," *Webster's New International Dictionary of the English Language*, Second edition, pp. xxii-lxxx. New York: G. and C. Merriam Co., 1960.
11. Strickland, Ruth G., "The Contribution of Structural Linguistics to the Teaching of Reading, Writing, and Grammar in the Elementary School," *Bulletin of the School of Education, Indiana University*, 40 (Jan., 1964) 1-44.

ALBERT H. YEE

The Generalization Controversy on Spelling Instruction

An enduring and sometimes confusing controversy involving leading authorities in spelling continues today. Most school leaders and teachers have been unaware of this prolonged debate and do not realize that the issues of concern involve them most significantly. Elementary school teachers and their classes have been involved in the debate insofar as their choice and use of spellers and particular methods of instruction may be concerned. The purpose of this article is to clarify conflicting points of view and offer a critique of the problem.

Very simply, the debate centers on the question of whether competency in spelling can be obtained through a general use of spelling generalizations (rules) or not. Some authorities say that English-American language spelling forms are highly irregular and offer learners and their teachers only a confusing and contradictory mass resistant to any broad systematized set of spelling rules. For example, Horn (22) wrote: "The sound of long *a* (a) . . . was found 1,237 times, with 601 exceptions to the commonest spelling; the sound of *k* was found 2,613 times, with 932 exceptions; and the sound of *s* in *sick*, 3,846 times, with 1,278 exceptions. One is hardly justified in calling spellings 'regular' or in teaching the commonest spellings as principles or generalizations when the exceptions are numbered not merely by the score but by hundreds." Therefore, spelling instruction by this point of view becomes a gradual accumulation of necessary and practiced words, including the introduction of generalizations whenever warranted by applied research evidence.

The contrasting point of view by other authorities argues that there is greater phonetic regularity or sound-to-letter relationship in spelling than opponents claim and that spelling would become more efficient and easier by learning spelling rules to generate effective spelling ability. For example, according to Rudolf Flesch (7) in his well-known publication of 1955, *Why Johnny Can't Read*, "About 13 percent of all English words are partly irregular in their spelling. The other 87 percent follow fixed rules." Hanna and Moore (17) wrote, "Words learned in splendid isolation are likely to remain in isolation with no relation to words of similar sound and construction . . . children should learn early the techniques which will enable them to proceed successfully in making letter-sound relationships." In describing how various approaches to spelling should be balanced in a modern spelling program, Hanna and Hanna (15) wrote:

> A phonetic analysis of words and an inductive study of the letter symbols used to spell the sounds in words *provide a firm base for the spelling program* [italics the writer's]. This new approach, coupled with a word-study plan which uses the visual and

Dr. Yee is an Assistant Professor of Curriculum and Instruction in the School of Education at the University of Texas, Austin. This is the ninth in a series of articles dealing with spelling and handwriting which will be published jointly as a bulletin by the National Conference on Research in English and the National Council of Teachers of English. *Elementary English*, XXXXIII (February 1966), 154-161.

the hand-learning for reinforcement, gives us hope of a day when all our pupils can spell correctly the words they need to write.

We will now review research findings and conclusions for both sides of the debate.

None or Limited Teaching of Spelling Rules

One question in the debate has dealt with the ability of learners to apply spelling rules to their general spelling requirements. In 1912, Cook (6) found that out of seven spelling rules learned earlier by college and high school students, only one rule was of real value. That rule states that words ending in *ie*, such as *lie*, change the *ie* to *y* before adding the suffix *ing*. Also in 1912, Turner (37) reported that results with a group of 16 pupils taught by the method of direct drill without reference to spelling rules were superior to results obtained from another group of 16 pupils taught with reference to spelling rules. The two groups were matched prior to the study of spelling rules.

In 1930, Archer (3) reported negative transfer operating in pupils' (5th and 7th grades) spelling of certain words; his findings showed that children generalized from experience with one type of words and misapplied the generalization to other words. Archer, therefore, concluded a rule must be justified on its lack of ambiguity in application.

In 1931, Sartorius (35) concluded from her study of generalization in spelling that "rules should be treated with caution until experimental evidence concerning their functional value is secured." In 1932, King (29) reported that the teaching of spelling rules appeared to be impractical, considering unsatisfactory results in a study where a limited set of spelling rules were taught. King concluded that it would be very hard for children to learn to apply the many complicated rules that would be necessary for comprehensive spelling ability. Jackson (28) reported in 1953 that no statistically significant increase in spelling achievement was found in comparison between classes receiving extra phonetic instruction in spelling and classes acting as controls. Jackson concluded that extra phonetic instruction for the experimental classes was not worth the time spent in overlearning phonetic relationships. It may well be, however, that inefficient teaching methods made significant contributions to the failure and hindered benefits from teaching generalizations.

A more specific concern has dealt with the ability to spell efficiently, *i.e.*, without hindrance and a minimum of spelling errors. Hahn (11) found in 1960 that additional teaching of phonics in reading to pupils in grades three through six produced no significant difference in spelling errors compared to results obtained from pupils in similar grades receiving "no phonics" instruction. In 1964, Hahn (10) tested pupils in three schools in three separate school districts in Pennsylvania matched on socio-economic background, teacher training, and children's group IQ tests. Spelling instruction was varied in the three schools to test different methods of teaching. According to Hahn, ". . . pupils in School A had received much formal training in phonics for two years, while pupils in Schools B and C had received a *normal* [italics the writer's] amount of such training as a part of their regular reading program. No special phonics work was done in spelling classes in any school." According to the investigator, the results of the spelling tests for the three school districts showed that there was no statistical difference between the mean scores of phonics and "normal" groups. The phonics group scored lowest of all three districts on a spelling test made up of words that none of the pupils had studied and upon whose phonics training should have helped most if phonics training

has transfer validity. Since no special phonics training was provided in School A's spelling program and the phonics training was provided through the *reading* program, phonics training in *spelling* may have provided more significant differences.

Another area of concern in the debate has been the nature of the language and logical assessments of available research findings and the problems involved in spelling effectiveness. Ernest Horn, who for many years contributed much writing and research in this area, has consistently expressed doubts that spelling rules based on sound-to-letter relationships can replace direct instruction of words. In 1919, he wrote:

> Most of the articles dealing with the subject contain a peculiar fallacy, namely, that by discovering that words are covered by a given rule, one may discover the efficiency of teaching that rule . . . one must show . . . that a rule can be easily taught, that it will be remembered, and that it will function in the stress of actual spelling. Evidence seems to cast a doubt on all three of these assumptions. . . . (25)

In 1954, Horn (23) found it possible to conclude that "the limited success in attempts to teach pupils to learn and apply even a few spelling rules suggests that we should not be too optimistic about the practicability of teaching the more numerous and complicated rules or principles in phonetics." With greater finality, Horn (22) wrote in 1957 that, "There seems no escape from the direct teaching of the large number of common words which do not conform in their spelling to any phonetic or orthographic rule." Later in 1957, writing for the *Encyclopedia of Educational Research*, Horn (21) listed the type of evidence which he considered must be recognized as possible limitations to the benefits of teaching phonetic generalizations:

1. Over one-third of the words in *A Pronouncing Dictionary of American English* have more than one acceptable pronunciation due to regional and cultivated differences.
2. Many different spellings can be given most sounds and even the most common spellings have numerous exceptions.
3. A majority of words contain silent letters, and about a sixth are spelled with double letters even though only one of the letters may be pronounced.
4. Responses become uncertain when more than one reasonable choice is available, such as "*bizzy* for *busy*, *honer* for *honor*."
5. Unstressed syllables characterized by the schwa or short *i* sound are very hard to spell by sound.
6. Any spelling rule, phonetic or orthographical, can be used incorrectly as well as correctly.
7. Some spelling elements are fairly consistent, such as word positions and the adding of prefixes and suffixes. More adequate evidence is needed to realize the value of relating sounds to symbols, but it appears that such value "should be utilized as an aid to spelling rather than as a substitute for the direct study of these words."

Horn's view is not one-sided, however, as he demonstrates in his research pamphlet, *Teaching Spelling:*

> When dependable evidence is available . . . it is entirely possible that teaching sound-letter relationships will be regarded as an essential part of the spelling program. . . . Even though the evidence is meager on some important matters, it seems to justify considerable emphasis upon phonics. . . . Instruction in phonics should be regarded, however, as an aid to spelling rather than as a substitute for the systematic study of the words in the spelling list (20).

Greater Phonetic Emphases in Spelling

We turn now to the research findings and conclusions of those supporting a greater emphasis on teaching spelling rules utilizing phonetic or sound-letter relationships.

In 1917, Lester (30) countered critics of the use of spelling rules with a well-argued article stressing the helpful and short-cut nature of common spelling rules. Lester, however, emphasized the point that spelling rules should be taught as "necessary tools with which to perform a piece of work," and wrote in a manner which did not place him entirely in an "either-or" position.

In 1926, Watson (38) reported two studies dealing with competency in spelling. In one study, individual high school students were taught either spelling rules or spelling words by drill; in the second study, two different high school classes were compared — one received instruction in spelling rules and the other received class drill. In both studies, the results favored instruction in spelling rules.

In 1930, Carroll (4) presented findings of a comparative study of the ability of bright and dull children to make use of spelling generalizations. Carroll found positive results in the use of spelling rules by bright children and negative results for dull children, and concluded that the group differences in spelling errors were due to "the marked superiority of the bright over the dull in phonetic generalization ability."

In 1930, Archer (2) pursued a suggestion he gained from his earlier study (3) that a spelling rule would be useful if the rule could be applied to enough words to justify its use and taught to be applied in proper situations through inductive and deductive methods. In the follow-up study, Archer (2) reported statistically significant results supporting the instruction of one spelling generalization. He wrote:

> We must . . . recognize that the question as to *how* a rule is taught is just as important as *what* is taught. We must develop the rule in a psychological manner and teach it in a way that will function in the words to be spelled.

The most elaborate efforts to emphasize the value of spelling generalization and the relationship of sound and letter have been made by Paul R. Hanna and his colleagues at Stanford University. Their main contention is that the "American-English language is not based upon a one-to-one relationship between phoneme and grapheme, but that there are patterns of consistency in the orthography which, based upon linguistic factors, may be said to produce correspondences that are surprisingly consistent" (14).

In 1953, Hanna and Moore (17) presented an article that has received much attention. It has become well-known, because it has been cited as evidence for the support of instruction in spelling rules dealing with letter representations of sounds; and it has drawn considerable criticism from opponents, such as Horn (22) and Petty (33), for the interpretations Hanna and Moore made from the results of their study. The study dealt with an investigation of a 3,000 word spelling list "to determine the extent to which each speech sound in the words comprising the spelling vocabulary of the elementary school child is represented consistently in writing by a *specific* letter or combination of letters." According to the researchers, the results indicate that sounds to a high degree were consistently represented by particular letters. One finding showed that "approximately four-fifths of the phonemes contained in the words comprising the spelling vocabulary of the elementary school child are represented by a regular spelling."

More recently, Hodges and Rudorf (19), working under the direction of Hanna, presented the first of a series of five articles dealing with the relationships of linguistics to spelling instruction. Capitalizing on the advances in computer technology, the researchers conducted an impressive investigation of the relationships between phonemes and graphemes in over 17,000 differ-

ent words, thus exceeding by far Moore's earlier study of 3,000 words. The two phase study[1] also was designed to provide an analysis of the structure of American-English orthography in general. In Phase I, the orthography was found to be "a far more consistent reflection of spoken language than had been assumed, particularly when the several components of the phonology (sound system) underlying the orthography are examined." Granting that phonemes have more than one way of being spelled, Hodges and Rudorf, however, point out that "a remarkable amount of consistency is found" when positions of phonemes in syllables and in monosyllabic words and the amount of stress given to syllables are considered.

In Phase II, a second computer program called for "predicting" the spelling of the sample of 17,000 different words. The process in Phase II was as follows:

> For each phoneme a set of rules (an algorithm) was constructed which indicated which spelling of that phoneme should be used under various conditions of position, stress, and environment. The algorithm was then utilized to process the 17,000 words from their phonemicization to their graphemic representation (19).

This computer process showed that of the 17,000 words 49 percent were spelled correctly, 37.2 percent were spelled with only one error, 11.4 percent with two errors, and 2.3 percent with three or more errors. As interpreted by the researchers, the results strengthened "the phonological approach to spelling," since "many of . . . (the) errors may not constitute a serious spelling problem. Many of them could be obviated with the mastery of simple morphological rules." Suggestions, therefore, by Hodges and Rudorf are that "regularities exist in the relationship between phonological elements in the oral language and their graphemic representations . . . and that a pedagogical method based upon oral-aural cues to spelling may well prove to be more efficient and powerful than present methods which rely primarily upon visual and hand learning approaches." Thus, results of the two linguistic analyses by Hanna and his students showed certain consistencies in sound-to-letter relationships. From such results, the researchers felt that more emphasis on instruction of phonetic relationships may be more valuable than the usual "drill" method. In stressing greater application of sound-to-letter patterns in spelling, the Stanford group has attempted to further this particular point of view through much writing and research. Nevertheless, they have insisted that a balanced perspective toward the total spelling program must be maintained. With their efforts directed primarily to one approach, mistaken impressions that they believe spelling depends *wholly* on oral-aural means must be guarded against. In 1959, Hanna and Hanna (12) wrote:

> While we know that the brain acts as a unit, we can still educate the brain for spelling through first emphasizing one type of input and imagery, and then stressing another type. Each of the types – visual, oral-aural, and haptical – must be systematically planned and learned in the spelling program. And as each type of imagery is learned, it must be systematically joined and coordinated with the other types of imagery so that the net result is a reinforcement by each of the other.

Spelling instruction stressing a greater combination of approaches may prove that what have been held to be conflicting points of view can become complementary in a concerted program. Schonell (36) believes that spelling instruction should be based on grouping words with auditory and visual

[1] A 1,500 page report of the study, USOE sponsored Project No. 1991, is being published by the United States Government Printing Office.

similarities and emphasizing the necessary articulatory and graphic responses with the utilitarian worth of the words being learned. Investigating the spelling achievement of Scottish children, most of whom were being taught to spell with the Schonell speller, Personke (32) found that the Scottish sample (ages 7, 11, and 14) ranged from 18 months to 28 months above the American norms on the Metropolitan Spelling Test (1947 edition; Primary II Battery, Forms; Intermediate Battery, Form V; and the Advanced Battery, Form V).

Discussion

There is always the danger of assuming an "all-or-none" or "either-or" stance, as the reader may well realize, on any complex issue involving many variables and alternatives. In the past, many writers have tended to write in dichotomous terms on the question of instruction in spelling generalizations. Definitive writings by spelling authorities have argued for balanced spelling programs which incorporate a variety of approaches, including phonological methods. However, one main source of confusion in the spelling controversy has been basic disagreement over which instructional approach predominates over others in interpretations of what constitutes "balanced" spelling programs. In reading discussions of spelling programs, one must try to perceive how writers rank alternative approaches in their instructional strategies. For example, is the use of sound-to-letter generalizations to be considered the predominant approach in spelling programs or should generalizations be merely aids supplementary to "drill" approaches? Although all authorities call for "balanced" spelling programs, writers have emphasized favored approaches and sought deemphasis of other approaches. Readers, therefore, must guard against drawing "either-or" conclusions themselves by reading more than what writers intend. Researchers pursuing certain aspects of their total spelling programs in depth, such as the Stanford group at this time, must continue to make clear to readers how their present emphases relate to their conceptual views of total spelling programs. Accordingly, the Stanford group has recently presented a number of definitive statements, *e.g.*, (13) (14) (18).

At this time, the most relevant issues to be clarified appear to be as follows: (1) The question as to why the Stanford group inferred so much greater regularity of sound-letter relationships than did Horn (22) from a linguistic study of his own raises at least two issues. First, are the bases used to establish the degree of regularity debatable? Second, should spelling instruction be based upon some assumed or controversial degree of regularity? (2) In a phonologically oriented spelling program, how can we effectively teach pupils the many phoneme-grapheme relationships they would require for a comprehensive command of English-American spelling? (3) How should we relate such instruction to other proven methods? (4) Would such instruction significantly improve the learner's spelling ability? Hodges and Rudorf rightly called for research to answer such methodological and evaluative questions. The burden of proof for pedagogical applications, therefore, rests on the shoulders of advocates for increased emphasis on phonetic approaches. Yet the classroom results may still be similar to earlier studies on the question of instruction in spelling rules, for the preponderance of studies appear to question the effectiveness of strict phonetic approaches. The degree of benefits and the extent of limitations obtained through predominant reliance on spelling generalization in spelling programs have yet to be established by empirical research on such application. Significant results supporting the use of a few rules provides little proof that

a major emphasis on rules in spelling would be successful. However, attention should be given the fact that broad formulations of consistently valid generalizations were not feasible by conventional means prior to the computerized investigation of a 17,000 word corpus at Stanford. Previous research findings on the value of generalizations in spelling instruction may be of less value if the studies utilized generalizations now found to be invalid.

Certainly new research efforts on the issue of spelling generalizations need to be better designed and conducted. Hypotheses need to be stated in the clearest possible terms and tested by rigorous statistical analyses. The need for an improvement in research design and analysis can be seen in many studies that merely report the numbers of spelling errors and percent of words spelled correctly without any statistical test of significance applied to differences found in results. Proof or disproof of a hypothesis does not depend merely on higher or lower spelling scores secured for an experimental group of subjects as compared to a control group. The differences in scores may not be statistically significant, *i.e.*, the difference may have a high probability of occurring by chance alone. Also, design defects involving pupil or teacher variables may invalidate test results.

Interestingly, there are still those in education who seek simple answers to complex questions. Sometimes the questions are stated so only simple answers seem adequate or no reasonable answer can be given. A teacher may be classed with the "drill" group of research subjects on the basis of her speller which deemphasizes phonetic relationships (actually, all spelling textbooks provide for some instruction in sound-to-letter relationships), but the teacher may be supplying her own supplementary phonics instruction when she teaches spelling. Any further research on teaching methods in spelling should carefully consider the variables dealing with the teacher, her actual methods of instruction, and the pupil's background and spelling needs. As an example, the pupil's vernacular speech would seem to be an important variate, if one assumes that in writing with phonetic rules the pupil will spell as *he* pronounces.

Another matter that has tended to contribute to educators' finding simple answers to complex concerns has been the manner in which researchers have generalized conclusions from their research results. Quite often, researchers have overstated their cases; almost all have generalized their conclusions beyond their unrandomized samples of classrooms. For example, would results for two classes of tenth graders in Kalamazoo be the same in the majority of tenth-grade classes in the U.S.A.? Would such results be the same in other grades, such as grades 2 and 3? Further research should have provisions for the careful consideration of the proper randomization of samples. Unless such provisions are made, any claim by researchers in generalizing conclusions beyond the specific sample tested are highly questionable and scientifically unsound.

Interpretation and discussion of results should be stated in unequivocal and objective terms. Inferences made beyond the limitations of results, such as lack of randomization and direct investigation of certain concerns, have been misread as conclusions and are destined to be misread unless writers add more definite precautionary notes or not venture too boldly into inferences beyond the scope of their study. The conclusions of Gates and Chase's (9) study generalizing from a sample of deaf children did not lend support to phonetic approaches, but did support others. Nevertheless, the study has been cited quite often as support for phonetic emphases in the teaching of spelling due to the report's last seven

lines which commented on Watson's (38) study. School personnel responsible for the choice and purchase of spellers may want to give more deliberate attention to the theoretical nature of available spellers under consideration and the references cited to support the authors' points of view.

The controversy of phonics versus "look-say" in reading methods has been largely demolished by the vast majority of educators and parents who realize that the controversy is a false dichotomy, *i.e.*, both methods and others together help provide the most effective reading program for children. Likewise, in the controversy between spelling rules or no spelling rules, the false dichotomy should be apparent. A review of the more carefully written works on the issue show that the question of spelling generalization may be maturing into one of degree and points to the need to fully investigate classroom applications before curriculum materials and methods are recommended for widespread use.

References

1. Aaron, Ira E., "The Relationship of Audio and Visual Discrimination to Spelling Ability," unpublished doctoral dissertation, University of Minnesota, 1954.
2. Archer, C. P., "Shall We Teach Spelling by Rule," *Elementary English*, 7 (March, 1930), 61-63.
3. Archer, C. P., *Transfer of Training in Spelling*. University of Iowa, Studies in Education, Volume 5, No. 5, 1930.
4. Carroll, H. A., *Generalization of Bright and Dull Children*. Contributions to Education, No. 439. New York: Bureau of Publications, Teachers College, Columbia University, 1930.
5. Clymer, Theodore, "The Utility of Phonic Generalization in the Primary Grades," *The Reading Teacher*, 16 (January, 1963), 252-258.
6. Cook, W. A., "Shall We Teach Spelling by Rules?" *Journal of Educational Psychology*, 3 (June, 1912), 316-325.
7. Flesch, Rudolf, *Why Johnny Can't Read*. New York: Harper, 1955.
8. Gates, Arthur, *Generalization and Transfer in Spelling*. New York: Bureau of Publications, Teachers College, Columbia University, 1935.
9. Gates, A. I. and E. H. Chase, "Methods and Theories of Learning to Spell Tested by Studies of Deaf Children," *Journal of Educational Psychology*, 17 (May, 1926), 289-300.
10. Hahn, William P., "Phonics: A Boon to Spelling?" *Elementary School Journal*, 64 (April, 1964), 383-386.
11. Hahn, William P., "Comparative Efficiency of the Teaching of Spelling by the Column and Contextual Methods," unpublished doctoral dissertation, University of Pittsburgh, 1960.
12. Hanna, Jean S. and Paul R. Hanna, "Spelling as a School Subject: A Brief History," *National Elementary Principal*, 38 (May, 1959), 8-23.
13. Hanna, Paul R. and Jean S. Hanna, "Applications of Linguistics and Psychological Cues to the Spelling Course of Study," *Elementary English*, 42 (November, 1965), 753-759.
14. Hanna, Paul R. and Jean S. Hanna, "The Teaching of Spelling," *National Elementary Principal*, 45 (November, 1965), 19-28.
15. Hanna, Paul R. and Jean S. Hanna, "Spelling Today," *The Instructor*, 70 (November, 1960), 6, 106.
16. Hanna, Paul R. and Richard E. Hodges, "Spelling and Communications Theory: A Model and an Annotated Bibliography," *Elementary English*, 40 (May, 1963), 484-506.
17. Hanna, Paul R., and J. T. Moore, "Spelling — from Spoken Word to Written Symbol," *Elementary School Journal*, 53 (February, 1953), 329-337.
18. Hodges, Richard E., "The Psychological Bases of Spelling," *Elementary English*, 42 (October, 1965), 629-635.
19. Hodges, R. E., and E. H. Rudorf, "Searching Linguistics for Cues for the Teaching of Spelling," *Elementary English*, 42 (May, 1965), 527-533.
20. Horn, Ernest, *Teaching Spelling*. American Educational Research Association, Department of Classroom Teachers Research Pamphlet. Washington, D. C.: National Education Association, 1963.
21. Horn, Ernest, "Spelling," *Encyclopedia of Educational Research*, 3rd edition. C. W. Harris (Ed.). New York: Macmillan Company, 1960, 1337-1354.
22. Horn, Ernest, "Phonetics and Spelling," *Elementary School Journal*, 57 (May, 1957), 424-432.
23. Horn, Ernest, "Phonics and Spelling," *Journal of Education*, 136 (May, 1954), 233-235, 246.
24. Horn, Ernest, "A Source of Confusion in Spelling," *Journal of Educational Research*, 19 (January, 1929), 47-53.
25. Horn, Ernest, "Principles of Methods in Teaching Spelling as Derived from Scientific Investigation," 18th Yearbook, NSSE, Part II,

Bloomington, Illinois: Public School Publishing Company, February, 1919, pp. 52-77.
26. Horn, Ernest and E. J. Ashbaugh, "The Necessity of Teaching Derived Forms in Spelling." *Journal of Educational Psychology*, 10 (March, 1919), 143-151.
27. Horn, T. D., "Research in Spelling," *Elementary English*, 37 (March, 1960), 174-177.
28. Jackson, J., "The Influence of Word Analysis upon Spelling Attainment," *Journal of Educational Research*, 47 (October, 1953), 106-115.
29. King, Luella M., *Learning and Applying Spelling Rules in Grades Three to Eight*. Contributions to Education, No. 517. New York: Bureau of Publications, Teachers College, Columbia University, 1932.
30. Lester, John A., "Delimitation of the Spelling Problem," *English Journal*, 6 (June, 1917), 402-411.
31. O'Reilly, Robert, "Phonics and Spelling," *Elementary English*, 42 (February, 1965), 126-127, 210.
32. Personke, Carl, "A Comparison of the Spelling Achievement of Groups of Scottish and American Children," unpublished doctoral dissertation, The University of Michigan, 1963.
33. Petty, Walter, "Research Critiques – II" *Elementary English*, 42 (May, 1965), 584-587.
34. Russell, David H., *Characteristics of Good and Poor Spellers*. New York: Bureau of Publications, Teachers College, Columbia University, 1937.
35. Sartorius, Ira C., *Generalization in Spelling*. Contributions to Education, No. 472. New York: Bureau of Publications, Teachers College, Columbia University, 1931.
36. Schonell, Fred, *Backwardness in the Basic Subjects*. London: Oliver and Boyd, 1942.
37. Turner, E. A., "Rules Versus Drill in Teaching Spelling," *Journal of Educational Psychology*, 3 (October, 1912), 460-461.
38. Watson, Alice E., "Experimental Studies in the Psychology and Pedagogy of Spelling," unpublished doctoral dissertation, Teachers College, Columbia University, 1926.

CARL PERSONKE AND ALBERT H. YEE

A Model for the Analysis of Spelling Behavior

This paper is based on the concept that spelling instruction should be determined by the totality of spelling behavior. Past theory and research in spelling have not been based on such a concept. Instead, the research presented and the methods used have emphasized "either-or" approaches. These segmented approaches have tended to present teachers and researchers with fragmentary views of the spelling process—often presenting dichotomous situations where one must make a choice between conflicting positions. In part, this is the situation referred to by Ernest Horn when he wrote, "But while the existing evidence will be refined, enlarged, and in some instances corrected by new research, the chief problem today appears to be a more critical and universal application of the evidence now available" (5).

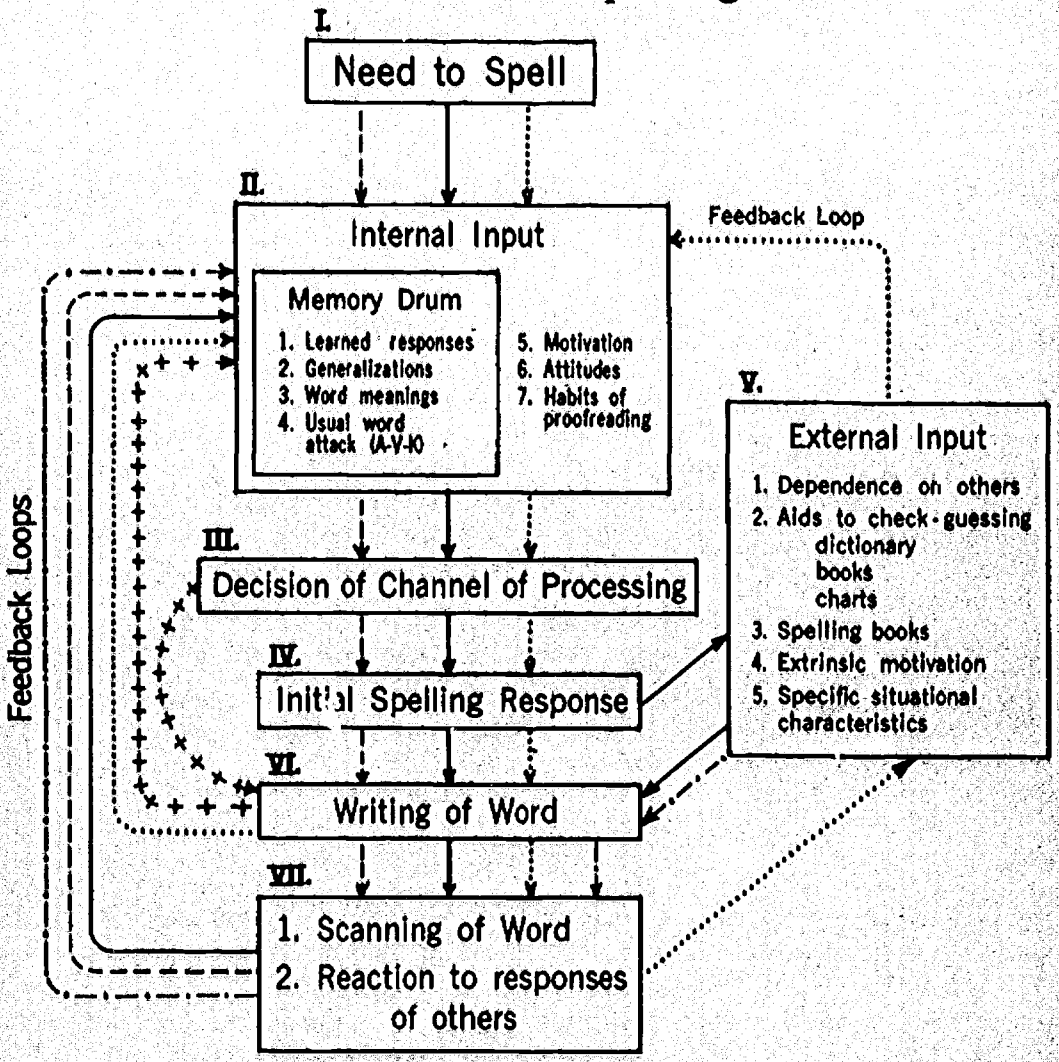
Many writers have presented proposals for the teaching of spelling by use of orthographical rules and generalizations; others have proposed very good reasons for not using such methods (4). Some researchers have attempted to prove the efficacy of informal spelling programs versus formal programs. Within the literature, a number of rather simple models have been presumed with confidence. By virtue of their incompleteness, these models have presented a confusion of conflicting views. What has been missing, and is sorely needed, is a theoretical model of *total* spelling behavior. The nearest approach to this need has been the Hanna and Hodges spelling model based on communication theory which, according to the authors, "... would aid in making a system out of all the elements that go into the act of spelling" (3). However, this model was described in general and did not attempt to examine the actual processes of spelling behavior in detail. In an earlier article, Hanna and Hanna proposed several facets to the spelling process but did not organize these into a working scheme or model (2).

A theoretical model, presenting a systematic description of spelling behavior, would be most helpful to educators, curriculum writers, and researchers in describing all steps in the various patterns comprising total spelling behavior. Such a model would demonstrate that views now held to be conflicting are, in fact, complementary. The model presented in this paper proposes to do this according to elements of an information processing system (6). Essential elements of information processing systems are held to consist of the logical phases as follows: (a) initial input processing—sensing and analyzing problems and needs; (b) processing information before deciding what courses of action to consider and take; (c) decision-making as to what information is available and acting through chosen channels; (d) execution of selected behavior; (e) feedback of infor-

Drs. Yee and Personke are Assistant Professors in the Department of Curriculum and Instruction, the University of Texas, Austin.

Elementary English, XLIII (March 1966), 278-284.

Theoretical Model of Spelling Behavior



1. (- - - -) Memory Channel (M)
2. (+ + +) Kinesthetic Detour (Mk)
3. (———) Check Channel (C)
4. (·····) Proofread Channel (P)
5. (—·—·) Proofread-Rewrite Detour (Pr)

mation through self-evaluation or from other persons to modify or reinforce processing of information and decisions.

The model assumes that all spelling behavior proceeds with a felt need to spell a word. This need may be consciously determined, as in a classroom spelling lesson or when grappling with the unfamiliar spelling of a word when writing. It may involve the unconscious retrieval of memorized spelling behavior not discernible as a separate process, as when one writes familiar words in the continuous, active process of writing one word after the next without pause. Whether spelling behavior develops primarily from conscious or unconscious needs, it is postulated that spelling behavior proceeds from needs to strategies, all of which begin with the speller's internal input. The internal input, (II), fulfills the system's phases of (a) and (b) described above. The decision-making phase, (III), fulfills the functions of (c); and phase (IV), the initial spelling response phase, fulfills the functions of (d) above. The writing phase, (VI), is comparable to the (e) phase described above. The feedback channels will be described in greater detail later, but the phase for self-evaluation and scanning other people's responses, (VII), is a vital part of feedback. In examining the model, it will be noted that phase (V), the external inputs, has been added. This last phase represents aids that supplement the resources of the internal inputs.

Three major channels or patterns of spelling behavior emerge from the internal input phase. Within these patterns, two by-pass or detour routes may be followed to the point of execution. In addition to demonstrating the complementary nature of the various spelling patterns, this model suggests that the pattern to be followed is not absolute but rather a matter of *situational choice* and the constant development of spelling efficiency. Heretofore, educators have addressed themselves only to the problem of spelling instruction in a particular pattern. Greater concern for making the most efficient situational choice from among several alternative channels of spelling behavior would seem to be called for by this model.

Before discussing the channels offered by the model, significant details of Phases II and V of the system will be described. Phases III, IV, VI, and VII will be clarified in the description of processing channels.

(II). The *internal input* may be conceived of as all of the spelling habits which have been internalized by the individual. Among these, a *memory drum* has a central role as the storage vehicle for encoded words and generalizations. The memory drum may be viewed as a storehouse for past information and a receptacle for new information. It is at this stage of the spelling process that the individual must sort out his available internal resources and begin to determine a processing pattern. The memory drum is the essential character of the internal input machinery and provides stored knowledge to the speller. If all of the speller's needs can be satisfied with the available store; that is, if he knows how to spell the word without hesitation and reflection, the spelling process is relatively simple. The speller simply sorts out the desired information and uses it in the spelling response. Use of a response deemed correct reinforces its use in similar situations. If the speller does not know how to spell the word spontaneously, he may still withdraw learned spelling generalizations from the memory drum to aid him in producing the desired response.

Within the resources of the memory drum, two other components offer means of processing spelling needs. These are learned word meanings, necessary especially with homonyms; and favorite means of word attack, either auditory, visual, or

kinesthetic, on which the speller will rely in most situations. Other components of the internal input which fulfill essentially the learning role of the system include the spelling habits, attitudes, and motivation to spell correctly accumulated by the individual in his previous spelling experiences. It may be seen that these components other than the memory drum rely on outside or external inputs, which will now be described.

(V). The *external input* consists of all of those aids which lie outside the speller but which may be used in obtaining a desired spelling response. These include dependence upon other people, such as the teacher; aids to check-guessing through the use of dictionaries, spelling books, and other sources of word spelling; and extrinsic motivations, such as provided by other people's attitudes and specific situational characteristics confronting the speller at the time of spelling, *e.g.*, the reason for writing. It may be noticed in the diagram that the external inputs become necessary when the internal inputs provide insufficient information. It should be noted that specific spelling situations which may require external inputs one time may not require the same external inputs the next time they are confronted. Through the feedback channels, they may become a part of the store in the memory drum. Phase (V) becomes essential when it is realized that it is by receiving and retaining the external inputs that new spellings are "learned," or encoded in the memory drum.

Description of Processing Channels

Three channels of processing spelling behavior with one by-pass and one detour route are presented in the model. It is proposed that all spelling behavior, whether that of mature or immature spellers, may be explained in terms of these channels. Description of the three channels of spelling behavior and the two possible detour routes follow. In the descriptions, these channels will be referred to by labels which, while not completely descriptive, should serve to differentiate them in terms of their basic functions.

The *memory channel* (M) has been so designated because it operates with reference only to the memory drum of the speller. The *kinesthetic detour* (Mk) maintains a similar position and is simply a more efficient variation of the (M) channel. The *checking channel* (C) represents spelling behavior which refers to external inputs immediately upon making an initial response and before writing the word. The *proofread channel* (P) represents the behavior of a speller who first writes the word, with or without the intent that what he writes is a correct response, and then refers to external inputs for confirmation of the correctness of the written response. The *detour* (Pr) is used when the speller receives information from the external inputs that his response was not correct. These two channels offer reference to the check-guess and habits of proofreading discussed by Dolch (1). It should be noted that the (M) and (Mk) channels represent spelling behavior with already learned words. The (C), (P), and (Pr) channels may be considered "learning" channels and deal primarily with difficult and unfamiliar words.

From the accompanying diagram, it can be seen that spelling behavior commences with a felt need to spell a word and proceeds to the internal inputs. It is the component parts of the internal input which first influence the processing channel to be followed. The first three phases (I, II, and III) are followed in the same order no matter which channel is finally determined as the most suitable in the particular situation. Once the speller has completed these phases and made a decision in Phase III,

divergence of the processing channels takes place.

If the desired spelling lies within the individual's experience, that is, if sufficient information can be extracted from the memory drum, he will proceed along one of the memory channels. A word which has become so strongly habituated as to require no conscious spelling thought will proceed directly along the (Mk) channel to a *written response,* phase (VI). This response is immediately reinforced for future use via the feedback loop to the memory drum. Words less familiar to the speller, but still determined to be amenable to spelling through learned generalizations or other favorite methods of attack, may be processed through the (M) channel. The speller makes the *initial spelling response* (IV), *writes the word* (VI) according to this response, and *scans the word* (VII) to be satisfied that this is his desired response. He thus receives reinforcement for future use of this response through the feedback loop to the memory drum. It should be observed that neither memory channel provides reference to any external input to ascertain "correctness" of response. The desired response may, in fact, be incorrect in terms of commonly accepted spelling, but in this case the distinction is not made by the speller.

Alternate channels of processing provide methods of handling situations when difficult or unfamiliar words must be spelled. In such cases, the speller will proceed to the initial spelling response which may be an attempt to spell the word and/or come to the simple response that, "I don't know how to spell this word." Further programming of the behavior will now depend upon the processing of needs and information which has gone before and those components of the internal machinery not a part of the memory drum. If the speller chooses to use (C) channel, he will turn immediately to one or more of the external inputs available to him in order to discover the "correct" spelling. He will then write the word, scan it to determine its desirability as output spelling, and be reinforced in his future use of this response through the feedback loop. Feedback will also reinforce the tendency to use or not use this channel of processing in similar situations in the future.

The final means of processing available to the speller lies in the (P) channel. Following the decision-making phase, the speller makes his initial spelling response. At this point, he proceeds to writing the word. This is his desired response and may include an intent of correctness. After writing the word, the speller scans the word himself and/or may react to the response of others who have had the opportunity to scan and evaluate the output. If such scanning raises doubts concerning the output's desirability, the speller proceeds to the external inputs (V) for confirmation of "correctness" in the output response. Receiving such confirmation, the response is immediately reinforced through the feedback loop. The tendency to use or not use this channel is reinforced at the same time.

If confirmation from the external input indicates the output response to be incorrect, the (Pr) channel can be followed and information in the external inputs can be used to rewrite the word correctly. After scanning for desirability, reinforcement both for the correct response and of the tendency to use this channel of processing is received through the feedback loop.

Critique of the Channels

It has already been noted that the choice of channels for processing a spelling response will depend upon the specific situation in each case. That is, certain channels are more suitable for one situation than for another, and this suitability will be

determined by an evaluation of the strength and weaknesses of each of the approaches. It should be noted that although some comparison on an absolute basis may be necessary to facilitate this critique, the complementarity of channels cannot be overemphasized.

It almost goes without saying that the quickest and most efficient type of spelling behavior lies in the (Mk) or *kinesthetic by-pass* channel. The goal of each speller and each teacher of spelling should be to enlarge the individual's store of words that can be handled in this way. Fluency in writing is almost dependent upon a large store of words which can be "written without thinking."

However, there are weaknesses in this approach which make it necessary for the speller to use alternate channels in specific situations. For one thing, this channel can be used only with previously stored words. If used with an unknown word, the speller must retrieve a response from his store that approximates the correct response. Use of the response will tend to reinforce the possibility that it will be used again, whether it is correct or incorrect.

The (M) and (Mk) channels offer the same relative strengths and weaknesses, except that (M) will be somewhat less efficient in that this channel requires a conscious thought process. Thus the added process of conscious thought consumes time and the speller's attention. Involving the speller's conscious attention to the spelling of a word produces what can be called a *conceptual break*—the writer momentarily thinks of the spelling of a word rather than the message he is attempting to communicate. The conceptual break becomes an even greater problem if the student processes his response through the checking (C) channel. When using this channel, the speller stops the writing process in order to get the correct response from among the external inputs. The break in attending to the message thus becomes more complete and extended than when the (M) channel is used. However, channel (C) can provide effective spelling behavior when the speller is confronted with an unfamiliar word. By using this channel, the speller can be assured of a correct response when writing the word. This response alone will be entered into the internal input and reinforced by way of the feedback loop.

The (P) channel, like the (C) channel, checks unfamiliar words. However, (P) has the disadvantage that while it offers a guaranteed reinforcement of a correct response, it also makes possible the reinforcement of an incorrect response. If the speller writes the word with the intent that it is correct, the feedback loop will immediately reinforce that response even though it may be incorrect. Subsequent feedback of the correct response after turning to the external inputs will not necessarily eliminate the tendency to make an incorrect response in a similar situation. However, if the speller initially writes a word with the intent that it may not be correct, there will be little danger of undesirable feedback occurring. The subsequent feedback of a correct response after use of any of the available external inputs will help insure the possibility that the correct response will be used in a similar situation. At the same time, the (P) channel has the important advantage of avoiding at least the more complete and extended conceptual break of the (C) channel.

Summary and Conclusions

The model presented above has been conceived of as representing total spelling behavior according to an information processing system. With this model, it may be possible to view all spelling behavior as the processing of needs within specified spelling channels, with the speller as the

one who selects the channel to be used. Some tentative conclusions which should be considered in both research and instruction in spelling arise from the preceding analysis of the theoretical model.

1. All spelling is processed from among a number of complementary channels. No one channel should be considered the "correct" channel. The speller must choose according to the situational conditions and the resources available to him that channel most suitable to his requirements at the moment.

2. No one channel is correct for spelling a particular word each time it is met. Reinforcement of correct responses enlarges the store of the memory drum. The internal inputs, particularly of the immature speller, are subject to constant change. This shifting from one channel to another is perhaps the best indication of the complementarity of channels.

3. Research and instruction in spelling can be facilitated by a model of total spelling behavior. With complementary channels, adjustments in one channel affect all other channels. The model points to a new aspect of research and instruction in spelling, the situational choice.

4. Research and instruction in spelling have been concentrated on the relevancy or use of one part of one channel of processing behavior. This model indicates that instruction in spelling should include the mastery of *all* channels of processing and skill at choosing the most suitable channel for the particular situation. When each instance of spelling behavior is viewed as a part of total spelling behavior, present conflicts in spelling theory may be revealed as paper tigers.

References

1. Dolch, Edward W., *Better Spelling*. Champaign, Illinois: The Garrard Press, 1942.
2. Hanna, Jean S. and Paul R. Hanna, "Spelling as a School Subject: A Brief History," *The National Elementary Principal*, 38 (May, 1959) 8-23.
3. Hanna, Paul R. and Richard E. Hodges, "Spelling and Communication Theory: A Model and an Annotated Bibliography," *Elementary English*, 40 (May, 1963) 483-505, 528.
4. Horn, Ernest, "Phonetics and Spelling," *Elementary School Journal*, 57 (May, 1957) 424-432.
5. Horn, Ernest, "Spelling," *Encyclopedia of Educational Research, Revised Edition*, Chester W. Harris, ed. New York: Macmillan Company, 1960.
6. Ryans, David G., *An Information System Approach to Theory of Instruction with Special Reference to the Teacher*, SP-1079. Santa Monica, California: System Development Corporation, 1963.