Methods and Theories of Learning to Spell Tested by Studies of Deaf Children

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Research is reported on the reading and spelling ability of children congenitally deaf. In comparison with their other linguistic abilities and with normal children of similar reading experience, deaf children (1) greatly excell in spelling ability, and (2) possess extraordinary word-perception ability. Both abilities appear due to a peculiarly effective type of perceiving which relies on a visual reaction to words. For normal children learning to spell, much may be gained by visual study of the word and mastering the habit of writing the word.

A series of studies of the acquisition of various linguistic abilities by children congenitally deaf were begun two and a half years ago for the purpose of discovering certain facts which might be applied to the improvement of methods of teaching and learning of normal children. In this paper will be described the results of one of the preliminary studies and some of the plans for further investigations now under way or contemplated.

The first study, begun in November 1923, was designed to throw some light on the influence of phonic[1] and phonetic experience and training upon reading and spelling. For several decades various good and ill effects have been attributed to these types of experience and training of which there are nearly innumerable varieties of formal and informal procedures. Among those most competent to appraise these practices in the light of established principles of learning agreement does not, by any means, prevail. Nothing short of extensive experimental work is likely to yield a valid estimate of the merits of phonic and phonetic training. A system of teaching so widespread in use and yet so varied in character as phonetics in America merits most careful investigation.

While developing plans for a comprehensive experimental attack upon the problem, it occurred to the writer that one method of discovering what abilities or deficiencies result from phonic and

Visible Language, x 4 (Autumn 1976), pp. 339-350.
Visible Language, Box 1972 CMA, Cleveland, Ohio USA 44106.

phonetic experiences would be to study, analytically, the achievements and performances of children who had had no such training. Children born deaf fulfill perfectly this requirement; having never heard sounds, they could not be given phonetic work of any sort.

Through the courtesy of Harris Taylor, Principal, and Edith Buell of the Institution for the Improvement of the Instruction of Deaf-mutes of New York, children suitable for investigation were found. The status of these children is indicated below. The "Institution Grade" indicates the grouping within the school; the "Approximate School Grade" suggests a roughly equivalent level in the ordinary public school:

Institution grade	*Approximate school grade*	*Number of pupils*	*Extreme ages*	*Average age*
VIIB	IIIB	12	12–17	13.6
VIIIB	IV	11	13–16	14.2
IXB	VB	9	15–19	16.4
XIB	VIII	13	16–20	18.1

Since it was our purpose to compare the achievements of these pupils with those of normal children as nearly as possible equivalent by nature except in auditory capacity, a measure of general intelligence was sought. Of several instruments tried, the Pintner Non-language Tests seemed most satisfactory. The results of the measurements need not be given in detail since they indicate that the pupils studied were but slightly lower in intelligence than normal individuals of corresponding age.

Reading Ability of the Deaf

Before giving the tests of spelling ability, the achievements of the pupils in reading were ascertained since there are good reasons for believing that absolute spelling ability is greatly influenced by the level of ability and amount of experience in reading. Once the spelling of a word is learned it is probably kept alive in no small measure by being perceived repeatedly in the process of reading as well as by experience in writing.[2] Spelling ability should, therefore, be evaluated in connection with the evidence concerning reading ability and experience.

The Burgess Reading Test was given to all pupils. The paragraphs of which this test is composed are approximately equal in difficulty to the following:

"These ducks are out walking on a cold winter day. The black duck is ahead; but she is unhappy because the cold snow hurts her feet. Make one short line under her feet to represent a board for her to stand on. Then make one more short line for the white duck to stand on. Now both ducks will keep their feet warm."

This material is easy reading for normal Grade III children and not too difficult for many in Grade II. The scores of the several grades on the test—which is five minutes in length—were as follows:

Institution grade	*Average chrono-logical age*	*Per cent making 0 score*	*Per cent reading 1 or 2 para-graphs*	*Per cent reading 3 or 4 para-graphs*	*Per cent reading 5 or more para-graphs*	*Average number of para-graphs*	*Average reading, age*	*Average reading, grade*
VIIB	13.6	50	50	0	0	0.8	?	?
VIIIB	14.2	18	18	45	18	3.0	8.2	2.5
IXB	16.4	0	55	11	33	3.6	8.5	2.8
XIB	18.1	0	25	17	68	5.0	10.0	3.5

The results revealed in this table were the most surprising outcome of the study. Half of those in Grade VIIB (whose ages varied from 12 to 20 years) failed completely to read a single paragraph of this easy material in five minutes and the other half read but one or two passages. In the higher grades, the reading was usually so slow and laborious that it could be neither very enjoyable or profitable. How significant this deficiency is and what the theoretical possibilities of remedying it are will be discussed in a later paper. At present, we shall utilize the results merely to illuminate the achievements in spelling.

Spelling Ability of the Deaf

The test of spelling ability was a list of 36 words from the Ayres-Buckingham Scale. The list comprised nine groups of 3 words each of the same length beginning with 2-letter words and culminating with 11-letter words. The nine groups of words, when applied to normal children, form a series of approximately equal steps of difficulty. Since an age scale has been constructed for scores on this test, it is possible to appraise the achievements of the deaf by translating their raw scores into the chronological age of normal children who average the same score. The results are given in the accompanying table:

Grade	*Average actual age of deaf*	*Average spelling age*
VIIB	13.6	11.2
VIIIB	14.2	11.6
IXB	16.4	12.6
XIB	18.1	13.0

While the absolute achievements of the deaf are not as high as those of normal children of corresponding ages, they are distinctly excellent when certain relevant factors are taken into account. First, the meagerness of the reading and other linguistic experiences of the deaf constitutes a highly potent handicap. Compared to their ability in reading, the deaf pupils' spelling achievements are very high. Secondly, the examination as given proved to be not only a test of spelling but also of lip-reading ability. Despite all efforts to make the dictations intelligible, many quite obviously misinterpreted the pronunciations. For example, among the "misspellings," of *estimate* appear the following: *examine, depend, expect, Easter,* etc., and a number of blanks which meant inability to catch the word. Such "misspellings" and omissions ran through all of the records. Such words were called wrong, with a few exceptions: *build* substituted for *built* in over half of the cases; *difficulty* for *difficult; teacher* for *teach* and a few similar spellings were counted correct. These allowances, however, scarcely provided equal spelling opportunity for the deaf. Finally, some of the words appeared to be utterly unknown to the deaf. For example, *information* was attempted by only three pupils in the entire group and of these only one apparently had any idea what the word was. Unfamiliarity with abstract words of this type was very evident in the deaf children's reading and was doubtless in no small measure responsible for their difficulty in this subject.

Since it has been established that reading experience and as a consequence, reading ability exert a pronounced influence on spelling it will be illuminating and probably not unfair to compare the spelling of deaf children with that of normal children *of the same reading ability*. This may be done in terms of the age scale for normal children. The results are as follows:

Deaf group	*Spelling age of deaf children*	*Spelling age of normal children of same reading ability*	*Superiority of deaf, in years*
VIIB	11.2	6.9	4.3
VIIIB	11.6	8.1	3.5
IXB	12.6	8.4	4.2
XIB	13.0	9.4	3.6

The table shows that, with reading ability equal, the deaf greatly excel the normal children in spelling ability; the differences average but a trifle less than four years on a spelling age scale based on normal children. The spelling ability of the deaf, thus computed, is about 150 per cent that of the normal child.

To appraise in another way the spelling ability of the deaf, a further test was devised. This was termed a "spelling recognition" test. It consisted of 36 words ranging in length and difficulty, each presented with four misspellings, as in the following samples:

7. nime, nin, nyme, nine, nein.
20. circular, sircular, circlear, cirkilar, sirculer.
36. consensions, kontientions, conscientious, konsienscious, constientious.

The task was to underline the correct word. Neither for deaf nor normal pupils were the words pronounced.

In this test the deaf children in the lower grades did relatively poorly—mainly I judge because they were quite unfamiliar with many of the words in speech, writing, or print—but relatively well in the upper grades. In the highest group all scored 31 or more correct out of 36 and averaged 33.8, a figure which is about equal to the score of normal pupils in the seventh grade at midyear.

When the deaf children are compared in this test with normal pupils of equal reading ability, the results are as follows:

Deaf group	*Deaf spelling recognition age*	*Normal subjects of same reading ability*	*Difference in favor of deaf in years*
VIIB	9.4	6.9	2.5
VIIIB	10.8	8.1	2.7
IXB	12.7	8.4	4.3
XIB	14.6	9.4	5.2

The superiority of the deaf, when reading ability is rendered constant, is very marked and increases perceptibly with longer school experience. If these data are reliable and valid, the deaf child's ability to distinguish correct from incorrect spellings increases with extraordinary rapidity, in comparison with normal children, as their reading experience is extended.

In order to avoid the handicaps of the deaf due to unfamiliarity with abstract words and the earlier difficulty of conveying them the word to be spelled, a test of 16 names of concrete objects was presented by means of the lips in combination with a drawing to suggest the proper word. The words were: *hatchet, bicycle, soldier, umbrella, elephant, scissors, children, policeman, cigarette, telephone, butterfly, automobile, typewriter, battleship, locomotive, phonograph.* The number of correct spellings (out of a possible 16) on these tests was as follows:

Grade	*Number Words Correct*
VIIB	12.1
VIIIB	12.7
IXB	13.6
XIB	15.2

Since no scores for representative normal children on this list of words were available the test was given to the pupils in Grades IV, VI, and VIII in one New York City school and to Grades VA, VB and VIB in another. The scores were as follows:

Grade	*School A*	*School B*	*Average A and B*	*Scores of deaf in corresponding grades*
IV	7.8	—	7.8	12.7
VA	—	8.6	8.6	—
VB	—	9.8	9.8	13.6
VI	11.0	10.6	10.8	—
VIII	13.6	—	13.6	15.2

While the deaf children are older chronologically than the normal children in the corresponding grade, they have had much less reading and other language experience. The results shown in this table suggest a real superiority of the deaf.

On the whole, the evidence indicates that the deaf children possess, in comparison with their other linguistic abilities and in comparison with the achievements of normal children of similar reading experience, at least, superior spelling ability. If the sources of this superiority can be discovered, facts may be revealed which may make possible improvements in teaching spelling to normal children.

High spelling ability might be the result of extensive reading, extensive writing composition, extensive drill in spelling or of specially effective methods of learning and teaching in spelling. In this instance, it is certainly not due to extensive reading or writing (composition). It is quite surely not due to the amount of drill in spelling specifically, since except for occasional dictations of word lists, little time is devoted specially to spelling lessons. The means of teaching the pupils to learn to spell words, therefore, merit careful examination.

The spelling tests to which specific instruction in spelling is largely limited are of two forms: (1) mere requests to write words that occur to the pupils, (2) spelling words dictated by speech (lip-movements). In the first type of test no special teaching is used; in the second, a form of spelling technique is suggested. First the child tries to get the word by lip-reading and demonstrates his perception by pronunciation. This, in fact, is the way new words are introduced. The teacher speaks the word at the same time demonstrating its meaning by action or object. The pupils then try to pronounce the same word. If they cannot get it as a whole, they are assisted time after time in approximating the pronunciation of the word syllable by syllable, until they can reproduce the syllables in order perfectly or nearly so. Then the pupil writes the word as nearly as he can, usually syllable by syllable, on the board. When errors occur, the teacher gives the correct spelling by writing on the board the word with which the pupils compare their own written forms. It would seem that this method of developing the ability to lip read, speak, spell, and write all new words would tend to set up spelling habits not unlike those which prevail among normal children, namely, the device of relying primarily upon phonetic translation but closer examination may reveal significant differences. Normal children, enjoying phonic and phonetic experience, learn to depend primarily upon a phonetic rendering—translation of the sounds into letters which represent them—when attempting to recall the spelling of words. In several analytic studies, published[3] and unpublished, of good and poor spellers this habit was found to be almost universal. That this method alone should function unsatisfactorily is due to the fact that English spelling is not systematically phonetic in the sense that a given sound is invariably represented by the same letters. *Claim* may be phonetically spelled as *clam, clame, klam, klame, claim, klaim,* etc. The majority of spelling errors among normal persons are not due to erroneous phonetic rendering but to the inability to select the form which happens to be the traditional one from the many equally phonetic equivalents. In other words, by relying upon the device of simply translating sounds into a series of letters which does represent them, they are prone to error because so many possible translations are phonetically accurate.

The dictation lesson for the deaf encourages a habit of translating the lip-movement equivalents of syllables—which to the normal would be phonic units—into letters. The same difficulty prevails here as in phonetic translation, namely, the existence of many letter combinations which have been associated with the same lip-movements. But unlike the deaf, normal children have a life-time of phonic experience with language; long before they can read or write or spell they can recognize and articulate the word sounds. It is probably the greater facility in recalling the sounds and articulation of words that results in the common tendency to resort to utilizing the sound equivalents in spelling. The deaf, of course, are incapable of thinking first of the sounds and then recalling a combination of letters which represent them and despite the system of encouraging them to spell by recalling combinations of letters associated with the lip-movements of others or their own acts of pronunciation, it seems probable—both from observing the deaf during spelling and learning tests and from study of their misspellings—that they depend mainly on another learning device. This device, I believe, consists in a more careful visual study of the word forms in the final stages of learning when their written word is compared with the correct form placed on the board and in the attempt to recall not the lip-movement-letter combination associations but the visual appearance of the word during attempts to spell words not yet firmly habituated as writing habits. This hypothesis we tested by further examinations.

The first procedure consisted in comparing the abilities of deaf and normal children to learn to spell words misspelled previously in a test. Immediately after completing the test on the 16 words—*hatchet, bicycle,* etc.—these words in mimeographed form were distributed to the pupils who were instructed to study them for another test to be given a minute later. They were required to study by observing the printed words; but they were not permitted to spell the words aloud or to write them. After a minute of study, the lists were collected and the words again dictated. In the accompanying table are given the results for 23 deaf pupils each paired with a normal child of identical score on the first test.

Score for Normal Pupils

Average initial score	*Average final score*	*Average gain*	*PE gain*	*PE difference*
11.5	13.9	2.4	0.18	—
		Score for Deaf Pupils		
11.5	15.5	4.0	0.15	0.23

That the deaf learned more during the one minute period of study is apparent in the table. They acquired the spelling of 4 words while the normal learned 2.4. The difference between the gains (1.6 words) is approximately seven times the probable error of the difference. This superiority, under the conditions of the test, is in my judgment evidence that the deaf have a sharp perception for word-forms which is utilized in learning to spell. Another test of this hypothesis was also applied.

The "Word Perception" tests used considerably heretofore in the diagnosis of difficulties in reading and spelling among normal children were applied to the deaf. Both tests were designed to measure the speed and accuracy of perceiving words. The first, known as the Word Selection Test, measured the speed and accuracy with which a person can perceive an isolated word and immediately perceive it again in the midst of several other very similar (hence confusing) words. Two sample exercises follow:

hat	sat	pot	rat	bat	hat
	mountainous	everlasting	magnifersant	appointment
magnificent	distinction	magnificent	merchandise	maggnifsunt
	magnifficant	illustrious	measurement	composition

The second test, known as the Word Perception, Same-different Test, requires the subject to underline the pairs of words which are unlike leaving unmarked those identical, as in the following:

it	it	ground	grourd	children	chuldren
as	ar	behind	bekind	mountain	mountain
am	am	butter	butter	remember	remember
he	ha	rushed	rushed	thousand	thosand
me	me	marble	mardle	question	quastion

The tests obviously do not measure word-perception in exactly the same way but according to available evidence they are both symptomatic of the kind of perceptive skill which we desire here to measure. Since the tests correlated highly with familiarity with the words—that is, with reading experience and skill in which the normal and deaf differ widely—the two groups should be equated for reading ability before their achievements in this task are compared. Instead of presenting the data in this form, however, we shall show the scores in reading, spelling and word-perception since from these figures the significant facts may be estimated together with certain others. The scores below show the age of average normal children which the deaf equal in the four functions.

Deaf group	*Actual age*	*Reading age*	*Spelling age*	*Word selection age*	*Word perception same-different*
1	13.6	6.9 *	11.2	12.4	16.5
2	14.2	8.1	11.6	12.4	16.0
3	16.4	8.4	12.6	15.5	17.7

*Approximately.

The results are as striking as they are unequivocal. The deaf Group 1, for example, which could scarcely read at all and which, consequently, could have enjoyed but little reading experience shows a word perception ability in one test as great as that of average 16.5 year normal children, that is, normal children approximately three years above their own average chronological age. The results for the other groups were similar; Group 4 was omitted because their word perception ability exceeded all available norms for hearing children. There can be no doubt about the extraordinary word-perception ability of the deaf pupils.

Spelling ability, it may be observed, falls about midway between reading and word perception. Lack of reading experience tends to pull spelling ability down whereas keenness of word-perception tends to lift it up. This, at least, is our interpretation. The deaf owe their remarkable spelling ability primarily to a peculiarly effective type of perceiving, of reacting visually to words. Normal children, despite wider opportunities in reading and writing, do not seem to acquire as effective a type of word-perception. The hypothesis here offered is that normal children fail to develop this precise, accurate and—as far as the effects on spelling are concerned—effective form of word observation because they rely mainly on the easier, perhaps more natural—yet for spelling less productive—device of phonetic translation.

The results of the study of spelling by the deaf contribute certain suggestions for improving spelling ability among normal children. Practice in spelling may be directed to give primary emphasis to:

1. The motor activities of articulating the constituent letters (or letter-units such as syllables) silently or aloud.

2. The motor activities of writing the letters.

3. The mental activities of translating recalled word-sounds into letters which may be imaged, articulated or written.

4. The visual-perceptive activities of "seeing" the visual word as a whole of clearly distinctive parts.

5. The recall and application of spelling or phonetic rules which, in combination with (3) assist the learner to select from the many possible the one correct phonetic rendering.

Studies of spelling already presented and others to be published soon indicate that normal pupils rely greatly upon (1) and (3). The success of the deaf indicates that much may be gained by establishing better habits of visual study of words in learning to spell and then of exercising until firmly mastered the habit of writing the word. Studies to be reported indicate that elementary school pupils write or articulate the spelling only after recalling the letters by translation of sounds to letters or by visualization of letters or by both combined. Since English is so unphonetic, the most reliable device for determining which of the many genuine sound-to-letters translation is the correct one is to be able to recall some impression of the visual appearance of the word. This, I believe, is the method adopted by the deaf—with excellent results as we have seen. While the use of spelling rules has largely fallen into disrepute there are theoretical reasons and some experimental evidence[4] tending to show that when used as one of the means of emphasizing the visible similarities and differences among groups of like and unlike word forms they may be fruitfully employed to improve word-perceptive habits and, consequently, spelling ability.

1. By *phonic* is here meant any experience or training either in hearing or pronouncing words or both. Training in pronunciation, of course, involves experience in hearing one's voice. By *phonetic* is here meant training in either translating visual (printed or written) words or word elements—letters, syllables, phonograms—into sounds as in reading or conversely, sounds into letters and letter combinations, as in spelling.

2. For a defense of this belief see A. I. Gates; *The Psychology of Reading and Spelling.* New York: Teachers College, Bureau of Publications, 1922.

3. Gates, *op. cit.*

4. Alice Watson: Experimental Studies in the Psychology and Pedagogy of Spelling. Teachers College, Contribution to Education, forthcoming number.