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Elementary and junior high school students took part in a test involving the probability texture of the language to determine whether spelling ability is related to a student's understanding of possible letter combinations in English words. Two similar groups of 124 fifth grade students and 129 eighth grade students were ranked in spelling ability by performance on the California Achievement Test, with those scoring lower than the 50th percentile classified as poor spellers. A test instrument was constructed of 120 five-letter nonsense words of four degrees of approximation to English, ranging from combinations most remote to English (xkjzt) to those most similar to English (comer). Students were asked to select from the two words the one that looked most like English. The results of the study indicated (1) that good spellers performed better than poor spellers on the word-choice discrimination test except on problems of extreme difficulty, when performance of both dropped to chance levels, (2) that the relationship between spelling achievement and verbal intelligence was only moderate, and (3) that spelling achievement reflected, in part, increased knowledge of the probability texture of English. (MP)

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Spelling Ability and the Probability Texture of English

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ABSTRACT

Five letter nonsense words representing four orders of approximation to English were constructed. The words were arranged in pairs to form choice-discrimination problems. Difficulty level of the choice-discrimination problems was varied by pairing words from the different orders of approximation. Good and poor spellers were required to choose that member of a pair which looked most like a "real English word." Two separate studies were conducted, one with fifth grade subjects and the other with eighth grade subjects. The results obtained in the two studies were highly similar. In general, good spellers proved superior to poor spellers in number of correct choices. The differences between good and poor spellers were most apparent on choices of moderate difficulty rather than at the two extremes.

WHILE THE ability to spell is commonly thought of in terms of retrieval of stored units, it is conceivable that other processes enter into spelling. It is possible that spelling is, in part, a rapid *decision making process* with choice among alternatives determined by cues imbedded in the structure of the language itself. The present investigation is concerned with the possible utility of probabilistic cues concerning the sequential patterning of letters. If, for example, one is confronted with a choice between two alternative spellings of a word, one may utilize knowledge of sequential probabilities of given letter combinations as they occur in the language. Hence, highly improbable letter combinations would be rejected in favor of highly probable ones. From this perspective, differences between good and poor spellers should obtain on choice discrimination problems involving cues concerning the probability texture of English.

In the present investigation, good and poor spellers were required to choose one member of a pair of five letter nonsense "words." The pair members were drawn from pools of such items developed in such a way as to constitute four different orders of approximation to English. By requiring choices between pairs of items representing all possible combinations of the four order approximations to English, it was possible to vary difficulty level of the problems. Thus, for example, one set of choices required the subject to choose between a nonsense word which closely approximated English and one which was quite removed from the actual structure of the language. Another set required the subject to choose between a nonsense word which closely approximated the structure of English and one which was at an intermediate level in approximation to the language. It was hypothesized that good spellers would perform significantly better than poor spellers on the choice-discrimination problems. Moreover, an ability × difficulty level interaction was predicted in that greater differences between good and poor spellers were expected as the difficulty level of the discrimination problems increased. Two separate studies were conducted.

Method

Subjects

Subjects for the first study were fifth-grade students in a small elementary school district in California. All fifth-grade students from throughout the district who reported for school on the day upon which data were gathered were utilized. A total of 124 subjects were used in the first study. Scores on the *California Achievement Test* were employed in separating subjects into good and poor spellers. All subjects scoring above the 50th percentile on State of California norms were categorized as good spellers while all subjects scoring below the 50th percentile were categorized as poor spellers. This procedure resulted in eighty-eight good spellers and thirty-six poor spellers.

Subjects for the Study II consisted of all eighth-grade students who reported for school on the day upon which data were gathered. Identical procedures for creating two samples of good and poor spellers in the first study were employed. In the second study, there were a total of 129 subjects, 70 good spellers and 59 poor spellers. In both studies, a combined total of 253 subjects was employed. With the exception of the fact that eighth-graders were used, Study II was in all respects an exact replication of Study I.

Materials

For the studies 120 five-letter nonsense words

at varying orders of approximation to English were constructed. Four orders of approximation were employed with thirty words at each order. The procedures for generating the orders of approximation to English were as follows:

Order 0. This order was considered most remote from the structure of the language. The letters of the alphabet were numbered one through twenty-six. By selecting consecutive runs of five numbers from a table of random numbers, it was possible to generate thirty five-letter nonsense words at order 0. The procedure was designed to generate random letter sequences which bore little or no relationship to those occurring in English.

Order 1. The first 1,000 letters in a typical third-grade reader were numbered one through 1,000. Consecutive runs of five numbers taken from a table of random numbers permitted the construction of thirty five-letter nonsense words in which letter sequences were somewhat dissimilar to those occurring in English but did not constitute random patterns.

Order 2. A letter was chosen at random from the alphabet. This letter was designated *choice one.* The third-grade reading book was opened at random and choice one located in the text. The letter immediately following choice one was selected and designated *choice two.* The reader was again opened at random and choice two was located. The letter immediately following choice two was selected and designated *choice three.* Choice three was located and its following letter recorded and designated *choice four.* Choice four was located and its following letter recorded and designated *choice five.* In this fashion, it was possible to generate a five-letter nonsense word thought to correspond more closely with letter sequences occurring in the language. By repeating this procedure thirty times, the required number of five-letter nonsense words were generated.

Order 3. The procedure for generating order three approximations was identical to that employed for order two. However, the consecutive letter choices following first choice were by dyads rather than single letters. It was assumed that this procedure would insure the construction of letter sequences highly similar to those which actually obtain in English. Order three was considered the closest approximation to the structure of the language.

The stimuli were arranged in pairs such that each order was paired with every other order. Six combinations of orders were possible as follows: 0–1, 0–2, 0–3, 1–2, 1–3, 2–3. Sixty pairs of stimuli were obtained with ten pairs at each of the possible six combinations of orders of approximation.

Procedure

Subjects were tested in groups in their regular classrooms. The experimenter read the following instructions:

> On the pages after this one you will find pairs of nonsense words. For each pair, put a circle around the nonsense word that looks most like an English word. For example, suppose one of the pairs was: 'xkjzt' and 'comer,' you would circle 'comer' because it looks more like an English word than 'xkjzt.' Remember, for each pair circle the nonsense word in it that looks most like an English word. Be sure to do every pair. If you are not sure sometimes which nonsense word to circle, guess. It is important that you circle one of the nonsense words in every pair. There were no time limits. All children finished the choice-discrimination problems.

Results

Although the results for the two studies were analyzed separately, the high degree of similarity obtained renders separate presentation and discussion unnecessary. The major analyses consisted of 2 × 6 analyses of variance for repeated measurements with unequal numbers of *Ss* (3: 374–378). The experimental design, in both cases, consisted of two levels of spelling ability (good and poor) and six levels of difficulty for the choice-discrimination problems.

In general, good spellers proved superior to poor spellers at all levels of difficulty of the choice-discrimination problems. However, as will be discussed shortly, not all differences at the varying difficulty levels were significant.

Table 1 presents means and standard deviations obtained in both studies. Table 2 is a summary of the analysis of variance for Study I which involved fifth-grade subjects.

The obtained significant main effect for spelling ability indicated that good and poor spellers did differ on the choice-discrimination problems. In addition, the significant F obtained for difficulty levels of the problems indicates that performance varied across difficulty levels. The predicted interaction, ability × difficulty level, was not obtained.

The analysis of variance on the data obtained in Study II involving eighth-grade *Ss* yielded identical findings. Significant F values were obtained for spelling ability and difficulty level. However, once again, the predicted ability × difficulty level interaction was not obtained. Table 3 presents the summary analysis of variance for Study II involving eighth-grade students.

The obtained non-significant ability × difficulty level interaction renders individual comparisons between good and poor spellers at given difficulty levels questionable. However, such comparisons were conducted and suggest a non-linear relationship between spelling ability and difficulty

Table 1.—Means and Standard Deviations on Choice-Discrimination Problems

	Study I											
	0–1		0–2		0–3		1–2		1–3		2–3	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
Good	7.91	1.26	8.58	1.44	7.86	1.32	6.48	1.24	7.23	1.09	4.81	1.23
Poor	7.50	1.60	8.06	1.56	7.75	1.40	5.78	1.22	6.86	1.18	4.53	1.23
	Study II											
Good	7.89	1.30	9.46	.81	8.13	1.09	6.60	.89	7.07	1.18	5.26	1.29
Poor	7.59	1.58	8.56	1.55	8.22	1.26	5.93	1.42	6.98	1.34	5.19	1.34

level. When the discrimination problems were of extreme difficulty, e.g., choice between second order versus third order nonsense words, the performance of both good and poor spellers dropped to chance levels. On the other hand, when the discrimination problems were relatively easy, e.g., choice between zero order versus third order approximations, the performance of both good and poor spellers was well above chance but not significantly different. It was at moderate difficulty levels, e.g., zero order versus second order choices and first order versus second order choices, that differences between good and poor spellers appeared. The only differences between poor and good spellers that appeared reliable were at 0–2 ($F = 2.84$, $p < .08$, fifth graders; $F = 10.95$, $p < .01$ eighth graders) and at 1–2 ($F = 5.16$, $p < .05$, fifth graders; $F = 6.08$, $p < .05$, eighth graders). The great similarities between the two sets of data developed in two separate studies suggests strongly that the obtained differences at these difficulty levels were indeed reliable.

Table 2.—Summary of Analysis of Variance on Choice-discrimination Scores (Study I—Fifth Grade)

Source	SS	df	MS	F	p
Between Subjects					
Spelling ability (S)	24.35	1	24.35	9.98	<.01
Subjects w/in groups	279.56	122	2.44		
Within Subjects					
Difficulty level (D)	1,123.53	5	224.71	144.97	<.001
S × D	5.19	5	1.04		n.s.
D × Subjects w/in groups	944.78	610	1.55		

Table 3.—Summary of Analysis of Variance on Choice-Discrimination Scores (Study II—Eighth Grade)

Source	SS	df	MS	F	p
Between Subjects					
Spelling ability (S)	18.06	1	18.06	7.59	.01
Subjects w/in groups	302.30	127	2.38		
Within Subjects					
Difficulty level (D)	1,205.42	5	241.08	14.02	.01
S × D	24.07	5	4.81		n.s.
D × Subjects w/in groups	10,921.51	635	17.20		

Correlations Among Measures

Spelling achievement scores, verbal intelligence test scores (California Test of Mental Maturity, 1957), and experimental task performance were intercorrelated. Table 4 presents the obtained intercorrelations. All of the correlations in Table 4 are significant at the .05 level or below.

Table 4.—Correlations Among Verbal IQ, Spelling Achievement, and Choice-Discrimination Scores

	Verbal IQ	Spelling Achievement	Choice-Discrimination
Verbal IQ		.66 (.49)*	.21 (.24)
Spelling Achievement			.41 (.21)

*Values in parentheses are for Study II—Eighth Grade.

In Study I involving fifth graders, the relationship between spelling achievement and choice-discrimination scores is clearly substantially greater than that between verbal IQ and choice-discrimination. Verbal intelligence, although related to performance on the experimental tasks, clearly does not account for all of the variance on the experimental tasks. However, in Study II which involved eighth graders, the relationships between spelling achievement and task performance and between verbal intelligence and task per-

formance are of approximately equal magnitude. In both studies, the relationship between spelling achievement and verbal intelligence is moderate. Interpretation of these relationships involving verbal intelligence as will be discussed shortly, is not altogether clear.

Procedures for Generating Order Approximations

If the procedures for generating the various approximations to English were valid, one would expect to find certain patterns among the choice-discrimination problems at varying difficulty levels. Specifically, choices between remote and close approximations should, for both good and poor spellers, prove more accurate than choices between adjacent orders. In order to assess the degree to which the obtained data conformed to such expectations, good and poor spellers were combined and individual comparisons conducted (3:378). In general, the data supported these expectations. For the group of problems, 1–2, 1–3, and 2–3, performance was poorest on the two sets involving adjacent orders. For the group of problems, 0–1, 0–2 ,and 0–3, the data conform partially to expectations. Performance on 0–1 was significantly poorer than performance on 0–2. However, performance on 0–3 proved inferior to that obtained with 0–2. This latter finding in both studies does not conform to expectations and suggests that the procedure for generating third order approximations requires modification. The fact that performance on the problems involving the adjacent orders 0–1 proved significantly better than that obtained on the adjacent orders 1–2 and 2–3 is understandable. Order 1 stimuli apparently contained sufficient cues to enable the *S* to differentiate such stimuli from random letter sequences readily. However, since the stimuli comprising orders one, two, and three all exhibited some degree of approximation to English, confusion would be expected. Results of the individual comparisons are given in Table 5.

Table 5.—Individual Comparisons for Combined Groups at Difficulty Levels

Comparison	Study I		Study II	
	F	p	F	p
0–1, 0–2	16.4	<.001	6.67	<.01
0–1, 0–3	n.s.	n.s.	n.s.	n.s.
0–1, 1–2	92.4	<.001	7.48	<.01
0–1, 1–3	18.0	<.001	n.s.	n.s.
0–1, 2–3	374.4	<.001	23.0	<.001
0–2, 0–3	14.4	<.001	n.s.	n.s.
0–2, 1–2	186.8	<.001	28.2	<.001
0–2, 1–3	68.8	<.001	15.1	<.001
0–2, 2–3	547.6	<.001	54.3	<.001
0–3, 1–2	97.2	<.001	13.1	<.001
0–3, 1–3	20.0	<.001	4.81	<.05
0–3, 2–3	38.4	<.001	32.2	<.001
1–2, 1–3	28.8	<.001	n.s.	n.s.
1–2, 1–2	94.8	<.001	4.22	<.05
1–3, 2–3	228.4	<.001	12:15	<.001

Discussion

The obtained results lend some support to the hypothesis that spelling achievement reflects, in part, increased knowledge of the probability texture of the language. However, this interpretation obviously must be advanced with caution. It is indeed possible that good and poor spellers differ on other dimensions as well. The fact that verbal intelligence was positively related to experimental task performance may indicate that our findings are attributable to general intelligence differences between good and poor spellers. However, in the study involving fifth graders, it is clear that general verbal intelligence could not have accounted for all of the variance in the discrimination-choice scores. On the other hand, in the study involving eighth graders, such a statement is not possible.

In any case, it is difficult to evaluate the meaning of the obtained relationship of verbal intelligence to performance on the experimental tasks. It is, of course, possible to conduct analyses of covariance on the data. Covariance analysis would reveal the effects of spelling achievement with variance attributable to verbal intelligence test scores adjusted. However, it is not at all clear that this procedure would be meaningful. If spelling achievement does, in fact, reflect *implicit* learning of something other than specific spelling of particular words, e.g., transfer, then, it seems reasonable to suppose that in the absence of *explicit tuition for such transfer*, brighter students may very well be more likely to accomplish such learning than less bright. In other words, the ability to utilize probabilistic cues imbedded in language itself may very well be related to something called general verbal intelligence. In point of fact, such an ability may well constitute a learned component skill of the more general ability which we label verbal intelligence. By partialing out the effects of general verbal intelligence, one may be removing, in part, the effects of the skill one is attempting to assess.

One encouraging note is the essential agreement between the results of the present investigation and a highly similar study reported by Wallach (2). Although interested in precisely the same processes, Wallach came at the problem in a slightly different way. Investigating speed of perceptual recognition of approximations to English by good and poor spellers, Wallach found good spellers capable of recognizing reasonable approx-

imations to English more readily than did poor spellers. The present investigation involving choice-discrimination coupled with Wallach's findings on perceptual recognition lends further support to the notion that spelling ability involves, in part, knowledge of the probability texture of the language.

The present results may present a possible linguistic interpretation for Jensen's (1) intriguing finding that the distribution of spelling errors closely approximates the bow-shape serial position curve commonly found in serial learning. If it can be demonstrated that letter sequential probabilities are more consistent at the beginnings and endings of words than in the middle, one might be in a position to argue for a linguistic interpretation of Jensen's findings. In other words, maximal decision uncertainty may occur in the middle of most English words rather than at the beginning or at the end. This speculation is not intended to detract from the significance of Jensen's reanalysis of spelling errors in terms of serial learning. Rather, it is offered in the spirit of a suggestion for further research.

Without question, the difficulties involved in interpreting correlational studies such as the present one are formidable. However, it was not our intent to establish unequivocally, in this single piece of research, our hypotheses concerning spelling ability and ability to utilize letter sequential probability cues. Rather, the present research was undertaken as a preliminary investigation prior to an experimental remedial spelling program. Since the present research is not incompatible with the view that spelling ability is, in part, a rapid decision making process involving letter sequential probabilities, an attempt to teach such decision skills directly is in order. The next step in this program of research involves training of poor spellers over lengthy time periods to utilize letter sequential probabilities. The important questions that now need to be asked are as follows: Can poor spellers be trained to utilize letter sequential probabilities? If so, will such training yield transfer to the ability to spell actual English words?

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REFERENCES

1. Jensen, A. R. "Spelling errors and the serial-position effect," *Journal of Educational Psychology*, LIII (1962) pp. 105–109.
2. Wallach, M. A. "Perceptual recognition of approximations to English in relationship to spelling achievement," *Journal of Educational Psychology*, LIV (1963) pp. 57–62.
3. Winer, B. J. *Statistical Principles in Experimental Design.* (New York: McGraw–Hill, 1962).