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Spelling Proficiency and Sensitivity to Word Structure

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The connection between spelling and pronunciation in many English words is somewhat remote. To spell accurately, a writer may need to appreciate that the orthography maps regularities of more than one kind. Two experiments explored the possibility that young adults who differ in spelling ability also differ in sensitivity to morphophonemic structure and word formational principles that underlie the regularities of English spelling. In the first, an analysis of misspellings showed that poor spellers were less able than good spellers to exploit regularities at the surface phonetic level and were less able to access the underlying morphophonemic structure of words. A second experiment used pseudowords to extend these findings and to confirm that spelling competence involves apprehension of generalizations that can be applied to new instances.

All would agree that English spelling is not easily mastered. Even accomplished readers and writers may at times be uncertain about the spelling of particular words. There is less agreement about why English causes so much difficulty. The reason most often given for spelling failures is the supposed irregularity of English orthography. This diagnosis, though popularly accepted, is a misleading oversimplification. It reflects the widespread confusion about how the orthography represents word structure. An example will serve to illustrate that when English spelling departs from one-to-one correspondence with pronunciation, as it so often does, it may nevertheless preserve orderliness at some other level. The plural *s* in *cats* receives an s sound while the *s* in *dogs* is pronounced as *z*. We do not balk at this inconsistency perhaps because the convenience of representing the plural morphophoneme in a consistent way overrides considerations of strict one-to-one correspondence with pronunciation.

It is characteristic of English that the degree of transparency of the mapping between word components and their orthographic representation varies considerably from word to word. This diversity is a consequence of the many and varied sources of the English vocabulary. There are, on the one hand, words like *harp*, which have a morphophonemic structure, and hence a spelling, that is in close correspondence to a typical phonetic realization of the word. On the other hand, there are words in which the morphophonemic structure for one or more segments is at some remove from a phonetic realization of the word. This occurs frequently in words that are foreign borrowings (for example, *bour-*

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geois) or in words reflecting archaic forms (for example, *gnaw*). In contrasting these two extremes we might characterize the mapping for the first set of words as being all but transparent, whereas the mapping of the second set is relatively opaque to many, perhaps most, users of English.

Many English words have a degree of orthographic transparency that lies somewhere between the extremes represented by the examples given above. Many words are more or less straightforward except that they contain a "problem segment." Examples include such words as *thinned, misspell,* and *grammar.* At one specific location in each of these the relationship between the morphophonemic and phonetic structure is not immediately transparent in the spelling. In cases such as these, correct spelling could be facilitated by apprehending the morphemic structure (*mis* + *spell* requires retaining both *s*'s), the orthographic conventions (*thin* + *ed* requires doubling the *n*), or the derivational relationships (the identity of the reduced vowel in *grammar* can be uncovered by relating the word to cognate forms in which the same vowel segment is not reduced, as in *grammatical* or *grammarian*).

It is one thing, however, to demonstrate that order exists in the mapping of word and orthography. It is quite another to show that the regularities are apprehended and utilized by ordinary spellers who are not linguistic scholars. If we accept the premise that English orthography is by and large a rational system, it is reasonable to suppose that successful use of the orthography may be dependent on the users' ability to understand the system, or on what we shall call their "linguistic sensitivity."

We use the term "linguistic sensitivity" to refer to the ability to apprehend the inherent regularities at various levels of linguistic representation and the ability to exploit this knowledge in reading and writing words. There exists already considerable evidence that successful readers can be distinguished from unsuccessful ones on a number of metalinguistic abilities (Fowler, Shankweiler, & Liberman, 1979; Liberman, Shankweiler, Fischer, & Carter, 1974; Morais, Cary, Alegria, & Bertelson, 1979; Perfetti & McCutchen, 1982; Vellutino, 1979). It is possible that major differences in linguistic sensitivity so defined may also be associated with the large variations in spelling ability that are found even among highly schooled adults. In the past, investigators have looked repeatedly to nonlinguistic explanations, appealing, for example, to individual differences in visual memory ability (Shaw, 1965; Witherspoon, 1973). The alternative view is that spelling draws heavily upon knowledge of linguistic structure. Although this viewpoint is not new (see, in particular, Chomsky & Halle, 1968), the recent spate of papers on spelling offers little direct empirical evidence either pro or con (but see Frith, 1978; Marcel, 1980; and Steinberg, 1973). The present study was designed to fill what seemed an obvious need.

Before an empirical investigation could be started, test materials capable of assessing sensitivity to the structural properties of the orthography had to be developed. Although some experimental spelling tests (e.g., Barron, 1980) categorize words as "regular" or "irregular," the basis for classification is not usually made explicit. The classification of "regular" is typically applied to words having a presumed straightforward correspondence between spelling patterns and phonetic structure (e.g., *fresh*). Accordingly, words with regularities of all other kinds are typically designated as "irregular" (e.g., *sign*), despite their demonstrable adherence to a pattern or rule. A further shortcoming of the available tests is that they are constructed without regard to variations in word frequency. Together, these deficiencies make existing tests unsuitable for our purposes. Accordingly, an Experimental Spelling Test was developed to overcome these limitations. While controlling for word frequency, it attempts to capture some of the

structural properties that give rise to different levels of transparency in English spelling.

The hypothesis under investigation is that educated adults who differ in spelling ability on conventional spelling tests differ correspondingly in the knowledge we call linguistic sensitivity. To explore this possibility, two experiments were conducted. In the first, the performance of good and poor spellers was examined using the Experimental Spelling Test. It was anticipated that for all subjects those words in which the morphophonemic representation is at some remove from the phonetic structure would be more often misspelled, other things equal, than those words in which the two levels of representation more nearly coincide. Moreover, if good and poor spellers are primarily distinguished on the basis of their metalinguistic abilities, then the largest differences between the groups on the Experimental Spelling Test ought to occur in spelling the words whose mapping can only be rationalized linguistically. Smaller differences, or no difference, should occur on the opaque words, for the spellings of which the subjects may have to rely chiefly on rote memory.

If college-level adults who differ in spelling proficiency can be distinguished on the basis of their sensitivity to certain structural characteristics of real words, then differences among them should be especially evident on tasks that are free from the effects of word-specific learning. The second experiment of this investigation explored this possibility by comparing the performance of good and poor spellers on tasks that tap certain linguistic abilities presumed to be useful in spelling the words on the Experimental Spelling Test. These abilities include knowledge of abstract spelling patterns, familiarity with principles involving prefixation and suffixation, and ability to use tacit knowledge of English morphophonemics in order to disambiguate reduced vowels. New materials had to be developed for tapping these abilities. Pseudowords rather than actual words were used where necessary to ascertain that the subjects had acquired general principles of orthographic representation that can be applied to new instances.

In addition to the assessment of metalinguistic abilities associated with spelling performance, Experiment 2 also examined the possibility that good and poor spellers may differ in their use of visual retention strategies. Since visual memory is often cited as a major determinant of spelling proficiency (Shaw, 1965; Sloboda, 1980; Tenney, 1980; Witherspoon, 1973), a task assessing visual memory ability for abstract designs was included. It was anticipated that on the linguistic tasks, good spellers would continue to outperform those who were less proficient, while no difference between the groups would emerge on the task of visual memory for designs. Finally, the groups of good and poor spellers were compared on tasks designed to tap broader aspects of literacy, namely, reading skills and vocabulary knowledge.

Experiment 1

The purpose of this experiment was to compare the performance of college-educated adults who differ in spelling proficiency on spelling tasks that incorporate graded changes in orthographic transparency.

Method

Subjects

Two groups of subjects, good spellers (N = 18) and poor spellers (N = 20), were selected from a larger sample of 88 undergraduate psychology students who responded to a notice inviting them to participate in an investigation of spelling ability. The notice had encouraged people to sign up regardless of their level of spelling proficiency. The 88 initial participants were all native speakers of American English, 21 males and 67 females, ranging in age from 18 to 37 years (mean age = 20 years). While

they do not constitute a random sample, those participating did represent a broad range of spelling proficiency as indicated by their scores on the spelling section of the Wide Range Achievement Test (Jastak, Bijou, & Jastak, 1965). Grade equivalent scores on the WRAT ranged from 8.4 to 15.7 with a mean of 12.3.

Those identified as good spellers for the purpose of this study performed at or above grade level on the WRAT (mean grade equivalent was 14.4, SD = 0.51). Those categorized as poor spellers were clearly deficient performing on the average 4 years below grade level (mean grade equivalent was 10.2, SD = 0.64). The good speller group included 6 males and 12 females, the poor spellers consisted of 4 males and 16 females.

Stimuli

The chief instrument used was the new three-part Experimental Spelling Test of 120 words. The words were grouped into three levels, 40 in each, differing in the transparency of orthographic representation. For Level 1 words, the phonetic realization is, for any given speaker, reasonably close to the orthographic representation, and the spelling patterns are, for the most part, restricted to those having a high frequency of occurrence in written English. Examples of words so classified are *harp, adverb,* and *retort.*

Level 2 words each contain an ambiguous segment involving some departure from straightforward phonetic mapping. They are further partitioned into two subtypes. Level 2A words require either a rote application of established orthographic conventions, or a sensitivity to regularities at the surface phonetic level. For example, a speller may know that the /n/ segment is represented by *nn* in *thinned* but by *n* in *chained.* The experienced writer does this quite mechanically, having learned that in monosyllabic words the final consonant letter is doubled when preceded by a single vowel but not doubled when preceded by a vowel digraph. Indeed, in many instances the graphemic conventions relate to phonetic facts such as those involving lax versus tense vowels. In contrast, Level 2B words draw upon abstract morphophonemic knowledge to derive the spelling patterns for the ambiguous segments. For example, in order to know that the final consonant letter in *confer* is doubled in *conferring* or *conferred* but not in *conference,* a speller must apprehend linguistic regularities relating to stress placement, and how these govern spelling. The generalizations included in the list are described in Appendix 1.

Level 3 words can be derived only partially by using morphophonemic knowledge, since they contain one or more segments that do not generally occur in English or occur with low frequency. Their relative lack of transparency stems from two factors: the words are related to borrowed forms largely obscure to the nonscholar and the nonpolyglot, and their spelling patterns have a much lower frequency of occurrence in English than do the patterns appearing in Level 1 and 2 words. Examples include such words as *gnaw, bourgeois,* and *Fahrenheit.*

The three levels were balanced insofar as possible for syllable length (each level approximating a mean of 2.8 syllables) and frequency of occurrence in written English (each level approximating a mean of 6.1 occurrences per 1,014,232 words of natural language text), according to the Kucera and Francis (1967) statistics. Within Level 2 the 2A words had a mean frequency of occurrence of 5.7 versus 6.8 for the 2B words. The 2A words had a mean of 2.4 syllables versus 3.4 for the 2B words. The 120 words (which are listed in Appendix 2) were randomized, and recorded on magnetic tape at 10-s intervals.

Procedure

The subjects were tested in small groups. The testing session lasted for 1 h during

which the following tasks were administered.

1. *Spelling Production Task.* The subjects' task was to print each dictated word in the space provided and to attempt every word. Each was repeated once.

2. *Spelling Recognition Task.* The same items were presented again, this time as a multiple-choice recognition test. The answer sheet offered three alternative spellings for each dictated word and, additionally, a "none of these" option. Each of the three alternatives was phonetically readable as the stimulus word; thus no foil could be eliminated merely on the basis of a gross disparity between the spelling of an item and its phonetic realization. Common misspellings of the stimulus words appeared as foils.

3. *Spelling Subtest of the Wide Range Achievement Test.* (Jastak et al., 1965). The words from the Level 2 spelling list of the WRAT were recorded on magnetic tape at 10-s intervals. The subjects' task was to print the words in the space provided.

Scoring of Spelling Errors

The following error categories were used to analyze the misspellings:

1. Word Errors were scored for each misspelled word without regard to the number of misspelled segments (for example, when *grammar* was spelled "grammer" or *sergeant* as "sargent").

2. Segment Errors were scored for every incorrect spelling pattern, as defined by guidelines established by Hanna, Hanna, Hodges, and Rudorf (1966). Segment errors were further classified as substitutions, omissions, or insertions.

a. Substitution Errors were scored when an incorrect grapheme was used in place of the correct letters. These were further classified as "phonetic substitutions" when the word as spelled captures the word's approximate phonetic shape (as when *rhododendron* was spelled "rododendron" or when *gnaw* was given as "naw") and "nonphonetic substitutions" (for example, when *adverb* was spelled "advert").[1]

b. Omission Errors were scored when a grapheme needed for the orthographic representation of a phonological segment was omitted (for example, *inflate* for "infate").

c. Insertion Errors were scored when an additional grapheme was included (for example, *retort* for "restort").

Results and Discussion

A preliminary step was to establish that the Experimental Spelling Test designed provided a reliable and valid estimate of general spelling ability. A test–retest comparison of word errors carried out on a subset ($N = 30$) of the 88 participants resulted in a reliability coefficient of .97 ($p < .001$) on the Spelling Production Task. The results of a correlational analysis revealed that word error scores on the Spelling Production Task correlated significantly ($r = .84$, $p < .001$) with error scores on a standardized test of spelling achievement, the Wide Range Achievement Test. Together, these results suggest that the test yields a reliable measure of spelling achievement and gives results that are highly comparable to a widely used conventional test of spelling proficiency.

An analysis of item difficulty on the Spelling Production Task was also conducted to examine for possible floor or

[1] The nature of the mapping between phonemes and their graphemic representations is the subject of considerable debate, particularly in the case of the so-called "silent" letters. Whereas some silent letters (such as the *e* in make, life, and code) function as diacritic markers for a preceding vowel phoneme and as such may readily be classified as part of the vowel spelling, others serve no obvious function (e.g., the *b* in lam*b* or the *u* in g*u*ard). In such instances it is not clear with which phoneme the grapheme is to be associated. We have followed Hanna et al. (1966) in classifying "silent" consonant graphemes with consonant phonemes and "silent" vowel graphemes with vowel phonemes. According to this procedure the *gn* in gnaw is treated as a single spelling pattern. Thus, any of the following spellings for /n/ would be scored as substitution errors (*nn, kn, pn, mn*) since like *gn* they are alternative spelling patterns for /n/.

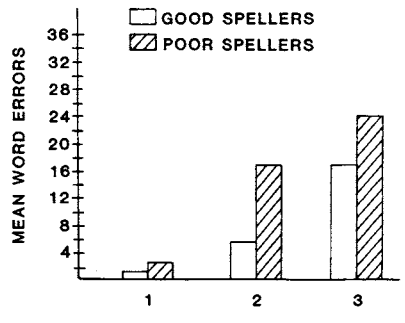

FIG. 1. Comparison of word errors on spelling production task as a function of orthographic transparency, good versus poor spellers.

ceiling effects. It was found that no word was misspelled by every subject, and even the most difficult words on the list (*desiccate* and *sarsaparilla*) were spelled correctly by at least two of the 88 subjects. Although 20 of the 120 words were never misspelled, no subject obtained a perfect score. The number of misspelled words ranged from 18 to 52 with a mean of 33.9 (SD = 8.9).

Spelling Production Task: The Locus of Spelling Difficulty

It is important to discover whether the spelling mistakes made by poor spellers are limited to words having particular orthographic or structural characteristics or whether the difficulties reveal more general deficiencies in transcribing English. To answer this, we first looked at the distribution of misspelled words on the Spelling Production Task across the three levels of orthographic transparency (see Figure 1).

The data were analyzed by a two-way analysis of variance in which the between-groups factor was spelling group, the within-groups factor was orthographic level, and the dependent variable was the number of word errors. As can be seen in Figure 1, the good and poor spellers differed sharply across each of the three orthographic levels: $F(1,36) = 154.73$, $p < .001$, $MS_e = 7.95$, for group; $F(2,72) = 717.44$, $p < .001$, $MS_e = 4.57$, for level. The interaction between group and orthographic level was also significant, ($F(2,72) = 42.21$, $p < .001$, $MS_e = 4.57$). Good spellers made significantly fewer errors at each level than did poor spellers (at Level 1, $t(36) = 4.46$, $p < .001$; at Level 2, $t(36) = 12.64$, $p < .001$; and at Level 3, $t(36) = 7.35$, $p < .001$). It is of interest to note that the interaction remains significant when the group by level analysis is recomputed for Levels 2 and 3 alone ($F(1,36) = 13.43$, $p < .001$, $MS_e = 27.14$). This suggests that the full interaction effect is not simply a consequence of the greater accuracy of both groups in spelling the orthographically transparent Level 1 words, but instead reflects performance differences all across the range of orthographic transparency.

The finding that good and poor spellers differ significantly in their ability to spell words at each of the three levels suggests that they have general deficiencies in spelling rather than isolated, local difficulties restricted to particular exceptional words.

As expected, few Level 1 words were misspelled by either group. Nevertheless, even on these the two groups differed significantly. Errors made by poor spellers were quite varied. In 11% of the cases the dictated item was apparently misperceived perhaps because of unfamiliarity with the word—for example, *vortex* rendered as "thortex" or "vortext." In 29% errors occurred in relation to the representation of free versus checked vowels—for example, *diplomat* rendered as "diplomate," *emit* as "emite." However, the bulk of the errors (60%) were instances of the use of spelling patterns that in another context would be appropriate but are incorrect for the particular morpheme being represented, for example—spelling *retort* as "rhetort," and *punishment* as "punnishment." In contrast to the greater range of difficulty experienced by poor spellers, the Level 1 errors of good spellers, with the exception of the word *canister* (which many spelled "cannister"), were confined to occasional mis-

perceptions of a stimulus word (spelling *thinned* as "fend" or *compensates* as "compensate").

Differences in the ability of good and poor spellers to transcribe words are reflected in quantitative differences in virtually every aspect of performance on which the two groups were compared. Table 1 presents an overview of the analysis of segment errors.

As anticipated, most errors occurred on those phonologic segments that departed most conspicuously from a straightforward phonetic transcription. As Table 1 reveals for both groups substitution errors accounted for the bulk of the errors made, followed by a much smaller percentage of omissions and even fewer insertions. Overall, the poor spellers made significantly more errors of each type (for substitutions, $t(36) = 8.98$, $p < .001$; for omissions, $t(36) = 3.65$, $p < .001$; and for insertions, $t(36) = 2.42$, $p < .02$). The low percentage of omissions and insertions indicates that both groups were generally accurate in preserving the segmental structure of words.

Since errors of substitution were most numerous, the analysis focused on these. It was found that for both groups significantly more substitutions occurred on vowels than on consonants with the poor spellers again making significantly more errors than good spellers on both consonants ($t(36) = 8.03$, $p < .001$) and vowels ($t(36) = 10.39$, $p < .001$). The greater difficulty in spelling vowel segments is expected since the mapping between orthographic patterns and vowel sounds is generally more variable than it is for consonants. Finally, for both groups phonetic substitutions significantly outnumbered nonphonetic substitutions with the poor spellers again making significantly more of each error type than the good spellers (for phonetic substitutions, $t(36) = 10.88$, $p < .001$; for nonphonetic substitutions, $t(36) = 3.15$, $p < .01$). These data suggest that highly schooled adults usually represent the phonetic characteristics of words adequately but sometimes fail to attend to the deeper morphophonemic regularities that would have led to the correct spelling.

Production Errors versus Recognition Errors in Spelling

In examining the effect of orthographic transparency on spelling accuracy it is of interest to compare the performance of the two groups on the task utilizing a recognition format. Table 2 presents these data for the good spellers and poor spellers. The

TABLE 1
SUMMARY OF SEGMENT ERRORS ON SPELLING PRODUCTION TEST
GOOD AND POOR SPELLERS

	Good spellers			Poor spellers		
Error type	Mean	Percentage substitutions	Percentage total error	Mean	Percentage substitutions	Percentage total error
Substitutions	31.9	—	85.8	63.2	—	83.9
Phonetic	27.9	87.5	75.0	56.2	88.9	74.6
Nonphonetic	4.0	12.5	10.8	7.2	11.4	9.6
Consonants	12.5	39.2	33.6	22.8	36.1	30.3
Vowels	19.3	60.5	51.9	40.6	64.2	53.9
Omissions	4.4	—	11.8	10.2	—	13.5
Insertions	0.9	—	2.4	1.9	—	2.5
Total errors	37.2	—	—	75.3	—	—

TABLE 2
MEAN WORD ERRORS ON PRODUCTION AND RECOGNITION TASKS AS A FUNCTION OF LEVEL OF ORTHOGRAPHIC TRANSPARENCY

Task	Good spellers	Poor spellers
Production		
Level 1	1.1	3.0
2	5.9	16.9
3	17.2	24.1
Recognition		
Level 1	0.7	2.4
2	7.0	16.1
3	11.2	18.2

data were analyzed using a three-way analysis of variance in which the between-groups factor is spelling group and the within-groups factors are condition (production and recognition) and level of orthographic transparency (Level 1, 2, and 3). The dependent variable was the number of misspelled words.

As expected, the task of recognizing correctly spelled words proved to be significantly easier for the two groups combined than the task requiring spelling production (for condition, $F(1,36) = 92.32$, $p < .001$, $MS_e = 2.68$). The mean word error score under the recognition format was 27.8 compared with a higher mean error score of 34.0 on the production task. No differences were found for the interactions of group by condition ($F(1,36) = 2.54$, $p < .12$, $MS_e = 2.68$), or group by condition by level ($F(2,72) = 2.56$, $p < .08$, $MS_e = 2.16$). Of particular interest, however, is the finding that for both groups the overall increase in accuracy that occurred under the recognition condition is largely concentrated on the morphophonemically opaque, Level 3 words (for condition by level, $F(2,72) = 97.85$, $p < .001$, $MS_e = 2.16$). Whereas subjects typically reduced their word error score on Level 3 words, smaller reductions in errors occurred in spelling the more transparent words. The mean word error score on Level 1 words was 2.0 on the production task versus 1.5 on the recognition task and on Level 2 words, 11.4 mean word errors versus 11.5 mean word errors, respectively.

Differences between Good and Poor Spellers in Linguistic Sensitivity

While these findings underscore the quantitative differences between good and poor spellers, the critical abilities distinguishing the two groups remain undefined. From a linguistic perspective there are certain skills that still need to be explored. On the one hand, for example, poor spellers might be differentiated from good spellers in their lack of sensitivity to surface orthographic and phonetic regularities that signal the use of particular spelling patterns. Alternatively, or additionally, they might differ in their ability to penetrate below the surface structure to the deeper morphophonemic regularities that determine the appropriate spelling patterns.

In order to evaluate these possibilities, it was useful to examine the performance of good and poor spellers on the Level 2 words where the performance differences between the groups were largest. It will be recalled that each Level 2 word contained an ambiguous segment. In approximately half of the words (Level 2A), the spelling of that segment could be ascertained by recognizing certain orthographic regularities and by implementing the relevant orthographic conventions. In the remaining half (2B), the ambiguous segment could be derived only by accessing the morphophonemic information.

In order to determine whether the good and poor spellers differed in their ability to spell these two subclasses, it was necessary to ascertain whether the errors that occurred did indeed involve the segment designated as the ambiguous segment (the "problem segment"). An examination of the errors revealed that, in both groups, 83% occurred on problem segments involving either orthographic or morphophonemic decisions, while the remaining 17% occurred on other segments within these

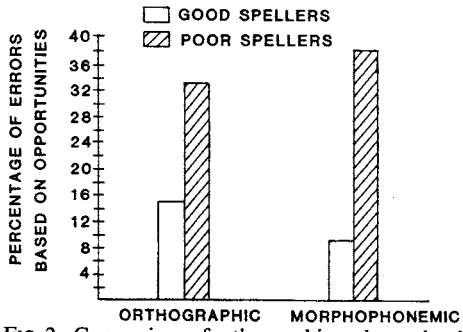

FIG. 2. Comparison of orthographic and morphophonemic errors on level 2 words, good versus poor spellers.

words. The analysis was therefore restricted to those errors that occurred at the critical location. In addition, because two spellings were found to be acceptable for one of the Level 2A words (*cancelled* and *canceled,* Webster, 1963), it was excluded from the analysis, reducing the total number of words to 19.

In Figure 2 the mean percentage of word errors is presented for Level 2A (orthographic) and Level 2B (morphophonemic) words. The data displayed in Figure 2 were analyzed by a two-way analysis of variance in which the between-groups factor was spelling group and the within-groups factor was error type (orthographic or morphophonemic). The dependent variable was the percentage of word errors based on 19 words in Level 2A and 20 words in Level 2B.

Figure 2 shows a wide separation in the performance of the good and poor spellers. Of particular interest, however, is the unequal performance of the two groups on the two categories of words, yielding a significant interaction between group and error type, $F(1,36) = 10.29$, $p < .003$, $MS_e = 51.04$. As would be expected, good spellers made fewer errors than poor spellers both in applying orthographic conventions, *Fisher's post hoc* $t(36) = 7.00$, $p < .001$, and in spelling words involving access to morphophonemic structure, $t(36) = 9.54$, $p < .001$. The more notable result, however, is that good spellers found words involving morphophonemic decisions significantly easier than words involving purely orthographic decisions ($t(17) = 2.73$, $p < .02$), while the poor spellers showed no significant difference in their ability to spell the two types of words, $t(19) = 1.98$, $p > .05$. This suggests that good and poor spellers may differ in their ability to penetrate below the surface phonetic structure to the underlying morphophonemic structure of words. To ascertain whether this finding could be generalized to other words not included in the present list, a second ANOVA was computed using the 39 Level 2 words as the random variable (Clark, 1973); the between-groups factor was word type (orthographic vs morphophonemic) and the within-groups factor was group (good vs poor spellers). The dependent variable was the percentage of errors made by good and poor spellers on each of the words. The analysis indicated significant effects of word type, $F(1,37) = .02$, $p < .05$; group, $F(1,37) = 60.30$, $p < .001$, $MS_e = 162.21$; word by group, $F(1,37) = 6.32$, $p < .001$. As a further step, the min F' was computed. The outcome suggests that the differences observed between the groups in spelling the Level 2A and 2B words extend beyond the particular words used in this experiment, min $F'(1,54) = 5.0$, $p < .03$.

The Contribution of Nonlinguistic Abilities to Spelling Proficiency

So far the findings have suggested that differences in spelling achievement are at least in part associated with differences in apprehension of word structure. It is also of interest to examine the results as they relate to a long-held belief that individual differences in spelling proficiency may reflect differences in visual retentiveness. Two aspects of the data are pertinent to this question. If visual memory skill were the critical distinguishing factor, then the greatest performance difference between the groups should occur in spelling the opaque, Level 3 words, since these presumably have to be learned and recalled by

rote. However, on reexamining Figure 1, one finds that although good and poor spellers did in fact differ in their ability to spell Level 3 words, the magnitude of the difference is smaller than that which occurred in spelling the derivable, Level 2 words. These results suggest that if there are differences between the groups in their ability to recall visual images of word patterns, these differences are of lesser importance than those relating to the understanding of how the orthography maps word structure.

Moreover, if visual memory ability were an especially critical skill in spelling, good and poor spellers should differ in their ability to recognize correct spellings when given alternatives from which to choose. Reexamination of Table 2 suggests that the two groups are not readily distinguishable in this regard. This is confirmed by the finding that the relevant interaction effects were not significant (for group by condition, $F(1,36) = 2.54$, $p > .05$, $MS_e = 2.68$ or for group by condition by level, $F(2,72) = 2.56$, $p > .05$, $MS_e = 2.16$. Thus, on the spelling recognition task good spellers were not significantly better able than poor spellers to profit from visually presented alternatives. While it is quite likely that visual memory plays some role in spelling (especially for Level 3 type words), these comparisons have uncovered no evidence that differences in the ability to access words as visual patterns can account for the sharp differences in spelling performance observed in this study.

Instead, the results of the spelling test suggested that linguistic factors play an important role in spelling. For both good and poor spellers the accuracy with which words were spelled was clearly influenced by the variations in orthographic transparency represented by the three levels of words. Spelling was most accurate in cases where the underlying morphophonemic structure was straightforwardly reflected in the phonetic realization of the word and became progressively more difficult as the relationship between the underlying morphophonemic structure and the written representation became increasingly obscured by intervening phonologic and orthographic rules.

Further evidence that linguistic abilities are critical in differentiating good and poor spellers came from the finding that the two groups were most readily distinguished by their performance on Level 2 words. If rote memory were the critical skill in spelling, Level 3 words should have most sharply distinguished the groups. Indeed, further analysis of the Level 2 errors revealed that poor spellers were less proficient in accessing the underlying morphophonemic structure when it was not clearly reflected in the phonetic realization of the word. This finding underscores what may be an important difference between the two groups: while good spellers found the spelling of words involving access to morphophonemic structure significantly easier than words involving the implementation of orthographic conventions, poor spellers did not.

Experiment 2

The primary purpose of Experiment 2 was to discover whether the abilities that underlie spelling competence are instances of specific learning or whether they are generalizations that can be applied productively to other English words. Specifically, the question addressed was whether college students who differ in their ability to spell familiar words would also differ in their ability to spell pseudowords that conform to the phonotactic constraints of English. The specific spelling skills under investigation included knowledge of the recurrent spelling patterns of English orthography, familiarity with the morphological principles guiding the use of prefixes and suffixes, and ability to use morphophonemic information to disambiguate reduced vowels. The relevance of these skills to other aspects of written language, namely, word recognition and reading comprehension, was also ex-

amined. A secondary purpose of the experiment was to explore the possibility that good and poor spellers differ in their ability to learn and subsequently to recognize nonlinguistic, nonrepresentational visual patterns.

Method

Subjects

The intent was to include the 15 best and the 15 poorest spellers from Experiment 1, but because some of the original subjects were unavailable for Experiment 2, eleven additional subjects were recruited from the original subject pool. The 15 spellers constituting the good speller group all scored more than one standard deviation above the mean on the earlier described Spelling Test of Experiment 1 (mean error score = 23.7); the 15 poor spellers scored at least one standard deviation below the mean (mean = 44.1). The mean WRAT spelling grade equivalent was 13.9 for the good spellers and 10.5 for the poor spellers. Eight of the good spellers and 11 of the poor spellers had participated in Experiment 1.

Stimuli and Procedure

The following tasks, designed to evaluate specific metalinguistic and nonlinguistic abilities relating to spelling, were administered. The 30 subjects were tested in small groups in two 1-h sessions.

1. *Knowledge of Abstract Spelling Patterns.* This task assessed the subjects' knowledge of the 174 principal spelling patterns identified by Hanna et al. (1966). The patterns included 93 consonant patterns and 81 spellings for vowels.

A list of 348 English-like spoken pseudowords was prepared and recorded on magnetic tape. It included two items for each of Hanna's 174 spelling patterns. Pseudowords that adhere to the phonotactic constraints of English were used instead of actual words in order to promote adoption of an analytic mode of processing; that is, to discourage the subjects from responding to items holistically as they might well do in the case of overlearned, familiar words.

Each dictated pseudoword was printed on a prepared sheet. In each a single spelling pattern was underlined. In half of the items the underlined portion constituted an acceptable spelling for the corresponding phoneme and in half an impossible spelling. In each case, the nonunderlined portion was spelled in a manner consistent with English orthographic practice. All 348 items appeared as orthographically acceptable letter sequences regardless of whether the underlined portion was appropriately spelled; that is, there were no letter sequences that do not occur in English. In those items where the underlined spelling was not a legitimate representation of the corresponding phoneme, the presented spellings were confined to the appropriate class of phoneme (consonant or vowel) but never included spelling patterns that could, in any English context, legitimately represent the targeted phoneme.

The tape-recorded stimuli were presented at intervals of 6 s. Subjects were asked to circle "yes" if the underlined portion of the stimulus word was judged to be an acceptable spelling of the target segment or to circle "no" if it was not. Three sample items were administered as a pretest.

2. *Principles of Prefixation* assessed knowledge of how the orthography attaches the prefix to the base word. A list of 60 items was prepared for auditory presentation consisting of three types of words: monomorphemic words (for example, *constable*); words with assimilated prefixes, such as those formed by the addition of the prefix /ad/ to base words beginning with *c, f, g, l, p, s,* and *t* (for example, *accrue, affluence* and *aggravate*), or those formed by addition of /con/ to base words beginning with either *m, l,* or *n* (for example, *committee, collateral,* and *connubial*); and words with prefixes not involving consonant assimilation such as those formed by the addition of the prefixes *mis, dis, contra,*

and *un* (for example, *misshapen, dissimilar,* and *contradiction*).

In order to forestall the possibility that a subject could mechanically partition the initial letters of the word as the basis for dividing the prefix from the stem, without examining the whole word, an effort was made to include words in the list that began with the same phonetic sequence even though different principles of prefixation are involved (e.g., *constable, connubial, concurrent*).

The tape-recorded words were presented at 10-s intervals. Subjects were asked to print each dictated word and to separate the prefix from the base by a dash. They were cautioned that some of the words would not involve a prefix, in which case they were to write a dash first, followed by the spelling of the word. Three examples, with and without prefixes, were given. Items were scored correct if the letter immediately preceding and succeeding the dash was accurate.

3. *Disambiguating Reduced Vowels.* This task tested ability to access and utilize phonological information in representing reduced vowels. The test list was made up of 50 English-like words all of which ended in the unstressed syllables, /ə/*ble* or /ə/*nts*. In some cases the target pseudoword was dictated alone, while in other cases it was preceded by one or more pseudowords phonologically related to the target. In either case, relevant phonological cues were available to assist the speller in disambiguating the reduced vowel in the targeted word. For some of the items the cue was in the relationship of the spoken pseudoword to its "derivative form." The basis of the derivations is, of course, by analogy to actual words of similar structure. For example, given the strings [ĕkstrʌpt, ĕkstrʌpʃən, ĕkstrʌptəbəl], the relationship of [ĕkstrʌptəbəl] to [ĕkstrʌpt] and [ĕkstrʌpʃən] signals the use of the vowel *i* to orthographically represent the reduced vowel in the penultimate syllable of *extruptible* as in the case of the words *corrupt, corruption, corruptible*. In other cases, the phonemic context supplied by the pseudoword itself provided the necessary cue for choosing the correct spelling pattern to represent the reduced vowel. For example, the orthographic representation for the reduced vowel in the penultimate syllable of [kəntrəmIsəbəl] is most likely to be *i* since the pseudoword was formed in analogous fashion from a stem originally occurring in Latin adjectives ending in *ibilis* and later borrowed by English.

Spellings corresponding to each of the tape-recorded target pseudowords were listed, but with omission of the reduced vowel in either the final or the penultimate syllable. The omitted vowel was marked by a blank space in the appropriate location. Beside each pseudoword, two vowel spellings were presented as choices, *a* and *i* for pseudowords ending in /ə/*ble* and *a* and *e* for items ending in /ə/*nce*. The subject's job was to choose the correct spelling for the reduced vowel.

4. *Principles of Suffixation.* To assess mastery of the principles for appending suffixes, a list of 24 pseudowords was prepared for taped presentation along with directions for changing each word into a new word by adding a given suffix. Thirteen English orthographic "rules" were incorporated (for a listing of the rules see Witherspoon, 1973, pp. 282–285).

The items were dictated at 10-s intervals in a standard carrier phrase, which instructed the subjects to change each stimulus item to a related form by attaching a specified suffix (for example, "Change *prin* to *prinnish*"). The answer sheet presented a spelled out version of each pseudoword with space alongside to write the word with the appended suffix.

In addition to the foregoing tasks that were specially prepared for this study several standard tests were also administered.

5. *Wechsler Adult Intelligence Scale (WAIS) Vocabulary Subtest* (Wechsler, 1958).

Subjects were given answer booklets in

which items were printed with a space provided for the subject to write the definition of each stimulus word. Before beginning the task, the examiner read each of the stimulus words aloud.

6. *WRAT Reading Recognition.* Oral reading level was assessed using the reading section of the Wide Range Achievement Test (Jastak et al., 1965). This requires subjects to read aloud a series of progressively more difficult words within a prescribed time limit. The test was administered individually to each subject according to the standard procedure.

7. *Scholastic Aptitude Test Verbal Ability:* (Educational Testing Service). SAT scores, required for admission to the university, were available with the subjects' permission.

8. *Kimura Recurring Figures Test* (Kimura, 1963). A test of memory for abstract designs that do not lend themselves readily to verbal labeling was used to assess visual memory ability. The test was chosen to provide a measure of visual memory, uncontaminated by verbal cues.

The test was administered in the standard manner. Subjects first viewed a set of 10 cards on each of which was displayed a single design. They then were shown seven additional sets of 10 cards each. In each of the latter sets, four of the designs from the original set recur, randomly interspersed with six nonrecurring designs. The task was to identify the recurring figures in each of the seven sets of cards by circling "yes" or "no" on the accompanying answer sheet.

Results and Discussion

Performance on Linguistic Tasks That Pertain to Spelling

As can be seen in Table 3 the general error pattern for the two subject groups was remarkably similar. In both groups errors on vowel patterns accounted for approximately 68% of the total error score while consonant errors accounted for the remaining 32%. But overall, the poor spellers made significantly more errors than did the good spellers in recognizing acceptable spelling patterns for English morphophonemes, ($t(28) = 5.35, p < .001$). The greater difficulty experienced by poor spellers occurred both in identifying consonant patterns, $t(28) = 3.21, p < .01$, and vowel patterns, $t(28) = 5.23, p < .001$.

In segmenting prefixes from base morphemes, poor spellers again demonstrated significantly more difficulty than did good spellers ($t(28) = 3.81, p < .001$). There was no difference between good and poor spellers in segmenting nonassimilated prefixes from their base morphemes, $t(28) = 1.47, p > .05$, but a significant difference emerged in segmenting prefixes involving consonant assimilation ($t(28) = 3.48, p < .01$). The nature of the difficulty encountered by both groups was the same. Errors resulted from a failure to use the double consonant pattern at the juncture of the prefix and the base morpheme (for example, representing *con-nubial* as "co-nubial").

It is of interest to note that although good and poor spellers did not differ significantly in recognizing the monomorphemic words, $t(28) = 1.67, p > .05$, both groups found this aspect of the task difficult. Attempts to segment words not having prefixes (for example, writing *constable* as "con-stable") accounted for approximately 50% of the total error score.

On the remaining linguistic tasks good spellers continued to outperform poor spellers. On the test of suffixation, poor spellers made significantly more incorrect responses than the good spellers ($t(28) = 6.08, p < .001$). Similarly, in representing the reduced vowel in various pseudowords, poor spellers made significantly more errors ($t(28) = 7.29, p < .001$).

In contrast to the sharp differences between the groups on the tasks assessing linguistic ability, no difference in the performance of good and poor spellers was found on the visual memory task, $t(28) = 0.30, p > .05$. This finding suggests that while the

TABLE 3
SUMMARY SCORES FOR GOOD AND POOR SPELLERS ON LINGUISTIC AND NONLINGUISTIC TASKS

Task	Good spellers			Poor spellers		
	Mean error	Standard deviation	Percentage total	Mean error	Standard deviation	Percentage total
1. Abstract Spelling Patterns Test						
Consonant errors	4.7	2.9	32	8.1	2.9	32
Vowel errors	10.0	2.5	68	17.1	4.6	68
Total errors	14.7	4.5	—	25.1	6.1	—
2. Prefixation Test						
Nonassimilated prefixes	2.2	1.9	15.5	3.1	1.3	14.4
Assimilated prefixes	4.1	2.5	28.9	7.9	3.4	36.6
No prefixes	7.9	4.8	55.6	10.6	4.2	49.1
3. Suffixation Test						
Total errors	4.1	1.6		9.8	3.2	
4. Reduced Vowel Test						
Total errors	9.7	3.0		18.8	3.8	
5. Kimura Figures						
Total errors	8.8	4.7		9.3	5.2	

ability to remember visual information may enhance spelling proficiency in some individuals, it may not by itself account for the performance differences observed in this sample of college students.

Performance on Reading and Vocabulary Tasks

It was also of interest to determine whether the two groups of university students could be distinguished on tests of reading ability. Whereas both good and poor spellers demonstrated college level proficiency in reading English words and in verbal scholastic aptitude, good spellers were distinctly superior to poor spellers in both these areas. As shown in Table 4 on the reading subtest of the WRAT good spellers obtained a mean grade equivalent score 2 years above that achieved by the poor spellers (15.3 years versus 13.3 years, respectively). Differences between the groups in reading ability were found both on the WRAT test of oral reading ($t(28) = 3.49$, $p < .002$) and on comprehension of printed text as assessed by the verbal aptitude score on the Scholastic Aptitude Test ($t(28) = 2.57$, $p < .01$). Together these results suggest that the linguistic abilities associated with differences in spelling proficiency may also contribute to differences in broader aspects of skill in written language. The fact that reading ability, as it was assessed on these two measures, was less conspicuously retarded than the spelling performance of the poor spelling group may stem from the fact that reading is a recognition task and, as such, provides more opportunities than are available in spelling for arriving at the correct answer by using contextual cues. The easier demands made by reading may therefore mask the difficulties that more readily surface in written language tasks requiring production.

In contrast, it is notable that no reliable difference between the groups was obtained on the WAIS Vocabulary Subtest, $t(28) = 1.92$, $p > .05$. This finding suggests that performance on a measure commonly used to assess verbal intelligence is not a factor associated with differences in spelling proficiency. Instead, the findings point to a de-

TABLE 4
SUMMARY SCORES FOR GOOD AND POOR SPELLERS ON READING AND VOCABULARY MEASURES

Measure	Good spellers		Poor spellers	
	Mean score	Standard deviation	Mean score	Standard deviation
1. WRAT Reading Grade equivalent	15.3	1.3	13.3	1.7
2. Scholastic Aptitude Test Verbal aptitude	534	75.8	465	66.7
3. WAIS Vocabulary Subtest Scaled score	14.6	1.8	13.5	1.5

ficiency on the part of poor spellers in ability to apprehend the internal structure of words.

As anticipated, the results revealed that good spellers were consistently more sensitive than poor spellers to the structural principles embodied in the English-like pseudowords. Not only were good spellers significantly better in recognizing acceptable spelling patterns for English morphophonemes, they were also more proficient in appending both prefixes and suffixes to words and in using morphophonemic information to correctly represent phonetically neutral, reduced vowels. The finding that good spellers were able to derive the correct spelling for the pseudowords suggests that their earlier success in spelling the real words on the Experimental Spelling Test was not entirely the result of whatever ability they might have to memorize the spellings of specific words. Indeed, it would seem more reasonable to suppose that good spellers have succeeded in abstracting regularities that are instanced in the orthography and have learned to exploit this knowledge when called upon to spell. This finding is consistent with the results of a few studies that have addressed this question (Fowler, Liberman, & Shankweiler, 1977; Hanson, Shankweiler, & Fischer, 1983; Schwartz & Doehring, 1977). The fact that poor spellers performed as poorly on the abstract spelling tasks as they did on the familiar words of the first experiment suggests that they are either less sensitive than good spellers to the uniformities that underlie English orthography or are less apt than good spellers to access this knowledge in transcribing words.

GENERAL DISCUSSION

The misspellings of college students provide insight into the nature of spelling difficulty and offer a means for identifying those abilities that underlie competence in spelling English words. The findings of this investigation suggest that sensitivity to linguistic structure is a critical component of spelling proficiency and may account for much of the variation between otherwise literate adults who differ in spelling achievement. The data presented here revealed that college-level students who differed greatly in spelling proficiency also differed in their sensitivity to various regularities of word structure. Poor spellers were not only less able than good spellers to abstract the orthographic regularities existing at the surface phonetic level of language, but were also less successful in penetrating below the phonetic surface of words to the underlying morphophonemic representations that are captured in a word's written form. Indeed, it was the ability to access and utilize morphophonemic knowledge, both in spelling actual words and in spelling English-like pseudowords, that most clearly differentiated good and poor spellers. The finding that these perfor-

mance differences are found with pseudowords implies that the knowledge that contributes to linguistic sensitivity is of a generalized sort that can be applied to new words.

It was apparent in questioning good spellers that their linguistic sensitivity was often not manifested in an explicit form that could be verbalized. Although, in some instances, individuals could describe the principles underlying their choice of a particular spelling pattern, in many other instances they were unable to explain how their choices were made. This suggests that linguistic sensitivity involves tacit knowledge as well as a more explicit understanding of how written language maps onto its spoken form. By exploiting this knowledge good spellers were able to avoid many pitfalls in spelling that proved to be insurmountable to subjects lacking in this sensitivity, as for example, the representation of reduced vowels and the affixation of prefixes and suffixes to base morphemes.

This investigation suggests that some college students have inadequately learned the principles by which writing represents the language, despite the lack of apparent deficits in reading. Of course, it is not surprising that reading would be easier than spelling, since reading is a recognition task that provides multiple cues and requires only a passive recognition of spelling patterns.

The possibility exists that some poor spellers may be experiencing difficulty not because they are insensitive to the various kinds of regularities existing at different levels of linguistic structure, but because they fail to apply this knowledge in spelling. It would be of interest to determine whether poor spellers could appreciably improve their spelling accuracy after receiving some instruction about how their linguistic competence might assist them in deriving the orthographic representation of words.

It is, of course, unlikely that differential access to linguistic structure can account for all variations in spelling proficiency. Other investigators have found spelling difficulties in some individuals to be associated with underlying deficits in serial ordering ability (Kinsbourne & Warrington, 1964; Orton, 1937; Lecours, 1966) or with dysfunctions in aspects of visual or auditory perception (Critchley, 1970; Boder, 1973). However, these investigations were conducted either on children with developmental dyslexia or on adults with acquired dyslexia following brain damage. Therefore the findings of these studies may be of limited relevance to the questions with which this study is concerned. Although some writers have proposed that individual variation in the spelling proficiency of adults is largely the result of differences in visual memory (Shaw, 1965; Witherspoon, 1973), no evidence of differences related to visual memory was found among the good and poor spellers in this study.

At all events, it is clear that competence in spelling involves more than rote memorization of words. It requires the ability to abstract regularities instanced in word structure at several levels of representation. At the most basic level, it entails abstracting the spelling patterns that stand in approximate correspondence to the phonemes of English. At the morphemic level, it requires learning English morphemes and the conventions for combining morphemes to form new words. At a higher level, it entails learning the phonological rules that map underlying morphophonemic segments to their surface phonetic form. The latter abilities especially are critical for productive use of the orthography and seem to be lacking in many otherwise literate adults who are unable to spell proficiently.

The findings of this investigation serve to emphasize that spelling is not a skill that is fully acquired as a part of an elementary education. Many young adults continuing on in higher education have persistent spelling problems. This study has produced evidence that spelling is not an isolated,

low-level ability, but, like other aspects of writing skill, draws upon a variety of linguistic abilities, which continue to develop with experience, and which may be poorly developed even in highly selected college students. The findings reported here would seem to lend substance to the claim (Chomsky, 1970) that some abilities required for full use of an alphabet are rather late intellectual developments.

Appendix 1: Orthographic and Morphophonemic Generalizations Exemplified in the Level 2A and 2B Words Used in Experiment 1

Level 2A

1. Words of one syllable ending in a single consonant that follows a single vowel double the final consonant before a suffix beginning with a vowel. Examples include: *clannish, strapped, sobbing,* and *thinned.* Witherspoon (1973, p. 282)

2. Words ending in silent *e* usually drop the *e* before a suffix beginning with a vowel. However, words ending in *ce* and *ge,* and a few other words, do not drop the silent *e* before a suffix beginning with certain vowels. Examples include: *changeable* and *noticeable.* Witherspoon (1973, p. 282)

3. Words ending in silent *e* preceded by one or more consonants usually retain the *e* before a suffix beginning with a consonant. Examples include: *sincerely, ninety,* and *definitely.* Witherspoon (1973, p. 283)

4. In American usage, the final *e* is usually dropped before the suffix *-ment* when it is preceded by *dg.* An example is *abridgment.* Witherspoon (1973, p. 284)

5. Final *y* following one or more consonants changes to *i* before the addition of letters other than *i.* Examples include: *flier* and *skies.* Witherspoon (1973, p. 284)

6. Words ending in *c* add *k* before an additional syllable beginning with *e, i,* or *y.* An example is *picnickers.* Witherspoon (1973, p. 284)

7. In combinations with *ful* the second *l* of the word *full* is dropped when the word is used as a suffix. An example is *skillful.* Witherspoon (1973, p. 285)

8. *I* before *e* except after *c,* or when sounded as *A,* as in *neighbor* or *weigh.* Examples include: *disbelieve, beige,* and *unperceived.* Witherspoon (1973, p. 276)

9. Some nouns ending in *o* preceded by a consonant add *es* to form the plural. Others, including most musical terms that end in *o,* add *s* to form the plural. An example is *echoes.* Witherspoon (1973, p. 294)

Level 2B

1. Words of more than one syllable, ending in a single consonant preceded by a single vowel, if accented on the last syllable usually double the final consonant before a suffix beginning with a vowel. Examples include: *preferring, omitted, equipped,* and *regrettable.* Witherspoon (1973, p. 282)

2. When a prefix ends with the same letter with which the root to which it is to be united begins, retain both letters in spelling the word. Examples include: *misspell* and *dissimilar.* Witherspoon (1973, p. 277)

3. When the prefix /ad/ is appended to base words beginning with the letters *c, f, g, l, p, s,* or *t,* the *d* is assimilated and is orthographically represented by the letter beginning the base word. An example is *aggravate.* Webster (1963, p. 10)

4. When the prefix /con/ is appended to base words beginning with either *m, l,* or *n,* the *n* is assimilated and is orthographically represented by the letter beginning the base word. Examples include: *commemorate* and *commiserate.* Webster (1963, p. 164)

5. The identity of reduced vowels within words can often be recovered by relating the word to cognate forms in which the same vowel segment is not reduced. Examples include: *grammar–grammatical, continuance–continuation, inspiration–inspire, repetition–repeat.*

6. If the root forms its noun by the immediate addition of *-ion,* the correct ending is likely to be *ible.* There are, however, exceptions. Examples include: *indigestible* and *inexhaustible.* Lewis (1962, p. 103)

7. If the root ends in *-ns,* the ending is probably *-ible.* An example is *defensible.* Lewis (1962, p. 103)

8. If the root to which the suffix is to be added is a full word in its own right, the correct ending is usually *able.* An example is *regrettable.* Lewis (1962, p. 1)

9. If a two-syllable verb ending in *-er* is accented on the first syllable, the noun ending is likely to be *-ance.* An example is *utterance.* Lewis (1962, p. 13)

10. If a verb ends in *-ear,* the likely ending is *ance.* An example is *clearance.* Lewis (1962, p. 13)

Appendix 2: Word List

Level I	*Level IIA*	*Level III*
1. yam	1. strapped	1. chihuahua
2. inflate	2. skillful	2. onomatopoeia
3. adverb	3. cancelled	3. Fahrenheit
4. vortex	4. picnickers	4. plagiarism
5. cameo	5. abridgment	5. sarsaparilla

6. harp	6. flier	6. hemorrhage
7. terminates	7. changeable	7. sergeant
8. trump	8. sincerely	8. eunuch
9. vacate	9. echoes	9. connoisseur
10. update	10. disbelieve	10. mnemonic
11. vibrated	11. sobbing	11. reveille
12. mandated	12. beige	12. desiccate
13. compensates	13. skies	13. syphilis
14. delimit	14. unperceived	14. pygmy
15. zebra	15. clannish	15. sacrilegious
16. blunder	16. noticeable	16. diphtheria
17. emit	17. ninety	17. hieroglyphic
18. boxer	18. thinned	18. thumb
19. repent	19. basically	19. gnaw
20. intertwined	20. definitely	20. lengthen

Level IIB

21. uncover	1. misspell	21. Wednesday
22. diplomat	2. aggravate	22. soldered
23. retort	3. commemorate	23. talker
24. canister	4. defensible	24. subpoena
25. clustering	5. grammar	25. annihilate
26. undiminished	6. clearance	26. rhododendron
27. terminology	7. inexhaustible	27. kaleidoscope
28. mask	8. utterance	28. pyorrhea
29. manifestation	9. continuance	29. bourgeois
30. definitions	10. prevalent	30. thigh
31. frustrated	11. dissimilar	31. listener
32. expectation	12. preferring	32. slaughter
33. alternate	13. inspiration	33. indebted
34. stimulation	14. omitted	34. climb
35. examiner	15. repetition	35. answering
36. preventive	16. indigestible	36. knock
37. unemployment	17. recommend	37. beautifully
38. punishment	18. regrettable	38. laugh
39. establishing	19. equipped	39. folk
40. electronics	20. commiserate	40. tongue

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