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## Spelling and Morpheme Recognition: An Experimental Study

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### Introduction

This study was motivated by an interest in how educationally derived knowledge (such as knowledge gained with exposure to the written form of the language) may contribute to the development of normal adult linguistic competence. Since most psycholinguistic research utilizes subjects who are either literate or in the process of becoming literate, it would seem to be important to address this issue experimentally.

Since there is (at present) a growing body of experimental evidence that knowledge of English orthography does, in fact, have some effect on the way speakers conceptualize the sound structure of words, it is possible that this knowledge may affect other linguistic judgements as well. In particular, since the English orthographic system is not simply an irregular code of phoneme-grapheme correspondences but also codes some morphological information, as illustrated by such word pairs as *right-righteous*, *grade-gradual*, *major-majority* *sign-signal* etc., it is possible that there may be some relationship between a knowledge of particular spellings and a recognition of certain morphological relationships between words. (Conversely, a perception of derivational relations may play a role in improving spelling performance - or lead to misspellings [as in the notorious case of *pronunciation*]). To date, this topic has been the object of very little empirical research. One of the reasons for this is the current state of psycholinguistic knowledge in the area of derivational morphology.

In terms of linguistic discussions of word formation (derivational morphology), there are some basic problems which have hindered the formalization of a theory. One of these is that of lexical identity, which includes the definition of the "morpheme" and the difficulty of determining morpheme relatedness between words. In psycholinguistic terms, these problems translate into at least two questions which need to be addressed:

- 1) To what extent does the average speaker engage in morphological analysis?
- 2) What are the sources of speakers' morphological knowledge? Can the various sources of morphological knowledge be sorted out?

While linguists can appeal to historical considerations in their discussions of word formation, there are, of course, some rather obvious problems with invoking diachronic knowledge in a synchronic analysis. For example, if words are analyzed etymologically, the word *disease* has two components. However, the contemporary meaning of *disease* bears little relationship to the historical combination of *dis* - and *-ease* (example from Bolinger, 1948). Etymology, in and of itself, is not a very reliable guide to word relatedness, since historically related word pairs can be located anywhere on a gradient from transparent (*love-lover*) to completely opaque (*doff-hacienda*, which are both ultimately derived from a common source, namely, Latin *facere* 'to do'.) (examples from Bauer, 1983).

Since it cannot be assumed that the average language learner has an awareness of historical morphological relationships, empirical investigation is required in order to assess the ability of typical subjects to recognize morphemes or to make judgements about morphological relationships.

This study had a dual objective. The primary interest of the study was to investigate the role of spelling knowledge in morpheme recognition, or, more specifically, to examine the extent to which the ability to recognize morphemes in "derived" words is correlated with the ability to spell these words. The general hypothesis is as follows:

Knowledge of spellings may play a role in the awareness of morphological relationships, particularly for items where there is a clear orthographic connection

but some discrepancy on either or both of the dimensions of semantic or phonetic similarity.

To study "awareness of morphological relationships," it was clear that some new methodological tools were required first of all, that is, an experimental procedure was needed to establish some empirical measure of morpheme recognition (MR). Such a procedure could then be used to probe the differences in perception of derivational relationships between spellers and non-spellers (of particular stimulus items), while controlling for factors such as age and educational background. Since both spelling and MR were being investigated, the experiment consisted of a spelling production task and a morpheme recognition task.

## The Experiments

### TASK 1: SPELLING PRODUCTION

The spelling task was administered to 207 subjects in grades 4 through 7. Data from students who were identified as having obvious language deficits, ESL backgrounds, etc., were eliminated from the study.

The stimulus items were 60 pairs of English words, where one member of the pair was the putative "root" of the second "derived" word. All word pairs involved spelling similarities that could potentially make the morphological relationship clearer than what it would be solely on the basis of phonological/semantic similarity. As well, all were commonly used words whose spelling difficulty ranged from grades 3 to 8.

The final list represented varying degrees of orthographic, phonological and semantic similarity, but was limited to a small number of common affixes. The list also contained a number of etymological compounds (e.g., *breakfast*, *cupboard*, *handkerchief*) and a few word pairs having a dubious or patently false morphological connection (e.g., *draw-drawer*, *price-precious*, *ear-eerie*, *fry-Friday*, *sting-stingy*, *table-vegetable*).

### PROCEDURE

The "derived" members of the word pairs were randomized and dictated to each class. Subjects were asked to attempt the spellings of all words and to indicate (by means of a check) whether they knew the meanings of the words. The spellings of the "roots" were elicited as the last step in the MR task.

### TASK 2: MORPHEME RECOGNITION

Subjects and stimulus items selected for the MR task were subsets of the subject groups (n=207) and stimulus sets (n=60) described above. Because the MR task was rather elaborate and time consuming, the number of subjects and stimuli had to be kept to a practical minimum. In the final analysis, 12 pairs of subjects were chosen at each grade level. At 24 subjects per grade, there were therefore a total of 96 subjects selected for Task II.

The final selection of the stimulus items for Task II involved 2 sets of words: one for the subjects in grades 4-5 (Set 1) and one for the subjects in grades 6-7 (Set 2), as follows:

#### SET I: (Grades 4-5)

awful	cupboard*	necklace
cavity	drawer*	president
creature	electricity	signal
criminal	messenger*	

## SET II: (Grades 6-7)

cupboard*	drawer*	pollution
decision	fabulous	precious
description	knowledge	vegetable
discussion	messenger*	

(\* denotes the items common to both sets)

## PROCEDURE

In order to assess MR, a new “enhanced” technique was developed, incorporating elements from two prior experimental investigations of morpheme recognition (Berko 1958 and Derwing 1976). Each subject was individually interviewed by the examiner in a quiet room at school. All subject responses were recorded, and the directions to the subjects included the following two training examples:

**EXAMPLE 1:** (This example was the word pair TEACH-TEACHER which was taken as a clear, uncontroversial case of morphological relatedness.)

- Q1. (Definition question) What does the word TEACHER mean to you?  
 Q2. (Berko-type question) Why is a TEACHER called a TEACHER?  
 Q3. (CF1) Does the word TEACHER “come from” any other word that you know of?

A. If answer to Q3 is YES:

- Q4. Which word?  
 What does this word mean?  
 Q5. Why do you think so?  
 (If subjects seemed uncertain or were unable to give a reason here, they were asked to confirm/disconfirm with CF2: Do you think that TEACHER “comes from” the word TEACH?)  
 Q6. Did you ever think of this before or did you just think of it now that I asked you about these words?  
 Spell TEACH-----  
 Spell TEACHER-----

B. If answer to Q3 is NO or NOT SURE:

- Q4. Do you know the word TEACH?  
 YES NO  
 What does it mean? Questioning terminated.  
 Spell TEACH-----  
 Spell TEACHER-----  
 Q5. Do you think that TEACHER “comes from” the word TEACH?  
 YES NO  
 Why do you think so? Questioning terminated.  
 Spell TEACH-----  
 Spell TEACHER-----  
 Q6. (Recall question) Did you ever think of this before or did you just think so now that I asked you about these words?  
 Spell TEACH-----  
 Spell TEACHER-----

**EXAMPLE 2:** (This example was the word pair HAM-HAMMER, which was taken as a clear case of non-relatedness: though the two words are similar phonologically and orthographically, they are not related, either historically or synchronically.) The questioning followed the same procedure as

the previous example. Subjects who responded positively to the MR questions were asked the following questions.

1. What does the word HAM mean?
2. Why do you think the word HAMMER comes from the word HAM?  
(None were able to think of a plausible reason.)
3. Do you think HAM is related to HAMMER like TEACH is related to TEACHER?
4. Do you think that the word HAMMER "comes from" the word HAM or do you think that HAM is a different word that sounds the same?
5. Did you ever think before that HAMMER came from the word HAM- or are you just trying to think of a word now?

At the end of this questioning, all subjects had concluded that HAM was not related to HAMMER but was rather a different word that merely sounded the same. This was the only "coaching" or other guidance which subjects received. It was considered essential in the training examples, however, in order to ensure that the subjects were aware of the nature of the task and did not simply think that they were always expected to find a new word within each stimulus word.

After the examiner was satisfied that each subject understood the task, the testing proceeded with the 11 items in the appropriate stimulus set. Each individual testing session lasted approximately 20 minutes.

#### SCORING SYSTEM

Although three alternative systems were devised to score the MR data, a "profile" system was used for most of the analyses. In this system, a subject's responses to each item were coded in terms of a six-point "profile," with a 0 or 1 supplied for each of the six questions outlined previously and summarized for convenience below, with the criterion for a positive response to each shown in parentheses.

- Q1. Definition of derived word. (Does the subject use the "root"?)
- Q2. Berko-type question. (Is the "root" used?)
- Q3. (CF-1) Does the derived word "come from" any other word?  
(Is the "root" indicated?)
- Q4. Does the subject know the "root" word?  
(Confirmed by having the subject define the word.)
- Q5. Subjects were given at least one of the following questions:  
(CF-2) Do you think that the derived word comes from the suggested word?  
(asked if the root was not identified in Q3)  
Why do you think the derived word comes from the word you suggested?  
(asked if root was was identified in Q3)
- Q6. Did the subject ever think of this relationship before?

A subject was assigned a score of 1 for every answer indicative of a "positive" linkage of the derived word with its putative root and a score of 0 for each "negative" response. In all, the following 25 different response profiles were produced from a data base containing 1056 MR responses, and these are arranged here as to high (4-6 correct) and low (0-3) scores (\*denotes isolated cases):

## HIGH AND LOW SCORE PROFILES

<u>HIGH</u> (4-6)	<u>LOW</u> (0-3)
111111	110100
111110	100110
111100*	100100
110111*	010110
110110	010100
101111	001110
101110	001100
100111	001010*
011111	001000*
011110	000111
010111	000110
001111	000100
-----	000000

## ANALYSES AND RESULTS

Data gained from the 96 subjects' responses to the two tasks were analyzed with respect to the two objectives of the study. That is, some analyses were concerned with evaluating aspects of the methodology and studying the inter-correlations among the various parts of the MR test. Other analyses focused on exploring the relationship between spelling knowledge and morpheme recognition. This paper will focus only on these latter analyses.

## DEFINITION OF SPELLING GROUPS

Groups of spellers and misspellers for each stimulus item were defined in terms of a notion of "critical" spelling error. This grouping distinction considered both the spelling of the "root" and the (pre-MR) spelling of the "derived" words. If the spelling of the root and the derived word corresponded, the subject was given a score of "S," indicating that the critical spellings were the same, while a score of "D" was assigned to represent cases where the critical spellings differed. Misspellings beyond the root were considered irrelevant to the MR issue.

There were two categories of spellings that were coded "S." In the first case, the subject spelled the root CORRECTLY, and the initial spelling of the derived word contained all the letters that the derived word and its root have in common. For words like SIGNAL and CUPBOARD the "critical" spelling is the entire root. (Only one root was focused on for compounds, in this case CUP.) For words like CRIMINAL and DECISION, the "critical" spelling is the first four letters which are shared. Thus CUP/CUPBERD, KNOWLGE/KNOW and CRIMNEL/CRIME were all included in the "S" category.

A second spelling pattern which was coded "S" was consistently incorrect spellings. That is, the subject misspelled the root and the derived word in the same way, as in SIGHN/SIGHNAL, NO/NOLADGE, POLUT/POLUTION and CREAT/CREATURE. All other misspellings were coded "D." A few spellings raised some interesting questions. For example, the spelling KNOW/KNOLEGE was coded "D" according to the strict standard, due to the absence of the W in the second word, yet the presence of the silent K in both words suggests that an "S" coding might well have been more appropriate in this case.

In addition to a few such problematic scoring cases, a few items (CRIME/CRIMINAL and CAVE/CAVITY at the grade 4-5 level and TABLE/VEGETABLE and FABLE/FABULOUS at the grade 6-7 level) were eliminated from useful grouping analyses, as the spelling errors involved in these words were mostly of the non-critical variety.

## ITEM ANALYSES

The analyses addressed the question of whether there were any significant differences between the S and D groups, taking a variety of different profiles as definitions of morpheme recognition. For example, a Chi-square test was performed on the groups S and D for the responses YES (a morphological relationship was perceived) and NO (no perception of a morphological relationship was indicated). By the least stringent definition, YES was defined in terms of positive responses to Q4 (knowledge of the root) and Q5 (second CF question), while NO was defined as a positive response to Q4 and a negative response to Q5 (the second "comes from" question). In other words, only subjects who indicated that they knew the potential root were included in the analysis. (Note that one advantage of this particular definition is that the sub-profile in question is characteristic of all but one of the full profiles that correspond to a HIGH (4-6) score on the complete MR test, as can be seen from the complete list of response profiles provided above.) This and the other two profiles used are summarized below in general form, where "1" and "0" have the same meaning as before and "x" indicates that the responses are irrelevant (i.e., free to vary):

	<u>CRITERION 1</u>	<u>CRITERION 2</u>	<u>CRITERION 3</u>
YES =	xxx11x	xx111x	xx1111
NO =	xxx10x	xx011x or xx110x or xx010x	all other profiles

The following items, then, are those for which a significant difference was found between the S and D groups by at least one of the three definitions of MR given above. Some items showed up repeatedly at various levels of significance (especially CUPBOARD, which always showed high levels of significance), while other items showed up in only one or two analyses (particularly the least stringent definition of MR). Note that, for all but one of the items indicated, the spelling of the "root" is completely within the spelling of the "derived" word (the exception is CREATE).

There were a number of stimulus items for which there were no significant differences in MR between the two spelling groups, who responded to these items in similar ways. Basically, two types of responses were identified for these items.

(a) For one group of items, the subjects saw no relationship between the "derived" word and its putative "root." The item VEGETABLE, for example, was a control item whose treatment indicates that spelling alone (in the absence of a semantic connection) was not sufficient for establishing a morphological relationship with the word TABLE. Even a relatively obscure semantic connection can be made more accessible, however, if the orthographic evidence is clear, as indicated by the fact that the spellers were more successful than the non-spellers in recognizing the LACE in NECKLACE, the DRAW in DRAWER, and to some degree, even the CREATE in CREATURE. In the items CAVE/CAVITY, FABLE/FABULOUS and PRICE/PRECIOUS, however, the orthographic evidence is tenuous and the semantic connection appears to be obscure to both spelling groups, leaving little doubt that these words represent distinct lexical items for these subjects (contrary to the assumptions of some linguists).

(b) For a second group of items, subjects (regardless of spelling group) were inclined to agree that the derived word "came from" the putative root, although they may not have considered such a possibility prior to the experiment. This result cannot be taken to indicate that the knowledge of these morphological relationships was gained solely by exposure to the spoken forms and that educationally derived knowledge (such as knowledge of the spelling) played no role, as there are several reasons for suspecting that these factors were of some importance with some of these items.

All of the items that were treated in this manner have a relatively strong (synchronic) semantic connection with their putative roots, although the degrees of phonological and orthographic similarity vary somewhat. It is interesting to note that for the two of the three words in this set for which the orthographic evidence is the most clear (DISCUSSION and SIGNAL, but not ELECTRICITY),

several of the statistical analyses performed yielded differences which reached or closely approached significance, as noted above. For the most part, however, the strong semantic connections seem to be the most important factor, though it is not always sufficient to establish a morphological connection. The profiles for the item CRIMINAL, for example, show that most of the subjects responded positively to both of the “comes from” questions, yet few claimed to have considered any relationship with the word CRIME prior to the experiment. This may be due to the phonological discrepancy (vowel change) between the root and the derived word, combined with the fact that the suffix *-al* may be relatively nonproductive for these subjects. (Note the many English words ending in *-al* which have no obvious synchronic root, such as *royal, loyal, oral, capital, etc.*)

The word MESSENGER was the only item in this group to be presented at all grade levels and, although no differences were found between the spelling groups at any level, the degree of root morpheme recognition for this item increased markedly from grades 4-5 to grades 6-7. This may be indicative of educational experience as a significant factor in the ability to recognize morphological relationships between words.

The words containing the *-(t)ion* suffix were used at the grade 6-7 level only. There were no significant differences between the spelling groups (except for the item DISCUSSION) and, in all cases, two-thirds or more of the subjects claimed to have been aware of the relationship between the derived word and its root prior to the experiment. An examination of the misspellings of these words shows that, whatever the cause of the error, all attempts to spell these words end in either *-tion* or *-ion*, rather than the phonetically plausible *-shen* or *-shun*. This suggests that subjects have some awareness of *-(t)ion* as an affix and the potential for words containing this suffix is increased. This seems to be another case where educationally derived knowledge, particularly knowledge of the orthographic structure of words, can contribute to awareness of derivational relationships.

## Conclusion

This study complements prior research which showed that ordinary language learners do learn some morphological generalizations. This can be most clearly demonstrated in cases where both the phonetic and the semantic similarities between words are obvious and the affixes are regular and highly productive (cf. Derwing 1976). Beyond such “obvious” cases, however, there is little empirical evidence that the morphological awareness of the typical speaker anywhere approximates the linguist’s penchant for detailed morphemic analysis. We found evidence that many words thought to be related by linguists are unrelated for ordinary speakers.

It is clear that the semantic factor is the most important variable in morpheme recognition. (Subjects do not find any relationship between pairs like HAM-HAMMER or TABLE-VEGETABLE, for example). However, this study has provided evidence that the semantic connection can be critically tied to orthographic similarity. If a phonological discrepancy disguises a semantic connection, or if the synchronic meaning of a word bears only a slight relationship to its historical root, *literate* speakers may still accept the possibility of a morphological relationship when it is suggested to them on the basis of spelling support. This was clearly the case with the historically related pairs DRAW-DRAWER and LACE-NECKLACE in this study, for not only were statistically significant differences in MR found between the spelling groups for these words, but it was almost always the case that those subjects who scored YES on the MR task came from the S group. These same tendencies can also be found in the crosstabulations for a number of other items, such as CREATURE, KNOWLEDGE, SIGNAL, and especially CUPBOARD.

A final observation which points to differences in MR between the two groups is that, for a number of items, the S group accounted for many more types of profiles than did the D group. While these profiles did not necessarily correspond to clear cases of morpheme recognition, they did suggest that the spellers at least had different cognitive associations for these items. Consider the following conversation between the experimenter and a seventh-grade speller of the stimulus item:

CUPBOARD (110100).

- E: What does the word CUPBOARD mean to you?  
 S: It’s a little room that contains cups and dishes.  
 E: Why do you think a CUPBOARD is called a CUPBOARD?



- S: (smile) 'cause it's a place where cups board.  
 E: Does the word CUPBOARD "come from" any word that you know?  
 S: No  
 E: Do you know the word CUP?  
 S: Well...yeah (as if to say "of course").  
 E: Do you think that the word CUPBOARD "comes from" the word CUP?  
 S: Uh...Nah.

This subject has clearly capitalized on the potential morphemic information provided by the spelling of the word CUPBOARD, but is still not convinced that this provides a sufficient basis for establishing a morphological relationship between the two words, evidently because the semantic connection is simply too obscure to be taken seriously.

In summary, this study has provided evidence that subjects do make use of orthographic information in analyzing words morphologically, although knowledge of the spelling will not necessarily lead to the perception of a relationship if there is not a reasonably accessible (synchronic) semantic connection to go along with it. We have found evidence that other sources of educationally-derived knowledge can also lead to an increased capacity for morphological awareness. Further empirical investigation and more refined methodological tools will be required in order to gain more insight into the sources of speakers' morphological knowledge and to determine the extent to which speakers actually engage in morphological analysis.

#### Note

<sup>1</sup>The first author, M.L. Smith, gratefully acknowledges travel assistance provided by the Faculty of Graduate Studies and Research and by the Alma Mater Fund of the University of Alberta.

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