SPELLING ERRORS AND PHONOLOGICAL LEVELS OF SPECIFICATION

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ABSTRACT

As shown in a briefer study of a handwritten corpus of American English [1], a large number of spelling errors cannot be explained without reference to phonological representations or operations. In this respect, reduced vowels, which appear to cause spelling errors twice as often as statistically predictable, may provide an indication that neither surface nor underlying representations are fully specified. An experiment designed to elicit spelling errors showed improved performance with words having phonologically informative derivatives. It is hypothesized that the higher level of underlying specification was responsible for lower error rates, an argument in favour of the cognitive value of certain principles of the Under-specification Theory.

INTRODUCTION

In spite of increased attention from psychologists and linguists since the publication of Frith's *Cognitive Processes in Spelling* (1980) [2], the analysis and typology of spelling errors remains a difficult and often confusing subject. One of the reasons for this situation is the fact that no classificatory tool is, so to speak, "theory-neutral". But even within a (traditional) framework, designed for the analysis of dyslexic slips or buffer memory failures, a number of statistical oddities can be discovered, all pointing to a predominantly phonological origin of spelling errors. After a brief presentation of the traditional typology, I proceed to show that surface representations as well as deeper constructs are involved in spelling errors. Unstressed vowels, which provide the majority of letter substitutions in the corpus, serve the argument that underspecification at the underlying level is responsible for the observed graphic indeterminacy. An experiment confirms this point by means of a 2x2 table showing that an increase in underspecification also results in improved spelling performance.

1. ERROR TYPOLOGY

1.1. The corpus

In a previous study [1], I analyzed a corpus of 204 essays, 3 to 4 pages long, written by American students of English as part of their university requirements. The precautions customary with handwritten material were taken to ensure that all collected errors were genuine, even if this meant "losing" a certain number of corrected or ill-written items. This, together with the student population under study, may explain why the corpus yielded proportionally less errors than other comparable bodies of handwritten text [3]. The *American Heritage Dictionary* [4] was used as reference, and all variants therein were considered correct (e.g. *fulfil*, *fulfill*, etc.). 120 essays turned out to contain one or more misspelled words, giving a total of 324. Even among misspellers, the number of faulty words per student varied a great deal (from 1 to 13, with a mean of 2.7), 23% of the subjects being responsible for 52% of the misspelled words.

1.2. Classification problems

The purpose of the study required that spelling errors (rather than misspelled words) be identified and quantified. While 3 separate mistakes can easily be isolated in *definitely* < *definitely* or *dissolutions* < *dissolutions*, this result is less certain in *beaucracy* < *bureaucracy*, and quite impossible to assess in *opportunities* < *opportunities*. A typology based on hypothesized causes [5] seemed open to criticism because of overlapping categories, and methodological circularity. A widely accepted structural classification (cf. [6], [7], [3]) seemed preferable, at least as a quantifying tool. An error was consequently identified each time a letter had been added or deleted, changed or swapped, in the system, the word *beaucracy* < *bureaucracy* could be analyzed as containing 1 Additon, 1 Change and 2 Deletions. Unfortunately, this typology can produce diverging results (with obvious quantitative consequences), a fact not reported in previous research. A misspelling like *imparative* < *imparative* can thus receive as many as 4 different interpretations:

1. im a g i n a t i v e → 2 changes
2. i m a g i n a t i v e → 1 deletion
3. i m a g i n a t i v e → 1 deletion
4. i m a g i n a t i v e → 1 deletion

Figure 1. Four structural analyses of *imparative*.

This difficulty was solved by imposing a certain order on the operations (i.e. Swapping, Change, Deletion, Addition), according to which the more complex structural changes took place before simpler ones. Under this protocol, the four categories could function in a mutually exclusive way, yielding one and only one solution per item (solution 4 in the above example). 415 individual errors were thus unambiguously identified in the corpus, falling as follows: Added : 117, Deleted : 126, Changed : 137, Swapped : 36.

2. THE PHONOLOGICAL BASIS OF SPELLING ERRORS

2.1. The problem of units

Such classifications are not free from presuppositions, however. Let us consider errors like *acheive* < *achieve*, *thier* < *their*, etc. The letter inversion causes them to be identified as Swaps. While factually correct, this solution misses an important point. In effect, out of 650 possible combinations of any two letters, and with a cumulative statistical probability of occurrence of 0.055, e and i were involved in 72% of contiguous Swaps in the corpus... A fact for which no explanation can be offered, unless one ceases to consider letters but graphemes. In this respect, e and i have to be the only English digraphs which are "reversible" without change of phonological value. If letters e and i have indeed been "swapped" on a superficial level, what the subjects actually did was choose the closest graphic solution to represent a given sound.

Many other statistical oddities argue in favour of considering phonological, rather than graphic representations as the operative units in spelling, leaving a small minority of errors (e.g. *convience* < *convenience*, *opinon* < *opinion*, *previus* < *previous*, *psychological* < *psychological*, *television* < *television*, etc.) to illustrate dyslexic or short-term memory mechanisms ("slips of the pen" proper). The level of such phonological representations remains to be discussed.

2.2. Phonetic spelling

Attempts by subjects to represent their actual pronunciation with some degree of phonetic realism are not infrequent in the corpus (e.g. *close* < *clothes*, *identity* < *identity*, *government* < *government*, *help* < *helped*, *informative* < *informative*, *environment* < *environment*, etc.). The suprasegmental tendency of [r] is reflected (*opportunities* < *opportunities*, *structured*, etc.), as well as the schwa deletion in the *C_rV* environment (*differently* < *differently*, *separated* < *separated*, etc.). More generally, the frequent choice of plausible, though visually incorrect, strategies (e.g. *extremely* < *extremely*, *lude* < *lend*, etc.) argues in favour of surface-level driven operations.

2.3. Underlying forms and rules

The reverse tendency, namely the attempt to represent underlying, prederivational forms is also observed (e.g. *embarrass* < *embarrassed*, responsible < *responsible*, *truly* < *true*, etc.).
On the contrary, the remaining 18
(18) primary or secondary stressed vowels
were found to be misspelled because a
varied of heterogeneous reasons:
choice of a plausible digraph (*geerid <
geared; *weened < weaned; *teengers <
teenagers), greek-style etymological
spelling (*styma < stigma); non-
phonological changes (*relaxation,
*intellectual; *prohibition <
prohibition). Clearly, the
only class that presents any kind of
unity is the one hosting the unstressed,
reduced vowels.

3.2. Phonological underspecification

One obvious explanation for this
particular vulnerability of unstressed
vowels would be that the phonetic cues
as to their identity are erased in such an
environment. With unspecified articula-
tory parameters (except for the fact that it
is a vowel), schwa would be character-
ized by zero articulation [9]. Now, this
situation can only arise in two cases:
a) if information has been deleted between
the Underlying Representation and the
surface (with features such as [high],
[low], [back] and [tense] losing their
specification); or b) if the UK never
contained such information. Since
spellers have been seen to rely on deep
forms when they contain phonological
information (cf. § 2.4.), their higher than
normal error rate in unstressed position
may be an argument in favour of case b.
This (cognitive) hypothesis is in
accordance with the Underspecification
Theory [10] [11] [12] which argues on
other grounds in favour of (variable
degrees of) underlying underspecification.
If we are right in postulating some form of
psychological reality to this concept,
any increase in feature specification
should result in improved spelling
performance.

4. LEVELS OF PHONOLOGICAL
SPECIFICATION

4.1. The role of alternations

The fact that phonologically informa-
tive derivations (e.g. informal, informal-
ity; negative, negate, etc.) exist in
a subject’s lexicon should result in such an
increase in specification level. This
hypothesis was tested with the following
experiment. In what was presented to
them as a lexical recall task, American
university students were asked to supply
the missing word in each of 70 unrelated
sentences. All 70 target-words were
words whose unstressed vowels had been
misspelled at least once in the corpus.
The first 40 words (part A of the test)
were chosen so that derivationally related
words, if any, would shed no light as to
the underspecifying form of their reduced
vowel(s). The remaining 30 items (part B
of the test) were selected for the opposite
reason. In this part of the test, the
subjects were asked to fill in the blank
and write down any “word of the same
family” that they could think of.

In part A of the test, the 30 subjects
found 65.6% of the target-words (a total
of 823) and made 56 spelling errors in
unstressed position. In part B, they found
74.9% of the target-words (a total of
652), and made 27 errors of that type.
The error ratio (weighted by the number
of target-words found) was 6.80% and
4.14% for parts A and B, respectively, a
difference which was found to be
significant (p < 0.025).

4.2. Discussion

Though clear, the improvement in
performance should not be exaggerated:
the subjects involved in the experiment
supplied only 60% of the expected
related words; they committed a few
spelling errors in spite of their
knowledge (and correct spelling) of
alternations; on a few occasions, they
spelled the reduced vowel of the initial
word correctly, and misspelled the cor-
responding stressed vowel of the derived
word. All in all, however, they improved
their performance by 39%, which means
that derivational information does help
specify underlying representations.

5. CONCLUSION

The degree of indeterminacy which
remains does not truly reflect the
spellers’ actual performance, however. A
computer program, designed to simulate
the above-described situation [13], still
came up with improbable (and
attested) errors, until additional factors
were taken into account. Among them,
the familiarity of certain affix forms and
the strangeness of others was found to
raise or lower the probability of occurrence
of a given vowel. Phonological
rules themselves bar (or impose)
certain underlying vowels, e.g. after
velar stops (or their softened transforms),
eliminating implausible spelling errors like
*eligible < eligible or *nicotine <
nicotine. Whether such factors increase
the specification of the underlying forms
or on the contrary contribute to
“streamline” underlying representations
remains a matter for theoretical
discussion and, possibly, empirical study.
In the first case, subjects would use
already specified representations as the
basis for spelling; in the second, they
would reconstruct underlying forms,
spelling so to speak “by rule”.

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