THE 'VOWEL-STICKINESS' PHENOMENON: THREE EXPERIMENTAL SOURCES OF EVIDENCE[1]

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ABSTRACT

Data are reported from three independent sources, involving active word-manipulation tasks, substitution-identification tasks and both active and passive syllable boundary tasks. All show a consistent tendency for glides in English to adhere most closely to vowels, followed by /r/, then by /l/, then by nasals, and last by obstruents. Cross-linguistic studies are now underway to test the universality of these findings, as well as formal modeling planned to account for these results.

1. BACKGROUND

We use the term 'vowel-stickiness' to refer to the tendency for some segments to adhere more closely to vowels than others [1]. Though much of the evidence for this phenomenon was conducted under the rubric of 'syllable structure' or 'intra-' or 'sub-syllabic units,' these terms imply a sharply delineated or 'hierarchical' view of syllables that is less well supported by the facts. Experimental evidence for the 'stickiness' notion comes from three distinct sources: production experiments and pattern-identification studies that were focussed on questions of the internal structure of syllables, plus a combination of production and judgment tasks that were directed at the question of syllable boundaries.

2. EXPERIMENTAL WORD GAMES (PRODUCTION TASKS)

Treiman [2,3] used a variety of experimental word games (notably word-blending) to explore the internal structure of English syllables, and Dow strengthened these findings, using primarily a unit-substitution (or deletion) task [4,5]. What all this work demonstrated was that there was more to a syllable than a simple linear sequence of (phonemic) segments. It also purported to show that well-defined 'units' were also involved (such as the onset, the rime, the nucleus/peak and the coda) and that the structure of syllables was not only hierarchical but also (at least for English) right-branching.

One disquieting fact emerged from this early work, however, to complicate the picture. Specifically, in one series of studies [6], Treiman found that the boundary between the nucleus and the coda was less than firm and, in fact, tended to shift in response to the sound class of the post-vocalic consonant involved. Specifically, subjects tended to break VCC syllables before the first consonant if that consonant was an obstruent, but after it if the consonant was a liquid (i.e., /l/ or /r/), whereas the two tendencies were of about equal strength if the first consonant was a nasal. Thus liquids (L) tended to stick with their original vowel in these tasks and

obstruents (O) to split away, with the nasals (N) holding an intermediate position. In terms of their general tendency towards vowel-stickiness, therefore, the order **L > N > O** was observed.

3. SUBSTITUTION-PATTERN IDENTIFICATION TASKS

In order to circumvent the slow and laborious production data-collection methods of these early production studies, we experimented with a new forced-choice judgment technique called the 'substitution-pattern identification task.' In this task, rather than asking subjects to actively replace some part of a syllable (such as the vowel, or an all-obstruent onset or post-vocalic coda) with a substitute segment or string, as Dow had done, subjects were trained instead merely to identify such a replacement. Thus, in a training session, subjects were orally presented with a dozen or so examples of a particular substitution pattern (e.g., replace the vowel by /I/; or delete the onset; or replace the coda by /ps/); then, in the testing phase, the subjects were asked to respond to new word pairs, merely by indicating whether the subsitutions involved were the same ('YES') or different ('NO') in kind to the particular pattern that they were trained on. Reinforcement items from the training set were also regularly interspersed among the test items, in order to remind subjects of the nature of the pattern that they were looking for (see [1,7,8] for details).

What was critical about the test items in this last study was that they all contained either pre- or post-vocalic sonorant consonants, and these were sometimes replaced along with the units in question and sometimes not. Thus, having been trained to replace an all-obstruent coda by /ps/ (as in /vIk/-/vIps/ or /f∧sk/-/f∧ps/), a subject might now be asked whether the nonsense-pair /r ɛlst/-/r ɛps/ illustrated the pattern (where all post-vocalic consonants were replaced) and, somewhere else on the test, also asked whether the pair /r ɛlst/-/r ɛlps/ did (where only the post-vocalic obstruents were replaced, leaving the sonorant - in this case /l/ - 'stuck to the vowel.') Using a slightly modified form of the d' statistic from signal detection theory, the relative tendency of the various sonorant consonants to adhere to vowels was then calculated, taking into account not only correct HITS (involving the nominally correct pattern, where all sonorants were treated as part of consonantal clusters) and MISSES (where such nominally correct substitutions were rejected), but also CORRECT REJECTIONS (where all but the nominally correct substitutions were rejected) and FALSE ALARMS (where nominally incorrect pairs were accepted, i.e., pairs that kept the vowel and associated sonorant stuck together). On the basis of a large body of experimental data for such a task, the following differential tendency was observed, adding the categories G (for the English glides /w,y/) and R (for English /r/) to the ones already discussed, and where data for O came from reinforcement items from the training session:[2] **G > R > L > N > O.** (Other tasks, such as onset deletion and vowel substitution, showed a similar tendency in this study, though the absolute differences were not in all cases statistically significant.)[3]

4. TESTS FOR SYLLABLE BOUNDARIES

Similar effects can also be extracted from the more recent work done on the problem of syllable boundaries by Treiman & Danis (T&D). Relying primarily on a production task of syllable inversion, T&D [10] investigated the problem of where common English disyllabic words were broken that contained only a single intervocalic consonant. Their results (largely confirmed by an associated forced-choice written task) showed that the position of the break depended on a number of factors, including (1) the quality (tense vs. lax) of the vowel in the first syllable, (2) the position

of stress (on first vowel or second vowel), (3) the way the medial consonant was spelled (i.e., with one letter, as in *melon*, or two, as in *gallon*) and (4), most interesting from our current standpoint, the quality of the consonant itself. Most notably, in the case of consonants with singlet spellings in words with initial stress on lax vowels (such as *melon*, *lemon* and *seven*), L showed the strongest tendency to be treated as part of the first syllable, and O the weakest, with N, once again, taking the intermediate position.[4]

Finally, in the attempt to extend this work to typologically diverse languages (see [11] in these proceedings for some initial results for Korean), Derwing sought to develop a simpler technique for syllable division that could be performed by subjects who were not necessarily literate, as well as administered to large groups of subjects simultaneously. The result was a so-called 'pause-break' task, in which subjects were asked to choose which of two or three alternative 'breakings' of a word sounded the 'most natural.' In the case of the English word *melon*, for example, the following three alternatives were offered (where ... indicates the location of the pause):
(a) /m ɛ...l ə ɹ/ (where /l/ is treated as the onset of the second syllable),
(b) /m ɛl... ə ɹ/ (where /l/ is the coda of the first syllable), or (c) /m ɛl...l ə ɹ/ (where /l/ is ambisyllabic). In the English pilot study, 95 speakers were presented with a word-set much like T&D's.[5] All four of T&D's main effects re-emerged, as well as a new factor of the morpheme division. Of chief interest to us here, however, is the now-familiar four-way distinction among R, L, N and O, which the table below displays for words like *herald*, *melon*, *lemon* and *seven*:

Sound Class	S1/Co	S2/On	Amb[6]
R	**.76**	.07	.18
L	**.62**	.19	.19
N	**.52**	.37	.12
O	.29	**.61**	.09

Once again we see the same familiar differential tendency towards 'vowel-stickiness' as before, in this case realized as a tendency for singlet-spelled consonants to stick together with a lax, stressed vowel as part of the first syllable of a word: **R > L > N > O.**

5. CONCLUSIONS

In sum, the 'vowel-stickiness' phenomenon now seems to be quite firmly established, as it has been shown to be manifested in a consistent way across three different methodologies originally conceived for quite different purposes: in productive word-blends, in substitution-pattern judgments, and now in both production and judgment tasks for syllable divisions. Two major questions now remain: (1) to ascertain whether the same pattern holds for other, typologically diverse languages; and, if so, (2) to find a satisfactory explanation for the phenomenon. (It is worthy of note that a tantalizingly similar ordering - variously referred to as the 'sonority' or, inversely, 'strength' hierarchy - has emerged from descriptive linguistics, based on the investigation of both synchronic and diachronic data.) Extensive cross-linguistic work is now underway in our laboratory in search of an answer to question (1), combined with theoretical modeling and testing efforts suitable to satisfy the needs of (2).[7]

NOTES

[1]The research reported here was supported in part by a research grant from the Social Sciences and Humanites Research Council of Canada (No. 410-88-0266), awarded to the first author.

[2]Note that L here now refers to English /l/ alone, as the distinct term R has been applied to /ɹ/.

[3]Using this same technique, the L > N portion of this hierarchy was re-confirmed in a later study [7] for post-vocalic sonorants, which also demonstrated the effect on 'stickiness' of both vowel and consonant quality, much along the lines suggested by Selkirk [9].

[4]In this study, both English /l/ and /ɹ/ were again treated as members of the same class ('liquids') and analyzed together.

[5]Except that the list was modified to include separate samples for both /l/ and /ɹ/, which, as already noted, were collapsed in T&D and treated together as 'liquids.' A few new words (*oily* vs. *doily, sailor* vs. *molar, foaming* vs. *moment*, etc.) were also added to check on the effect of morpheme boundaries.

[6]S1/Co = coda of first syllable, S1/On = onset of second syllable, Amb = both (ambisyllabic). Response proportions are shown for each, with majority responses in boldface.

[7]These include the construction of Markovian and neural network models of our own design, as well as alternatives proposed elsewhere (e.g., [12]).

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