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First International Conference on
Spoken Language Processing (ICSLP 90)
Kobe, Japan
November 18-22, 1990

REAL-TIME EFFECTS OF SOME INTRASYLLABIC COLLOCATIONAL CONSTRAINTS IN ENGLISH

Bruce L. Derwing & Terrance M. Nearey[1]

Department of Linguistics, University of Alberta
Edmonton, Alberta, Canada T6G 2E7

ABSTRACT

This study sought experimental support for the following two proposed collocational constraints for English: (1) that syllable peaks consist of a vowel plus optional sonorant and (2) that the second consonant of a coda must be a coronal. In our experiment, subjects were trained to identify vowel or coda substitutions in words containing only post-vocalic obstruents, then were tested on their ability to identify the same substitutions in words where the first post-vocalic element was a nasal or /l/, which was sometimes treated as part of the nucleus (tense vs. lax vowel) and sometimes as part of the coda (coronal vs. other consonant or cluster). The following significant differences emerged, but only on the two coda tasks: (1) nasals were, in general, more coda-like ('C-sticky') than /l/, (2) nasals and /l/ together were more coda-like after tense vowels than after lax vowels, and (3) they were also more coda-like before single coronal consonants than elsewhere, as expected from the theory.

1. INTRODUCTION

For some time the syllable was regarded in linguistic theory to be a mere linear sequence of phonemic segments, with no internal structure beyond this [1], but recent experiments have shown that intrasyllabic structure is a psychological reality, in the sense that some phonemic sequences tend to "stick together" more cohesively than others, at least in English. Treiman [2,3,4], for example, found that word games involving the manipulation of full onsets, rimes and (to some extent) codas in English were learned with fewer errors than parallel games that involved breaking these units up, and Dow & Derwing [5], using a substitution-by-analogy task, found that English onsets and rimes (and to a lesser extent, codas and vowel nuclei) were significantly easier to manipulate than other, more arbitrary groupings of segments (such as syllable 'heads,' i.e., onsets together with their following vowels, or discontinuous syllable 'margins,' i.e., onsets plus codas[2]). The present experiment was designed to test a set of specific hypotheses about the assignment of sonorant consonants within the English rime.

The main focus of attention in this experiment was the vowel nucleus and its relationship to those sonorant segments that follow it. On the basis of distributional evidence, Selkirk [7] proposed the following two collocational constraints for English that bear on this issue: (1) that syllable nuclei (peaks) consist of a vowel plus optional sonorant and (2) that the second consonant of a coda must be a coronal. According to Selkirk's theory, therefore, a sonorant consonant must be treated as part of the nucleus/peak when it occurs between a lax vowel and a non-coronal consonant (or cluster), but as part of the coda between a tense vowels and a single coronal consonant; either assignment is permitted, however, when a sonorant occurs between a lax vowel and a single coronal consonant. Our experiment was designed to test these hypotheses by searching for real-time, behavioural evidence that English nasals and /l/ were differentially treated as a function of their preceding vowel (tense vs. lax) and/or following consonantal (coronal vs. non-coronal) context; we also wished to confirm our earlier, global finding that nasals were, in general, more obstruent-like (or C-sticky) than liquids, which showed a tendency to be more sonorant-like (or V-sticky) [8,9].

The basic experimental procedure employed here was the same as that used in the just-cited work, which involved what might be called a 'substitution-pattern identification task.' This procedure was the result of our search for an experimental procedure that might yield useful fine-structure information about the internal organization of syllables, while at the same time avoid the laborious subject-by-subject individual testing required of the earlier unit-manipulation studies cited in the first paragraph above. The compromise we arrived at was to teach a specific substitution-pattern to subjects during a training session and then to require them to identify new exemplars of the same pattern during a testing session, thus permitting the training and testing of subjects in large groups simultaneously.

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

[2]Vennemann [6] refers to 'heads' as the 'bodies' of syllables, and to syllable 'margins' as 'shells.'

2. PROCEDURE

In the present experiment, 45 monosyllabic words were systematically selected with post-vocalic nasals or /l/ occurring in one of seven different environments, after either a tense (diphthongized) or lax vowel, and before either a single coronal consonant or a non-coronal (or cluster). Examples of each of these types are shown in Table 1 below.

Table 1. Sample Word-Types

WORD	TYPE
/peynt/	Nas with Vow=T and Ob=[+cor]
/gowld/	/l/ with Vow=T and Ob=[+cor]
/ɔyŋk/	Nas with Vow=T and Ob=[-cor][3]
/flænǰ/	Nas with Vow=L and Ob=[+cor]
/hɔlt/	/l/ with Vow=L and Ob=[+cor]
/kɔŋk/	Nas with Vow=L and Ob=[-cor]
/bʌlb/	/l/ with Vow=L and Ob=[-cor]

Subjects were trained on one of the following two pairs of tasks: (1) to replace a vowel by /I/ (Task IA) and to replace a coda by /s/ (Task IB) or (2) to replace the vowel by /ey/ (Task IIA) and to delete the coda (Task IIB). The training was done with a series of word-pairs that illustrated the substitutions in obstruent environments (e.g., /bʊps/-/bɪps/ (IA), /θɔpt/-/θɔs/ (IB), /vʌst/-/veyst/ (IIA) and /spowdz/-/spow/ (IIB)). For each of the word-types employed (e.g., /flænǰ/ from Table 1), two word-pairs were constructed, one which involved the nominally correct substitution (e.g., /flænǰ/-/flɪnǰ/ for Task 1A, where the vowel is replaced by /I/) and a second which treated the post-vocalic sonorant as though it were also a part of the vocalic nucleus (e.g., /flænǰ/-/flɪǰ/); the corresponding two word-pairs for Task 1B (where the coda is replaced by /s/) would thus be/flænǰ/-/flæs/ (the nominally correct pattern, where all post-vocalic segments are replaced) and /flænǰ/-/flæns/ (where the nasal is included within the nucleus, with the result that only the final segment is replaced). The result was a test consisting of 90 test items, plus 17 reinforcement items taken from the original training list, yielding a test of 107 items for each task. (In virtually all cases, the words that resulted from the substitutions were all nonsense words.) These word-pairs were recorded in a single randomized order, but with a single reinforcement item presented after every five test items, and were presented to subjects in two ordinary classrooms on a high quality portable tape recorder (Turbo Model MS-2070 in one classroom and Fisher Model PH-D800 in the other). All 87 subjects were native speakers of English with no known hearing defects, and all but 11 had no prior linguistic or phonetic training.

When subjects were confident that they understood the nature of the intended substitution, two groups of subjects were tested on each pair of tasks (i.e., four groups in all). Task I (IA or IB) was presented first to the first two groups, followed by Task II (IIA or IIB), and the presentation order was reversed for the other two groups. In all cases, subjects were required simply to respond 'Yes' if the change illustrated was like the target substitution, and 'No' otherwise.

3. RESULTS

Since our procedure required subjects to either accept or reject each stimulus word-pair as an example of a pre-established pattern, it seemed appropriate to analyze our results from the standpoint of classical signal detection theory [10]. Tables 2-5 below show the overall HIT, FALSE ALARM (FA) and d' values for each of the four sub-tasks described above, and for each of the theoretically relevant sub-sets of items on the test: (1) those where the sonorant is preceded by a tense vowel (Vow=T) or by a lax vowel (Vow=L), (2) those where the sonorant is followed by a single coronal consonant (Con = [+cor]) or by a non-coronal consonant or consonant cluster (Con = [-cor], and, finally, (3) those in which the sonorant in question was one of the nasal segments /m,n,ŋ/ or an /l/. The differences for each of the three pairs of d' values are shown in the fourth column of each of these tables, together with significance figures (as determined by randomization tests [11]).

Table 2. Nucleus /I/-Substitution (n=41)

	HITS	FAs	d'	Difference
Vow=T	.814	.203	2.848	
Vow=L	.824	.215	2.839	+.009(n.s.)
Ob=[+cor]	.836	.215	2.922	
Ob=[-cor]	.802	.207	2.746	+.167(n.s.)
Son=N	.816	.216	2.775	
Son=L	.829	.199	2.974	-1.199(n.s.)

Table 3. Nucleus /ey/-Substitution (n=44)

	HITS	FAs	d'	Difference
Vow=T	.785	.177	2.834	
Vow=L	.854	.195	3.184	-.350(n.s.)
Ob=[+cor]	.861	.168	3.425	
Ob=[-cor]	.800	.214	2.685	+.740(n.s.)
Son=N	.815	.190	2.932	
Son=L	.867	.187	3.345	-.431(n.s.)

[3]Syllables with /l/ between a tense vowel and a non-coronal consonant are non-existent in English and so no such words were included on our test. (Note that words with nasals in this environment [such as /ɔyŋk/] are also very rare and that all such syllables are considered by Selkirk to be ungrammatical, as indicated by her proposed constraints.)

Table 4. Coda /s/-Substitution (n=43)

	HITS	FAs	d'	Difference
Vow=T	.785	.277	2.255	
Vow=L	.621	.456	0.667	+1.558(**)
Ob=[+cor]	.820	.291	2.405	
Ob=[-cor]	.479	.535	-0.224	+2.629(**)
Son=N	.695	.348	1.449	
Son=L	.589	.544	0.182	+1.267(*)

Table 5. Coda Deletion (n=44)

	HITS	FAs	d'	Difference
Vow=T	.932	.259	3.667	
Vow=L	.634	.406	0.927	+2.740(*)
Ob=[+cor]	.919	.201	3.811	
Ob=[-cor]	.470	.550	-0.318	+4.129(**)
Son=N	.746	.274	2.053	
Son=L	.636	.584	0.221	+1.832(*)

(**) $p < .01$ (*) $p < .05$ (n.s.) $p > .05$

As can be seen from Tables 2 and 3, none of the three factors (vowel tenseness, consonant coronality or sonorant type) approached significance on either of the vowel-substitution tasks. On the other hand, as shown in Tables 4 and 5, all three factors were significant on both coda-replacement tasks, lending experimental support for the hypotheses under examination here. Evidently, our subjects had a clear enough concept of the notion "vowel" to perform the vowel-substitution tasks at a consistently high level, making only occasional (approximately 20%) and apparently random errors that were not significantly linked to any of the contextual factors under investigation. When asked to replace or delete "everything after the vowel," however, much larger error rates typically ensued, and the additional, non-random portion of the error was evidently influenced by all three of the factors of interest. Thus, by making the task more difficult for subjects, their sensitivity to these factors was made manifest, and in a most dramatic way.

On the coda substitution tasks, therefore, our results show that (1) nasals are, in general, more coda-like (C-sticky) than /l/, confirming our previous finding; (2) nasals and /l/ are together more coda-like after tense vowels than after lax vowels; and (3) they are also more coda-like before single coronal consonants than elsewhere. Though the latter two results are consistent with the two collocational constraints under investigation, the distinction between the nasals and /l/ was not expected from Selkirk's 1982 theory (but cf. [12]); moreover, the lack of sharp, constituent-like boundaries between the peak and coda (as evidenced by the vowel-substitution tasks, in particular) suggests that some theoretical alternatives to a strictly hierarchical model of the syllable will have to be considered (cf. [8]).

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