A Restriction on Minimal Words, or Endings?

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Abstract

Two well-known phonological restrictions in English target lax vowels: a restriction on minimal words, and a restriction on word-final open syllables with lax vowels. The fact that these processes have an overlapping environment (word-final syllables), as well as the same target (lax vowels), raises the question of whether these are the same phenomenon. This study attempts to explore this issue with an experiment based in magnitude estimation, finding that open monosyllables with lax vowels are judged worst, and are qualitatively different from polysyllabic forms with lax vowels.

Index Terms: minimal words, lax vowels, magnitude estimation

1. Introduction

Many languages exercise an absolute threshold on how small lexical words may be, so called *minimality* effects. The discussion of minimality effects in English is closely tied to the notion of vowel quality: the effect requires that all monosyllabic words consist of at least a tense vowel, a diphthong, or a lax vowel with a syllable coda. For example, the words [bi] 'bee', [beɪ] 'bay', and [bæt] are possible words in English, but words like *[bɪ] and *[tɛ] are not [1], [2], [3], [4].

The way that this relates to prosodic morphology is as follows: lax vowels are typically considered monomoraic, and tense vowels bimoraic [3], [5]. Phonetically speaking, the moraic structure of vowels is closely associated with their phonological length, and this is borne out in the experimental literature [5], [6]. For instance, it has been found that the lax vowels [ɪ], [ɛ], [ʊ] and schwa are classed together as significantly shorter in duration than other vowels [7]. While lax low vowels such as [æ] are phonetically long, relative height appears to be much more a factor in determining the phonological length of this vowel [6]. Thus, in English, it is ungrammatical for a word to be anything less than bimoraic [4], [8].

In addition to this minimality effect, there is also an independent restriction on *word-final* monomoraic syllables. That is, lax vowels cannot be word-final in many dialects of English without a coda consonant [4]. The fact that final lax vowels are actively avoided in the phonology of English is illustrated through a process of word-final (or stem-final) tensing [9], [10]: happ[i], cit[i], etc. One exception to this is schwa, which is able to appear word-finally in unstressed instances (such as *banana, alpaca, sonata, vanilla, umbrella*).

Apart from the case of schwa, the surface patterns for what we have called the minimality effect and the word-final effect are essentially identical. This gives reasonable doubt about whether or not this observed minimality effect is really a separate phenomenon from the word-final restriction at all, or if they are the same process applied across different 'sizes' of words. Since a monosyllabic word is by definition also word-final, it stands to reason that the two effects are simply the result of one monolithic word-final effect. In order to address this question, an experiment was designed to test speakers' judgments of existing, possible, and impossible words (given the restrictions above) in various contexts.

2. Methods

The aim of this experiment was to see if there was a difference between the grammaticality judgments of word final syllables with a tense vowel, a lax vowel and schwa. Not all tense and lax vowels were tested; instead, [i] was chosen as a tense vowel, and [ɪ] as a lax vowel, and schwa [ə].

2.1. Procedure and Participants

In order to test for grammaticality judgments, a version of Magnitude Estimation was employed. Magnitude Estimation is a standard method for investigating perception in the fields of psychology and psychophysics [11], [12] (see [13] for an overview), but it has also had relative success in recent years as an experimental method in linguistics [14], [15], [16]. The method demands that subjects, when presented with sensory stimuli, make estimations of the magnitude of those stimuli. This assumes that sensory continua are related to power functions. The method relies on the estimation of a modulus stimulus, with subsequent estimations of stimuli relative to that modulus. The specific method employed in this study is Absolute Magnitude Estimation (AME; [13], [17], [18]), which differs minimally from relative Magnitude Estimation in that it requires subjects to make estimations along an absolute, rather than relative scale. Thus, there is no (recurrent) presentation of a modulus stimulus, and all stimuli are rated independent of each other. There are two reasons for adopting this particular method: First, it attempts to eliminate a range of response biases, including biases introduced by sequential effects. Second, the method provides a more useful way of analyzing what is being measured; here it is judgments of acceptability and how they are a projection of the human perceptual system (cf. [13] for the differences related to measurement).

A total of 25 native English speakers participated in the experiment. Instructions were read to each participant, where they were asked to judge each word, and assign it a numerical value based on its perceived "strength". Participants were informed that they were to use their own preferred scale, and that the only limits on the scale were that it must consist of positive numbers. Participants were asked to judge forms based on their well-formedness (i.e. if they sounded as if they could be a word in English), and not on whether they were existing words of English.

Stimuli were presented in pseudo-random order. Since a modulus word was lacking, subjects were asked to begin rating stimuli in an absolute fashion from the beginning of the experiment. Subjects were aurally presented with word stimuli on a computer monitor in a PowerPoint presentation, after which they were presented with an image of a different landscape for 5 seconds. Each stimulus was presented for 5 seconds. The purpose of presenting subjects with the image between stimuli was to attempt to avoid any kind of sequential bias, where a judgment from previous stimuli might influence the estimation of the next stimulus. This allowed subjects to make judgments about individual stimuli without relating the well-formedness of other stimuli. Participants were given a warm-up period, where they became familiarized with the procedure and with estimating the value for words. The warm-up period consisted of 8 stimuli (all distractor words) used to get participants attuned to the AME task.

2.2. Stimuli

The participants were individually played recordings of sixty-five words spoken by a male adult speaker of American English. Five of these words were warm-up words, thirty were filler words and the remaining thirty were novel words constructed to fill various vowel and syllable structure requirements of interest. The filler words were randomly interspersed with the target words, while still ensuring similar target words were not played sequentially to participants. The five warm-up items were always presented first.

The conditions for the novel items included the number of syllables in a word (in order to test the hypothesis that lax vowels in open monosyllables will yield a judgment profile similar to disyllables with final lax vowels), syllable type (open vs. closed), vowel type (tense, lax, and schwa), and stress (penultimate vs. final). This yielded a total of 30 words (3 vowels x 2 syllable conditions = 6 monosyllables; 6 'bases' x 2 stress positions x 2 polysyllabic conditions = 24; 24 + 6 = 30).

Target syllables were constructed with the voiced stop [d], the target vowel, and were optionally closed with the voiceless stop [t]. Thus, the open monosyllables included [di], [dɪ], and [də], and the closed syllables included [dit], [dɪt], and [dət]. Disyllables were created by adding an extra syllable [ga] word-initially, with the penultimate stress condition preserving this vowel (e.g. [ˈgadit], and with the final stress condition yielding a reduced vowel (e.g. [gəˈdit]). Finally, trisyllabic words were constructed in the same manner, with each of the disyllables augmented with [də] word-initially. The resulting word template is (dV)(gV)dV(t). In addition, in order to test judgments on novel words vs. existing lexical items, a set of words with the same syllable counts and stress patterns to match the novel words was recorded and presented to speakers. Due to recording error, one form was not used, rendering 29 real words total. The set included 6 monosyllabic forms, 11 disyllabic forms (5 with final stress, 6 with penultimate), and 12 trisyllabic forms (5 with final stress, 7 with penultimate). Since there is a great deal of neutralization in post-tonic position in trisyllables for the speaker recording the stimuli, these were not as strictly controlled for vowel quality.

3. Results

Results from 3 participants were removed from analysis, as the scores for nearly every nonce item were at the absolute bottom of the (relative) scale, and where existing words were given scores from an entire range. Data from an additional participant were removed due to the participant's use of only 3 equal levels in their judgment scale. The results from the experiment are presented below. Since the scales used for each participant are different, the total data points for a given stimulus were used to generate a geometric mean, which performs the function of normalization.

Figure 1 presents judgment data for monosyllabic forms. What is obvious from these comparisons is the low rating for open monosyllables with lax vowels. Lax vowels in closed monosyllables, on the other hand, perform even better than closed monosyllables with the tense and lax vowels. In comparison, the open syllables with schwa and tense vowels received scores comparable to the closed syllable condition, with the open/tense condition rating higher than the closed/tense condition. The 6 lexical items tested (all closed syllables for the purposes of comparison) provide a reference point.

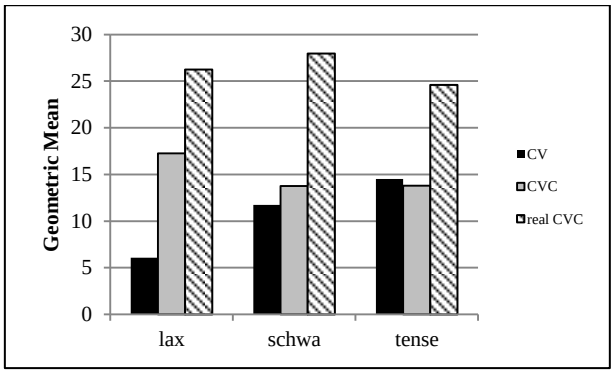

Figure 1: *Geometric means for monosyllables.*

Turning to the polysyllabic forms, the first relevant comparison is with the disyllables with final stress, as these are minimally different from the monosyllables, which also (vacuously) have stress on the final syllable.

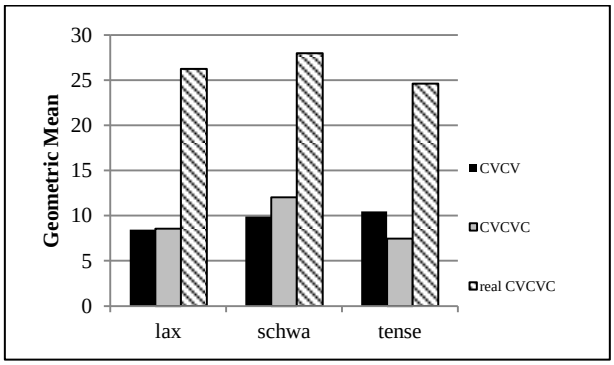

Figure 2: *Geometric means for disyllables with final stress.*

As is evident from the comparisons of disyllables with tense, lax, and schwa in Figure 2, there is virtually no difference between the open and closed syllable condition for a final lax vowel. While there is marginal improvement between the "minimal word" condition (from Figure 1) and the stressed word-final condition for open syllables with lax

vowels, the most notable difference is between closed monosyllabic forms with lax vowels and all other monosyllabic forms with lax vowels. It is also noteworthy that the lax vowels pattern fairly closely with schwa and the tense vowels for this particular condition.

Within disyllables, more substantial differences emerge in comparing the forms with final stress vs. those with penultimate stress, as evidenced in Figure 3.

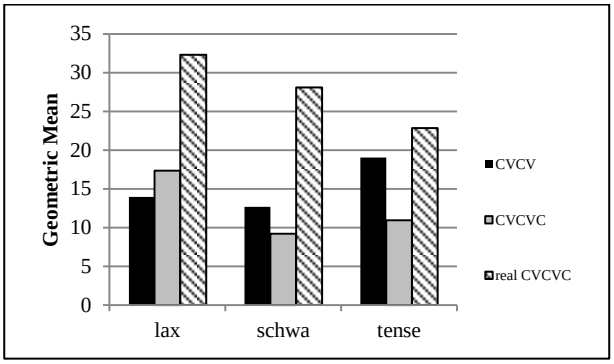

Figure 3: *Geometric means for disyllables with penultimate stress.*

As illustrated in Figure 3, the means for the lax vowels (both open and closed final syllables) are substantially improved. For schwa and the tense vowel conditions, the final open syllables are preferred to final closed syllables. The implication is that overall there is a preference for penultimate stress, especially when this involves final lax vowels; however, there is a peculiarity involving final schwa and tense vowels in closed syllables, the scores of which are substantially lower than those for final open syllables.

Finally, the trisyllabic forms serve as an ideal comparison for determining whether the word-final effect is mitigated by word-length. Figure 4 illustrates scores for trisyllables with final stress. Since vowel quality is not a consistent factor for the existing lexical items, these are not presented along with the nonce forms.

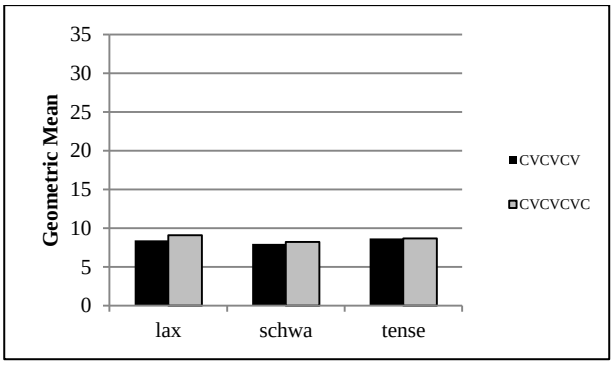

Figure 4: *Geometric means for trisyllabic forms with final stress.*

As is evident from Figure 4, scores for all three vowel conditions are marginal when placed in the context of monosyllabic and disyllabic scores (all having a geometric mean below 10), though there is little difference between vowels, and likewise little difference between open and closed syllable conditions.

Figure 5 presents results for the trisyllabic forms with penultimate stress, and indicates that penultimate stress yields a similar judgment profile for each of the vowel conditions. These numbers are comparable to the final-stress condition, where each of the scores was just under a geometric mean of 10.

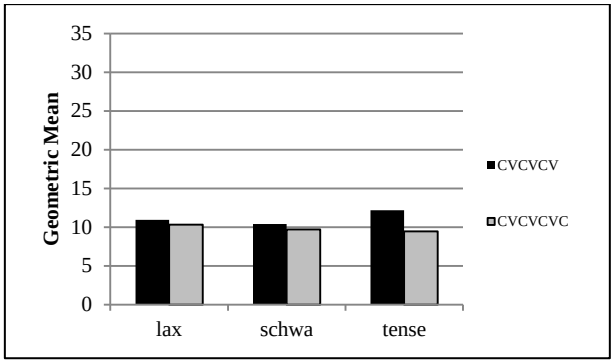

Figure 5: *Geometric means of trisyllabic forms with penultimate stress.*

For the trisyllabic conditions, there seems to be little difference between final stress and penultimate stress. Likewise, there appears to be little difference between the open and closed final syllable conditions, irrespective of the vowel in question.

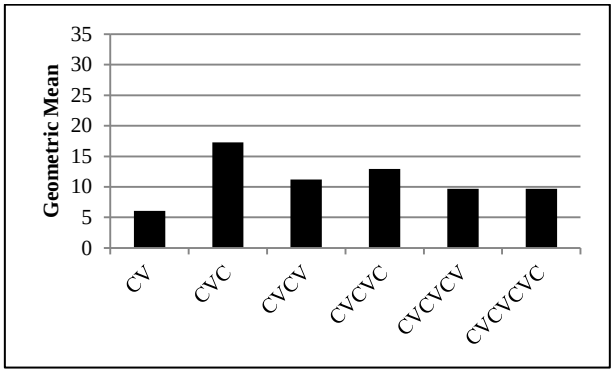

Figure 6: *Geometric means for all lax vowel conditions.*

When all forms with final-syllable lax vowels are compared, as in Figure 6, a few differences can be highlighted. While open monosyllables demonstrably have the lowest scores, these scores are marginally higher for the rest of the forms, aside from the closed monosyllabic condition. This condition has the highest score of all, even higher than the closed syllable conditions for the disyllabic and trisyllabic forms.

A one-way ANOVA was performed to determine whether there was a difference between the open and closed forms with lax vowels. Individual data points were first transformed into standardized scores by subtracting the arithmetic mean and dividing by the standard deviation. Results indicated that there is a significant difference between these conditions for the monosyllabic forms [$F(1,40) = 4.88$, $p < .05$]; however there was no significant difference between open and closed conditions for the combined means (both final and penultimate stress) of the disyllabic forms. This suggests either that there is a difference in perceived magnitude between the minimality and word-final effect, or that word-final tensing has resulted in a lexicon that currently has no word-final lax vowels (i.e. the result of reinterpretation being an accidental gap).

4. Discussion

One of the immediately obvious findings was that, despite the explicit instructions to participants to judge only the phonological well-formedness of a given stimulus, there are vast differences in judgments between existing lexical items and nonce items. An item will be judged by virtue of its being a lexical item. It remains to be seen how this type of judgment would compare across existing lexical items with drastically different type and token frequencies.

In polysyllabic forms, taking stress off the lax vowel improved the word-final open syllable condition. Since neither of these conditions exists with respect to real lexical items (given word-final tensing), this indicates that speakers treat them as reduced vowels. The same is true for the results for schwa and the tense vowels, though these contexts DO exist in real forms (e.g. *abut* vs. *China*, *a bee* vs. *body*). Thus, this appears to be a phonological preference that is allowed to emerge in novel forms. In studies of the syllabification of medial consonant clusters [19], it has been shown that short vowels (i.e. lax vowels) and stressed vowels tended to attract a following consonant into the same syllable. The results for word-final consonants appear to support this, as unstressed vowels are preferred in open syllables. However, the preference for unstressed lax vowels is contradictory in this regard.

While there appears to be a restriction on lax vowels in final open syllables, there is no such restriction on schwa. While schwa patterns similarly to lax vowels in many respects, the results above indicate that there is a substantial difference only for open monosyllables, where schwa does not receive the low scores that the lax vowel does. In many respects, schwa patterns very closely with the tense vowel, including in resisting closed syllables when stress is on the preceding syllable. This suggests that there is no clear-cut distinction, phonetically or phonologically speaking, between full and reduced vowels [20], at least in the context of the tense/lax distinction.

5. Conclusions

This study aimed to test whether the restriction on minimal words in English was qualitatively the same or different from the restriction on word-final syllables with lax vowels. Results from an experiment employing magnitude estimation revealed that (i) nonce forms scored lower than lexical items, (ii) schwa patterns with the tense vowel, and (iii) the restriction on word-final open syllables with lax vowels appears to be superficial, as judgments of these forms are on par with word-final closed syllables. Finally, it should be noted that any restrictions that are present on lax vowels appear to be gradient in nature; while lax vowels generally receive lower scores, there is no context in which a bimodal distribution is present, which would be required to indicate that there is an outright categorical restriction on the distribution of this vowel type.

6. Acknowledgements

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7. References

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