Morphologically Conditioned Lengthening as a Processing Effect

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In a recent article on incomplete neutralization, Roettger et al. (2014:22) question "whether it is really necessary to capture such a small effect in terms of reflexes of abstract linguistic entities." In this presentation, I seek to answer a similar question regarding the phenomenon of morphologically conditioned lengthening. Morphologically conditioned lengthening refers to any situation where (a) vowels before morpheme boundaries (e.g., the vowel of *tacks*) are longer than corresponding vowels in tautomorphemic environments (e.g., the vowel of *tax*), or (b) morphemes (e.g., the [-s] of *tacks*) are longer than corresponding nonmorphemic strings (e.g., the [s] of *tax*). Morphologically conditioned lengthening of the (a) type has been reported for English by Walsh and Parker (1983) and Losiewicz (1992), while morphologically conditioned lengthening of the (b) type has been reported for English by Frazier (2006) and Sugahara and Turk (2009).

The effects reported by these authors are indeed quite small. Frazier found that vowels that precede morpheme boundaries are 7.3% longer than vowels that do not; for Sugahara and Turk, this effect was only 4.7% (16 ms on average). Losiewicz reported an increase of 5 ms for morphemic /-d/ compared to nonmorphemic /d/. Attempts at explaining such phenomena by positing a morphologically sensitive rule of phonetic implementation face hurdles. Hurdle one: If the rule is learned, it follows that the effect must be large enough to be perceptible. Walsh and Parker found that the difference between morphemic and nonmorphemic /z/ was imperceptible, and similar experiments on incomplete neutralization have found that incompletely neutralized segments are imperceptible (Roettger et al. 2014), leading one to be wary of the perceptibility of "small" effects in general. Hurdle two: If the rule is posited to be innate, one has to answer the conceptual question of why such a rule should exist in the first place, particularly if one assimilates morphologically conditioned lengthening of the (a) type to preboundary lengthening in general, as Sugahara and Turk do. Since prosodic cues are generally recognized to aid in aspects of acquisition such as word segmentation and constituent identification, one would think that if any prosodically sensitive rule of phonetic implementation were to be innate, it would be one with perceptual advantages.

A plausible alternative hypothesis for the origin of morphologically conditioned lengthening is that it is a processing effect. It is worth considering an analogy with word frequency effects in production. Several studies have shown that frequent words are more quickly recognized in a lexical decision task than infrequent words are (see, e.g., Forster and Chambers 1973). The fact that frequent words are often *pronounced* with shorter duration than infrequent words are (Whalen 1991, Gahl 2008) can then be hypothesized to be derivable in some way from their quicker activation. Adapting this line of reasoning to the phenomenon of morphologically conditioned lengthening is straightforward. Since it has been shown that there is evidence for online decomposition of words with inflectional affixes (see McQueen and Cutler 1998:sec. 3.2 for a review), morphologically conditioned lengthening could then be derivable from the presence of an extra computational step (i.e., morpheme combination) in online production. Morphologically conditioned lengthening would then be thought of not as a rule of grammar (not part of the speaker's competence) but rather as an inevitable consequence of production (a "performance factor").

To provide evidence in favor of this hypothesis, one can try to show that the degree of lengthening can vary depending on factors that are known to affect processing of morphologically complex words. One such factor is—again—lexical frequency. Alegre and Gordon (1999) showed that, while low-frequency morphologically complex words were indeed stored as separate pieces, high-frequency morphologically complex words were stored as whole words. If morphologically conditioned lengthening were a grammatical rule, we would expect it to apply equally regardless of the word's frequency. But if morphologically conditioned lengthening is an artifact of production, we expect it to be sensitive to frequency: high-frequency morphologically complex words should behave as if they are morphologically simple, and resist morphologically conditioned lengthening. This line of thought was pursued by Losiewicz (1992), but in a somewhat roundabout way, as no single experiment compared the role of frequency in complex versus simple words.

To test the hypothesis more directly, I devised an experiment in which participants were asked to read aloud words of four different types: real simple, real complex, nonce simple, and nonce complex. Complex words had a *-s* suffix, and were matched with simple homophones ending in [z]. The real-nonce distinction was taken to be a logical extension of the frequent-infrequent distinction: if a word has never before been encountered, then it is not possible for it to be stored as a whole. The words were presented to participants within sentences, so that cues such as determiner choice or verb agreement could help participants recognize nonce words as being either morphologically complex or simple.

I predicted that the underlined part of a word such as *sees* would be longer than the underlined part of a word such as *seize*, in line with earlier studies showing (a)- and (b)-type lengthening. I also predicted that there would be a positive interaction between complexity and novelty, such that there would be a greater lengthening effect among nonce words (those where there is obligatorily a computational step of morpheme combination) than among real words (those where there might not be a step of morpheme combination). According to a linear mixed effects model (with complexity, novelty, and their interaction entered as by-subject random slopes, and complexity entered as a by-item random slope), the interaction of complexity and novelty had a positive effect on vowel+coda duration (10.5 ms, SE = 5.8 ms, $t = 1.95$). The 95% confidence interval of this estimate (found with the *confint()* function in R's lme4 package) did not dip below zero, suggesting that the positive effect was not due to chance. An ANOVA comparing this model with one without an interaction term revealed that the model with the interaction term was a significantly better fit ($\chi^2(1) = 4.14$, $p = 0.042$).

While there was no significant main effect of complexity for this model, a nearly significant complexity effect for a model fitted only to the nonce word data (i.e., the data where a complexity effect was most expected) was found (8.7 ms, SE = 4.3 ms, $t = 2.04$; model comparison revealed that the model with the complexity term was nearly a significantly better fit: $\chi^2(1) = 3.58$, $p = 0.058$). The absence of a significant main effect was likely due to the fact that participants were not instructed to pronounce the words at a slow speaking rate as (for example) Sugahara and Turk's participants were. As the size of the effect is roughly in line with what Sugahara and Turk found at a normal speaking rate, I take the lengthening effect to have nonetheless been sufficiently replicated.

The takeaway of these results—particularly the interaction result—is that there is some evidence supporting the idea that morphologically conditioned lengthening is an artifact of processing. While it still remains to come up with an explicit account of how extra duration can be derived from extra retrieval time, I take this data to support a link between the two, making a phonological (i.e., grammatical) explanation unnecessary.

References

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