

Subphonemic durational differences in word-final /s/ induced by morphological categories in German

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Recent research has shown that seemingly homophonous elements show phonetic effects of morphological structure that are unexpected in established models of speech production in which morphology does not play a role in later stages of production [1,2]. Most prominently, the duration of word-final /s/ in English is longest in non-morphemic contexts, shorter with suffixes, and shortest in clitics [3,4]. Studies suggest that these differences emerge from semantic and phonological interactions in the mental lexicon [5,6]. Subsequent research found that such differences are not only produced but also perceived by listeners and able to influence comprehension [7].

Most recently, [8] investigated whether L1 speakers of German were able to exploit such subphonemic durational differences in an artificial language to acquire the morphological categories singular (short word-final /f/) and plural (long word-final /f/). It was found that subphonemic cues were not sufficient to establish morphological categories. This finding, however, comes with one caveat: Similar to English, German knows non-morphemic and plural word-final /s/. If in German word-final /s/ follows the same durational patterns as in English, the artificial language learning experiment asked participants to use durational cues counter to their L1 experience. Thus, the main aim of the present study is to investigate whether subphonemic durational differences exist in word-final /s/ in German and, if so, to determine whether these differences pattern similarly to those found in English.

Following the most recent production study on durational differences in English word-final /s/ [4], an experiment was designed that made use of pseudoword stimuli consisting of either one syllable (CVCs) or two syllables (CV.CVCs), following the phonotactic constraints of German [9]. Each trial was made up out of three consecutive parts. First, the pertinent pseudoword was introduced accompanied by the image of a friendly alien creature, as the pseudowords were meant to be the names of these creatures, e.g. *Das ist ein Daps* ‘This is a daps’. Second, a context was introduced, e.g. *Das Daps beißt in einen Apfel* ‘The daps bites into an apple’. Third, a question was asked, e.g. *Was macht das Daps?* ‘What does the daps do?’. At this point, the speaker produced the answer to the question. Importantly, only one step was visible at a time, ensuring that speakers parsed all content, producing the word-final /s/ of interest. Besides 42 target items per speaker, 21 filler items (11 singular items without word-final /s/; 11 items with *-en* as plural suffix) were used.

Linear mixed-effects regression using the *lme4* package [10] in R [11] was used to analyse the influence of type of /s/ (non-morphemic vs. plural), while at the same time controlling for potential confounds, e.g. preceding and following segment, phonological neighbourhood density [12], following pause, and speaking rate. The analysis of the available preliminary data (20 speakers, 823 data points) revealed that the type of word-final /s/, i.e. non-morphemic vs. plural, showed a significant effect on /s/ duration. That is, non-morphemic word-final /s/ is significantly longer than plural /s/ ($p < 0.0001$; Fig. 1). Due to the stable effect size with increasing numbers of participants (*Cohen's d* = 0.3), we assume that collecting the data of at least 20 further participants (to arrive at 40 speakers as in [4]) will confirm this effect.

The results of the present investigation suggest that [8] indeed asked participants to use subphonemic detail counter to their L1 experience and that subphonemic durational differences caused by morphological categories are not a phenomenon restricted to English. Instead, this phenomenon seems to emerge in other languages with comparable segmental settings as well. Consequently, our findings call into question established models of speech. One framework that might provide insight into the nature of our findings is discriminative learning. Assuming that phonetics is directly influenced by the interrelations of forms and meanings in the mental lexicon, studies on word-final /s/ in English [5,6] already provided evidence that a theoretical approach following this assumption appears to be meaningful in accounting for subphonemic durational differences. Overall, our results add to the evidence that calls for a revision of our understanding of morphological influences on speech production.

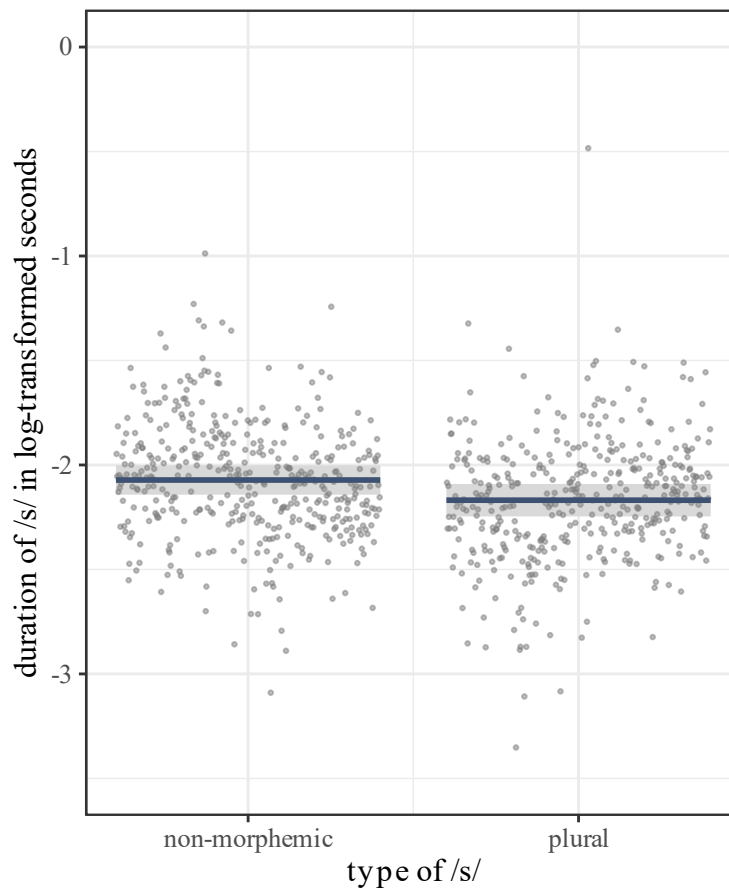


Fig. 1. Effect of type of /s/ (non-morphemic vs. plural) in the linear mixed-effects regression model, fitted to the log-transformed values of duration of /s/

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