Is frequency effect on phonological and phonetic encoding word-based or syllable-based?

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Linguistic predictability is pervasive and has been shown to influence acoustic realization (e.g., Arnon & Cohen-Priva, 2013; Aylett & Turk, 2004). Yet these effects have been mostly focused on a specific linguistic level, rather than across levels. One type of predictability is 'frequency of occurrence', which could occur at the level of word (word frequency) and syllable (syllable frequency). Word frequency effect is assumed to arise from the ease of retrieval, leading to fast response latency (RT). So is syllable frequency effect, arising from a postulated mental syllabary that mediates phonological and phonetic encoding (e.g., Cholin et al., 2006). Although frequency effects manifest in RT and acoustic realization, few studies examine both measures to get a better understanding of the processes that RT and acoustics reflect during phonological and phonetic encoding.

To investigate this issue, the current study examined the effect of high vs. low frequently-occurring monosyllabic (e.g., *Kind* gloss: child vs. *Gift* gloss: poison) and disyllabic words (e.g., *Fehler* gloss: mistake vs. *Feder* gloss: feather) containing a short or long vowel in a stressed syllable in German. Word and syllable frequency were estimated from CELEX and SUBTLEX-DE. High frequency monosyllabic words were manipulated to have low syllable frequency, whereas high frequency disyllabic words covary with stressed syllable frequency. Twenty monolingual German adults were instructed to formulate a verbal sentence in response to an auditory prompt question, incorporating the target stimulus label. Each target stimulus was elicited in 2 utterance positions: medial vs. final. We expect short acoustic vowel duration and fast RT in high frequently-occurring word and syllable. If word and syllable frequency conflict with one another, a serial encoding of phonological/phonetic processes will lead to longer RT for low frequency syllables. Two measures were taken and analysed using lmer (Bates, 2015) in R (R Core, 2022): vowel duration and RT as measured from the beginning of the prompt question to the beginning of the verbal response.

Results of vowel duration revealed a significant 4-way interaction with Word frequency, Number of syllables, Utterance position and Vowel type ($F = 5.1$, $df = 1, 1579$, $p = .02$*). Separate analyses revealed Word frequency effect on short vowels in utterance-final monosyllabic words, but no overall effect in disyllabic words. Low frequency monosyllabic words, despite conflicting high syllable frequency, increase duration of short vowels (Fig. 1). Results of RT revealed significant main effects: Word frequency ($F = 4.5$, $df = 1, 22$, $p = .04$*), Sentence duration ($F = 19.6$, $df = 1, 1233$, $p < .0001$***), and a significant Number of syllable-by-Utterance position interaction ($F = 5$, $df = 1, 21$, $p = .04$*). The number of syllables affects RT as a function of word frequency, with the effect in monosyllabic words (Fig. 2). In light of the interaction, RT is faster for low frequency monosyllabic words which have conflicting high syllable frequency, suggesting RT to be primarily driven by syllable frequency during phonological/phonetic encoding. In sum, acoustic duration and RT reflect separate frequency effects at word and syllable level.

(word limit = 498/500)

Figure 1. Vowel duration (ms) in disyllabic and monosyllabic words containing a long or short vowel with high vs. low word frequency in utterance-final vs. medial positions, with +/- 1 SD

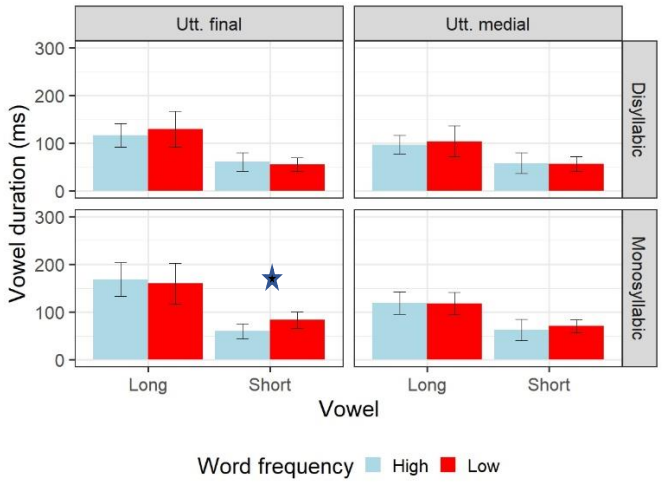
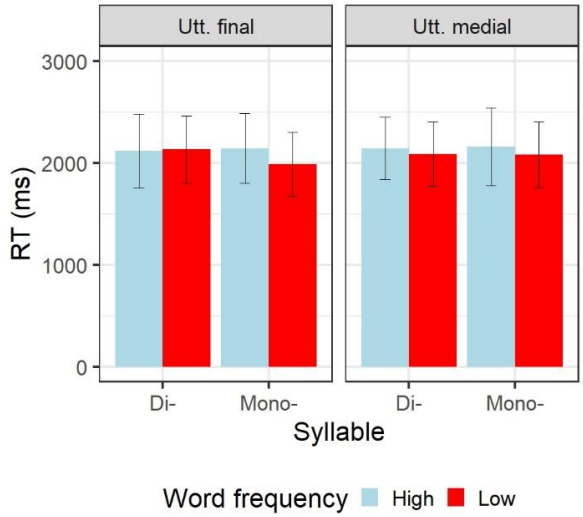


Figure 2. RT (ms) in disyllabic and monosyllabic words with high vs. low word frequency in utterance-final vs. medial positions, with +/- 1 SD



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