Cross-linguistic studies of allophonic durational differences

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Introduction

Are phonetic vowel length changes processed equally in English and Bengali?

Many languages use vowel length as a lexical contrast.

e.g., in Finnish /tuli/ 'fire' vs. /tu:li/ 'wind'

Previous studies in Finnish have shown reliable MMN responses to vowel length (e.g. Kirmse et al., 2008; Jaramillo, Alku & Paavilainen, 1999). These studies find a difference in the MMN response to shortened and lengthened vowels, where shorter vowel deviants elicit later and larger MMN responses than longer vowel deviants.

We examined post-lexical vowel change in both Bengali and English. Phonologically, Bengali has consonant length but not vowel length whereas English has vowel length that is associated with quality changes (e.g., bit vs. beat) but not consonant length.

In both Bengali and English, vowels in the context of monosyllabic words are phonetically long in comparison to vowels in polysyllabic words. But in English vowel length also changes post-lexically in the context of a following voiced or voiceless consonant, e.g. bit vs. bid. Vowel duration is longer before voiced consonants and shorter before voiceless consonants.

Methods

Two groups of participants:

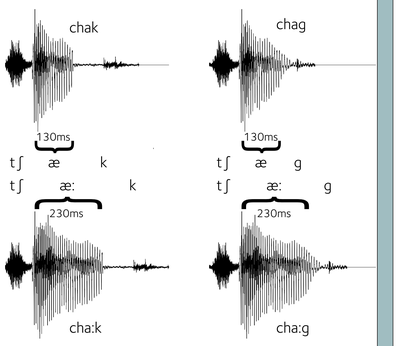
- 28 native speakers of Bengali at Gokhale Memorial Girls' College (Calcutta)
- 20 native speakers of British English at the University of Oxford (UK)

Standard-deviant-reverse presentation:

- Compensates for possible increase in perceptual intensity related to longer duration stimuli.

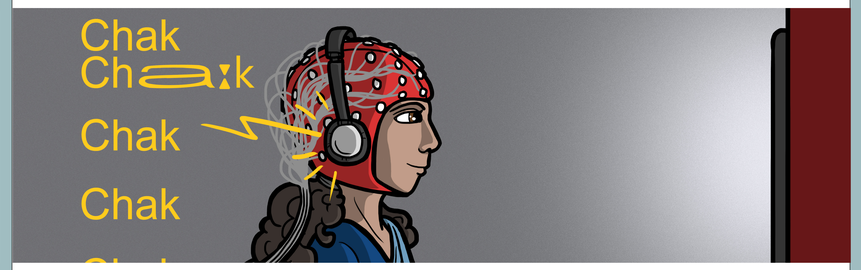
MMN responses time-locked to the start of the vowel.

Responses elicited to vowel length deviants within final consonant type.

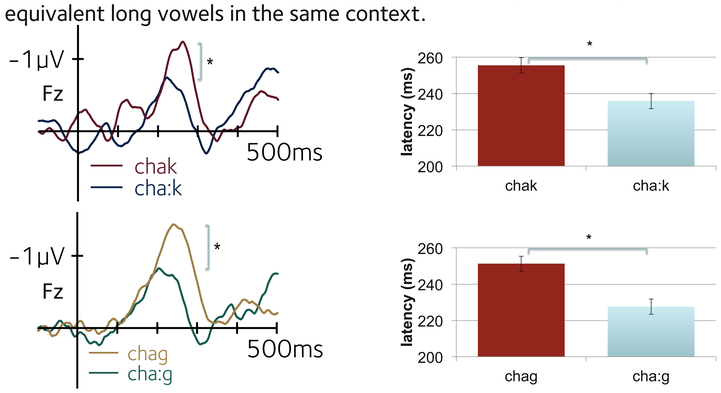


Acoustic waveforms of nonword stimuli presented to both groups of listeners. Within a condition (e.g., chak – cha:k), stimuli vary only in vowel length.

Bengali MMN



In Bengali, in both the context of a following voiced and unvoiced consonant, short vowels elicited higher amplitude and longer latency MMNs than equivalent long vowels in the same context.



Bengali listeners' MMN responses to changes in vowel length. Statistical analyses calculated on frontal region of interest (AFz, Fz, FCz, Cz).

Bengali MMN Discussion

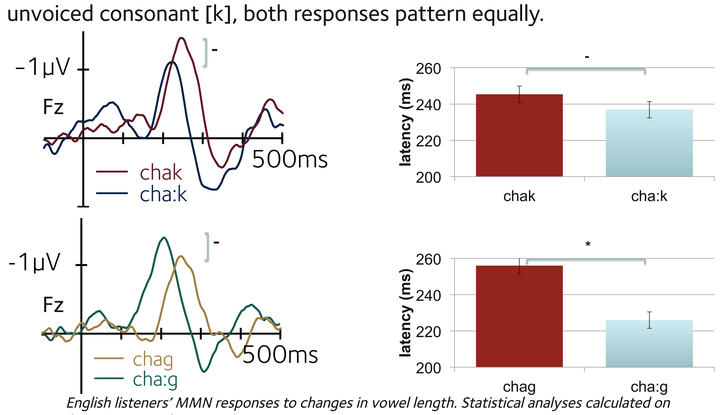
It is often assumed that vowel length changes before voiced / voiceless consonants are a language universal (e.g. Maddieson 1996). However, our results find no evidence for consonant related phonetic vowel length change in Bengali monosyllables.

Both the change in amplitudes and the latency differences show that in the context of a monosyllabic nonword, short vowels are not accepted and long vowels are accepted, regardless of the voicing of the following consonant.

While the contrast studied here is phonetic, these results pattern in the same way as phonemic vowel length distinctions in Finnish (e.g. Jaramillo, Alku & Paavilainen, 1999). This suggests that even when a language doesn't have a phonemic vowel length contrast, length is still used in accessing word meaning. This also supports the effect seen in Roberts, Kotzor, Wetterlin & Lahiri (2014) that reducing the duration of a speech sound within a word can prevent lexical access.

English MMN

In English, a latency difference is seen between long and short vowels in the context of a following voiced consonant [g]. However, in the context of an unvoiced consonant [k], both responses pattern equally.



English listeners' MMN responses to changes in vowel length. Statistical analyses calculated on frontal region of interest (AFz, Fz, FCz, Cz).

English MMN Discussion

There are two opposing theories for the voicing related vowel length rule:

Pre-lenis lengthening (e.g. Chomsky & Halle, 1968) assumes vowels are lengthened in the context of a following voiced consonant.

Pre-fortis clipping (e.g. Wells, 1990,1995; Walsh & Parker, 1981) assumes vowels are shortened in the context of a following voiceless consonant.

While some researchers consider these rules to coexist within a language (e.g. Kiss, 2013), we assert that only one rule is required to explain the pattern seen in our data.

Our results support a pre-lenis lengthening rule, with a short vowel treated as unacceptable in the context of a following [g], but find no evidence of a pre-fortis clipping rule as both vowel lengths were treated equally in the context of a following [k].

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Selected References

Chomsky, N. & Halle, M. (1968). *The Sound Pattern of English.* New York: Harper and Row. **Jaramillo**, M., Alku, P., & Paavilainen, P. (1999). An event-related potential (ERP) study of duration changes in speech and non-speech sounds. *NeuroReport, 10(16),* 3301-3305. **Kirmse**, U., et al. (2008). Modulation of the mismatch negativity (MMN) to vowel duration changes in native speakers of Finnish and German as a result of language experience. *International Journal of Psychophysiology, 67(2),* 131–43. **Kiss**, Z. G. (2013) Measuring acoustic correlates of voicing in stops and fricatives In: Szigetvári Péter (ed.): VLlxx. Papers presented to László Varga on his 70th birthday. **Maddieson**, I. (1996). Phonetic Universals. In Laver & Hardcastle (Eds.) *Handbook of Phonetic Sciences.* Oxford: Blackwells. **Roberts**, A.C., Kotzor, S., Wetterlin, A., & Lahiri, A. (2014) Asymmetric processing of durational differences – electrophysiological investigations in Bengali. *Neuropsychologia, 58,* 88-98. **Walsh**, T., & Parker, F. (1981). Vowel length and voicing in a following consonant. *Journal of Phonetics* 9:305-308. **Wells**, J. (1995). *Pronunciation Dictionary* (Eighth Edition). Longman. **Wells**, J. (1990). Syllabification and allophony. In *Studies in the pronunciation of English, A commemorative volume in honour of A.C. Gimson.* London & New York: Routledge.

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