

Segments, syllables and speech tempo perception

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Studies of speech tempo commonly use syllable or segment rate as a proxy measure for perceived tempo. In languages whose phonologies allow substantial syllable complexity these measures can produce figures on quite different scales; however, little is known about the correlation between syllable and segment rate measurements on the one hand and naïve listeners' tempo judgements on the other.

We report two experiments that follow up on the findings of a relevant study on German (Pfitzinger 1999), which suggest that listeners attend to both syllable and segment rates in making tempo estimates, through a weighted average of the rates in which syllable rate carries more weight. In Experiment 1 we manipulated phonological complexity and utterance duration in English utterance pairs such that pair members were constant in syllable rate but different in segment rate. An example pair is *this kit or that pack ~ this test or that step*, in which the nouns in the second utterance contain more segments than those in the first: on a constant utterance duration, this means the two utterances have the same syllable rate, but the second has a higher segment rate. Listeners decided for each pair which utterance sounds faster. For comparison, Experiment 2 kept segment rate constant, while varying syllable rate. An example pair is *I kept it the wrong way ~ I cook them my own way*, in which the utterance duration differed – and the syllable rate with it – to accommodate a one-segment difference. For both experiments, we manipulated durations through PSOLA, and also equalised pitch contours and average intensity across stimuli.

Our results show that when confronted with utterance pairs in which syllable rate is kept constant, listeners mostly perceive no difference in tempo. The differences they do perceive cannot be straightforwardly explained with reference to the segment rate of the utterances involved, but point at the relevance of acoustic and rhythmic factors. Notably, the failure to perceive tempo differences occurs even when segment rate differences are substantially beyond the Just Noticeable Difference for temporal variation (Quené 2007). By comparison, when segment rate is kept constant, listeners still consistently perceive even small differences in syllable rate as differences in utterance tempo.

One implication of our findings is that the use of segment rate as a measure of tempo on short stretches of speech that are similar in syllable rate but variable in phonological complexity may overestimate the degree to which listeners perceive tempo differences between the stretches.

References

- Pfitzinger, H. 1999. Local speech rate perception in German speech. *Proceedings of the Fourteenth International Congress of Phonetic Sciences*, 2, 893-896.
- Quené, H. 2007. On the just noticeable difference for tempo in speech. *Journal of Phonetics*, 35, 353-362. doi: 10.1016/j.wocn.2006.09.001.