

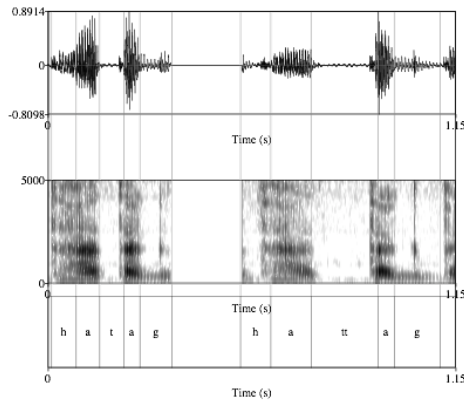
Perceiving Length Contrasts: The Role of Amplitude Drop

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Introduction

Some languages contrast short consonants and long consonants (a geminate contrast). Geminate consonants are characterized by long consonantal duration.



Arabic short [t] and long [tt]

In order to perceive duration of consonants, a listener has to detect the segmental boundaries between the consonants and surrounding vowels.

Question: How do human listeners detect segmental boundaries, which is necessary to perceptually calculate the duration of segments?

- Kato et al (1997) suggest that listeners use amplitude drop to locate segmental boundaries.

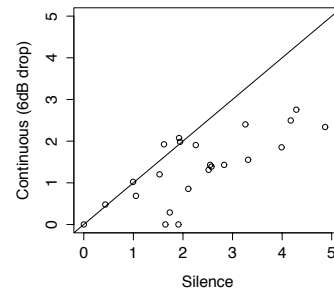
- Kawahara et al (2011) showed that spectral discontinuity makes the perception of duration easier.

Objective: The study tested how spectral discontinuity and amplitude drop contribute to the perceptibility of geminates.

Results

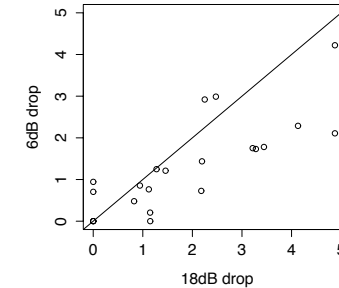
Experiment I

Detectability index (d')



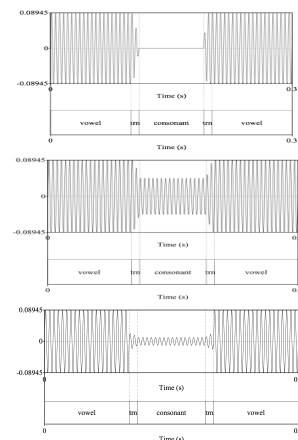
Experiment II

Detectability index (d')



Method

Stimuli consist of sine waves that mimic speech sounds in VCV structure. Vowels=70dB.



Consonant I=Silence;
(0dB; 70dB drop)
Discontinuous

Consonant II=64dB
(6dB drop)
Continuous

Consonant III=52dB
(18dB drop)
Continuous

The task: Same-different discrimination task.

Stimuli pairs: SS, LL, SL, LS. Short=80ms with 10 ms transitions; Long=145ms with 10ms transitions.

Experiment I compared the silence condition and the 6dB drop condition (22 participants). Experiment II compared the 18dB drop condition and 6dB condition (21 participants).

Analysis: d' (detectability index)

Discussion

Experiment I: In the first experiment, we replicated Kawahara et al.'s (2011) result: length contrasts of consonants that are spectrally continuous with surrounding segments are more difficult to discriminate.

Experiment II: Given two spectrally-continuous conditions, the length consonants of consonant intervals that involve less amplitude drop are more difficult to discriminate.

Answer: Both spectral discontinuity and amplitude drop facilitates the perception of segmental boundaries.

Amplitude drop accounts for both results; spectral discontinuity may be an extreme case of high amplitude change.

Future Research: What about a consonant that involves spectrally discontinuity but involves little amplitude change (fricatives)?

References

- Kato, Hiroaki, Minoru Tsuzaki, and Yoshinori Sagisaka. "Acceptability for Temporal Modification of Consecutive Segments in Isolated Words." *Acoustical Society of America* 101.4 (1997): 2311-322. Print.
Kawahara, Shigeto, Melanie Pangilinan, and Kelly Garvey (2011) Spectral continuity and the perception of duration: Implications for phonological patterns of sonorant geminates. Submitted.