

What is the domain of domain initial strengthening in American English?

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Overview

- Domain Initial Strengthening (DIS)
 - as articulatory phenomenon
 - behavior of vowels and consonants
- Production study (ultrasound) of DIS in vowels
 - comparison of vowels in C-initial and V-initial syllables
 - comparison of three prosodic domains
- Results
 - vowels do undergo DIS

Introduction

- Prosodic structure is established phonetically by:
 - **marking the boundaries** of prosodic domains (initial vs. final)
 - **marking prominence** within these domains (word stress, phrasal accent, etc.)
(cf. Beckman & Edwards, 1994)
 - realized via f₀, duration, articulatory **magnitude of speech gestures**

Introduction

- **Boundary-marking:**
 - (a) I've heard, Mary thought, that the movie is good.
 - (b) I've heard Mary thought that the movie is good.
 - (c) I've heard Mary.

Introduction

- (a) I've heard, Mary thought, that the movie is good.
(b) I've heard Mary thought that the movie is good.
-
- The [m] in 'Mary' is articulated stronger in (c) when IP initial vs. (d) AP(= iP) initial.
 - The vowel [æ] in the domain initial syllable, however, is reported **not** to be stronger in (c) compared to (d). (Fougeron & Keating, 1997; Cho, 2005)

Introduction

- In **boundary marking context:**
 - consonants in domain initial syllables strengthen cumulatively (Fougeron & Keating, 1997; Byrd & Salzman, 1998; Keating et al. 2003)
 - vowels strengthen in domain final syllables but seem not to show strengthening in domain-initial syllables (Fougeron & Keating, 1997; Cho, 2005; but see Cho, 2004)

Introduction

- Why asymmetry between vowels and consonants in domain initial position?
- Two possible scenarios:
 - A: **Segment identity** – only consonants, but not vowels are produced with greater magnitude domain-initially
 - B: **Segment position** - only the initial segment (consonant or vowel) are produced with greater magnitude domain-initially

Introduction

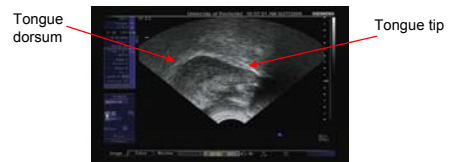
- How to find out?
 - Compare vowels in domain-initial CVC syllables to vowels in domain-initial VC syllables.
 - Problem:
 - Stimuli in previous studies consisted of CV syllables only (Fougeron & Keating, 1997; Cho & Keating, 2001; Keating et al. 2003; Cho, 2005).

Introduction

- Questions addressed in current study:
 - 1) Are vowels in domain-initial V-initial syllables articulated stronger than those in C-initial syllables?
 - 2) Can the magnitude of the vowel gestures distinguish between different levels of the PH?
- Questions will be answered by investigating:
 - articulation of the English vowels [ɛ] and [ɔ]
 - in consonant and vowel initial syllables
 - domain-initial in three different prosodic environments
 - using ultrasound

Method

- Why use ultrasound?
 - well suited to investigate vowels
 - EPG: measures contact of tongue with palate (Fougeron & Keating, 1997)
 - EMA: tracks flesh-points on tongue (Cho, 2004; 2005)
 - Ultrasound: images tongue surface



Method

- Subjects:
 - eight native speakers of American English (5 female, 3 male)
- Stimuli:
 - sentences with investigated vowel occurring either in a domain-initial CVC or VC syllable
 - vowels occurred in three prosodic environments: (Intonational Phrase (IP), Accentual Phrase (AP), and Phonological Word (Wd))

Method

Example:

	V-initial	C-initial
IP	That's <u>interesting</u> . Auk is a <u>sea</u> bird.	That will <u>interest</u> him. <u>Caulk</u> is a <u>sealant</u> .
AP	Silk, <u>auk</u> , and bolus are <u>rare</u> words.	Sill, <u>caulk</u> , and bolus are <u>rare</u> words.
Wd	The silk <u>auk</u> <u>won't</u> survive the winter.	The sill <u>caulk</u> <u>won't</u> survive the winter.

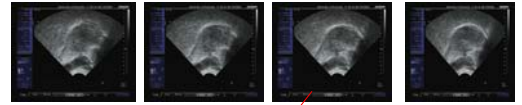
Method

- Procedure:
 - each speaker produced **6 repetitions** of sentences while tongue movements were scanned (Antares Sonoline) at 29.97 fps

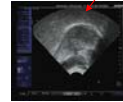


Method

- Analysis:
 - recordings of target vowels were extracted as sequence of JPEG images:

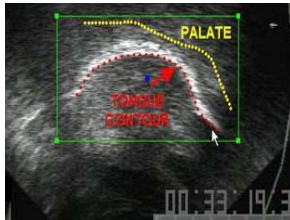


- frame of most advanced position of tongue body for investigated vowel was selected (cf. Benus & Gafos, 2007)



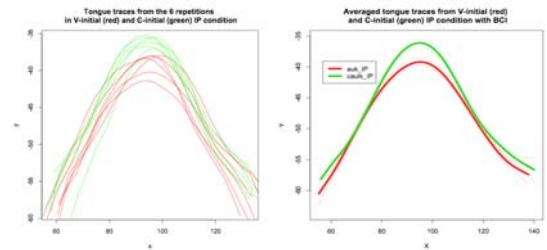
Method

- Curvature of tongue in target frame was traced using EdgeTrak (Li et al., 2005)



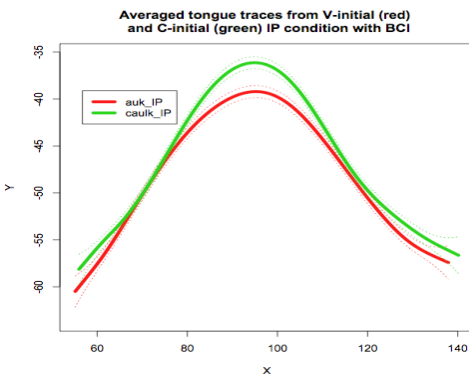
Method

- Analysis (cont.):
 - Tracings of the 6 repetitions were averaged and compared using assist package (Wang & Ke) in R



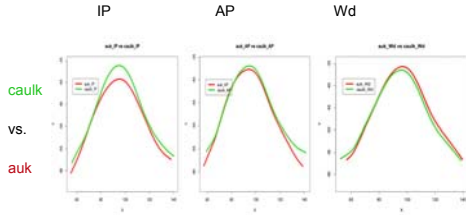
Method

- Analysis (cont.):
 - Data were analyzed for each participant by comparing:
 - vowel gestures in VC to CVC condition in all three prosodic domains (auk vs. caulk)
 - vowel gestures in each prosodic domain to the corresponding vowel in the two other prosodic domains (auk in IP vs. AP vs. Wd)



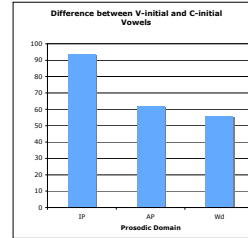
Results

- Are vowels in V-initial syllables articulated stronger than those in C-initial syllables?



- Vowel in "auk" shows more displacement (=lower)

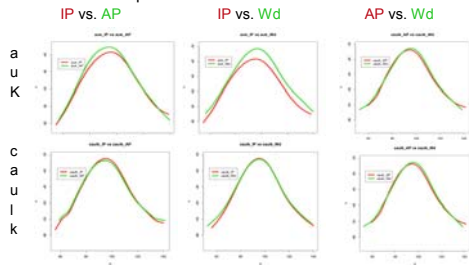
Results



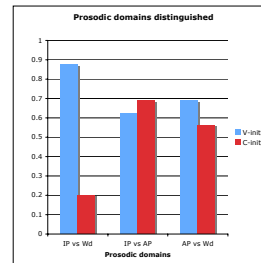
- Vowels in V-initial syllables were more likely to be **articulated stronger** if they occurred in a **higher prosodic domain**

Results

- Does the magnitude of the vowel gestures distinguish between the three different prosodic levels?



Results



- If **vowels are domain initial**, articulatory magnitude of vowel gesture can distinguish well between the different prosodic domains.
- If **vowels are preceded by a consonant**, two different levels are still distinguished, but the effect is not cumulative.

Conclusion

- Position (1st vs. 2nd segment) rather than segment type (vowel vs. consonant) determines domain-initial strengthening
 - Domain-initial strengthening is highly local (cf. also Fougeron, 2001 for French)

Conclusion

- Domain-initial strengthening of vowels (just like that of consonants) can distinguish up to three different prosodic levels depending on
 - position of the vowel within the domain initial syllable (VC vs. CVC)
 - speaker
- What's next?
 - Can listeners exploit DIS as perceptual cue to phrasal boundaries?

Acknowledgement

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Thank you!