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Gestural Coordination in Non-Native Onset Clusters: An Electromagnetic Articulography Study

Hung-Shao Cheng[1], Matthew Masapollo[2], Christina Hagedorn[3], Adam Buchwald[1]

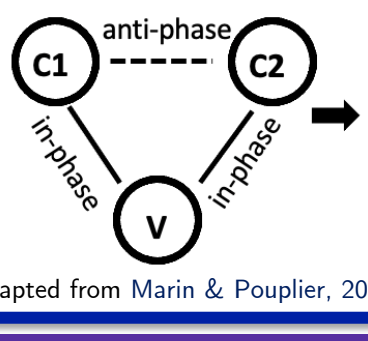
[1]New York University, Department of Communicative Sciences & Disorders
[2]University of Florida, Department of Speech, Language, and Hearing Sciences
[3]College of Staten Island - CUNY, Linguistics Program

Theoretical Background

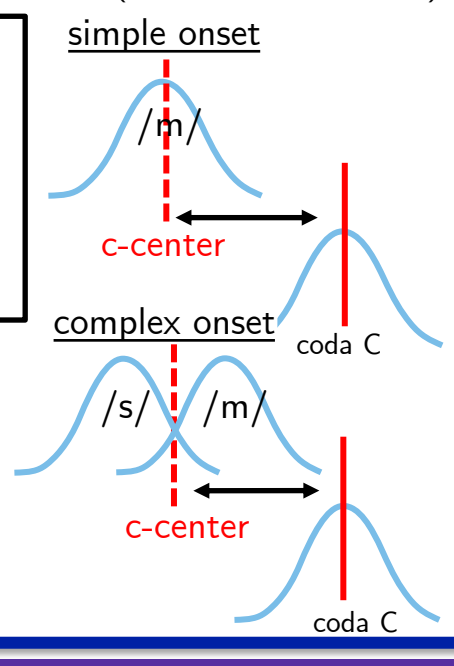
A major goal of research in speech production has been to explicate how speakers control the duration, timing, & sequencing of articulatory gestures.

Kinematic studies of **onset clusters** in AmE (Browman & Goldstein, 1988; Byrd, 1996; Marin & Pouplier, 2010) have reported that the timing of the onset as a whole with respect to the vowel remains relatively stable (i.e., ***C-center effect***).

"C-center" coordination:
- comparable temporal lag b/w c-center and the anchor in /sm/ and nasal singleton (/m/) to the anchor
- rightward shift for /m/ and leftward shift for /s/ in /sm/ compared to nasal singleton



adapted from Marin & Pouplier, 2010

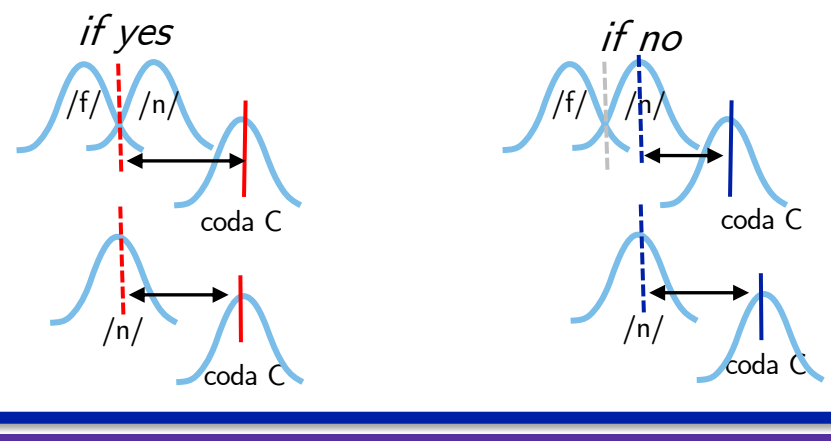


Current Research Question:
Do auditorily acceptable *non-native* onset clusters exhibit C-center timing?

Some non-native onset clusters, such as /fn/, tend to be produced with high accuracy when measured acoustically (Davidson, 2006)

Q1: Is inter-gestural phasing within onsets (C_1C_2) comparable between /sm/ and /fn/?

Q2: Do /fn/ sequences show C-center coordination?



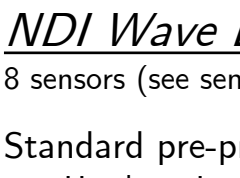
Methods & Data Processing

Participants:

2 native AmE speakers *(data collection ongoing)*

Speech Stimuli & Procedure:

Disyllabic nonwords		
/fn/	/fnɑb.zud/	/fnɑg.dwip/
/sm/	/smɑt.kis/	/smɑg.diʃ/
/n/	/nɑb.zud/	/nɑg.dwip/
/m/	/smɑt.kis/	/mɑg.diʃ/
One real word *(control for Q1)*		
/fən/	*fanatic*	/fənætɪk/



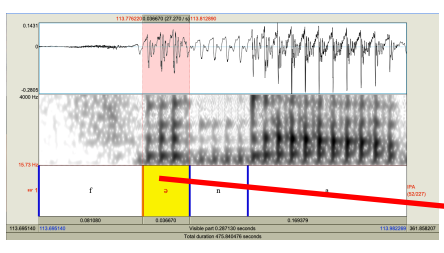
(each word produced in a carrier phrase
* 4 or 5 reps, randomized order)

NDI Wave EMA system

8 sensors (see sensor montage), data sampled at 100 Hz

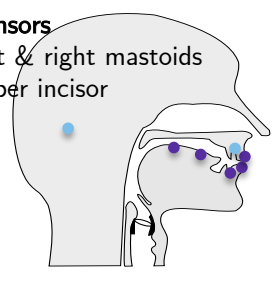
Standard pre-processing pipeline (Mview; Tiede, 2005)
- Head motion artifact correction
- Reference sensors were used to rotate & translate each position signal to a consistent maxillary reference point

Acoustic & Perceptual Analysis



Only clusters perceptually rated as properly sequenced were included in kinematic analyses
vowel epenthesis ≡ two repetitive cycles & higher F2 & F3 structure

Kinematic Analysis



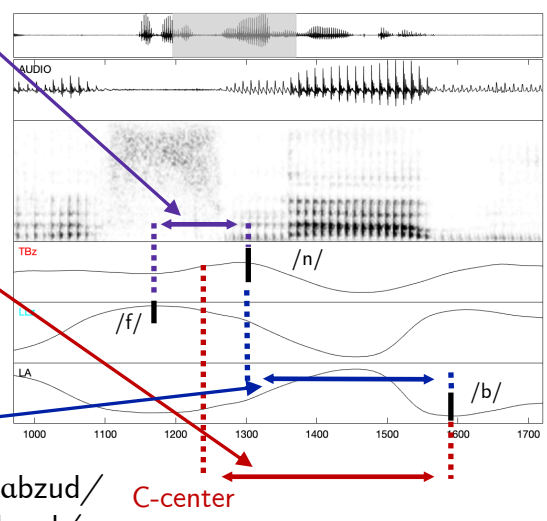
Ref sensors
- Left & right mastoids
- Upper incisor

Maximum constriction (MaxC)
(in vertical dimension; using *findgest* in Mview)
- lip aperture (LA) (/b/, /m/)
- lower lip (LL) (/f/)
- tongue blade (TB) (/s/, /t/, /n/)
- tongue dorsum (TD) (/g/)

For Q1: C_1C_2 lag
- all nonwords with /fn/ & /sm/onsets
- *fanatic*

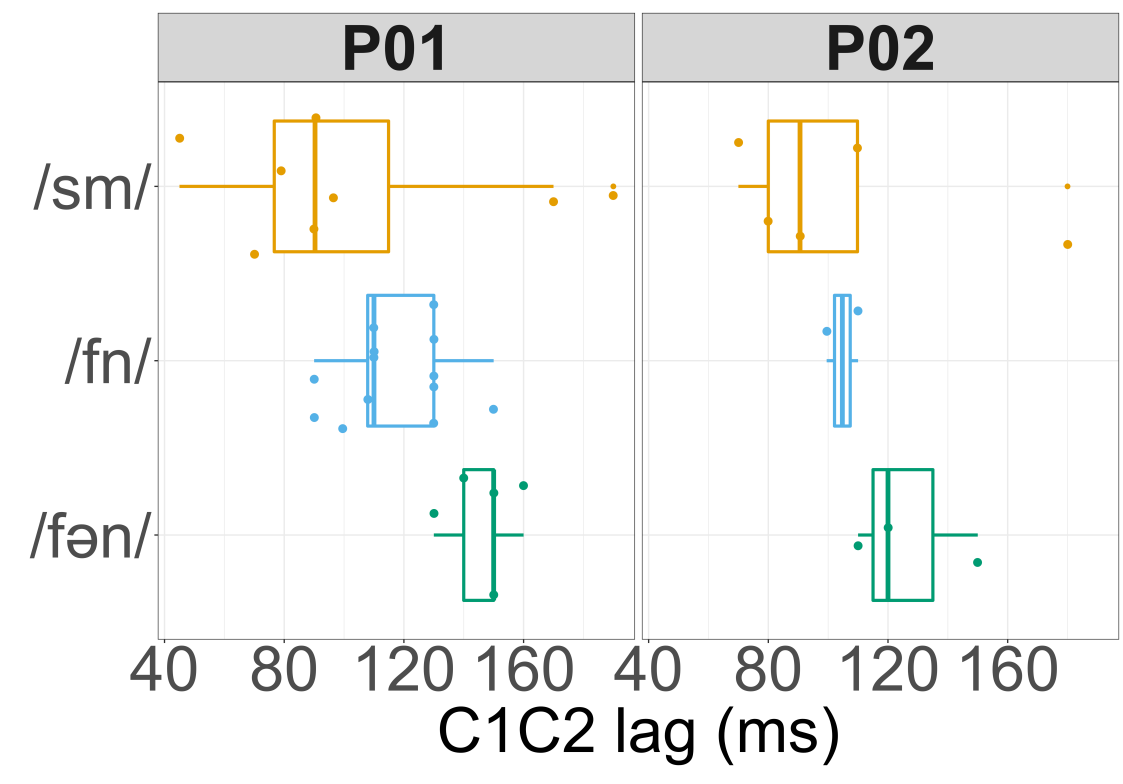
For Q2: C-center to anchor lag
- /smatkis/ & /fnabzud/

For Q2: nasal to anchor lag
- /smatkis/ & /fnabzud/
- /matkis/ & /fnabzud/



Preliminary Results

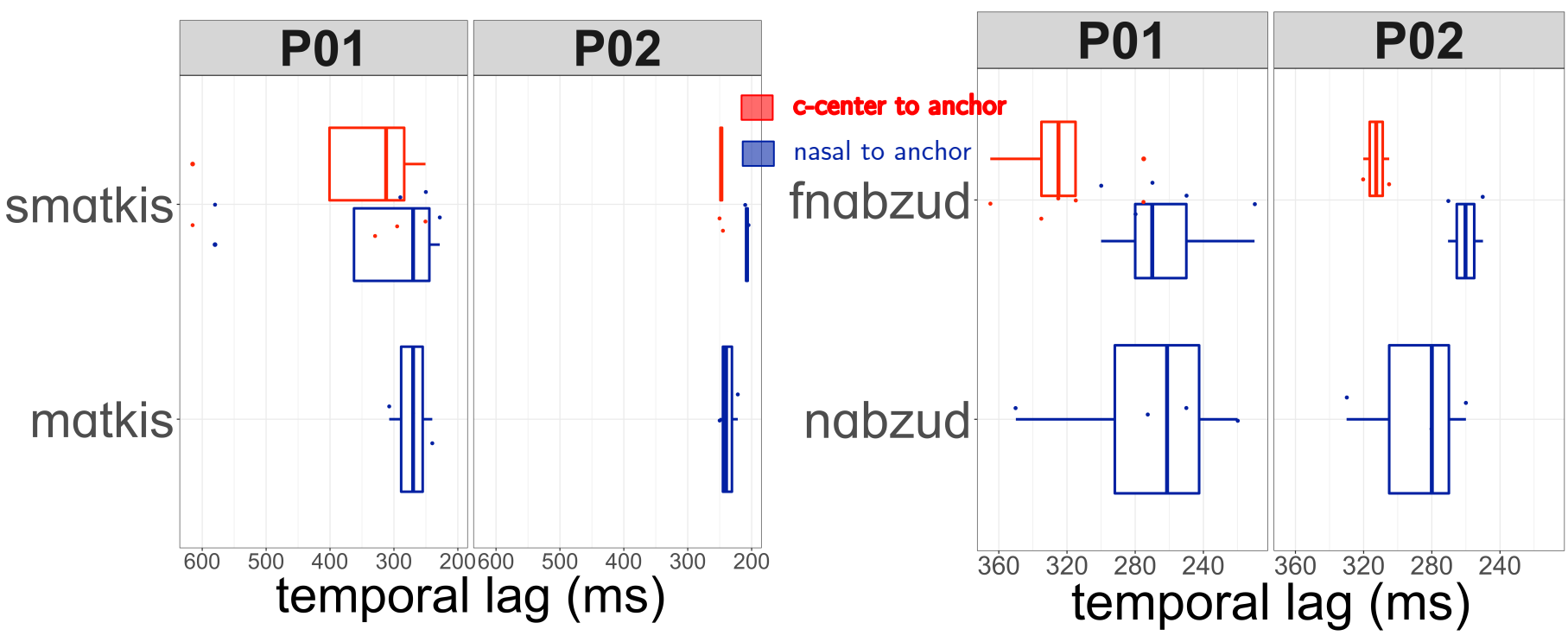
Q1: Is inter-gestural phasing within onsets (C_1C_2) comparable between /sm/ & /fn/?



C_1C_2 lag across sequence types: */sm/ < /fn/ < /fən/*

- trend such that C_1C_2 lag is short for native compared to non-native onset clusters
- Shorter C_1C_2 lag for non-native clusters compared to $C_1əC_2$

Q2: Do non-native /fn/ sequences show C-center coordination?



- C-center effect found in P02 but not P01 for /sm/
- No strong evidence of C-center coordination for non-native onset clusters

Discussion

- Preliminary analyses indicate that acoustically accurate/acceptable non-native /fn/ sequences do not show C-center coordination
- Critically, however, C-center coordination was not consistently observed for native /sm/ sequences
  - More data?
  - Clearer patterns may emerge when one compares standard deviation/coefficient of variation (as opposed to means) for each dependent measure of duration
  - Potential effects of lexical status (e.g., *smug* versus *SMAHTKEES*)
  - Speakers with keener phonological sensitivity may show stronger C-center timing
- Future experiments will examine whether C-center organization emerges as a function of speech motor learning