Segmentation and Intonation in Childhood Apraxia of Speech

Rachel T. Platt
Donald A. Robin, Ph.D., Jill C. Thorson, Ph.D

University of New Hampshire
Communication, Acquisition, and Translational Studies Lab

Introduction

Childhood apraxia of speech (CAS) is a motor programming disorder involving segmentation of sounds and syllables, speech sound distortions, word stress, and rhythm (McNeil, Robin, & Schmidt, 1997).

Segmentation deficits arise from transforming a linguistic code into coordinated patterns of muscle contractions to produce speech (Maas, Robin, Wright, & Ballard, 2008) and results from a working memory buffer, which cannot concatenate words or syllables (Wright, et al., 2009).

Prosodic Intonation affects fundamental frequency (F0) changes over an utterance. As the intonation of a declarative utterance falls naturally, the F0 will fall with each word. Intonation and declination are an overlapping system including the possible resetting of F0 (Ladd, 1996).

Research Goals

1. Compare segmentation of between and within word duration
2. Compare declination of F0 over an utterance and target word
3. Observe interaction between segmentation and intonation

Hypotheses

- Longer between and within word durations in CAS group
- Inconsistent F0 declination over utterance and target word in CAS group

Methods

2 Groups Comparison Design

- Native speakers of English
- No developmental, neurological, genetic, or speech disorders (other than CAS)
- Passed hearing screening

Typically Developing (TD)	Childhood Apraxia of Speech (CAS)
N = 10	*N* = 11
Ages 5;10-11;00 (*M* = 8;11)	Ages 5;10-8;00 (*M* = 7;06)
4 Female, 6 Male	2 Female, 9 Male
CELF-5 Core Language M = 115	*CELF-5 Core Language M* = 86

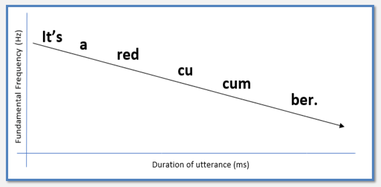
Speech Stimuli includes 10 different carrier phrases and 120 different target words including real and nonreal words with 3-4 syllables.

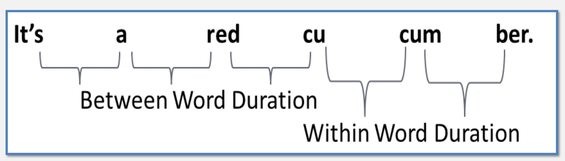
I saw a Blgatu. ***It's going to gaBAtugi.***
It's a red SHUziva. ***She has a cucumber.***

❖ Generated from baseline word lists from Treating Establishment of Motor Program Organization (TEMPO) study targeting the articulatory and prosodic accuracy of speech in CAS (Miller et al., 2018).

Dependent Variables

- Between word duration in ms (W1 = between words 1 and 2)
- Within word duration in ms (S1 = between syllables 1 and 2)
- F0 change between words or syllables and slope of linear regression of F0 in Hz

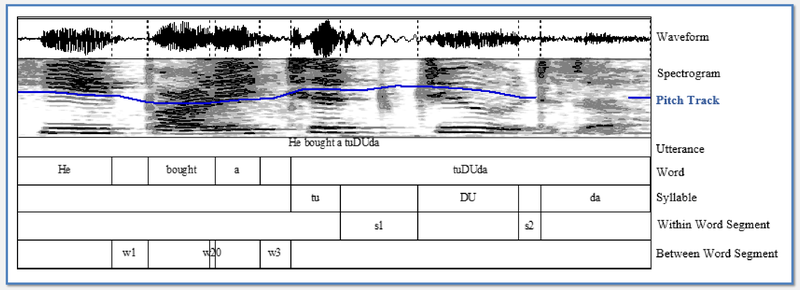




Methods cont.

Acoustical Analysis completed in Praat (Boersma & Weenink, 2017).

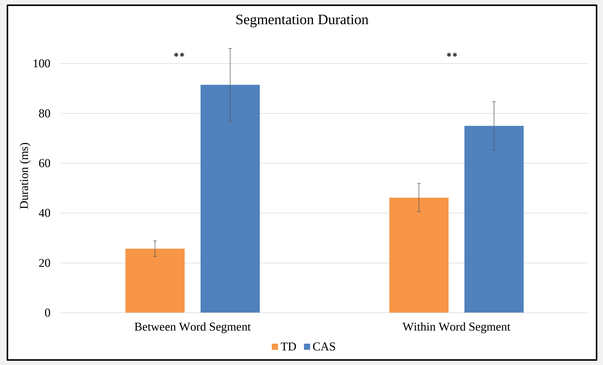
- 4,778 between word segments (*M* = 227 per participant)
- 3,572 within word segments (*M* = 324 per participant)
- 5,227 words for F0 declination over the utterance (*M* = 248 per participant)
- 3,934 syllables for F0 declination over target word (*M* = 357 per participant)

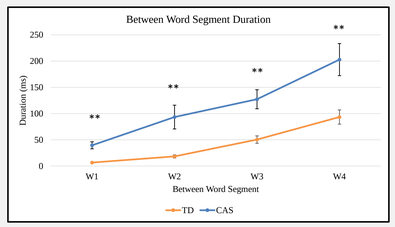


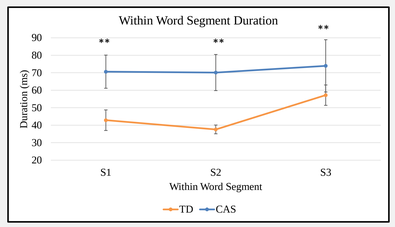
Results

Segmentation Duration

- Longer between word duration in participants with CAS ($p < 0.000$).
- Longer within word duration in participants with CAS ($p < 0.000$).
- Increase in segmentation duration from W1 to W4.







Acknowledgements & References

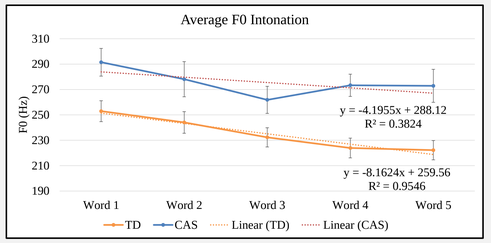
Special thanks to the participants and their families who were part of the study. Thank you also to Lauren Gabriel, Mikaela Coombs, and the members of the CAT Lab at UNH for their help with data coding and analysis. And thanks to Hilary Miller for recruiting CAS participants through TEMPO.

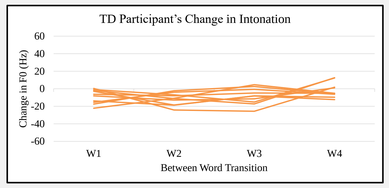
Boersma, & Weenink. (2019). Praat: doing phonetics by computer [Computer program]. Version 6.0.49, retrieved 2 March 2019 from http://www.praat.org/. • **Ladd, D. R.** (1996). *Intonational Phonology* (Vol. 79). Cambridge University Press. • **Maas, Robin, Wright, & Ballard.** (2008). Motor programming in apraxia of speech. *Brain and Language*, 106(2), 107-118. doi:10.1016/j.bandl.2008.03.004 • **McNeil, Robin, & Schmidt.** (1997). Apraxia of speech: Definition, differentiation, and treatment. In M. R. McNeil (Ed.), *Clinical management of sensorimotor speech disorders* (pp. 311–344). New York: Thieme. • **Miller, Plante, Campbell, Ballard, & Robin.** (2018). Treatment of lexical stress, segmentation, and sound distortions in childhood apraxia of speech. Presented at the *Conference on Motor Speech*, Savannah, Georgia. • **Wright, Robin, Rhee, Vaculin, Jacks, Guenther, & Fox.** (2009). Using the Self-Select Paradigm to Delineate the Nature of Speech Motor Programming. *Journal of Speech Language and Hearing Research*, 52(3), 755. doi:10.1044/1092-4388(2009/07-0256)

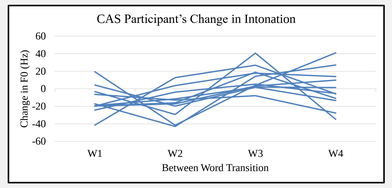
Results cont.

F0 over Utterance

- Pitch declination in both TD and CAS ($p = 0.282$).
- Inconsistent declination patterns in CAS.
- Evidence of pitch reset on final target word in both groups.

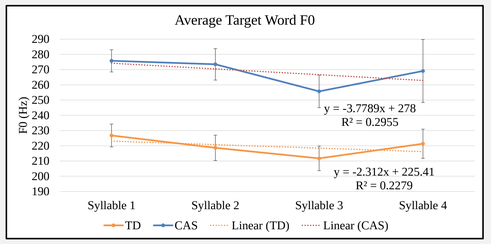


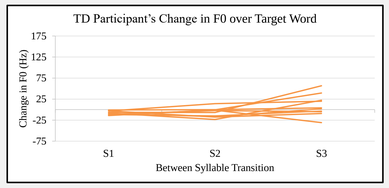


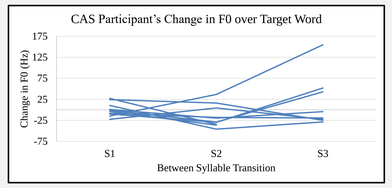


F0 over Target Word

- Pitch declination in both TD and CAS ($p = 0.114$).
- Inconsistent declination patterns in CAS.
- Evidence of pitch reset on final syllable in both groups.

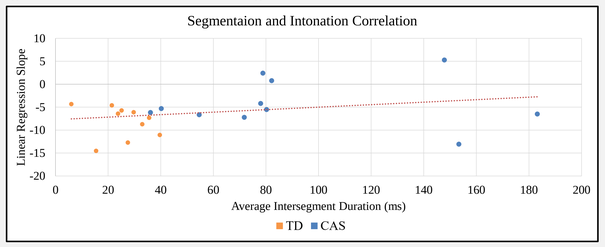






Segmentation and Intonation Correlation

- As between word segment duration increases, slope of F0 regression flattens.
- Between word segment duration explaining 5.1% of variation in F0 slope of the utterance.
- $r(19) = 0.275$
- $p = 0.227$



Conclusion

Segmentation between and within words was longer for CAS group with evidence of increased duration between carrier phrase and the target word.

Intonation had higher variability in the CAS than TD group. Evidence of pitch declination in both groups with reset on the final target word.

F0 change over the target word had higher variability in the CAS than TD group. Evidence of pitch reset in both groups for the final syllable.

❖ **Broader impact:** Comparing speech patterns in CAS and TD children will better establish treatment efficacy in improving speech production related to segmentation and intonation.