Acoustic evidence for the representation of stress in Southern East Cree

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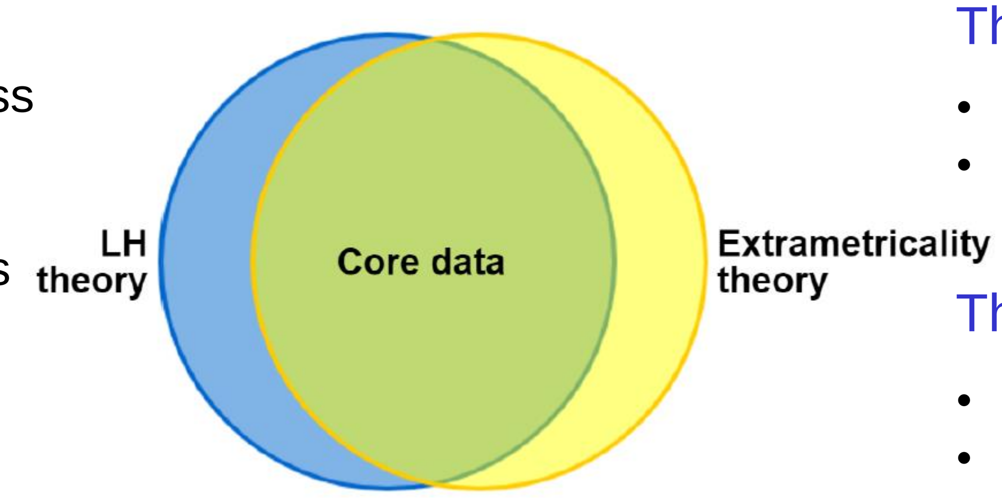
Introduction

Goals of this project:

- Argue for the LH theory of stress in SEC; stress placement is motivated by preference for 'uneven' light-heavy (LH) iambs
- Propose a method of theory-informed acoustic analysis to test the accuracy of stress predictions

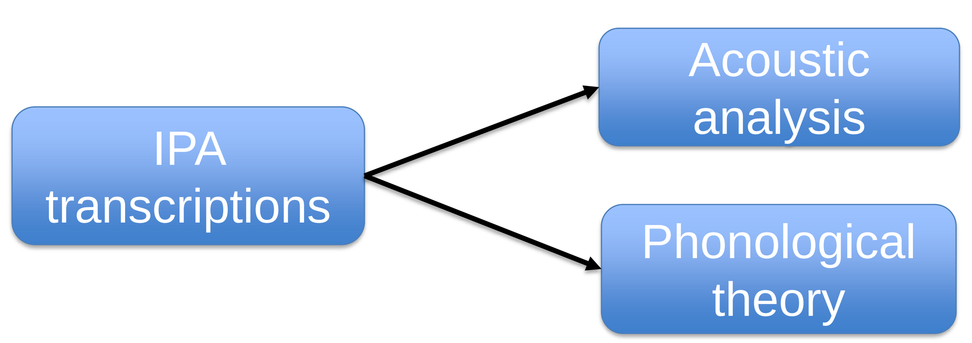


Language background

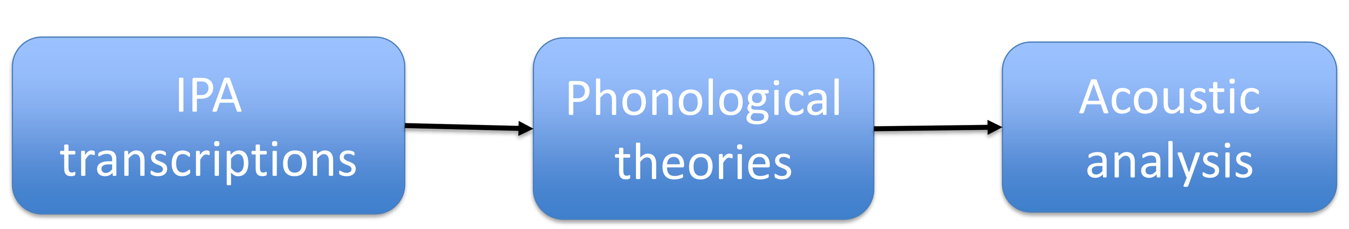
- **Southern East Cree** (SEC) is an Algonquian language spoken in northern Québec
- Its stress system is iambic and quantity-sensitive

Theory-informed acoustic analysis

Work on stress tends to posit theories to explain transcriptions, and to use transcriptions as input to phonetic analysis, but theory and acoustics do not interact:



- But what if our transcriptions are wrong?
- We have no quantitative way to evaluate our transcriptions, or to determine which of a set of competing transcriptions is correct.
- This **method** allows us to adjudicate between competing theories of stress by holding them accountable to acoustic facts.
- Instead of conducting acoustic and theoretical analyses separately, this method uses the predictions made by competing theories (based on a small data set) as input to an acoustic analysis of stress.



Acknowledgements

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Competing theories of stress

The LH theory (Kager 1999)

- Final stress is the default
- Non-final stress occurs when an **LH iamb** is available earlier in the word

The extrametricality theory (Brittain 2000)

- Non-final stress is the default
- Final stress occurs when the final-foot **extrametricality rule** is blocked

Comparing their predictions

The theories' predictions overlap on ~75% of the data, and make diverging predictions on the rest.

Profile	LH analysis	Extrametricality analysis
LHH	(ni.péː).win	(ni.péː).⟨win⟩
HLHH	niː.(mi.náː).nuː	niː.(mi.náː).⟨nuː⟩
LLLH	pa.tʃi.(wi.yáːn)	pa.tʃi.(wi.yáːn)
HLHLH	niː.ʃu.tʃiː.(ʃi.káːu)	niː.(ʃu.tʃíː).⟨ʃi.kaːu⟩
LHLH	ni.taː.(hku.sín)	(ni.táː).⟨hku.sin⟩
HLLH	teː.hta.(pu.wín)	(téː).hta.⟨pu.win⟩
LHHH	(ni.yáː).naː.neːu	ni.yaː.(náː).⟨neːu⟩

Materials

- Audio files were downloaded from the *Algonquian Linguistic Atlas* (Junker 2005).
- Items (just over 300) were recorded by Candice Diamond of Waskaganish, Québec, who speaks the coastal variety of Southern East Cree.

- Data were segmented in Praat (Boersma & Weenink 2013) and analyzed in R (R Development Team 2015)
- Segments and measures of duration, maximum intensity, and maximum pitch were extracted
- The following **nested linear regression models** test how well stress predicts each acoustic correlate of stress

Results

The models

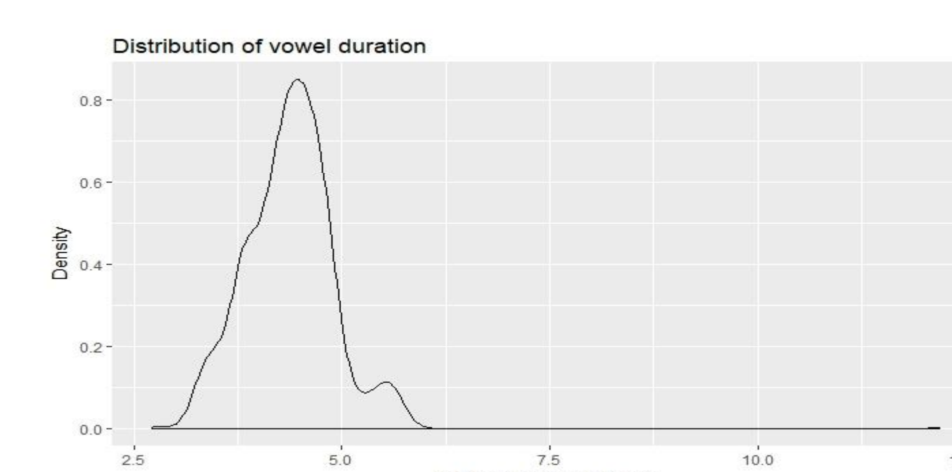
- Dependent variable: {duration, intensity, pitch}
- Fixed factors:
  - Vowel quality
    - {/a/,/e/,/i/,/u/}
  - Vowel length
    - {short, long}
  - Syllable type
    - {open, closed}
  - Word-finality
    - {nonfinal, final}
  - Stress
    - {unstressed, stressed}

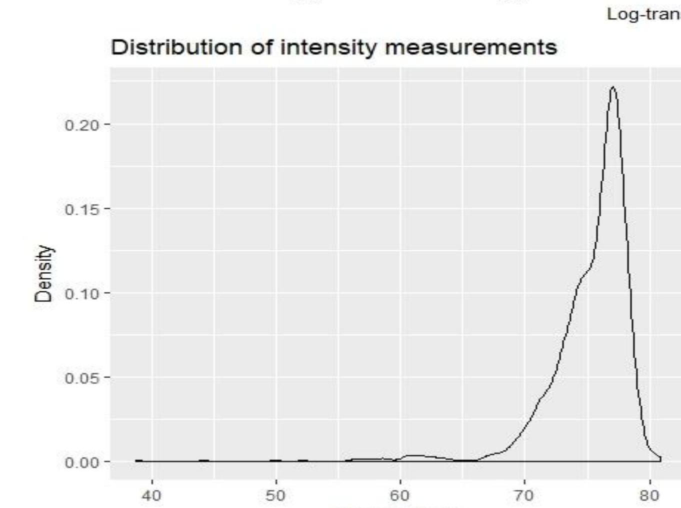
(Vowel quality, vowel length, syllable type and word-finality: **Base model**; all fixed factors: **Superset model**)

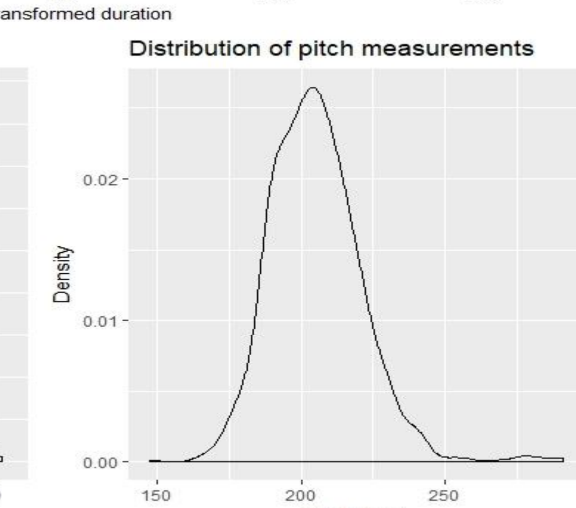
Core data

- Stress improves on models of duration, intensity, and pitch significantly
- We expect an accurate theory of stress assignment to roughly mirror these results

Measure	Model	Adj. r^2	AIC	χ^2	p value
Duration	*Base*	0.44	1015.20		
	Superset	0.47	979.4	7.21	< 0.001***
Intensity	*Base*	0.44	4123.7		
	Superset	0.45	4109.1	136.36	<0.001***
Pitch	*Base*	-0.001	6324.8		
	Superset	0.02	6310.4	3910.8	< 0.001***







Theory comparison

Duration

- Stress improves models of dur. under both theories
- LH theory (AIC=1102.8) improved on base model a bit more than extrametricality theory (AIC=1120.0)

Model	Adjusted r^2	AIC	χ^2	p value
Base	0.45	1145.6		
LH	0.48	1102.8	7.8	< 0.001***
Extrametricality	0.47	1120.0	4.8	< 0.001***

Intensity

- Stress improves models of inten. under both theories
- LH theory (AIC=4994.0) improved on base model a bit more than extrametricality theory (AIC=5000.6)

Model	Adjusted r^2	AIC	χ^2	p value
Base	0.397	5011.2		
LH	0.408	4994.0	152.6	< 0.001***
Extrametricality	0.404	5000.6	100.1	< 0.001***

Pitch

- Stress improves models of pitch under both theories, but effect magnitudes are very different
- LH theory (AIC=1102.8) improved on base model a bit more than extrametricality theory (AIC=1120.0)

Model	Adjusted r^2	AIC	χ^2	p value
Base	0.006	7857.9		
LH	0.032	7833.5	6712.0	< 0.001***
Extrametricality	0.009	7855.2	1227.1	0.03*

- The extrametricality theory predicts *lower* pitch in stressed syllables in the divergent data, cancelling out some of the effect from the core data

Model	β	t value	p value
LH	7.28	2.38	0.02*
Extrametricality	**-7.28**	-2.38	0.02*

Conclusion

- The divergence in each theory's results suggest that the LH theory more accurately captures SEC stress than the extrametricality theory does
- The method proposed can be broadly generalized to work on stress
- We can adjudicate between competing theories by holding these accountable for the acoustics of stress