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The acoustics of stressed velar fricatives in Munster Irish

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May 5, 2017
RULing

No recent metrical theory accounts for Munster Irish stress.

Project Goals

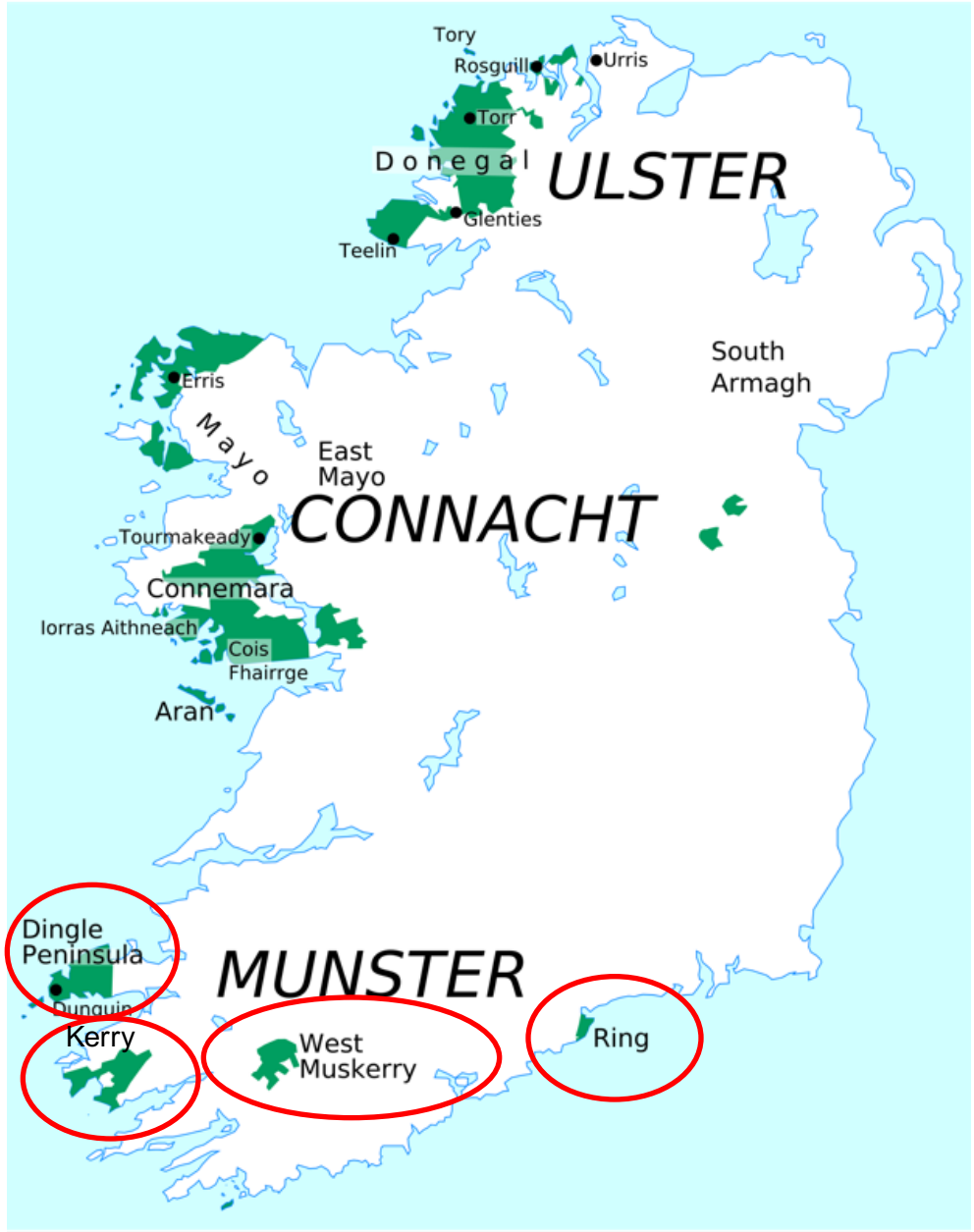
- Evaluate evidence for word level metrical structure

- Determine where phonetic stress falls
  - relation to metrical structure

Roadmap

- Dialects
- Phonological phenomenon
- Key analytical issue: /ax/
- Current analyses of stress and /ax/
- Phonological evidence
- Phonetic evidence
- Theoretical Implications
- Experiment
- Stress Overview
- Fricative Analysis
- Next Steps
- Acknowledgements
- References

Gaeltachtai



https://en.wikipedia.org/wiki/Irish_phonology#/media/File:Gaeltachtai_le_hainmneacha2.svg

Dialectal Stress Patterns

Dialect	Initial default	V:/VV attraction	CVCax
Ulster	ˈCVCV	ˈCV:CV ˈCVVCV	ˈCV.Cax
Connacht	ˈCVCV	ˈCVCV: ˈCVCVV	ˈCV.Cax
Munster	ˈCVCV	CVˈCV: CVˈCVV	CV.ˈCax

Munster Irish

Ó Cuív (1944), Ó Sé (1989, 2008), Blankenhorn (1981), Doherty (1991), Green (1996), Hickey (2011, 2014), Rowicka (1996), and Iosad (2013)

1. stress attracted to heavy syllables and /ax/

2. heavy = long vowel or diphthong
   - codas don't count

/ax/

- **attracts stress**: fə.ˈnaxt
- in 2nd syllable only: fi.ˈnax.tənʲ ˈcos.tə.sax
- leftmost stressed: ˈlʲax.təx bar.ˈhax.təx
- beaten by V:/VV : ˈe:nəx

The Key Analytical Issue

Ternary quantity distinction

- [VV], [V:] > [ax(t)] > [V] (Doherty 1991, Bennett 2012/5)

- Middle "weight" segmentally specific
  - nucleus must be [a], following consonant must be [x]
    - elsewhere, [x] can appear in coda or onset
      - [raxt], [xaik]

An Analysis

Quantity influenced by sonority

- [a] is most sonorous vowel, attract stress (de Lacy 2004)
- [x] is [+approximant], allowed in the nucleus (Bennett 2015)

Interim Summary

- [ax] described to attract stress away from an initial short vowel, but not a long vowel
- creates ternary quantity distinction: [VV], [V:] > [ax(t)] > [V] (Doherty 1991, Bennett 2012, 2015)
- Could be sonority driven stress (de Lacy 2004) with [x] syllabified in the nucleus (Bennett 2015)

Phonological Evidence

- Vowel Reduction
  - Green (1996), Iosad (2013)
- Morpho-phonological stress sensitive allomorphy
  - Bennett (2015)

Phonetic Evidence

- Ulster and Connacht
  - Bennett (2012), Elfner (2012)
- Munster
  - Acoustic work currently underway

  (Windsor et. al i.p.)

Why Worry?

- Compelling evidence for metrical structure is complex (de Lacy 2014)
- Impressionistic evidence has failed before
  - Bowern (2013), Shih (2016)
- New Experiment

Experiment Design

Does /ax/ attract stress away from initial position?

- Competing Hypotheses: ˈ**CV.C/ax/** **vs.** **CV.ˈC/ax/**
  - compare acoustic properties of [x] in un/stressed positions
  - disyllables
  - some wug
    - when few real words exist

Subjects

- adult
- raised in Munster region
- Irish only until 10 years old

Stimuli Shapes

Default	Long Vowels	[ax]
CV.CV	CVː.CV	CV.Cax
	CV.CVː	Cax.CV
	CVː.CVː	CVː.Cax
		Cax.CVː
		Cax.Cax

Stimuli

- Vowels: [i], [u], [a], [o]
- Consonants
  - word-medial only voiceless (van Santen 1992)
    - stops [p], [t], [k]
    - fricatives [f], [s], [x]

Two Frame Sentences

- introduce new information (focused)
  a. Dúirt Bríd an focal X sular imigh sí.
     [dɯɹtʲ.briːdʲ.an.fʌ.kl.X.sʌ.lɻ.ɪm.ɪg.ʃiː]
     "Bríd said the word X before leaving."

- repeat old information (not focused)
  b. Abair X faoi d'anáil.
     [a.bɹ.X.fʷi.da.nalʲ]
     "Say X under your breath."

Stimuli Presentation

- list of 69 target words
  - 7 of each shape
  - 13 CV.Cax
- three total copies of list, each randomized separately, then combined
- 207 total stimuli
- sentence inserted after every five words
- PsychoPy

Peirce, JW (2015); PsychoPy: for stimulus generation and experimental control in Python; Version 1.83.04; retrieved 2015 from http://www.psychopy.org

Stress

- No universal definition of stress (Hayes 1995; Kager 1995, 2007)
- Each language choses which acoustic correlate(s) it uses to distinguish un/stressed syllables
- Determine Munster correlate(s)
  - How do fricatives correlate with stress?

Fricative Acoustics

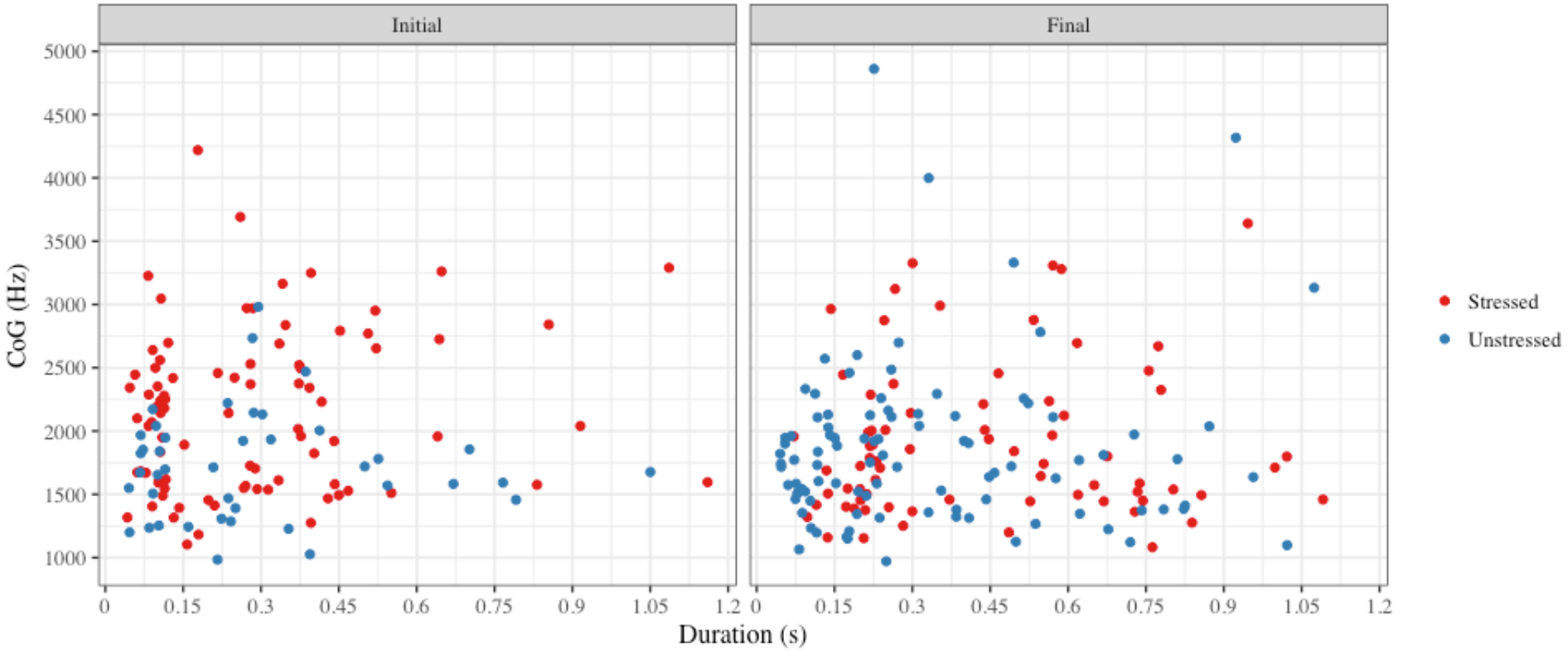
- Duration (s)
  - normalized to control for speech rate
  - phrase-final lengthening
- Intensity (dB)
  - loudness, amplitude
- Place of Articulation Correlates (Gordon 2002)
  - Center of Gravity (Hz)
    - higher = forward
    - lower = back
    - voicing can lower
  - Spectral tilt (Hz)
    - noise peak at higher frequency = forward
    - noise peak at lower frequency = back

Expectations

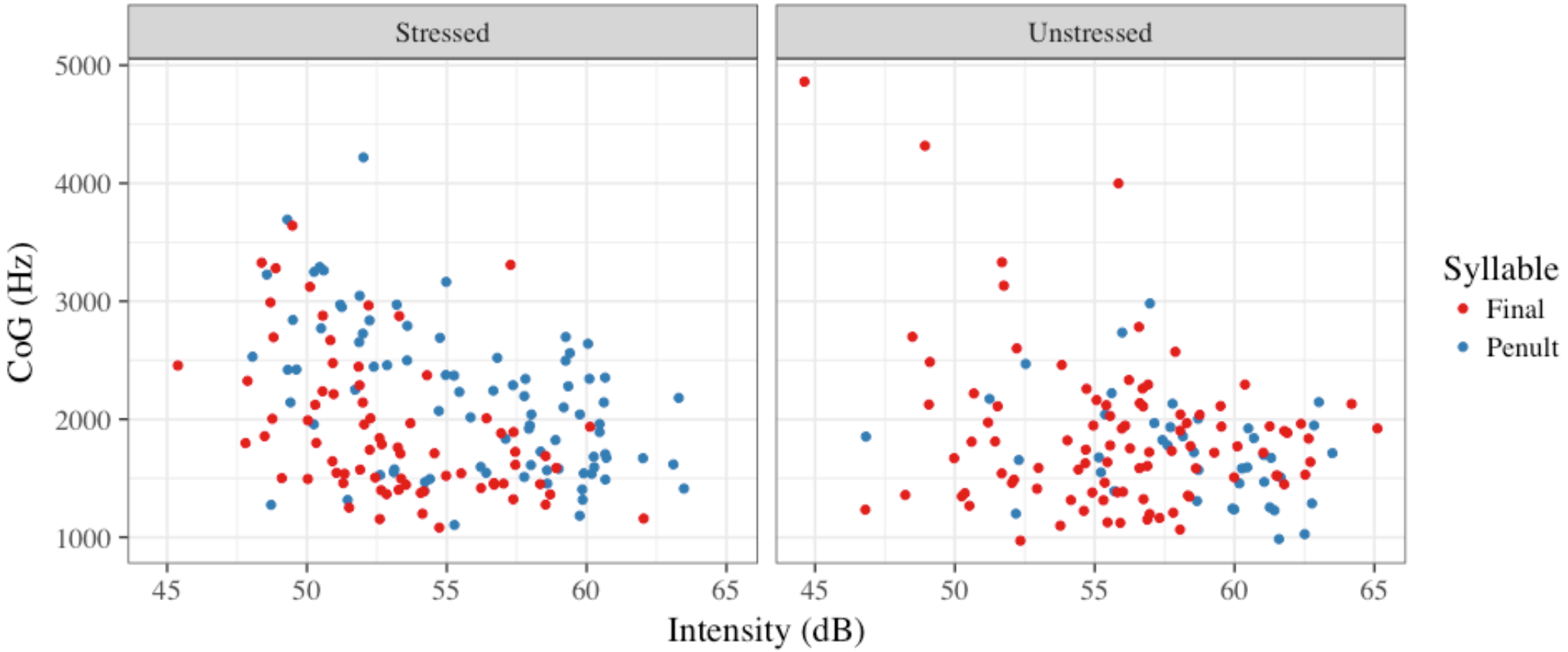
- If correlated with stress, fricatives should have different acoustic properties when stressed vs. unstressed

Stressed	Unstressed
Longer Duration	Shorter Duration
Higher Intensity	Lower Intensity
Lower CoG	Higher CoG
Lower freq noise peak	Higher freq noise peak

Duration Results



Intensity Results



Summary

- [x] duration and intensity do not strongly correlate with the described stress pattern.
- Center of Gravity does not vary in different syllable positions.

Next Steps

- Measure spectral tilt
  - second indication of place of articulation
- Analyze vowels
- Compare fricatives adjacent to syllable with long and short vowels
  - determine whether or not they are stressed in comparison
- Record speakers in Ireland this summer

Acknowledgements

QP Committee:

Paul de Lacy

Akinbiyi Akinlabi

Adam Jardine

Joseph Casillas

Also Shu-hao Shih and

attendees of RULing 2016 and PhonX

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