Artificially natural: Creating carefully-controlled acoustic cue continua from natural speech

**INTRODUCTION**

Multiple acoustic cues map onto phonetic categories in speech

- Vowel Length
- Voicing in Closure
- Closure Duration
- Release Burst

To study these distinctions, we need carefully controlled stimuli

Two methodological challenges:

1. Stimulus naturalness
2. Control over acoustics

Ideally, we want to maximize both

Several challenges in doing this:

- Listeners treat cues differently in natural and synthetic speech (Miller & Liberman, 1979; Shinn, Jongman, Blumstein, 1985)
- Procedures for controlling natural speech cause unnatural cue covariation (Toscano & McMurray, 2012)
- Developed new approach using word-final voicing as a framework (Raphael, 1972)

**METHOD**

We identified cues to word-final voicing, and created vowel length (VL) continua by removing individual pitch pulses, evenly spaced throughout vowel

Rendered other cues ambiguous by taking weighted averages of values measured from minimal pairs

Procedure is automated via Praat (Boersma & Weenink, 2015)

56 participants completed a categorization task measuring voicing judgments

**RESULTS**

1. Identify Salient Cues

2. Render Cues Ambiguous

2a. Isolate Closure

2b. Isolate Releases

3. Create VL Continua

Cutback Method

- Step 1: Vowel length: 312 ms
- F0 offset: 93 Hz
- F1 offset: 895 Hz
- F2 offset: 1847 Hz

- Step 2: Vowel length: 212 ms
- F0 offset: 195 Hz
- F1 offset: 1173 Hz
- F2 offset: 2005 Hz

- Step 3: Vowel length: 129 ms
- F0 offset: 232 Hz
- F1 offset: 1118 Hz
- F2 offset: 1702 Hz

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**DISCUSSION**

Sequential pulse cutting method yields sounds that are both natural-sounding and allow for precise control over VL

Continua are free of artifacts and retain natural amplitude envelope contour and formant trajectories; no cue covariation

Can use categorization functions as guides to adjust weighting of ambiguous cues