### Profiling Speech Motor Control: Validation of Novel and Existing Acoustic Features

Hannah P. Rowe1, Marc F. Maffei1, Sarah E. Gutzi1,2, Adam Lammert3, Jordan R. Green1,2

1MGH Institute of Health Professions
2Harvard University
3Worcester Polytechnic Institute

### Introduction

**Background**

* Articulatory features account for most of intelligibility loss [1]
* HOWEVER articulation is broadly defined and few measures have been validated

Critical need for framework to characterize articulatory motor control using quantitative, interpretable, and validated measures [2,3,4]

* Goal to identify articulatory phenotypes of speech motor disorders to improve: (1) differential diagnosis and (2) the development of new treatments

#### Coordination

#### Consistency

#### Speed

#### Distinctiveness

#### Rhythm

**Primary Objective**

* Need to assess construct validity of five components in order to establish framework as reliable and accurate tool
* THUS in current study, used speech rate manipulation as validation technique, as prior research has shown that changes in rate impact five proposed components

**Research Question**

Are there differences in performance on the acoustic-based articulatory features between healthy controls when speaking Fast, Normal, and Slow?

### Method

**Participants**

* 6 healthy English-speaking controls (1 M, 5 F) between 25-35 yo

**Procedures**

* Participants produced 3 repetitions of sequential motion rate (SMR) task in 3 different rate conditions [5,6] with auditory models:
  1. Normal rate
  2. 1.2x normal rate
  3. 2x normal rate

**Measurements**

- **Coordination** (F1 x F2 Corr)
- **Consistency** (Btmn-Sep Var in VOT)
- **Speed** (F2 Slope)
- **Distinctiveness** (Btmn-Con Var in Spectrum)
- **Rhythm** (Spectral Peak Prominence)

### Results

#### Coordination

- High vs Low = More coupled
- Further from 0 = More coupled

#### Consistency

- Fast vs Slow = More consistent
- Further from 0 = More consistent

#### Speed

- Fast vs Slow = Faster
- Further from 0 = Faster

#### Distinctiveness

- Fast vs Slow = More distinct
- Further from 0 = More distinct

#### Rhythm

- Fast vs Slow = More rhythmic
- Further from 0 = More rhythmic

* Consistent with findings of increased specification at slower rates [5,6]
* Consistent with research illustrating destabilizing effect of slow articulatory rate on speech movements, as reduced formant correlation may correspond with less lingual coupling [12]

### Discussion

**Takeaways and Limitations**

* Framework has potential as valid tool for assessing distinct articulatory components
* Further research needed to validate acoustic features
  - A. Using larger sample sizes
  - B. Using biomechanical measures (e.g., kinematics)
  - C. Using speech motor disorders known to differ in articulatory deficits

### References

5. Rowe, H., & Green, J. (2015). Articulatory features account for most of intelligibility loss [1].

* This work was supported by NIH/NIDCD Grant R01DC011549, R21DC011912, and 2R01DC011912.