Prosodic Contributions to Intelligibility in Dysarthria

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Introduction

- Dysarthria is a neurological speech disorder that affects the accuracy, speed, and strength of the movement required for speech production [1]
- Prosody is a component of speech that includes articulation rate, pitch variation, and intensity variation
  - Contributes to speech intelligibility, or how well one is understood [2]
- Within dysarthria prosody is impaired which may negatively impact speech intelligibility
- Within the literature, speech intelligibility is measured in two ways:
  - Orthographic Transcriptions: The percent of accurately transcribed words by a naive listener
  - Visual Analog Scale (VAS) Ratings: Measured on a scale from 1-100 from not being able to understand anything, to understanding everything [3, 4]

Purpose

This project evaluates many prosodic features and how they affect the intelligibility of patients who have dysarthria.

Research Questions

1. Which prosodic features are the best predictors of speech intelligibility across various dysarthria types?
2. Does the strength of the relationship between speech intelligibility and prosodic features differ between OT and VAS ratings of speech intelligibility.

Methods

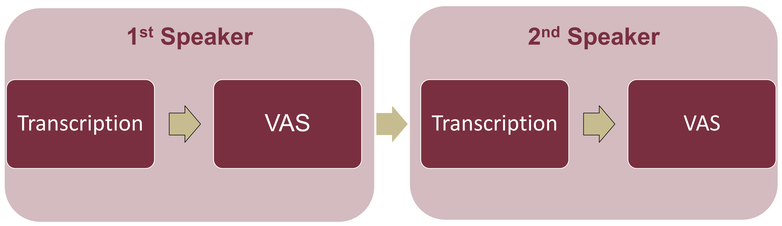
Participants

Listeners (n = 70)

- Age (years); M = 34.8, SD = 13.9
- Recruited via Prolific
- Inclusionary Criteria
  - Reside in the United States
  - No current speech-language or hearing disorders
  - Not a speech-language pathologist or audiologist
  - Fluent in English

Speakers (n = 20)

- Age (years); M = 65.3, SD = 14.2
- 11 males; 9 females
- Four Etiologies
  - Amyotrophic Lateral Sclerosis (n = 5)
  - Parkinson's disease (n = 5)
  - Huntington's disease (n = 5)
  - Ataxia (n = 5)
- Readings of "The Grandfather" passage [5]



Methods (Continued)

Target Measures

- **Articulation Rate (syl/s):** syllables per second for each breath group (i.e., connected speech excluding pauses > 150 ms or audible inspirations).
- Pitch & Loudness Variation
  - **F0 & dB Range:** Across all sentences, the absolute difference between the min and max F0 and dB values, respectively.
  - **F0 & dB SD:** The average F0 SD and dB SD across the phrases.

Results

Orthographic Transcription Model				
	Estimate	**SE**	**t-value**	**p-value**
Intercept	180.819	43.053	4.200	<.001
dB Range	-2.208	.781	-2.827	.011
R^2	.3074	$R^2_{adjusted}$	.269	

Visual Analog Scale Model				
	Estimate	**SE**	**t-value**	**p-value**
Intercept	199.042	54.114	3.678	.002
dB Range	-2.667	.982	-2.716	.014
R^2	.2907	$R^2_{adjusted}$	.2513	

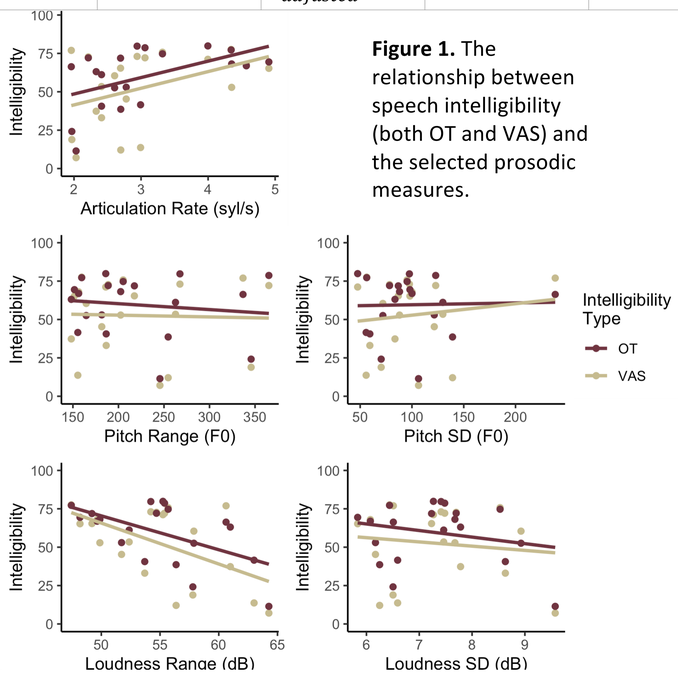


Figure 1. The relationship between speech intelligibility (both OT and VAS) and the selected prosodic measures.

Discussion

Research Question #1

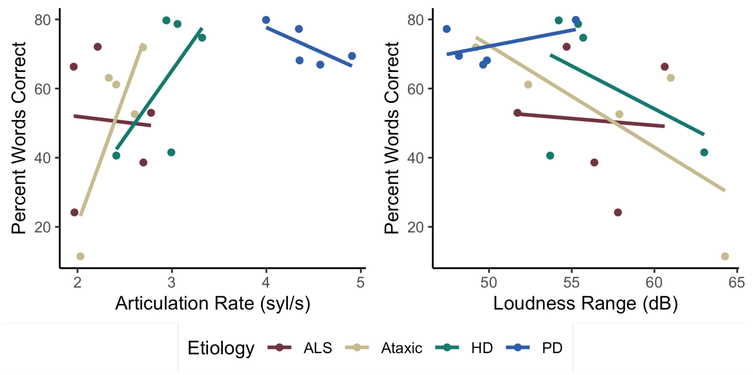
- Both articulation rate and dB range are predictors of speech intelligibility
  - dB range is the strongest predictor of speech intelligibility
- dB range showed a *negative* relationship to speech intelligibility
  - This is likely due to impaired phonatory control (i.e., excess loudness variation) often observed in speakers with Huntington's disease and cerebellar ataxia [6]

Research Question #2

- The relationship between intelligibility and the selected prosodic measures were comparable between OT and VAS ratings of intelligibility
- For research purposes, VAS ratings are sufficient for estimating speech intelligibility

Future Directions

- The relationship between intelligibility and prosodic measures likely vary between dysarthria etiologies (See figure 2)
  - For example, prosodic measures appear to be more strongly related to intelligibility for speakers with ataxia and Huntington's disease



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