Loud speech is a speaking technique frequently recommended to improve intelligibility of individuals with dysarthria secondary to various underlying disorders (e.g., Parkinson’s disease, multiple sclerosis, traumatic brain injury, amyotrophic lateral sclerosis). Tjaden, Susman, & Wilding, 2014). Prior studies suggest physiologic, acoustic, and perceptual improvements attributed to increased loudness for individuals with dysarthria.

Kierow et al. (2001) found greater loudness and jaw movement stability during loud speech in healthy controls and individuals with Parkinson’s disease. Neel (2009) found a greater intelligibility benefit when using loud speech as compared to normal speech in patients with Parkinson’s disease. Worhiet and Hammel (2000) suggest that while intensity is adjusted during loud speech, loudness manipulations also cause a reorganization of speech motor components (e.g., lip amplitude changes).

While loud speech effects have been studied for several dysarthria populations (e.g., Parkinson’s disease, multiple sclerosis, traumatic brain injury), research exists on talkers with amyotrophic lateral sclerosis (ALS). Studying the effects of loud speech at the articulatory kinematic level will help provide a stronger scientific basis for loudness-based strategies for individuals in the early stages of ALS.

### INTRODUCTION

#### BACKGROUND & SIGNIFICANCE

- Loud speech is a speaking technique frequently recommended to improve intelligibility of individuals with dysarthria secondary to various underlying disorders (e.g., Parkinson’s disease, multiple sclerosis, traumatic brain injury, amyotrophic lateral sclerosis). Tjaden, Susman, & Wilding, (2014).
- Prior studies suggest physiologic, acoustic, and perceptual improvements attributed to increased loudness for individuals with dysarthria.

#### STUDY AIM & HYPOTHESES

#### STUDY AIM

- To evaluate the effects of loud speech on tongue motor control in the ALS population.

#### HYPOTHESES

- **Hypothesis 1**: We predict that individuals with ALS will show greater tongue movement variability compared to healthy controls for habitual speech.
- **Hypothesis 2**: Because loud speech is known to stabilize articulatory movements, we predict that individuals with ALS will show lower tongue movement variability compared to healthy controls for loud speech.

### METHODS

#### PARTICIPANTS

- **Six subjects with ALS and six age- and gender-matched healthy controls**

#### WAVE DATA RECORDING SYSTEM

- A 3D electromagnetic articulograph (Wave Speech Research System, NDI Inc.) was used to track tongue movements using sensors attached to various parts of the tongue.

#### KINEMATIC DATA ACQUISITION AND SEGMENTATION

- Participants were asked to repeat the sentence “Say that I owe you a yo yo” twice their habitual loudness.
- Audio and vertical displacement trajectories for the tongue were used to segment ‘I owe you a yo yo’ from the carrier phrase for each repetition.
- **Onset**: vocal tract constriction for the alveolar consonant ‘t’ in “that”, which consistently coincided with the peak displacement for the tongue tip sensor.
- **Offset**: vocal tract constriction for the ‘t’ in “today”, which consistently coincided with the peak displacement for the tongue tip sensor.

#### SPATIOTEMPORAL VARIABILITY INDEX (STI)

- **STI = sum of 50 SD**
- **Higher STI values indicate more variability in tongue movement patterns**
- **Lower STI values suggest more stability of tongue movements patterns over repeated productions of an utterance**

#### RESULTS

- **H1**: Participants with ALS demonstrated lower tongue movement variability compared to the controls in the habitual condition.
- **H2**: Participants with ALS showed lower tongue movement variability compared to the controls in loud speech condition.

### DISCUSSION & CONCLUSIONS

- **Loud speech was accompanied by greater tongue movement stability in both ALS and control groups**
- **Loud speech may cause more stable reorganizations of articulatory motor control**
- **Individuals with ALS showed greater tongue movement stability for both habitual and loud speech compared to healthy controls**
- **More stable movement patterns may be a byproduct of compensatory adjustments that result in increased muscle stiffness and therefore, less movement variability**

- **Considerable variability in STI scores across talkers with ALS because of the wide range of**
  - Dysarthria severities
  - Disease stages
  - Strategies used by talkers to compensate for speech loss

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### REFERENCES


### FUTURE DIRECTIONS

- Future studies will examine:
  - Loud speech effects on speech motor control and speech intelligibility in both ALS
  - Compare loud and clear speech effects on speech motor control and speech intelligibility for individuals with ALS
  - Increased vocal intensity is often a byproduct of clear speech; therefore, comparing the two will provide a better understanding of the relationship between treatment techniques (Tjaden, Susman, & Widling, 2014).
- Larger sample size that is more representative of the ALS population
- Stratify subjects based on dysarthria severity and disease stage
- Include measures of stiffness derived from kinematic signals