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Evaluating aspects of speech motor stability in dysarthria

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INTRODUCTION
Characterizing speech motor performance in dysarthria important for diagnosis and treatment
- One way to assess motor control over different levels of speech production is to estimate the stability of movement patterns.
- Kinematic measures of speech motor variability (EMA, strain-gauge transducers) indicate changes in dysarthric speakers, but are expensive and invasive.
- Acoustically based measures also promising in signalling presence and severity of dysarthria [1].

Aim of the study
Evaluate speaking conditions and acoustic parameters of variability measures for their suitability to diagnose and classify dysarthria.

METHODOLOGY
Speakers
- 23 speakers with Parkinson’s disease and mild to moderate hypokinetic dysarthria (HD): 18 male, 5 female, age 40-81, M=66.6, SD=10.6.
- 9 speakers with various neurological diseases and mild to severe ataxic dysarthria (AD): 6 male, 3 female, age 37-70, M=49.0, SD=11.8.
- 27 age-matched control speakers (AMC): 16 male, 11 female, age 35-80, M=57.4, SD=13.9.

Procedure
- Stimuli: Repeat the phrase “Tony knew you were lying in bed” 20 times.
- Six speaking conditions: Habitual rate, Slow rate, Fast rate. Increased Length (IL) “One two three Tony knew you were lying in bed five six seven”, Increased Complexity (IC) “I heard that Tony knew you were lying in bed this Sunday morning”, and Dual task (during spiral drawing).

DATA ANALYSIS

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RESULTS

Principal Component Analysis
- Grouping 72 variables into relatively high number of factors (15-16).
- First 2 factors explain only 36 - 41% of total variance.

Logistic Regression
- Using PCA rotated factors as predictors resulted in improved logistic models.
- Each model contained at least 1 significant factor that improved the models.

Classification
- Classifications HD vs AMC and DYS vs AMC reasonably successful.
- AD vs AMC: 1 in 3 are classified as false negatives.
- HD vs AD: many AD speakers classified as HD.
- Possibly due to low sample size and varying speaker profiles in the AD group.

DISCUSSION

Conclusions
- Acoustic measures of variability may be used to signal dysarthria: HD (SPL, F1) and AD (SPL, F0, F1).
- ...and to distinguish dysarthria types (SV of SPL).
- Most robust overall: Spatial Variability of Sound Pressure Level in Slow and Increased Complexity conditions.
- Demonstrates added value of Functional Data analysis to STI.

Limitations
- Low sample sizes (AD group) and missing data (F2 contours).
- Different underlying etiologies in speakers with ataxic dysarthria.
- HD and AD group not comparable in severity (based on intelligibility).

REFERENCES


Financial support: The Scottish Funding Council.