Assessing dysarthria using variability measures from audio recordings

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Results

Identifying (sub-clinical) speech symptoms in PD

• More temporal and spatial variability were separately compared by Repeated Measures ANOVA.
• Speaker groups: PD and CON | Speaking conditions: Habitual and Fast | Speech parameters: Amplitude, F0 and F1

• Spatial variability was lowest for F0, compared to Amplitude and F1, across groups and speaking conditions, (Parameter F(2,26)=0.70, p=0.50).
• The PD group showed a trend of lower variability in F0, a trend of increased variability in Amplitude and significantly higher variability in F1 (p=.001) than the control group, across speaking conditions. (Group*Parameter F(1,26)=5.63, p=0.024).
• Relationship between speech parameters:
  - Amplitude = F0
  - PD F0 < Amplitude = F0
  - PD F0 = Amplitude = F1
• An increase in variability was shown from habitual to fast condition for Amplitude, but a decrease for F0 and F1 (all trends) (Parameter*Condition F(2,26)=0.70, p=0.50).

Differentiating severity levels in Ataxic Dysarthria

• More temporal and spatial variability were separately compared by Repeated Measures ANOVA.
• Speaker groups: ATD-A, ATD-B and CON | Speaking conditions: Habitual and Fast | Speech parameters: Amplitude, F0 and F1

• A main effect of Group was present across speech parameters and speaking conditions (F(2,17)=10.69, p<0.001).
• Post-Hoc analysis (LSD) showed:
  - Variability is higher in ATD-A versus CON, p<0.01
  - Variability is higher in ATD-B versus CON, p<0.01
  - Variability is higher in ATD-B versus ATD-A, p<0.01
  - ATD-B > ATD-A > CON

Discussion

• In general, the small and heterogeneous nature of the groups account for large within-group variability, obscuring detection of differences between groups and speaking conditions.
• Question 1: Can FDA detect sub-clinical impairments of motor control in PD speakers?
  • Yes, a significant increase in F1 variability and trends towards increased Amplitude variability and decreased F0 variability.
  • Also expressed in a different relationship of variability amongst speech parameters.
  • Might reflect emerging signs of hypokinetic dysarthria, i.e. impairments at F1, poor loudness control (Amplitude) and monophonic (F0).
• Question 2: Can FDA detect speech motor problems in ataxic dysarthria and reflect differences in severity?
  • Detection: Yes, an increase in temporal and spatial variability in Amplitude, F0 and F1 for both mild and moderate speakers with ataxia.
  • Differentiation: Yes, an increase in dysarthria severity is related to an increase in temporal variability.
  • Reflecting impaired timing of speech motor movements associated with cerebellar dysfunction.

References