Acoustic Markers of Dysarthria in Children with Cerebral Palsy: Comparison of Speech Tasks

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Introduction

- Dysarthria most frequent communication impairment in children with cerebral palsy (CP) (Parkes et al., 2010).
- Speech characteristics include shallow, irregular breathing, harsh and/or breathy voice, hypernasality, and imprecise articulation (e.g., Nordberg et al., 2014).
- Generally assumed that at least one - often all - speech subsystems (i.e., respiration, phonation, resonance, articulation, and prosody) are affected.
- Acoustic correlates of reduced intelligibility are deviations in articulation rate and F2 range (e.g., Allison & Husdard, 2008), perhaps other candidates.
- Measurements usually obtained from single words or short sentences, but research on adult dysarthria has shown the potential of measuring acoustic features in connected speech (e.g., Rusz et al., 2013; Tjaden et al., 2010).

Purpose

Identify acoustic markers that may aid in the characterization of speech in children with dysarthria due to Cerebral Palsy, and evaluate the suitability of different functional speech tasks by comparing possible group differences side-by-side.

Methods: Participants

- **Speaker**
  - **Gender**
  - **Age**
  - **CP Type**
  - **GMCFS**
  - **Dysarthria Type**
  - **Severity**

- **Control Speaker**
  - **Age**

- **Methods**: Speech in children with dysarthria due to Cerebral Palsy, and evaluate the suitability of different functional speech tasks by comparing possible group differences side-by-side.

Methods: Speech Tasks

1. Series of words from Children's Speech Intelligibility Measure (CSIM) (4).
2. 5-word sentences in varying sentence stress placement (Kuschmann & Lowitt, 2018).
4. Monologue: talking about past birthday

Results: Group comparisons pooled over Tasks

- **Group Comparisons of Acoustic Measures by Task Parameter**
  - **Group**
  - **CP**
  - **TD
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- **Notable results**
  - **Overall**: few very few differences between CP and TD groups when split out by speech task
  - **CSIM**: SPL range higher in CP group
  - **Sentences**: CPPS higher in CP group
  - **Monologue**: CPPS higher in CP group
  - **Story Retelling**: No group differences

- **Lack of group differences partly due to large within-group variation for the CP speakers; possibly due to underlying differences in dysarthria type.**

Results: Group comparisons separately by Task

- **Group Comparisons of Acoustic Measures by Task Parameter**
  - **Group**
  - **CP**
  - **TD

- **Notable results**
  - **Overall**: ratios of outcome measures mostly deviating in Spastic Dysarthria followed by Dyskinetic Dysarthria.
  - **Range** and **SD** of SPL and F0 most prominent markers.
  - **CPP and CPPS** values higher in speakers with dyskinetic and ataxic dysarthria: indicative of voice problems for these dysarthria types.

Summary & Conclusion

- **CPP and CPPS** possible marker of breathiness and strained voice problems in speakers with CP.
- Higher SPL and F0 range and SD indicative of excessive and variable stress patterns, and reflect reduced velopharyngeal control.
- **Current selection of quasi-automatically obtained acoustic measures might not capture differences in speech characteristics between CP and TD children / adolescents, regardless of speech task.
- Underlying variation in etiology and its manifesting dysarthria, as well as developmental differences may contribute to current results.
- **Overall results** point at need for an individualized assessment of acoustic characteristics in the speech of children with Cerebral Palsy.

Future directions:

- Identify relationships between acoustic measures and intelligibility measures.
- Fine-grained acoustic analysis on vowel level.

References


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