‘Autistic’-Sounding: Parsing Heterogeneity in Natural Conversations using Acoustic Properties of Speech

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Introduction

- Behavioral heterogeneity in ASD is a persistent challenge
  - (More) homogeneous subgroups could respond differentially to interventions
  - Parsing behavioral heterogeneity is a critical step toward pinpointing the biological bases of ASD
- Even after attempting to manufacture homogeneity by restricting variables such as age and IQ within study samples, children with ASD still behave very differently across contexts
  - E.g., standardized vocabulary tests vs. playground conversation

Objective

Parse **acoustic heterogeneity** in the *spontaneous speech* of children with ASD using a **latent growth curve approach**

Methods

Participants

- 35 verbally fluent children with ASD
- IQ estimates in the average range (>75), aged 7-16.9 years

Procedure

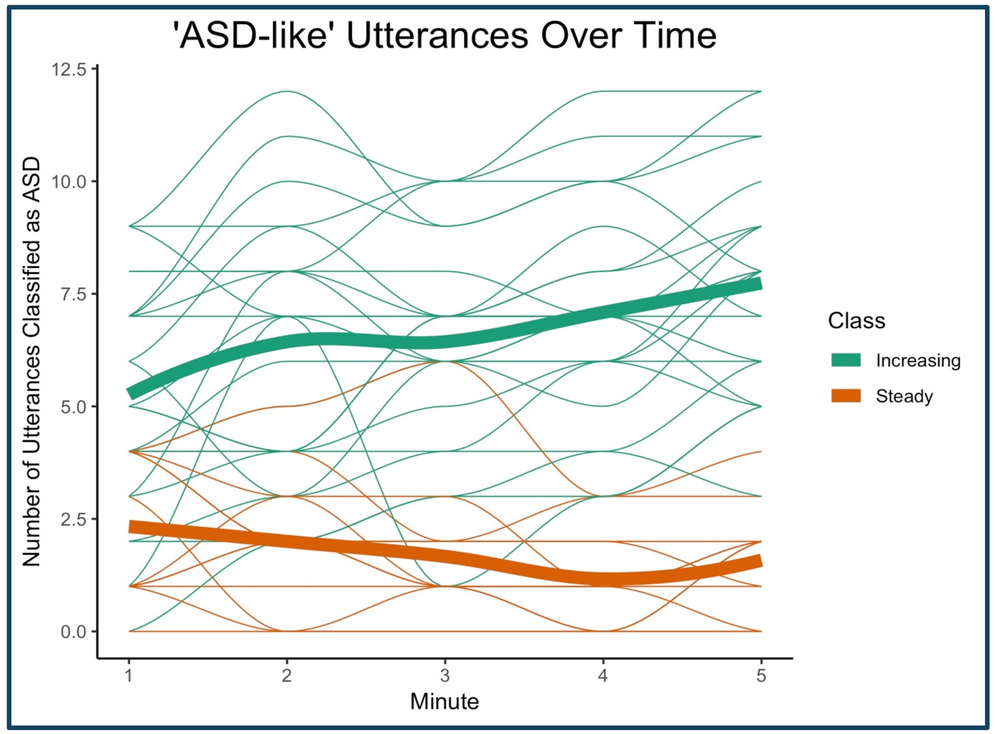
- Language samples from an unstructured 5-minute ‘get-to-know-you’ conversation with a novel confederate who was not an autism expert
- Time-aligned and orthographically transcribed in Xtrans using a modified Quick Transcription protocol (Parish-Morris et al., 2016)

Statistical Approach

- Children produced a total of 2,408 useable utterances (mean=68.8 utterances each)
- Machine learning with 5-fold cross-validation classified each utterance as ‘ASD’ or ‘TD’ using acoustic properties of speech (matched sample including both diagnostic groups described in Cho et al., poster #32426)
- Number of ‘ASD’-like utterances (~1-minute windows) was tested for the presence of latent classes (‘lcmm’ in R)
- Simple linear models compared class characteristics

Questions?
Contact Julia Parish-Morris at parishmorrisj@email.chop.edu

Machine learning classification using **acoustic properties** of speech revealed **two profiles**. The more talkative group sounded **increasingly atypical** over 5 mins.



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Results

- A 2-class model provided the best fit (vs. 3 or 4)
- **Two subgroups had (1) Increasing (N=23) or (2) Steady (N=12) numbers of ASD-like speech utterances over the course of the conversation** (Figure)
- Group **intercepts** differed significantly:
  - The Increasing group produced more ASD-like utterances at the start of the conversation than the Steady group (coefficient: -2.08, Wald test=-2.40, p=.02)
- Group **slopes** differed significantly:
  - Members of the Increasing subgroup produced growing numbers of utterances classified as ‘ASD’ over time (Coefficient=.49, Wald test=5.97, p<.0001)
  - The relationship between time and ASD-like utterances trended negative in the Steady subgroup (Coefficient=-.18, Wald test=-1.65, p<.10.
- *Classes did not differ* on age, sex ratio, nonverbal IQ estimates, ADOS-2 calibrated severity scores, average turn length, or total number of utterances produced
- *Classes differed* on verbal IQ scores (Steady > Increasing; estimate=11.58, t=2.97, p=.003) and total word count (Steady < Increasing; estimate=-150.58, t=-2.88, p=.007)

Discussion

- Machine-learning classification of speech utterances renders it possible to:
  1. Parse heterogeneous samples into more homogeneous subgroups and
  2. Assess dynamic changes over the course of a conversation
- Future research with an expanded sample will include language-based analyses within each class
- This ‘profiling’ approach holds promise for identifying subgroups that benefit from specific interventions and stands to advance the goal of personalized medicine

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