

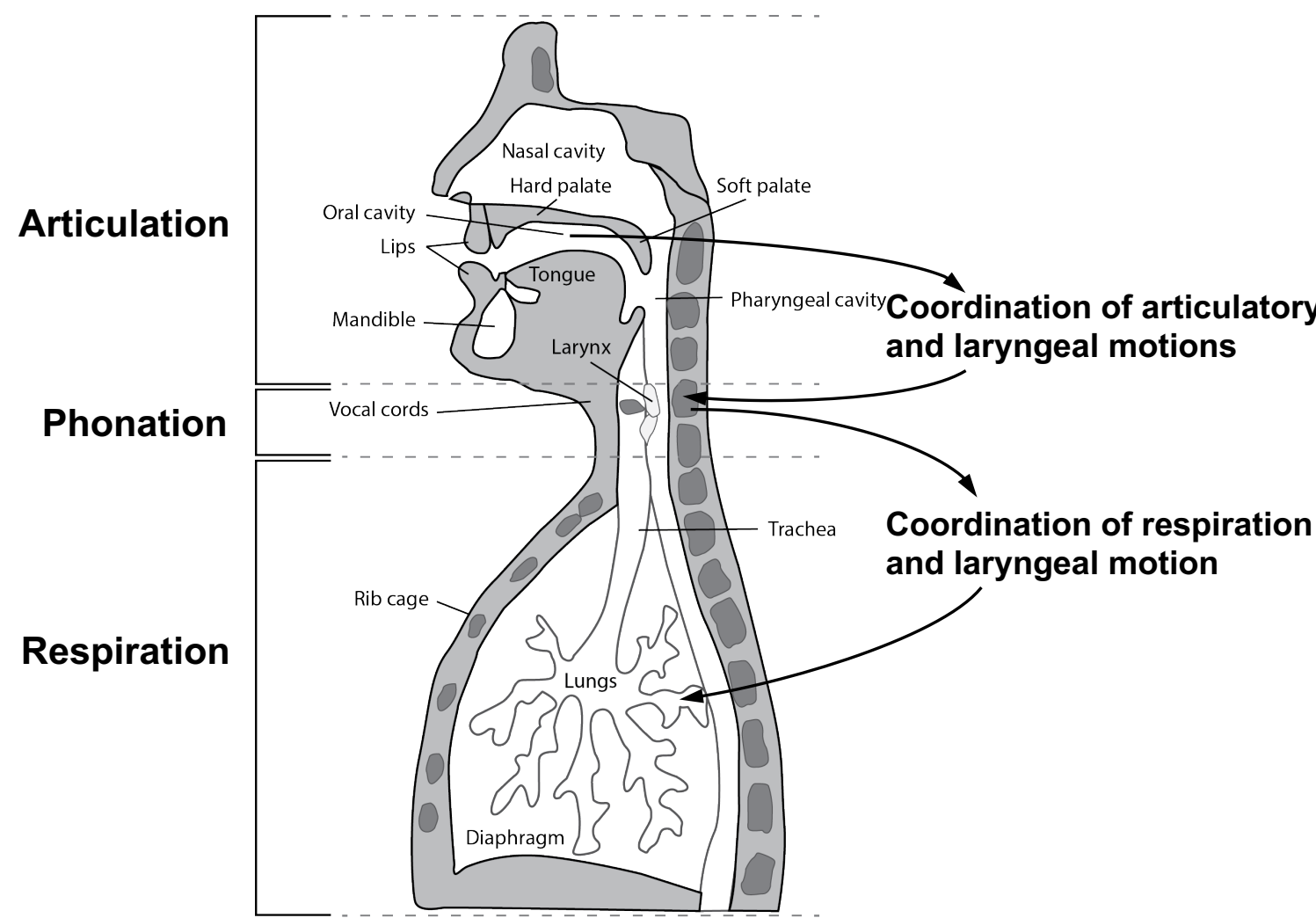
# Assessment of Speech and Fine Motor Interactions in Children with Autism Spectrum Disorder



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## Background and Motivation

- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that affects 1 in 59 children in the US [1].
- Highly verbal children with ASD produce a greater number of phonological errors as compared to their neurotypical equivalents [2].
- We hypothesize that these errors are partly due to underlying deficits in motor coordination across and within speech production subsystems, which also are manifested in degraded fine motor control of facial expressions and purposeful hand movements [3].

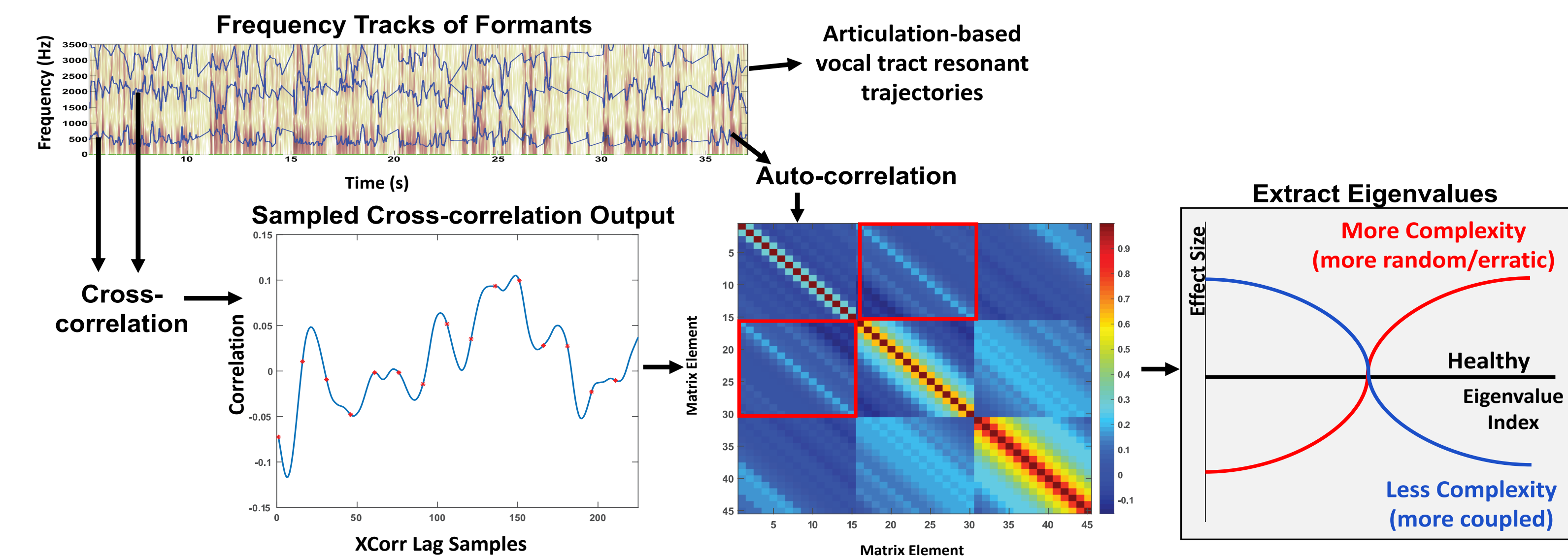


Speech subsystems involved in speech production and relationships across speech subsystems.

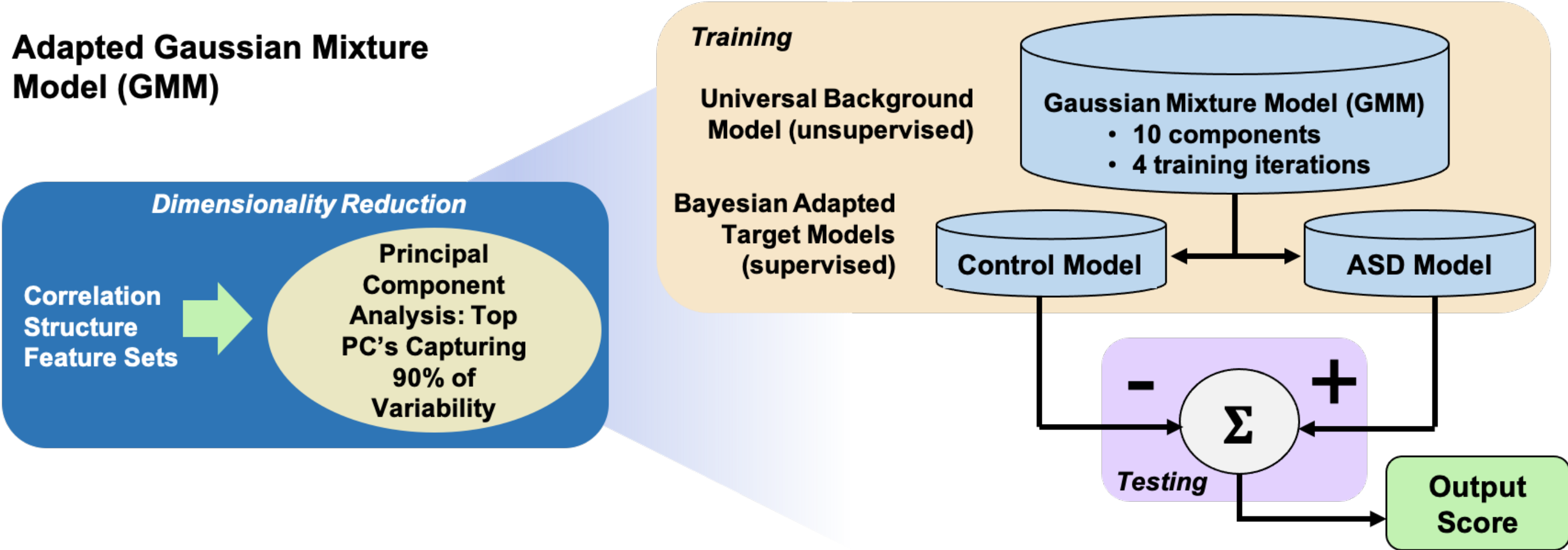
## Methods

- Population: 5 controls (1 female age 11; 4 males ages 6,6,6,7); 5 ASD (5 males ages 8,7,7,7,7)
- Data Materials: Speech Tasks - Caterpillar paragraph; repeated diadochokinetic phrase pa-ta-ka; free speech; sustained vowels, Handwriting Tasks – Adapted Beery-Buktenica Developmental Test of Visual-Motor Integration
- Features: Fundamental Frequency (F0), Formants (F1, F2, F3), Facial Action Units (FAUs), Intensity, Handwriting Accelerations (x,y,pressure)

### Eigenspectra as a Proxy for Motor Coordination [4]

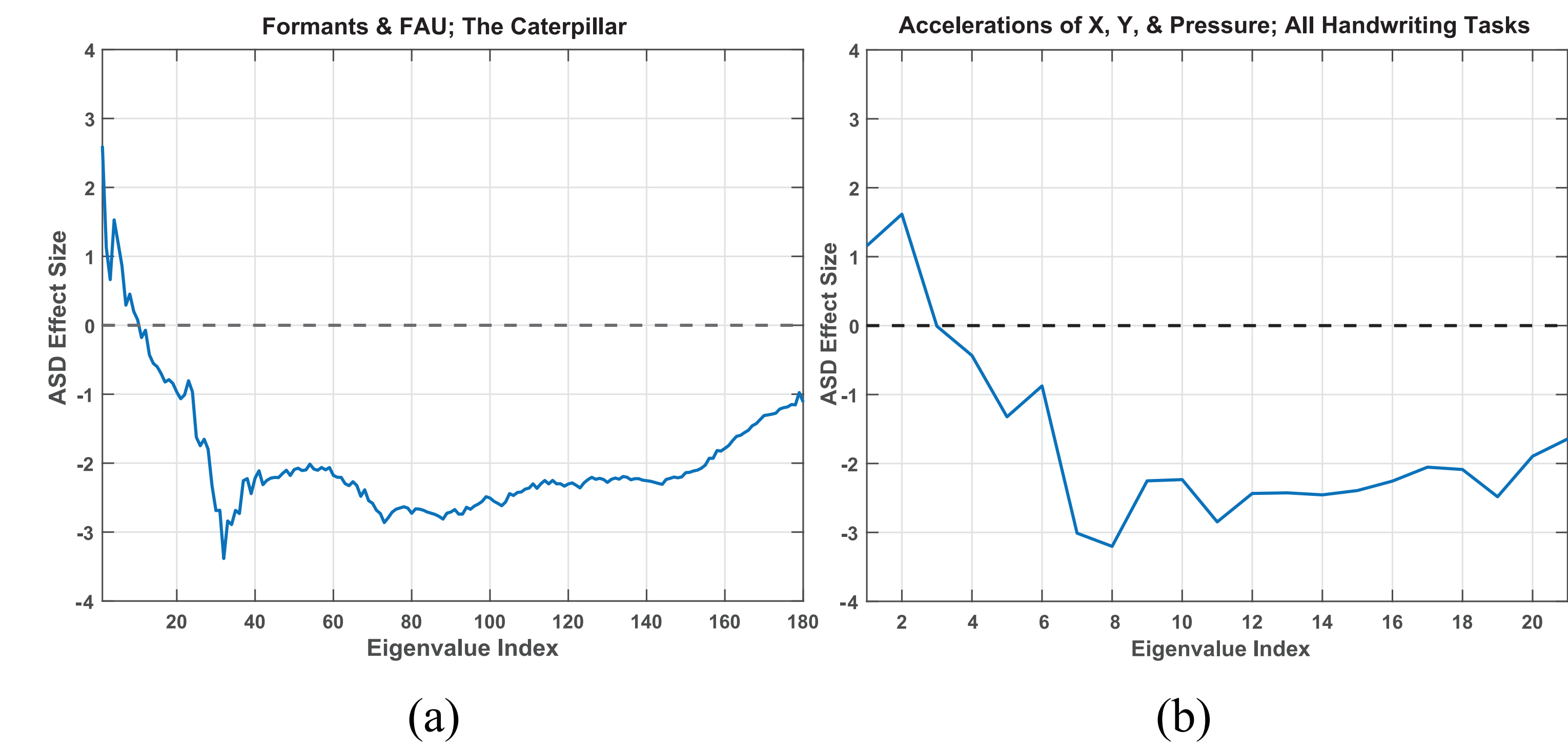


### Classification with Gaussian Mixture Models



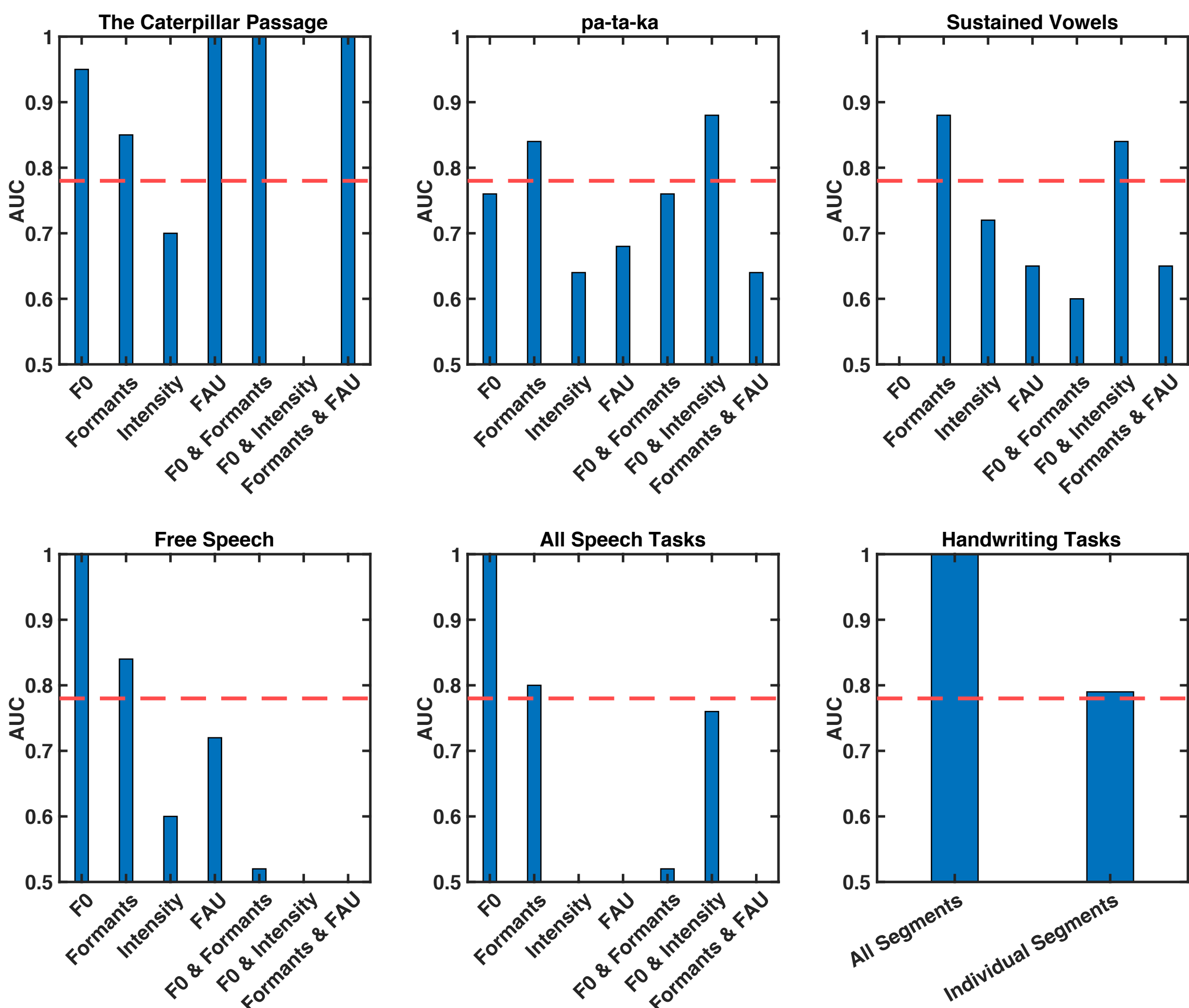
## Results

### Cohen's d Patterns Representing Complexity of Coordination



Cohen's d effect size patterns of eigenspectra derived from (a) formants and FAUs during the Caterpillar passage and (b) handwriting accelerations suggest that children with ASD have lower complexity of motor coordination as compared to neurotypical controls.

### Area Under the Curve (AUC) for Feature + Task Combinations



Eigenspectra used as feature inputs into GMMs allowed for perfect discrimination (AUC = 1.0) between the two subject groups, but showed some potential task dependence.

## Conclusions

- Analysis utilizing eigenvalues derived from correlation structures suggests that highly-verbal children with ASD have lower complexity of speech and handwriting coordination as compared to neurotypical controls.
- Eigenspectra can be used to discriminate between children with ASD and neurotypical controls using GMMs.
- Further work will expand to a larger population, incorporating analysis of eyetracking and correlations between language outcomes and assessment of motor coordination. We also aim to assess the neurophysiological meaning of outcomes and link the outcomes to the phonological errors witnessed in this population.

### References

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