

Objective Language Feature Analysis in Children with Neurodevelopmental Disorders during Autism Assessment

Manoj Kumar¹, Rahul Gupta¹, Daniel Bone¹, Nikolaos Malandrakis¹, Somer Bishop², Shrikanth Narayanan¹

¹Signal Analysis and Interpretation Lab, University of Southern California ²Department of Psychiatry, University of California San Francisco

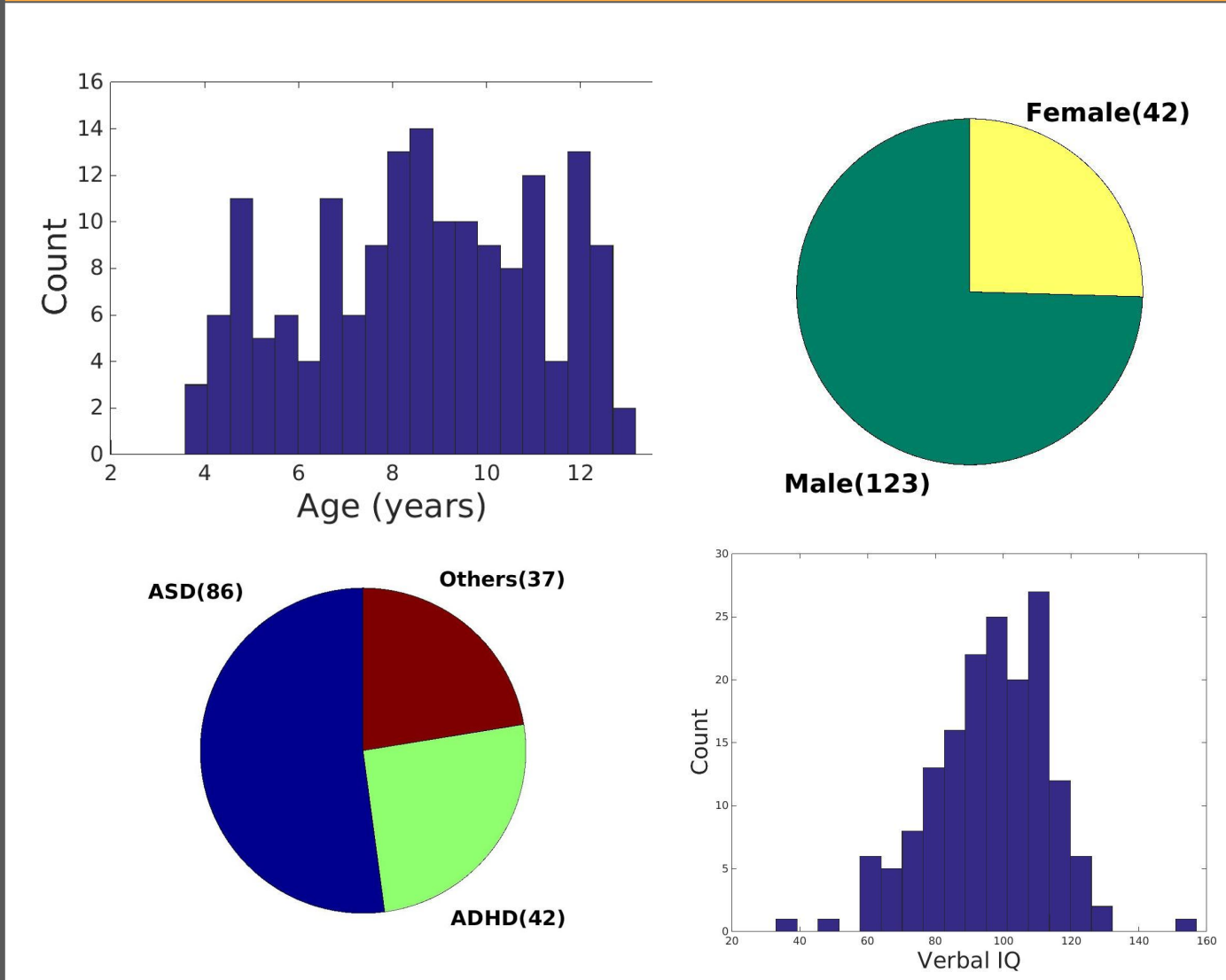
Motivation

- Growing prevalence of ASD. Among American children: 1 in 68
- Marked by delayed and impaired language production and use: Echolalia (meaningless repetition), neologism, etc.
- To come up with objective linguistic measures that quantify and describe behavioral characteristics
- Aid language-specific assessment and improve overall clinical diagnosis

Background

- Linguistic norms: Continuous affect measures extracted from transcriptions (Sentiment analysis, Document polarity)
- Recent works - explore linguistic norms beyond affect & scalability to large corpus
- Autism Diagnostic Observation Schedule: Semi-structured, module-specific ASD assessment tool
- Different categorical codes combined into Calibrated Severity Score (CSS).

Dataset



Classification Summary

- To test the discriminative power of psycho-linguistic norms over word usage distributions (Maximum Entropy Classifier)
- Train-validation-test split : 8-1-1; 10-fold CV

Classifier Setup	Accuracy(%)
Maxent	66.7
Maxent + LIWC	69.1
Maxent + Psycho-Linguistic Norm	69.7

Table 1. Performance of classification systems. Chance = 52.3%

- Feature selection returned *Gender Ladenness (F1)*; and *Affect (F2)* from negative valence conversations

Norm-Severity Correlates

- To analyze how closely lexical norms are indicative of the underlying behavioral characteristic
- Correlation analysis with Calibrated Severity Scores (CSS) driven by existing hypotheses from ASD literature

Norm	Child	Psychologist
Concreteness (F1)	0.09	-0.10
Valence (F1)	-0.15	-0.20
Gender Ladenness (F1)	-0.07	0.32
Affect (F2)	0.08	0.30

Table 2. Partial correlations for selected psycho-linguistic descriptors. Controlled for age, gender, verbal IQ ($p<0.05$)

- Findings in parallel with Bone et al. 2014., where psychologist’s prosodic patterns are indicative of child’s autism severity

Classification System

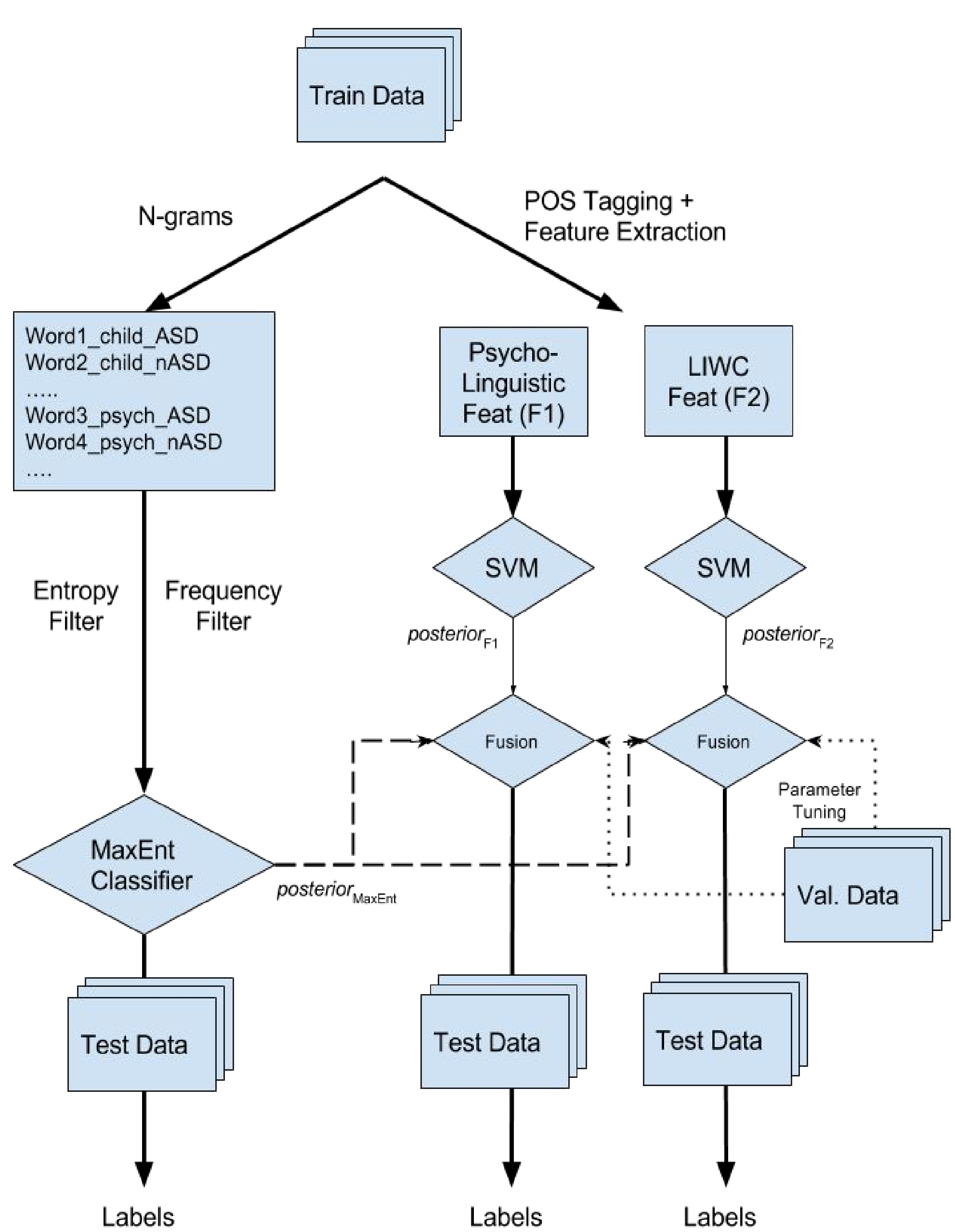


Fig 1. Overview of the classifier system. Best estimate clinical diagnosis used as ground truth.

Discussion

- Significant classification accuracy with MaxEnt. No significant increase with lexical norms
- Existence of variation in conduct of *Sadness, Anger* and *Fear* questions - child’s response and psychologist’s follow-up
- Psychologist's affect influenced by child’s diagnosis
- Selected frequent N-grams of different diagnostic groups:

	Child	Psychologist
ASD	I_DON'T, DON'T_KNOW, AND_I, UM_I, BUT_I	FEEL_WHEN, IT_FEEL, OTHER_PEOPLE, MAKES_YOU, DO_YOU
nASD	MY_BROTHER, IN_THE, I_GET, LIKE_I, I_JUST	YOU_FEEL, WHEN_YOU'RE, HOW_DOES, CAN_YOU, FEEL_INSIDE

Table 3. Selected significant N-grams returned by MaxEnt classifier

Future Work

- Automate lexical analysis using ASR decoded hypothesis/lattices
- Integrate audio/video modality in the classification setup

References

- Bone at al., “The psychologist as an interlocutor in autism spectrum disorder assessment: Insights from a study of spontaneous prosody,” Journal of Speech, Language, and Hearing Research (2014)
- N. Malandrakis and S. S. Narayanan, “Therapy language analysis using automatically generated psycholinguistic norms” in INTERSPEECH (2015)
- Lord et al., “The Autism Diagnostic Observation Schedule—Generic: A standard measure of social and communication deficits associated with the spectrum of autism” Journal of autism and developmental disorders (2000)