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

Manoj Kumar[1], Rahul Gupta[1], Daniel Bone[1], Nikolaos Malandrakis[1], Somer Bishop[2], Shrikanth Narayanan[1]

[1]Signal Analysis and Interpretation Lab, University of Southern California, Los Angeles [2]Department of Psychiatry, UCSF School of Medicine, San Fransisco

Motivation

➢ ASD Prevalence in American children : 1 in 68
➢ Marked by delayed and impaired language production and use : echolalia, neologism, etc.
➢ To come up with objective linguistic measures describing behavioral characteristics
➢ Aid language-specific assessment and overall diagnosis

Background

➢ Linguistic norms : Continuous affect measures extracted from transcriptions (eg : Sentiment analysis)
➢ Extension beyond emotion norms and scalability to large corpus explored in recent times
➢ ADOS : Semi-structured, module-specific ASD assessment tool
➢ Different categorical codes combined into ASD severity score
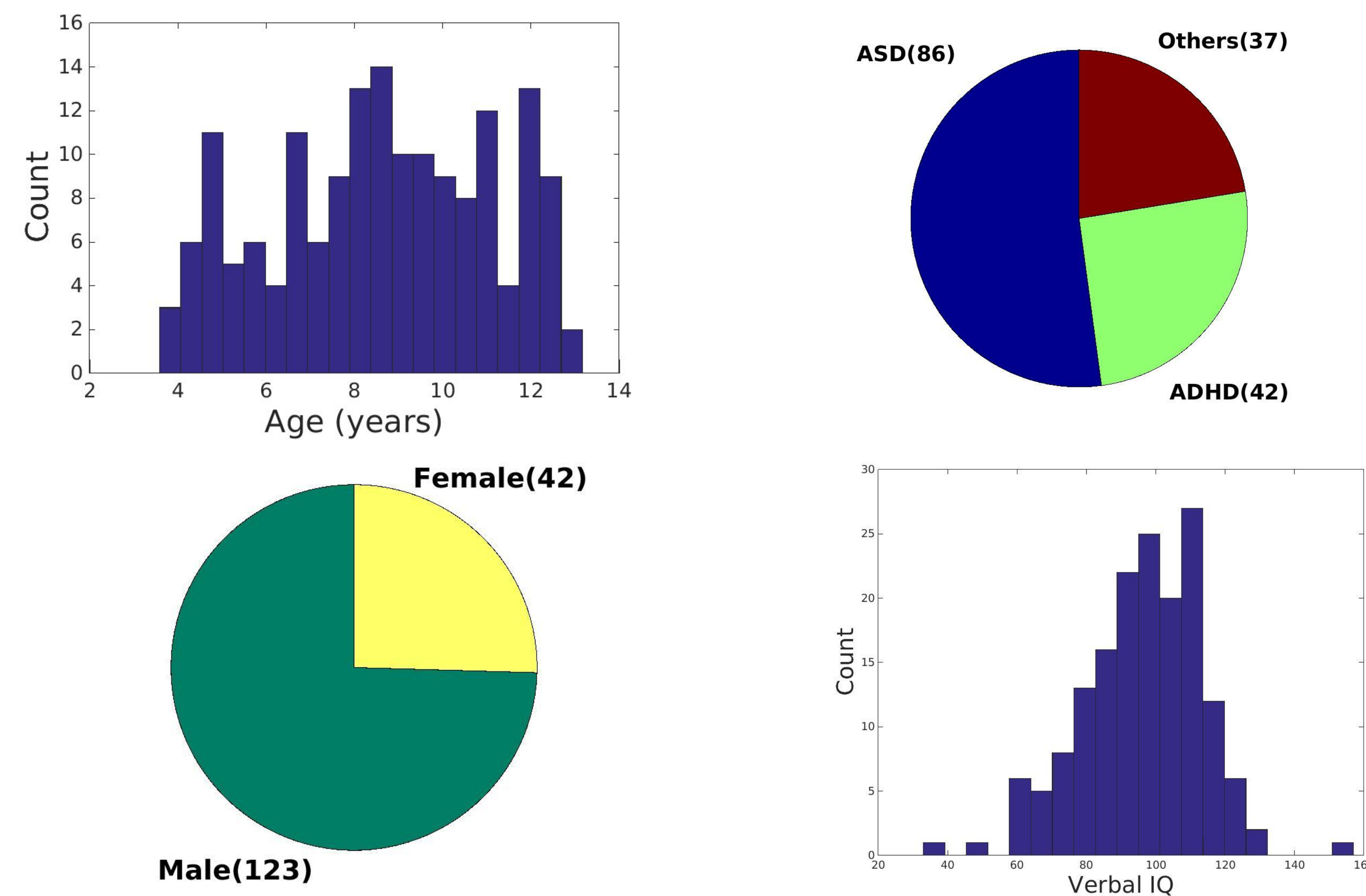
Dataset Demographics

Fig 1 : Demographic information. 'Emotions' and 'Social Difficulties & Annoyance' Tasks from Module 3 of ADOS are selected for this work

Posterior Fusion Based Classifier

➢ 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
➢ Classification accuracy significantly better than chance ($p<0.05$)
➢ Feature selection returned *Gender Ladenness (F1);* and *Affect (F2)* from negative valence conversations
➢ Existence of variation in conduct of Sadness, Anger and Fear questions - child's response and psychologist's follow-up
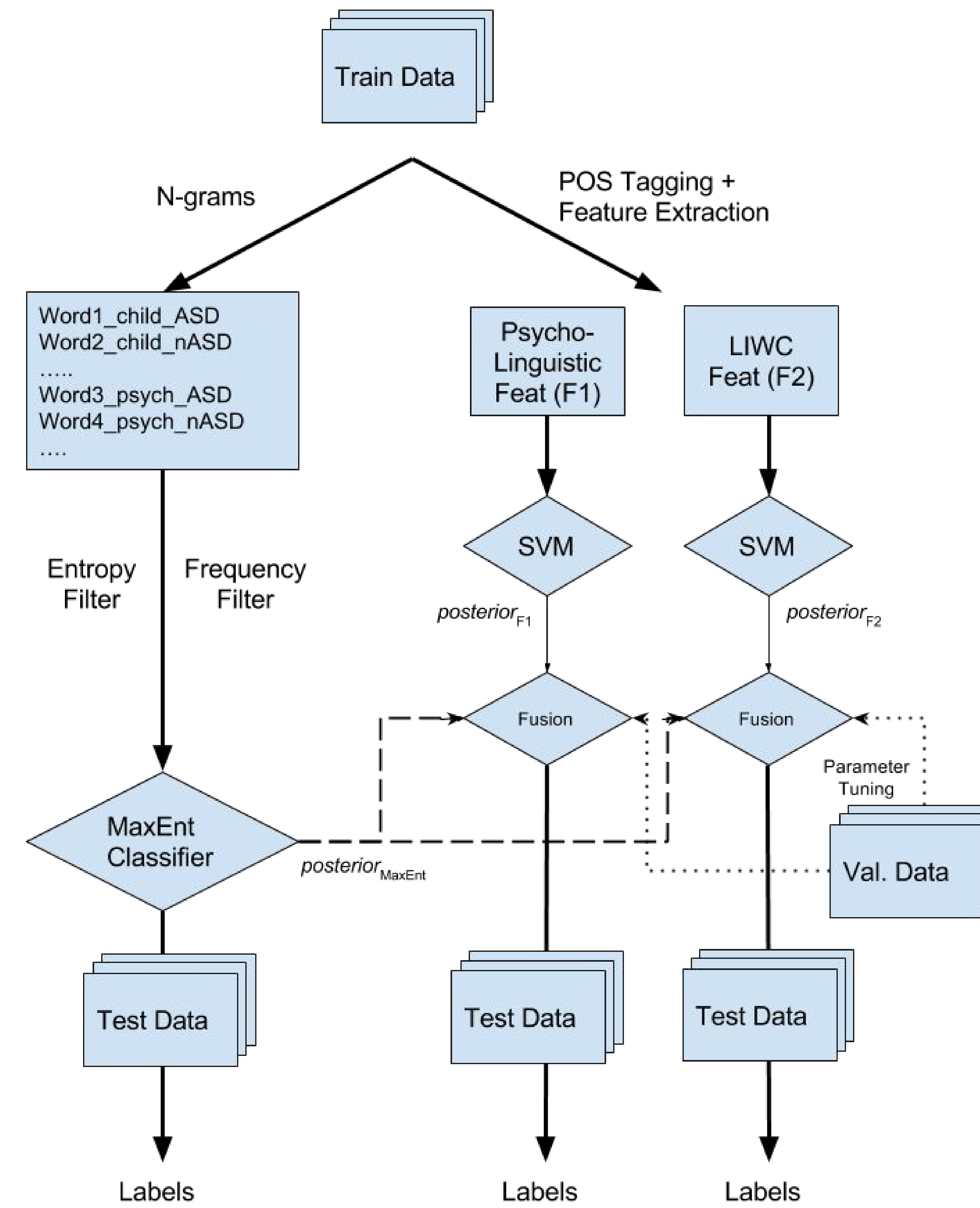

Fig 2 : *Overview of the classifier system. Best estimate clinical diagnosis used as ground truth.*

Norm-Severity Correlates

➢ To analyse how closely lexical norms are indicative of the affective quality
➢ 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 1 : Correlation analysis (**p<0.05**). Only selected norms presented here. Complete experiments reported in paper.

Discussion

➢ Significant classification accuracy with MaxEnt. No significant increase with lexical norms
➢ 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 2 : Most frequent N-grams selected by MaxEnt classifier.

Future Work

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