ANALYZING THE STRUCTURE OF PARENT-MODERATED NARRATIVES FROM CHILDREN WITH ASD USING AN ENTITY-BASED APPROACH

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BACKGROUND

- **Children with Autism Spectrum Disorders (ASD):**
  - Poor **linking of causal events** [Losh et al. '03].
  - Weak **emotional understanding** within a story [Losh et al. '03].
  - Less **coherent narratives** [Diehl et al. '06].
- **Parental elicitation strategies** affect:
  - The narrative **content** and **structure** [Peterson et al. '92].
  - The overall narrative **quality** [Clarke-Stewart et al. '99].
  - Children's **understanding** of emotions [Slaughter et al. '07].

HYPOTHESIS
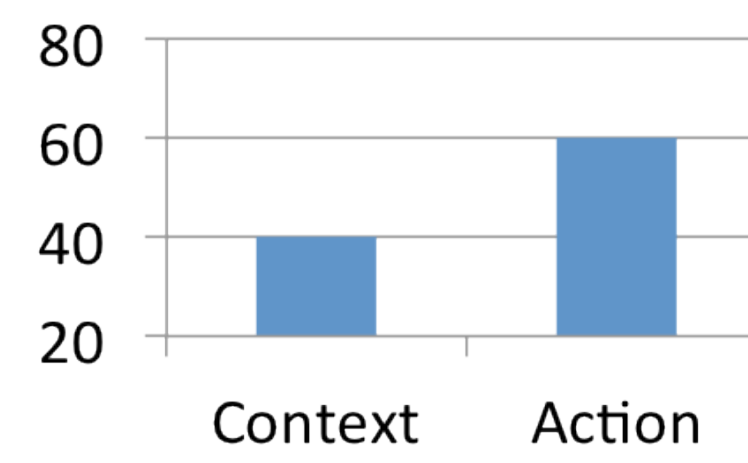
Context: description of people, objects, etc.
- e.g "Is that grass?", "How does he look?"

Action: focus on events, more structured story
- e.g. "What is going on in this picture?"

→ Narrative Structure

The way parents scaffold the story, and specifically whether they ask more context or action questions, affects the overall narrative structure.

NARRATIVE STRUCTURE FEATURES

- **Entity counts** (baseline)
  - # unique entities
  - % entities with frequency larger than 0.05-0.2
  - Larger values for action narratives.
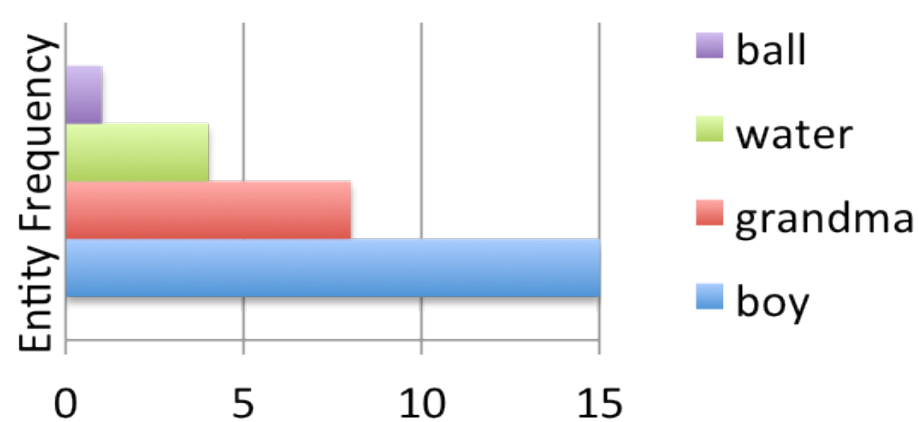
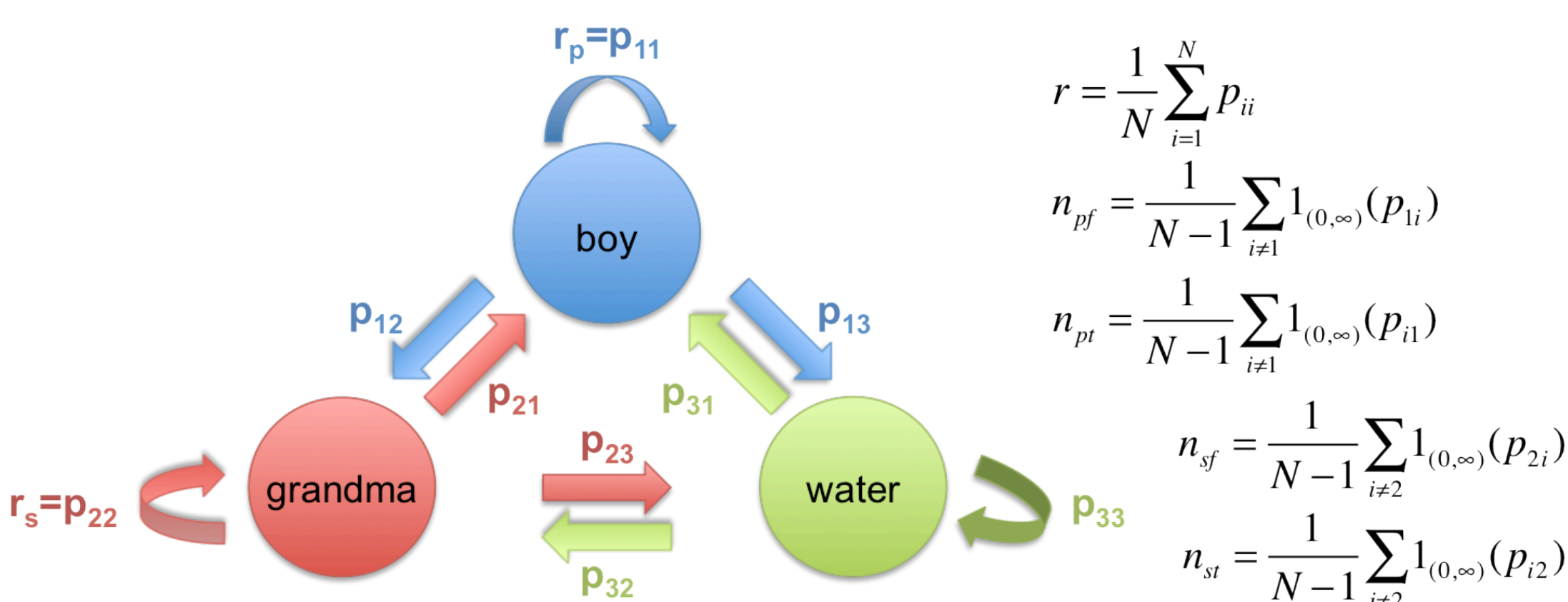- **Entities:** Co-referent noun-phrases representing main characters, ideas, etc.

- **Entity frequency distribution**
  - Decreasing shape of entity frequency distribution.
  - Shape and scale parameters of exponential, Pareto distributions.
  - Steep curve implies few important but commonly repeated entities.
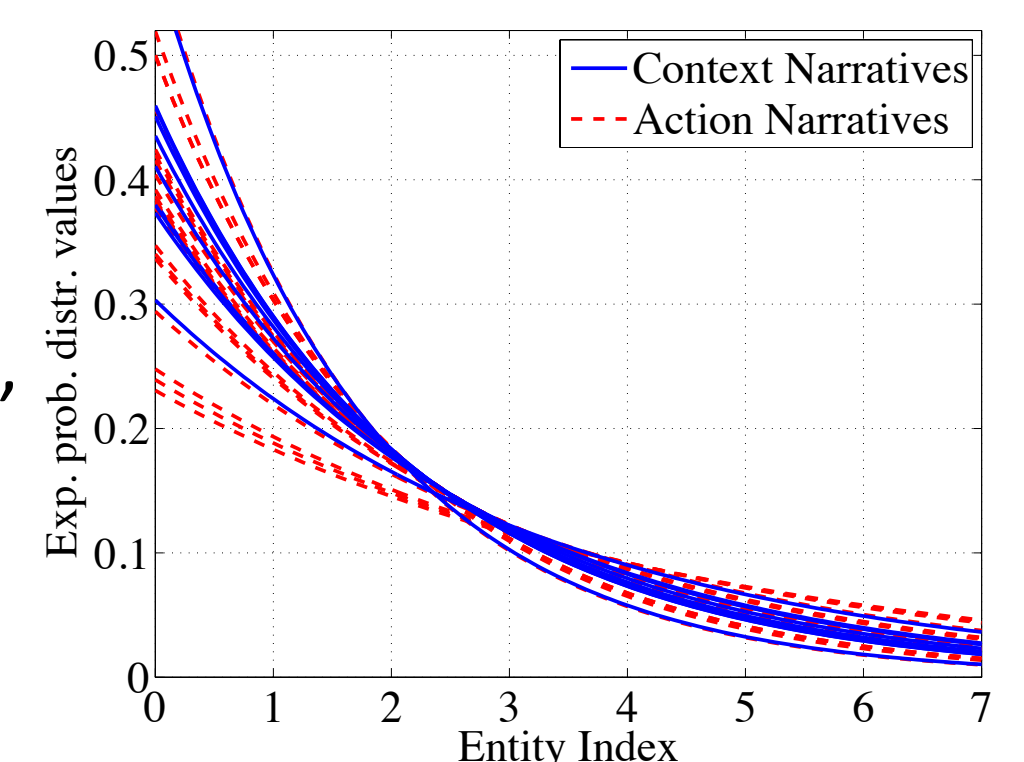
- **Entity transitions**
  - Narrative entities <-> states
  - Sentence evolution <-> transitions } Markov Chain P = [p_{ij}]
  - Less transitioning in action narratives between entities.
 - Most frequent entities dominate the plot in action narratives.

$$r = \frac{1}{N}\sum_{i=1}^{N} p_{ii}$$
$$n_{pf} = \frac{1}{N-1}\sum_{i\neq 1} 1_{(0,\infty)}(p_{1i})$$
$$n_{pt} = \frac{1}{N-1}\sum_{i\neq 1} 1_{(0,\infty)}(p_{i1})$$
$$n_{sf} = \frac{1}{N-1}\sum_{i\neq 2} 1_{(0,\infty)}(p_{2i})$$
$$n_{st} = \frac{1}{N-1}\sum_{i\neq 2} 1_{(0,\infty)}(p_{i2})$$

- **Entity evolution and interaction**
  - $\{X_{nk}\}$: n^{th} entity sequence at k^{th} step
  - $X_{nk}=X_{n,k-1}\pm 1$ if entity n exists (or not) in sentence k
  - Directional distances of sequences (larger in action narratives)

$$d_{nm} = E_{k\in S_h}(X_{nk} - X_{mk}),\ S_h = \{k : X_{nk} > X_{mk}\}$$
$$d_{mn} = E_{k\in S_l}(X_{mk} - X_{nk}),\ S_l = \{k : X_{nk} < X_{mk}\}$$
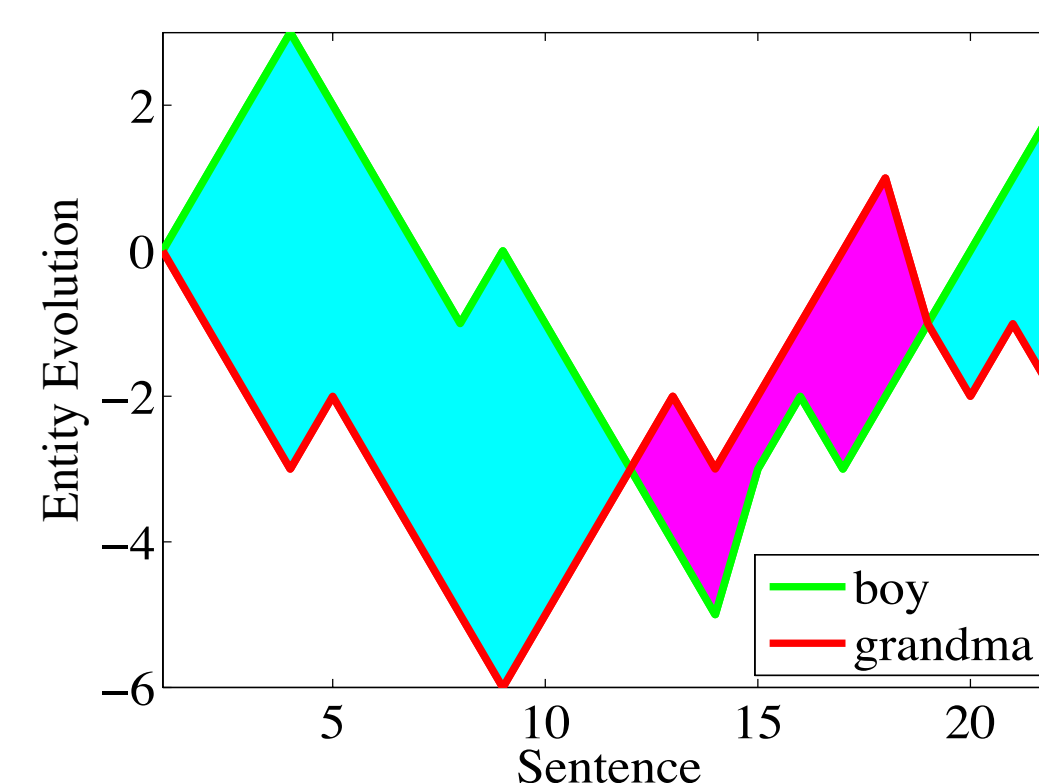
RESULTS

- **Rachel ECA Interaction Corpus**: 11 children, 4 stories each
- Classification of context, action and context/action narratives
- Fisher Discriminant Ratio + Linear Discriminant Analysis
- K-NN classifier

Feature Group	Unweighted Accuracy (%)
Entity Count	**52.27**
Entity Frequency Distribution	36.51
Entity Transitions	**59.85**
Entity Evolution/Interaction	44.70
Entity Count + Frequency Distribution	51.52
Entity Count + Transitions	**61.36**
Entity Count + Evolution/Interaction	**62.88**

CONCLUSIONS AND FUTURE WORK

Conclusions
- Story structure differs for context and action narratives.
- **Evolution** and **interaction** of entities affect story structure.
- **Action** narratives tend to focus on **few dominant entities**.

Future Work
- Agents for **personalized scaffolding** for children with ASD.
- **Semantic** and **syntactic** evolution of entities.
- Conditioning on more detailed **parental stimuli**.