Modeling the Development of Determiner Productivity in Children's Early Speech

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Are adult-like syntactic abstractions present in children's earliest speech?

Yes: Valian (1986) shows children use determiners correctly in the formation of noun phrases at 2;0

No: Pine and Martindale (1996) find children use a limited combination of determiners per the **overlap** measure

Yes: Valian et al. (2009) and Yang (2010, 2013) contend that limited combinations are an artifact of sampling and the Zipfian frequency distribution of nouns (confirmed by our analysis in Figure 1)

No: Pine et al. (2013) use revised methods to match parent and child samples; find that children are less productive

Current study: We use a model-based approach in which generalizers and island learners define a continuum

- Each noun's preference for determiner use is drawn from a beta distribution with mean μ and scale ν (Figure 2).
- The scale parameter ν (Figure 3) provides a concise metric of determiner productivity
- We infer the posterior distribution over model parameters given a sliding window of observations

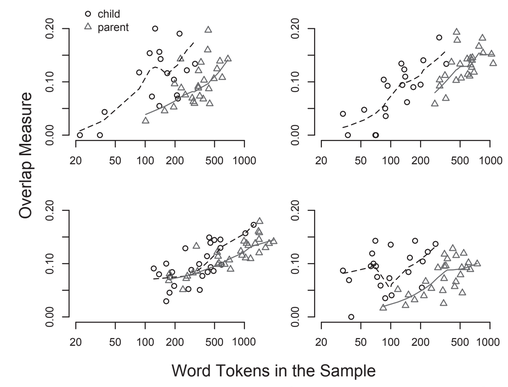

Figure 1: Determiner overlap increases as a function of sample size for 4 kids in the Providence Corpus.

Metric Model *estimates a speaker's determiner productivity*

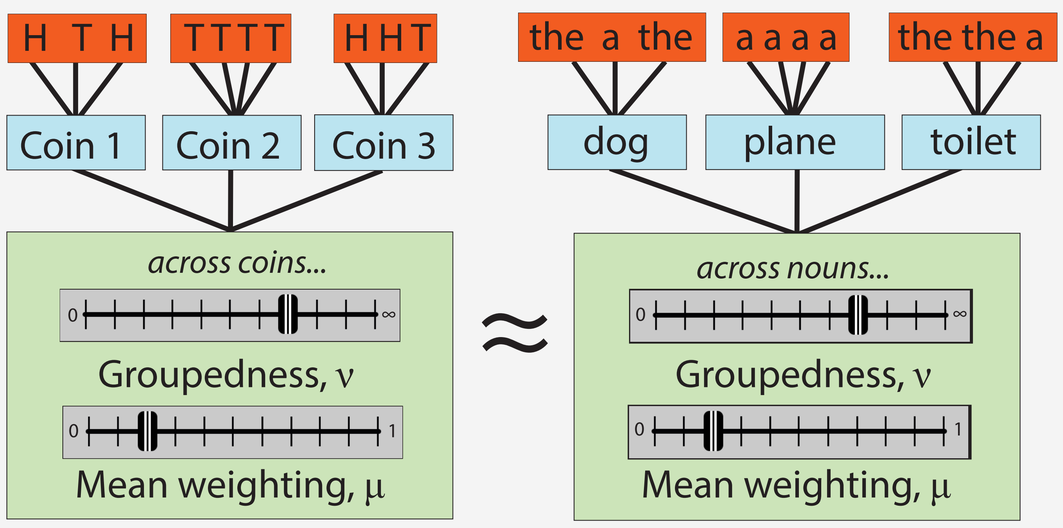

Figure 2: A model of the generative process for a child's observed determiner use.

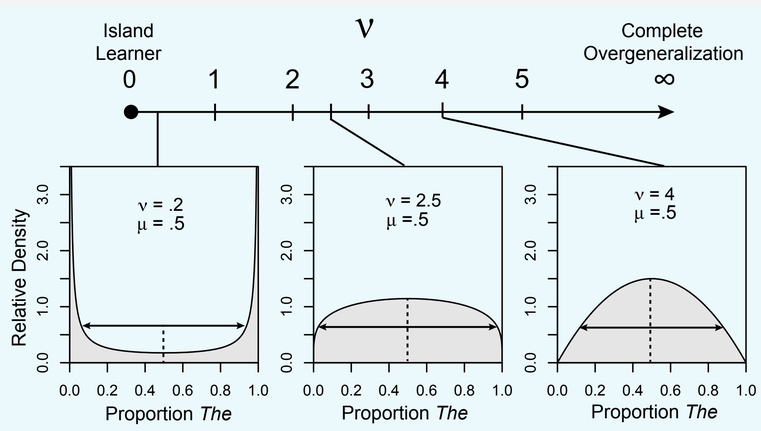

Figure 3: At low values of ν, little or no information is shared between nouns. At higher ν values, nouns exhibit more consistent usage as a class.

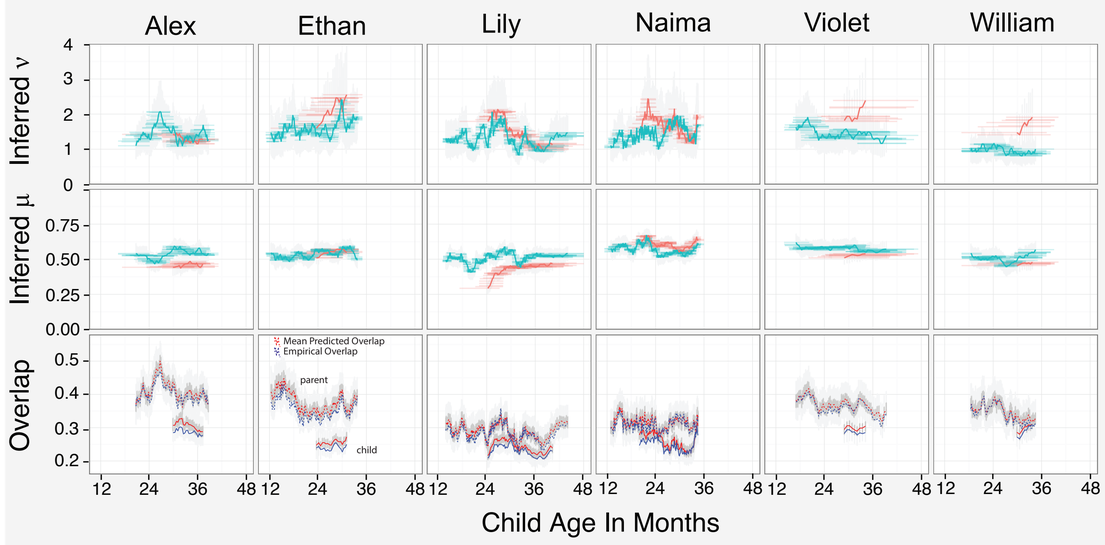

Figure 4: We find no significant difference between adult and child determiner productivity. Mean of posterior: Parent Child; Range of input data: Parent Child; 95% HPD

Linking Model *estimates child's generalization given adult speech*

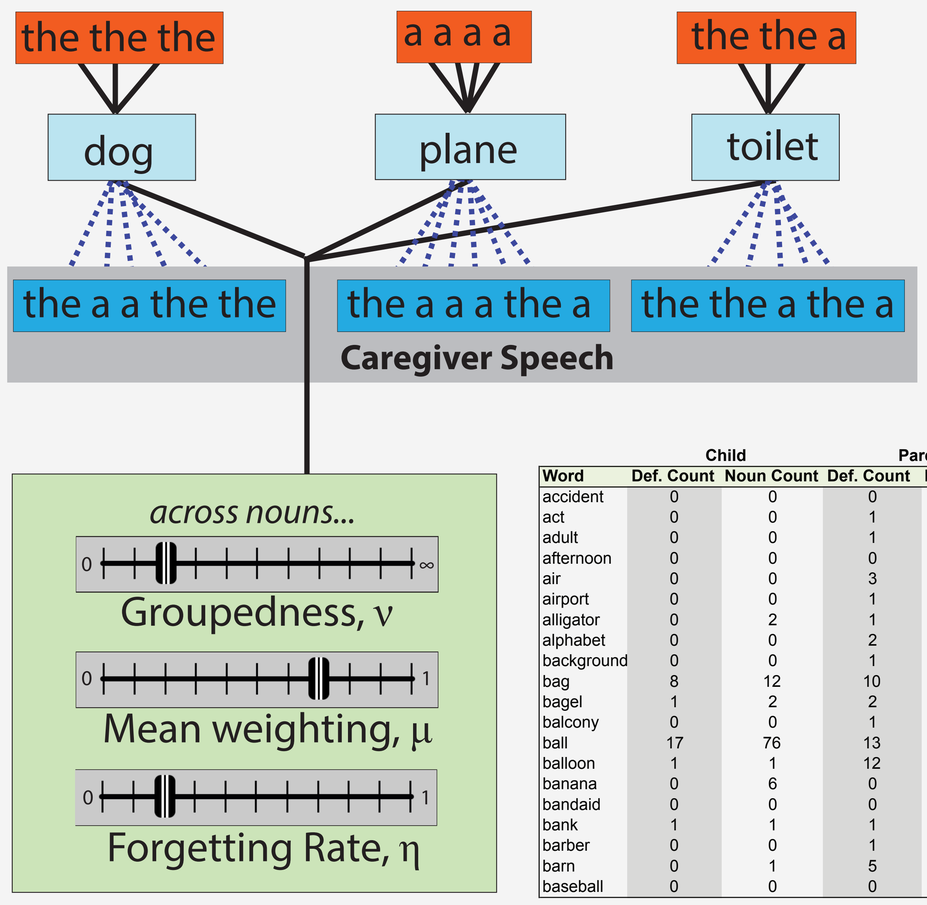

Figure 5: The linking model additionally accounts for caregiver speech

	Child		Parent	
Word	Def. Count	Noun Count	Def. Count	Noun Count
accident	0	0	0	3
act	0	0	1	2
adult	0	0	1	1
afternoon	0	0	0	1
air	0	0	3	3
airport	0	0	1	1
alligator	0	2	1	7
alphabet	0	0	2	2
background	0	0	1	1
bag	8	12	10	16
bagel	1	2	2	4
balcony	0	0	1	1
ball	17	76	13	41
balloon	1	1	12	13
banana	0	6	0	6
bandaid	0	0	0	1
bank	1	1	1	2
barber	0	0	1	1
barn	0	1	5	7
baseball	0	0	0	2

Table 1: Example noun and determiner counts used to parameterize the model

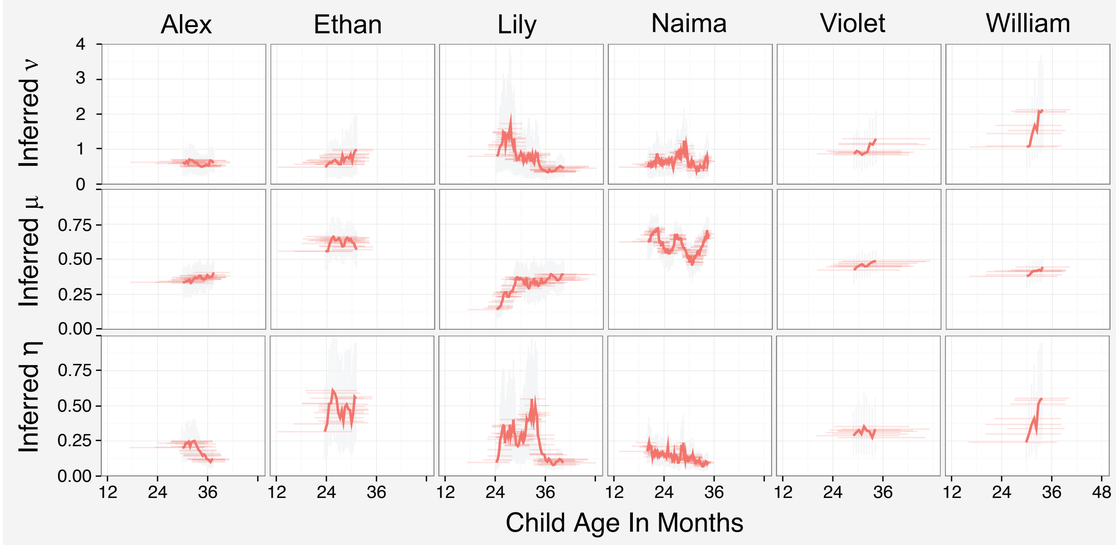

Figure 6: The linking model shows no developmental trajectory in children's productivity. Mean of posterior ; Temporal range of input data ; 95% HPD

Conclusion and Future Work

These models show no clear developmental trend in children's productivity. However, higher density data from earlier in development may show a developmental trend (work with Brandon Roy and Deb Roy of the MIT Media Lab).

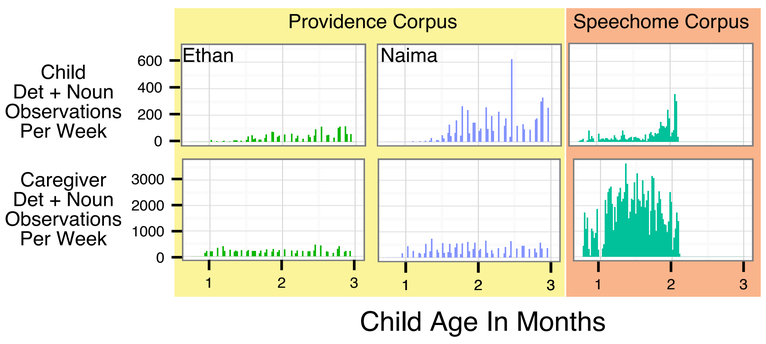

Figure 7: Density of the data from collected from two parent-child pairs in the Providence Corpus in comparison to the Human Speechome Corpus (HSP)

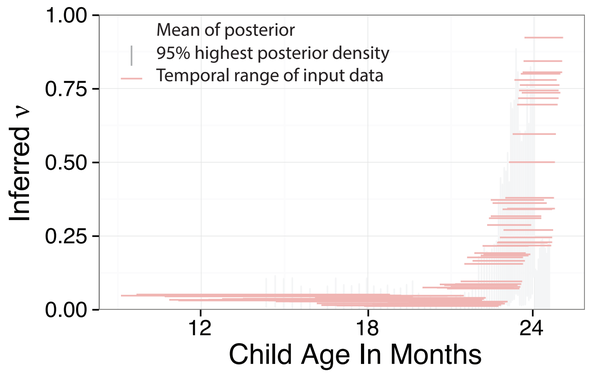

Figure 8: The HSP provides tentative evidence that children transition from specific item-based constructions to adult-like productivity

References

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