Using Language Input and Lexical Processing to Predict Vocabulary Size

Tristan Mahr & Jan Edwards, University of Wisconsin-Madison

THE UNIVERSITY of WISCONSIN MADISON

Background

Language input matters for word learning

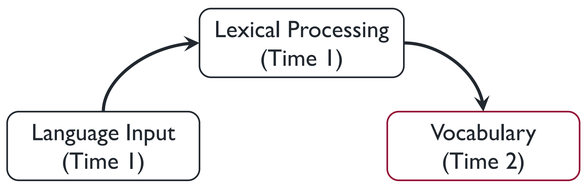
- Children learn language from their environment, and early language input from caregivers predicts language development (e.g., Hart & Risley, 1995; Huttenlocher et al., 1991).

Lexical processing matters for word learning

- Speed and accuracy of word recognition in early childhood predicts later language ability. (Marchman & Fernald, 2008).

Does lexical processing drive the effect of language input in word learning?

- Weisleder and Fernald (2013) found that lexical processing and language input at 19 months predicted vocabulary at 24 months.
- Moreover, lexical processing efficiency *mediated* the effect of input on vocabulary growth. The effect of input worked *indirectly*, traveling through lexical processing:



- These results suggest vocabulary development is not simply a matter of gaining exposure to language. Children have to process this input efficiently to capitalize on learning opportunities.

Current Study

Our study extends this mediation model to older children, using a different language processing task and a direct measure of expressive vocabulary.

- Do home language measures predict concurrent lexical processing and future vocabulary size?
- Does lexical processing in turn predict vocabulary size?
- Is there an indirect effect of input on vocabulary via processing?

Measures

Participants: 202 English-speaking preschoolers (106 boys, 96 girls) contributed data. Data were collected at two time-points:

- Time 1: 28–39 months old (Input and Eyetracking)
- Time 2: 39–51months old (Vocabulary)

Language Input

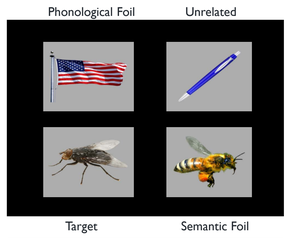
- Data was collected using a digital recorder worn by the children over 10+ hours on a typical day.
- LENA software (Ford, Baer, Xu, Yapanel, & Gray, 2009) analyzed each recording, reporting:
  - Hourly Counts: Adult words, child-adult and adult-child conversational turns, and child vocalizations.
  - Time In Listening Environments: Meaningful/close speech, distant speech, TV and electronics, noise, and silence.

Vocabulary

- Expressive Vocabulary Test 2 (EVT-2, Williams, 2007).
- Growth scale values used for analyses.

Lexical Processing: Visual World Paradigm

- Children heard a familiar word in a carrier phrase (e.g., *find the fly*) and saw an array of photos, with a semantic, phonological, and unrelated foil)
- Tobii T60XL eyetracker measured children's patterns of looking to objects over the course of a trial.
- Outcome measure: Growth curves of proportion of looks to target over time.



Sample trial: *fly* (target); *bee* (semantic); *flag* (phonological); *pen* (unrelated).

- Eyetracking data were downsampled (binned) from 60 Hz to 5 Hz to make data suitable for SEM. We analyzed looks from 200ms to 1700ms (after target word onset) in 200ms bins.

Structural Equation Models

- Analyses performed in R (3.2.2) using lavaan (0.5.20, Rosseel, 2012) with full-information ML (for missing data) with robust standard errors and a scaled test statistic (for non-normality).
- Language input measures analyzed using factor analysis.
- Lexical processing measures estimated using flexible latent growth curve analysis.
- Combined above models to fit an omnibus model to examine direct and indirect effects of input on vocabulary growth.

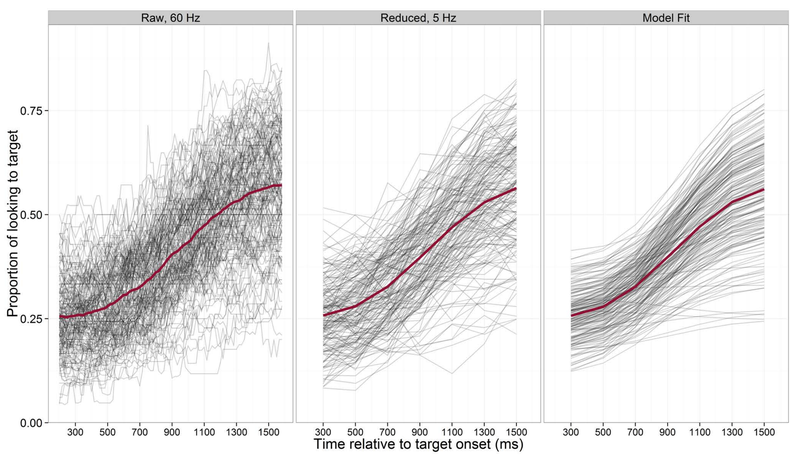
Results

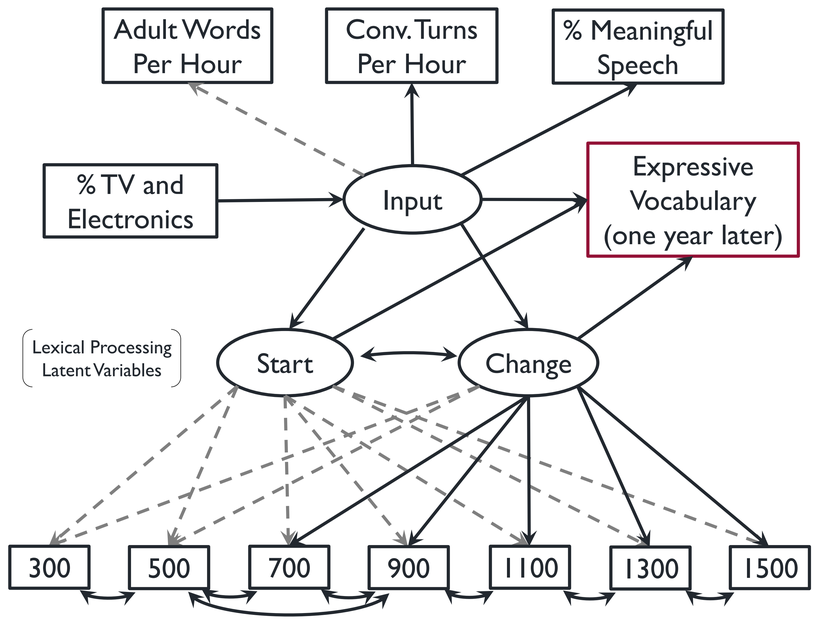
Single Measurements

Measure	n	Mean	SD
Input: Conversational Turns Per Hour	170	47.76	22.92
Input: Adult Words Per Hour	170	1126	440
Input: Proportion of Meaningful Speech	170	.2006	.0555
Input: Proportion of TV/Electronics	170	.0762	.0578
Vocabulary: EVT-2 Growth Scale Value	174	134.49	12.78

Lexical Processing

Raw, binned and fitted growth curves for 180 children are shown below.





$\chi^2(49) = 107.1, p < .001$, CFI = .97, RMSEA CI = [.057,.096]

Path Traces

- **Intercepts**: Estimated accuracy at Start in eyetracking task was 25.8%, and estimated Change from 300 to 500ms was1.36%. Input intercept was 1260 adult word equivalents (AWEs), and vocabulary intercept was 85.6 points.
- **Input >> Lexical Processing**: Increasing input by 500 AWEs increases Change by 0.35 %-points.
- **Input >> Vocabulary**: Increasing language input by 500 AWEs predicts an increase of 2.6 points in vocabulary.
- **Lexical Processing >> Vocabulary**: Increase in initial accuracy (Start) by 1 %-point predicts an increase in vocabulary by 0.74 points. Increase in processing rate (Change) by .1 %-point predicts an increase in scores by 1.06 points.
- **Input >> Lexical Processing >> Vocabulary**: Increasing language input by 500 AWEs predicts a corresponding increase in vocabulary size by 3.7 points indirectly.
- **TV >> Input >> … >> Vocabulary:** Increasing TV by 3 minutes (per hour) predicts a decrease in input of 86 AWEs, yielding a decrease in expected vocabulary of 1.09 points.

Discussion

- **Partial Mediation**: For 28-39 month olds, most of the effect of input (59%) on vocabulary was indirect, partially mediated by lexical processing, whereas Weisleder and Fernald (2013) observed complete mediation in 19 month-olds.
- Shift from complete to partial mediation suggests that the role of lexical processing in word learning changes over time, as children become more efficient and experienced listeners.

Research supported by NIDCD Grant R01-02932 to Jan Edwards, Mary E. Beckman, and Benjamin Munson and by NICHD Grant P30-HD03352 to the Waisman Center. We thank members of the L2T Labs at the UW-Madison and University of MN who collected the data. We also thank the children who participated and the families who gave their consent. Code/Data: github.com/tjmahr/Psynom15