The relationship between online lexical processing and expressive vocabulary size in a diverse group of young children: An eye-tracking study

Alissa Schneeberg, Jan Edwards & Chansoon Lee, University of Wisconsin-Madison

BACKGROUND

Rationale

- Receptive language is typically measured by picture-pointing in response to a verbal prompt but two children may recognize the same words at different rates.
  - The looking-while-listening (LWL) paradigm (Fernald et al., 2006) can be used to investigate lexical processing speed.
  - The more quickly a child recognizes a word, the more time he/she has to spend on other linguistic or cognitive tasks.
- Both vocabulary size and SES influence lexical processing speed in young children.
  - 18- and 24-month-old children from middle-SES families with larger vocabularies recognized familiar words more quickly than children with smaller vocabularies (Fernald et al., 2006).
  - 18- and 24-month-old children from middle-SES families recognized familiar words more quickly than age peers from low-SES families (Fernald et al., 2013).

Research Questions

1. Is a 4 AFC paradigm sensitive to differences in vocabulary size for children in the 30-60 month age range?
2. Are differences in lexical processing speed observed between children from middle- and low-SES families in the age range of 30-60 months?

METHODS

Participants

Two sets of participants
- Question 1: n=34 children from middle-SES families
- Question 2: n=8 children from low-SES families and n=8 children from middle SES families (matched for age and gender).

Tables 1 & 2. Demographic information for question 1 (top) and question 2 (bottom).

Number of males/females	Mean age in months (SD)	Average EVT-2 standard score (SD)	Primary caregiver education level (SD)	Average family income (SD)
15/19	38.8 months (6.6)	128.8 (11.5)	5.6 (.6)	3.8 (1.1)

	Number of males/females	AAE Speakers	Mean Age (SD)	Average EVT-2 standard score (SD)	Primary caregiver education level (SD)	Average family income (SD)
Middle SES	3/5	0	45.4 mo. (6.1)	128.1 (11.7)	5.5 (.8)	4.0 (1.2)
Low SES	3/5	8	48.4 mo. (7.6)	100.3 (16.6)	3.4 (1.0)	1.5 (1.0)

6-step scale for education:
1 = less than high school degree
2 = GED
3 = high school degree
4 = some college
5 = college degree
6 = post-graduate degree

5-step scale for family income:
1 = below $20,000/year
2 = $20,000 to $40,000/year
3 = $41,000 to $60,000/year
4 = $61,000 to $100,000/year
5 = above $100,000/year

Stimuli

Words
- Stimulus words chosen based on age of acquisition and pictureability.
- All target words paired with semantic, phonological, and unrelated foils.
- Target words and all phrases (*find the, see the, isn't this fun*, etc.) recorded in both Mainstream American English (MAE) and African American English (AAE
- Stimuli presented to children in their native dialect (dialect of primary caregiver).

Pictures
- Color photographs of target objects
- Pictures were normed for comprehension in both a middle-SES and a lower-SES classroom.
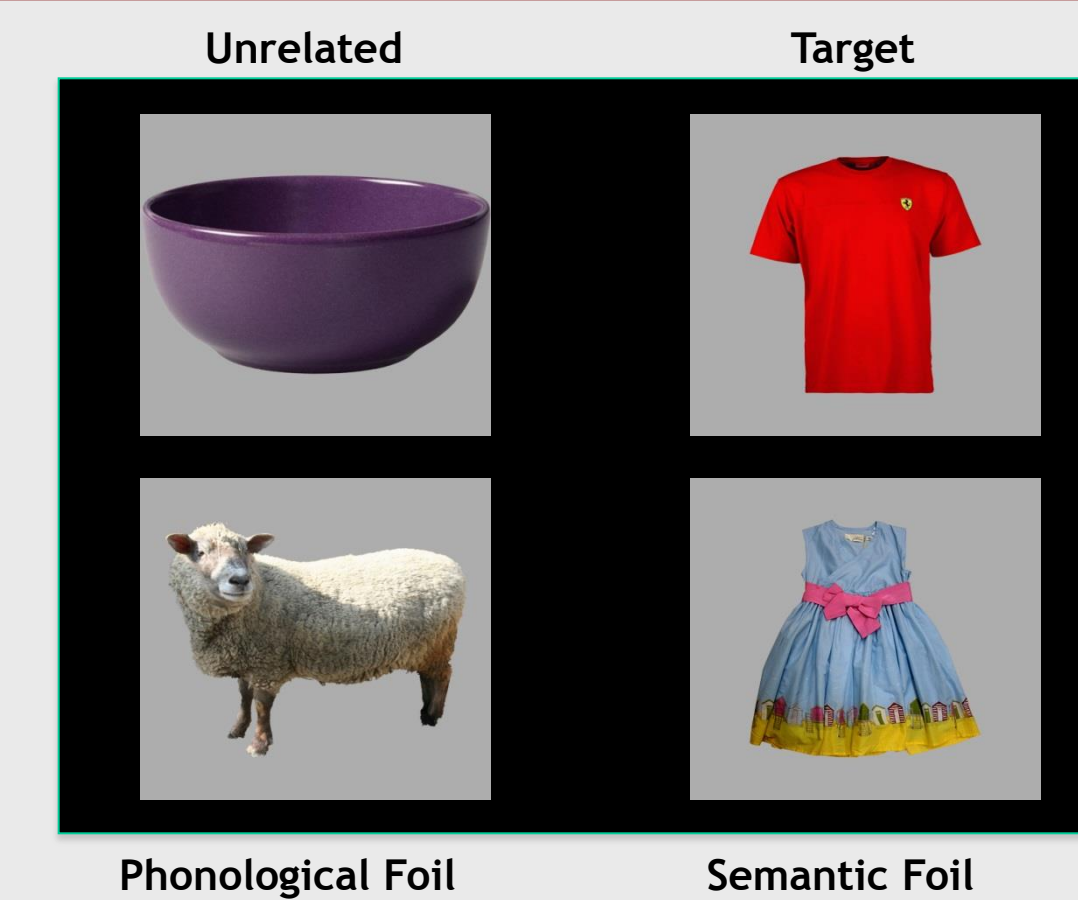- Pictures used only if 80% of children in both classrooms recognized it.

Figure 1. Sample of a stimulus presentation. Four images are presented: shirt (target); dress (semantic foil); sheep (phonological foil), bowl (unrelated).

Procedure

- Experiment programmed in ePrime and ran on a Tobii T60XL Eye Tracking System
- 33 Trials, 2 Blocks
- 4 alternative forced choice (4AFC) paradigm: Target, Semantic Foil, Phonological Foil, and Unrelated Foil

ANALYSIS

Data reduction:
- Identified four area of interest (AOI's) and coded looks to target and phonological, semantic, and unrelated foils.
- Binned data across three time points (51 ms)
- Computed log-odds of looking to target (or particular foil) in each time bin (averaged across all trials within a subject).

Data analysis:
- Growth curve analysis (e.g., Barr, 2008; Mirman et al., 2008).
- Dependent variable: Log-odds of looking to target (or specific foil) in a particular time bin.
- Level 1 independent variables: Time and Time^2 (orthogonal)
- Level 2 independent variables: Age, Expressive Vocabulary Size (EVT-2 raw score), and SES (for question 2 only).

RESULTS

- **Question 1**: A significant effect of expressive vocabulary size on looks to target was observed.
- **Question 2**: A significant effect of expressive vocabulary size, but *not* SES, on looks to target was observed . A significant interaction between expressive vocabulary size and time was also observed.
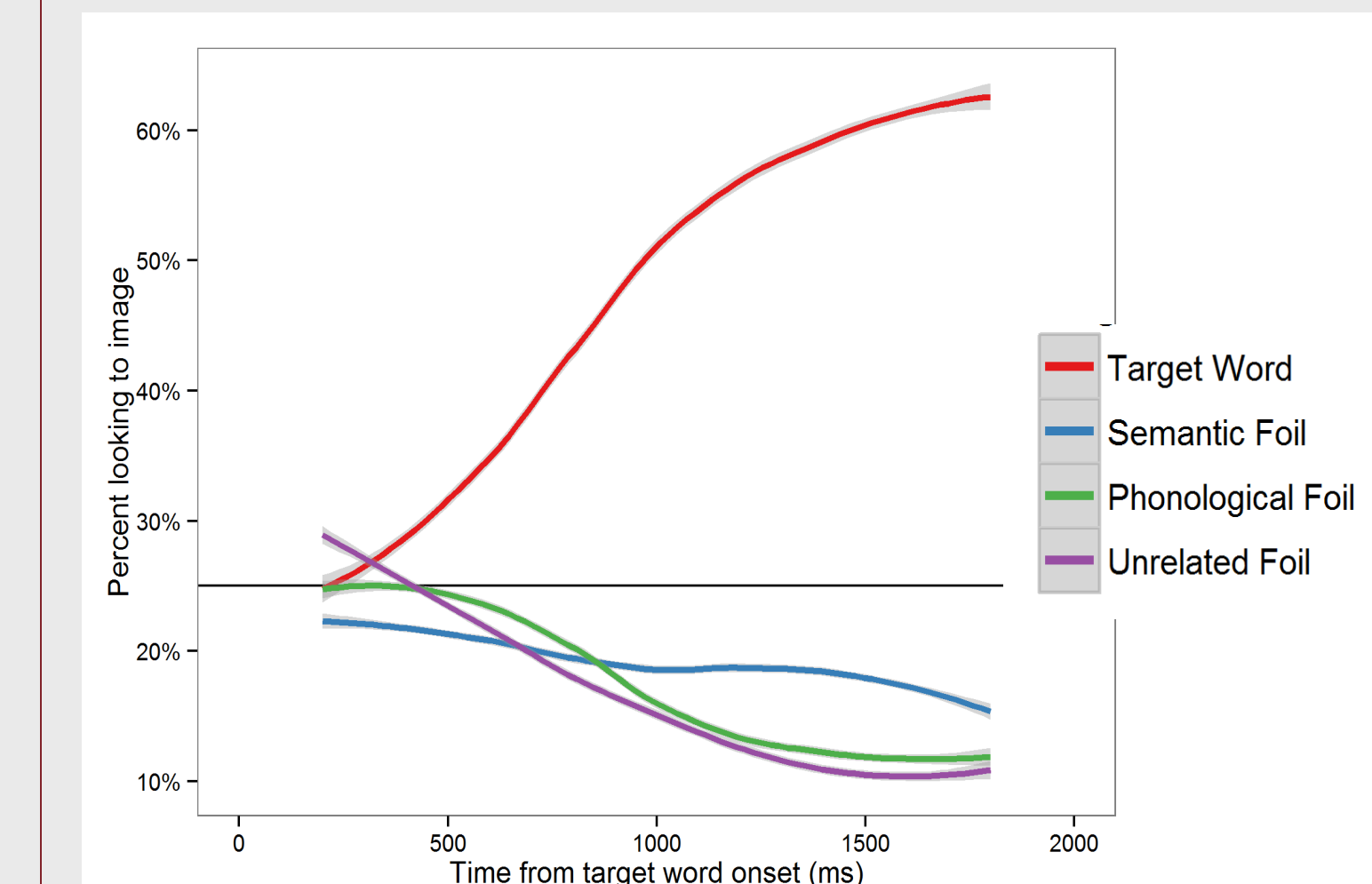
Question 1

Figure 2. Percent of looks to target and three foils over time for children from middle-SES families.

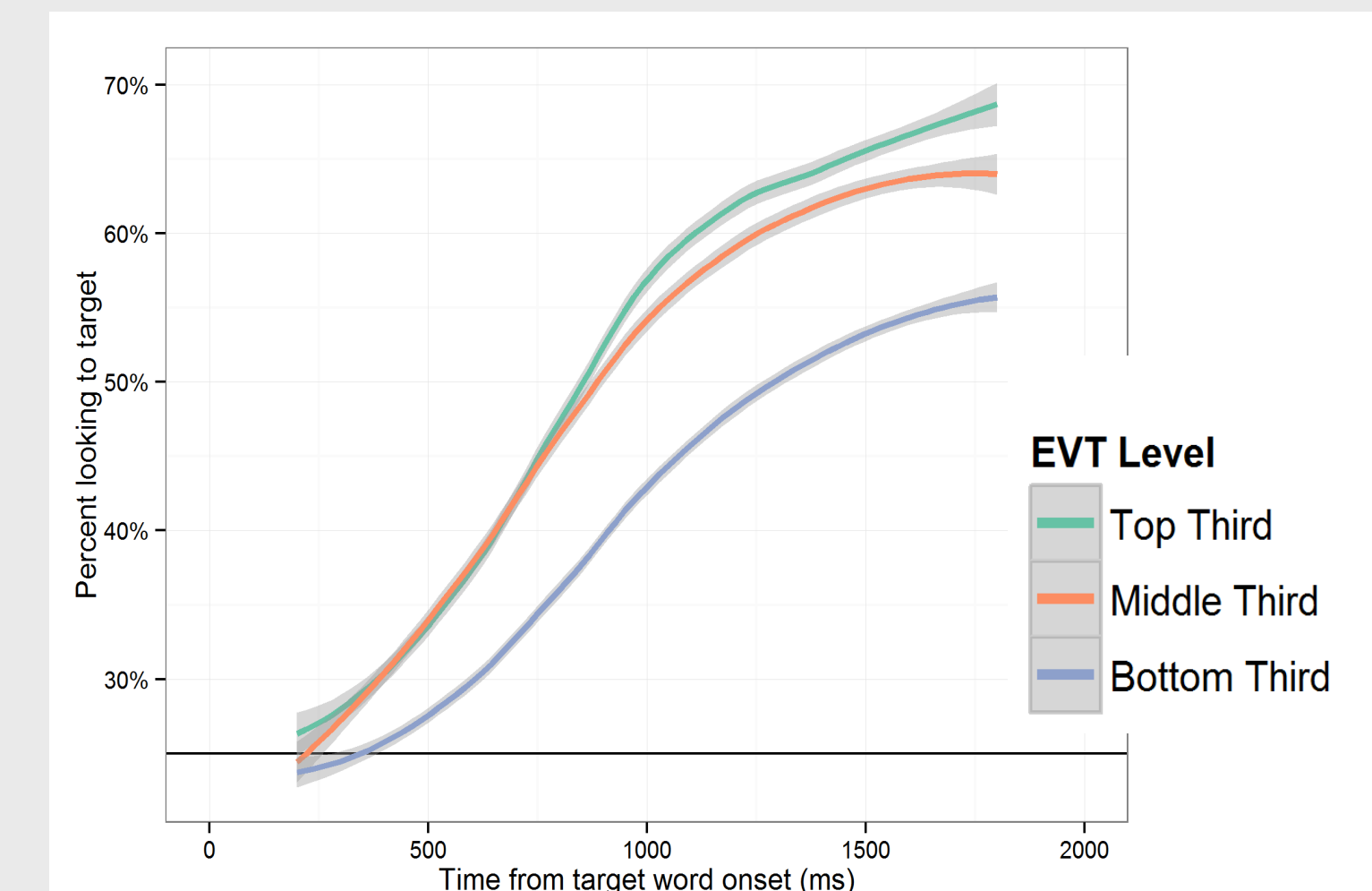Figure 3. Percent of looks to target over time for children from middle-SES families separated into three expressive vocab. sizes.
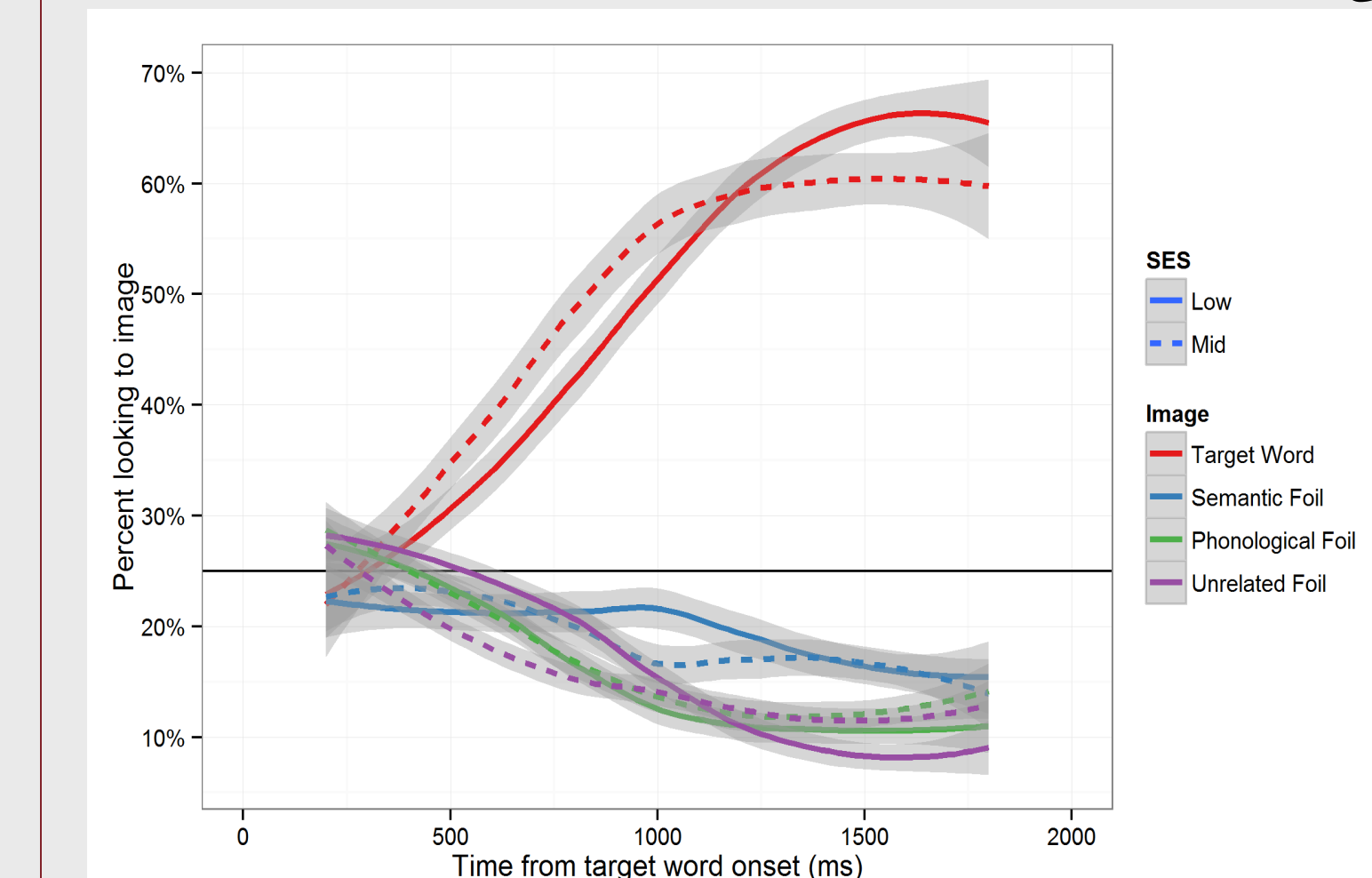
Question 2

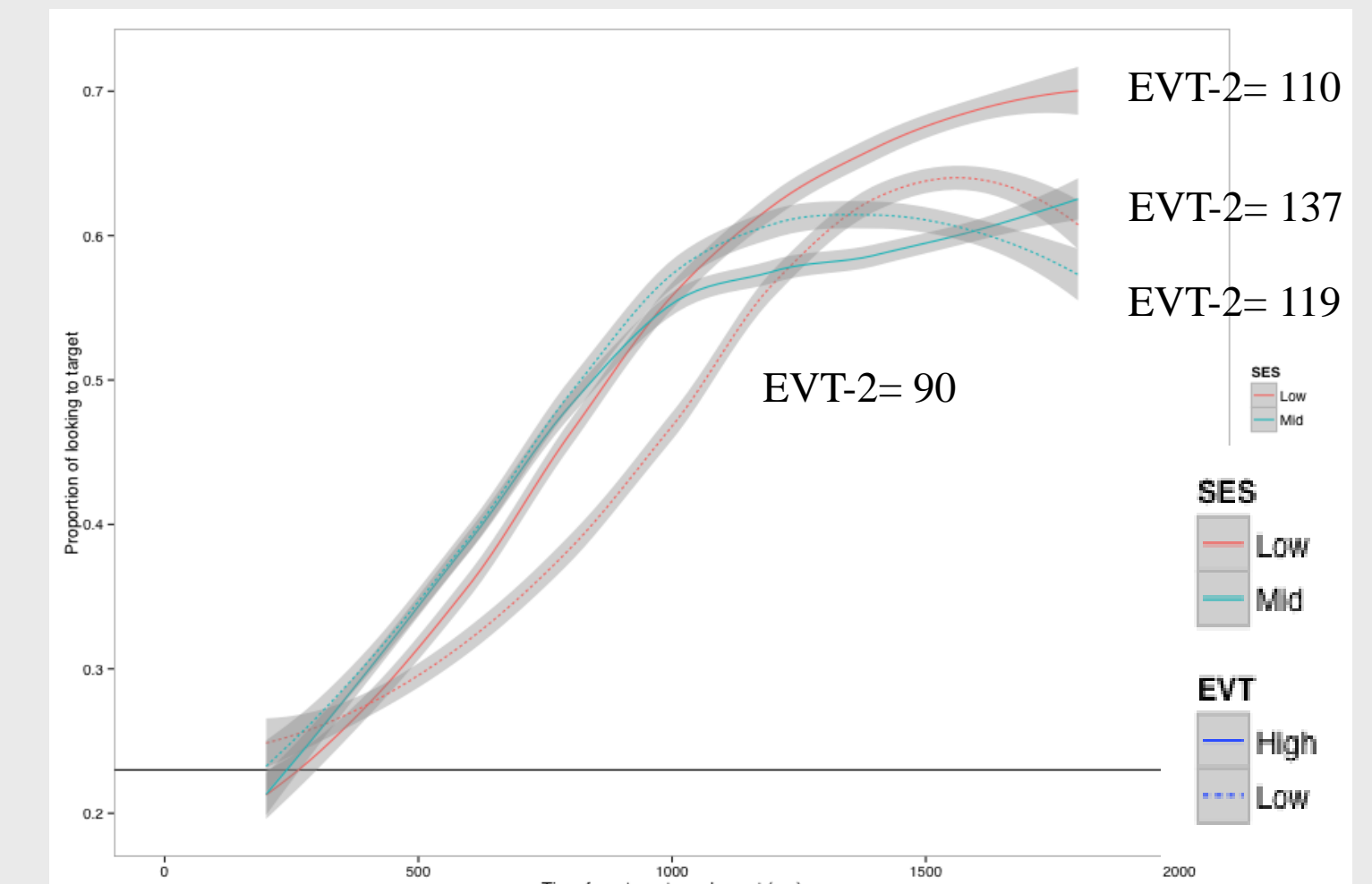Figure 4. Percent of looks to target and three foils over time for children from the two SES groups.

Figure 5. Percent of looks to target over time for children from the two SES groups, separated by two expressive vocab sizes.

DISCUSSION

Limitations of study (question 2):
- Very small number of subjects.
- No MAE speakers in lower-SES group and no AAE speakers in middle-SES group.

Conclusions:
Question 1: Children with larger expressive vocabularies, relative to children with smaller expressive vocabularies had faster lexical processing speed for familiar words.
- This extends work of Fernald & Marchman (2008) with a different paradigm (4AFC), older children, and a direct measure of vocabulary size.
- Children who process familiar words more quickly are at an advantage for other kinds of linguistic and cognitive processing.
Question 2: No direct effect of SES on lexical processing speed was observed. However, there was an effect of expressive vocabulary size and an interaction between time and vocabulary size on looking to target.
- The eye gaze patterns in Figure 5 suggest that, with a larger n, the interaction between SES and expressive vocabulary size may be significant. The high-vocabulary children from the low-SES group appear to have lexical processing that is as good or better than the children in the middle-SES group, even though their standard scores are lower.
- Is it the case that vocabulary size should be interpreted relative to SES?