Speech perception and spoken word recognition

Fall 2015 Meeting of the Acoustical Society of America

Jan R. Edwards and Tristan Mahr

Funded by:
NIDCD grants RO1 DC02932, R01 DC012513,
and NSF grant BCS 0729140

Spoken word recognition

- To take advantage of learning opportunities, children need to recognize words efficiently.

– Distinguishing familiar words from words to be learned.

Cup and saucer 

– Parsing and learning syntactic structures.

I eat cookies because I like them.

– Other aspects of learning.

Lions are bigger than dogs!

Spoken word recognition

- Spoken word recognition involves:
  - Encoding the signal
  - Activating a lexical neighborhood
  - Choosing the correct item and inhibiting the others

Spoken word recognition in young children

- Spoken word recognition is similar in children and adults:
  - Incremental (Fernald et al., 2001; Mahr et al., 2015)
  - Neighborhood activation
    - Phonological (Swingley et al., 1999)
    - Semantic (Arias-Trejo & Plunkett, 2010)

Studying spoken word recognition in young children

Looking-While-Listening (LWL) paradigm

- Two images presented on screen:
- Target words presented:
  - See the dog!
  - Find the book!
- Eyetracker records where child looks over time.

Spoken word recognition in young children

- 2-year-olds with larger vocabularies process familiar words more efficiently. (Fernald et al., 2006)
- Processing speed at age 2 predicts language and working memory scores at age 8. (Marchman & Fernald, 2008)
- 2-year-olds from high-SES families process words more efficiently than children from low-SES families (Fernald et. al, 2013)
- Children who hear more linguistic input process words more efficiently than children who receive less input. (Weisleder & Fernald, 2013)

Mispronunciation experiment

- First attempt to unpack role of vocabulary size in spoken word recognition.
- What are the contributions of the following factors to lexical processing efficiency for preschool children?
  - –speech perception
  - –inhibitory control
  - –vocabulary size

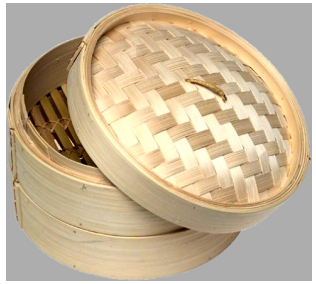
Mispronunciation experiment

See the dog! *or*
See the tog! *or*
See the vafe!

- Two pictures:
  - Familiar and unfamiliar object.
- Three different conditions:
  - Correct productions (CP)
  - Mispronunciations (MP)
    - Initial consonant differed by a single distinctive feature.
  - Nonwords (NW)

Stimuli

- Familiar words/objects
  - Early age-of-acquisition
  - Consonant-vowel-consonant structure (CVC).
- Mispronunciations
  - One feature change on initial consonant.
  - Not a real word.
- Unfamiliar objects/nonwords
  - Object names were unfamiliar to preschool children (*steamer*, *wombat*).
  - Nonwords had CVC structure.

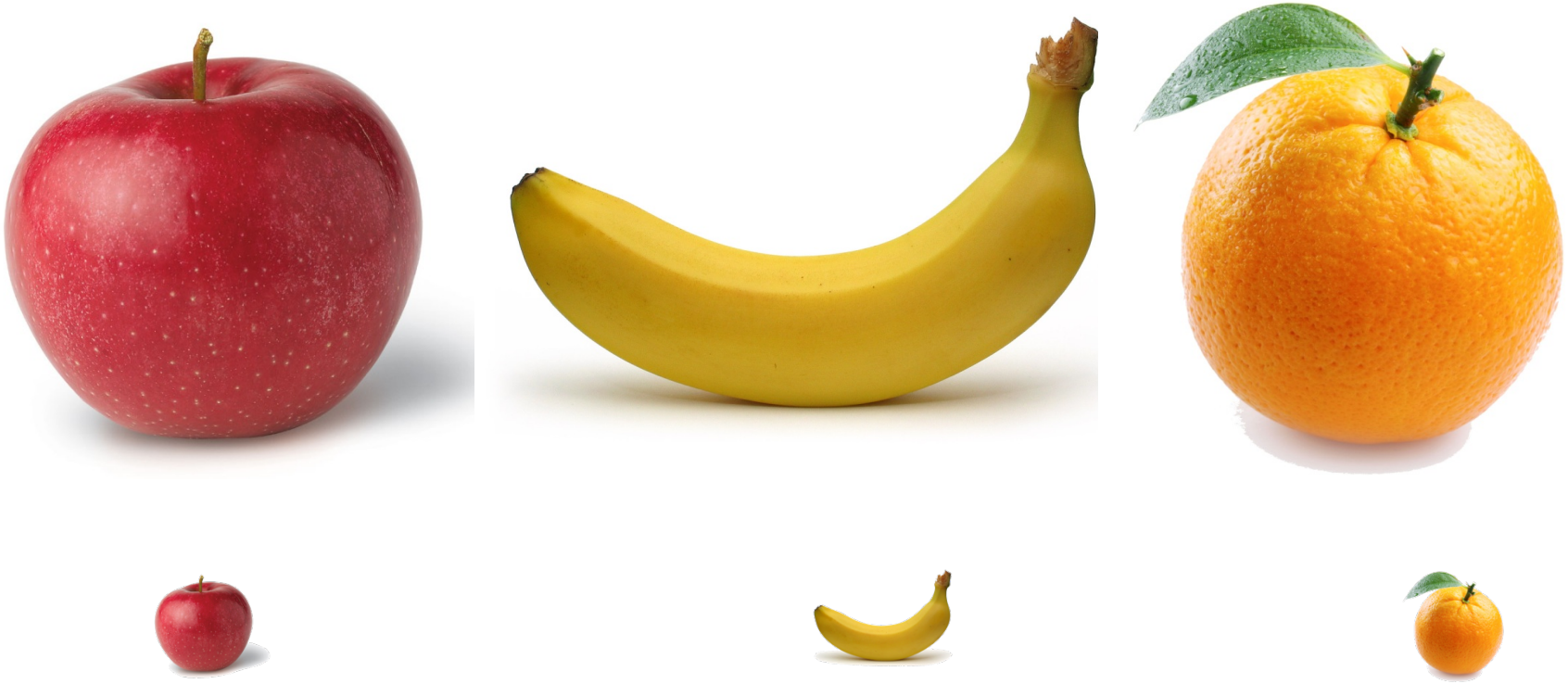


Participants

- 137 children, 28-39 months
- Mean EVT-2 score = 114
- Maternal education level:
  - n = 106: high
  - n = 31: middle or low
  - (Mahr, Law II, Munson, & Edwards, in preparation)

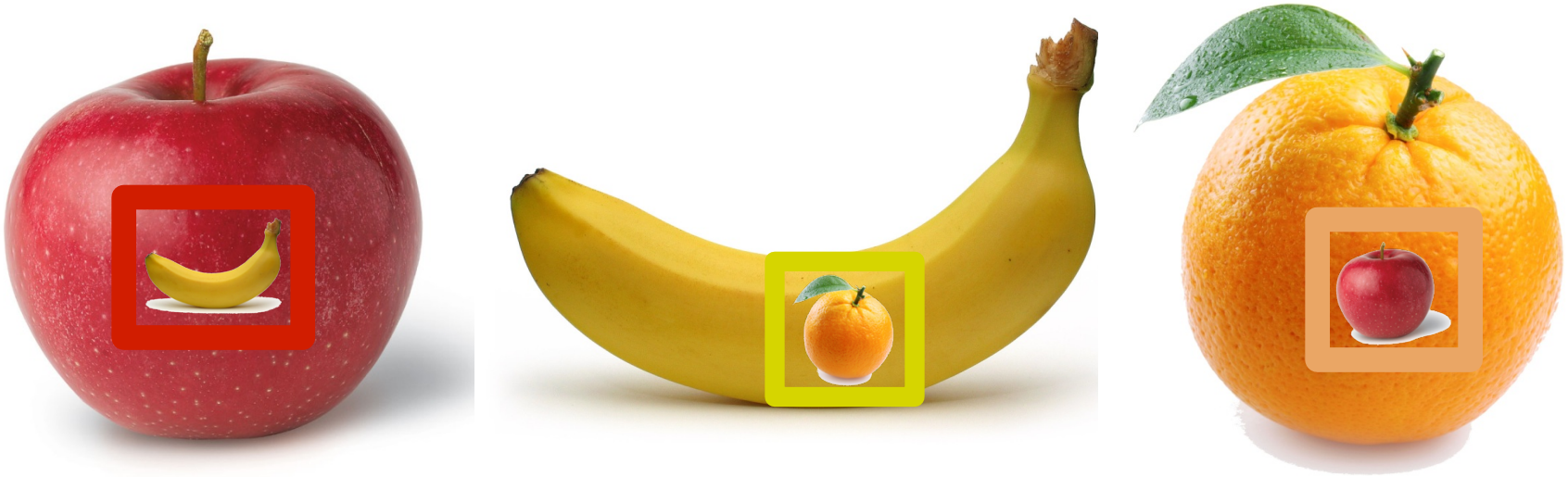
Subject-level variables

- Fruit stroop: measure of inhibitory control



Subject-level variables

- Fruit stroop: measure of inhibitory control

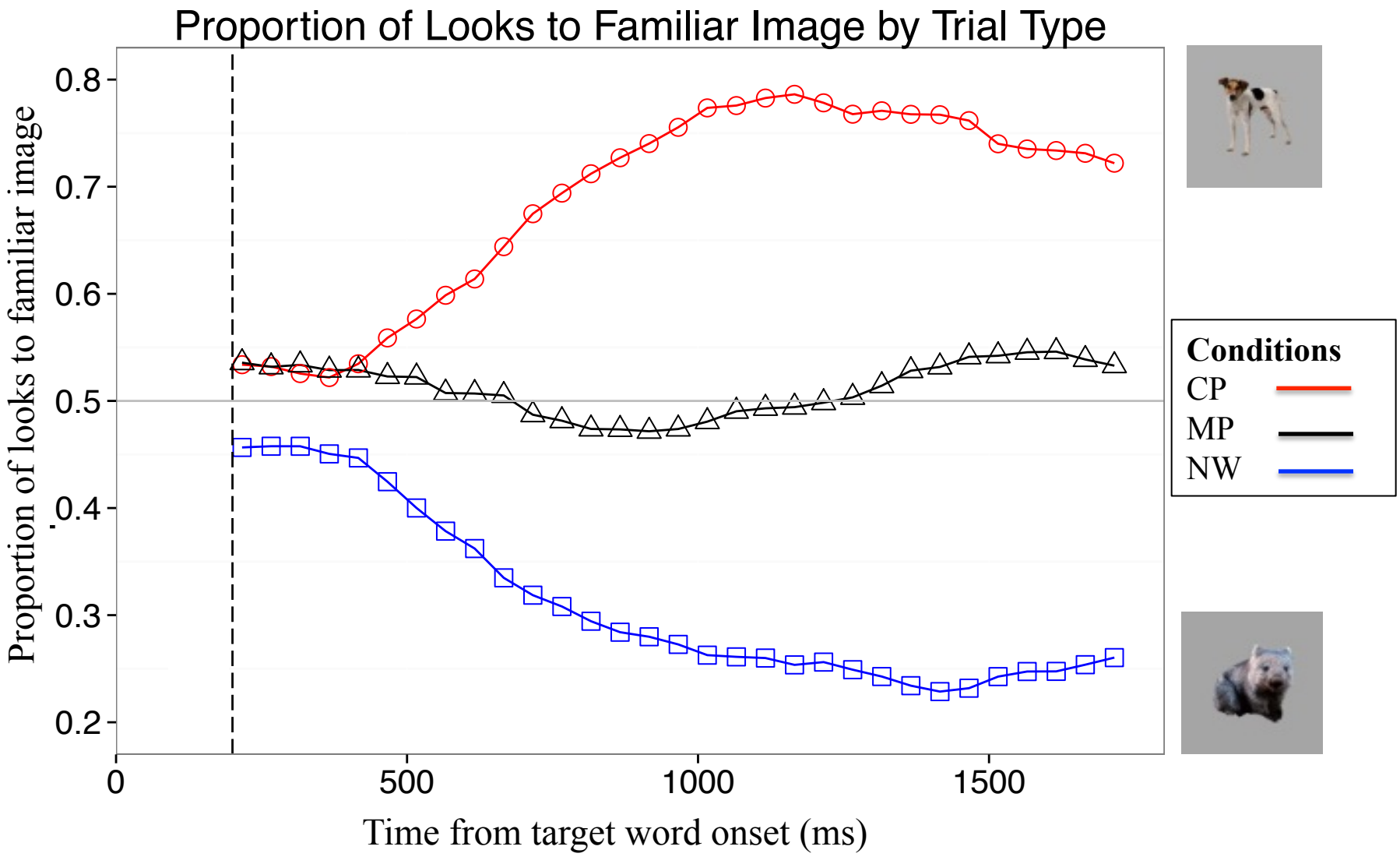


Subject-level variables

- Minimal pairs: measure of speech perception

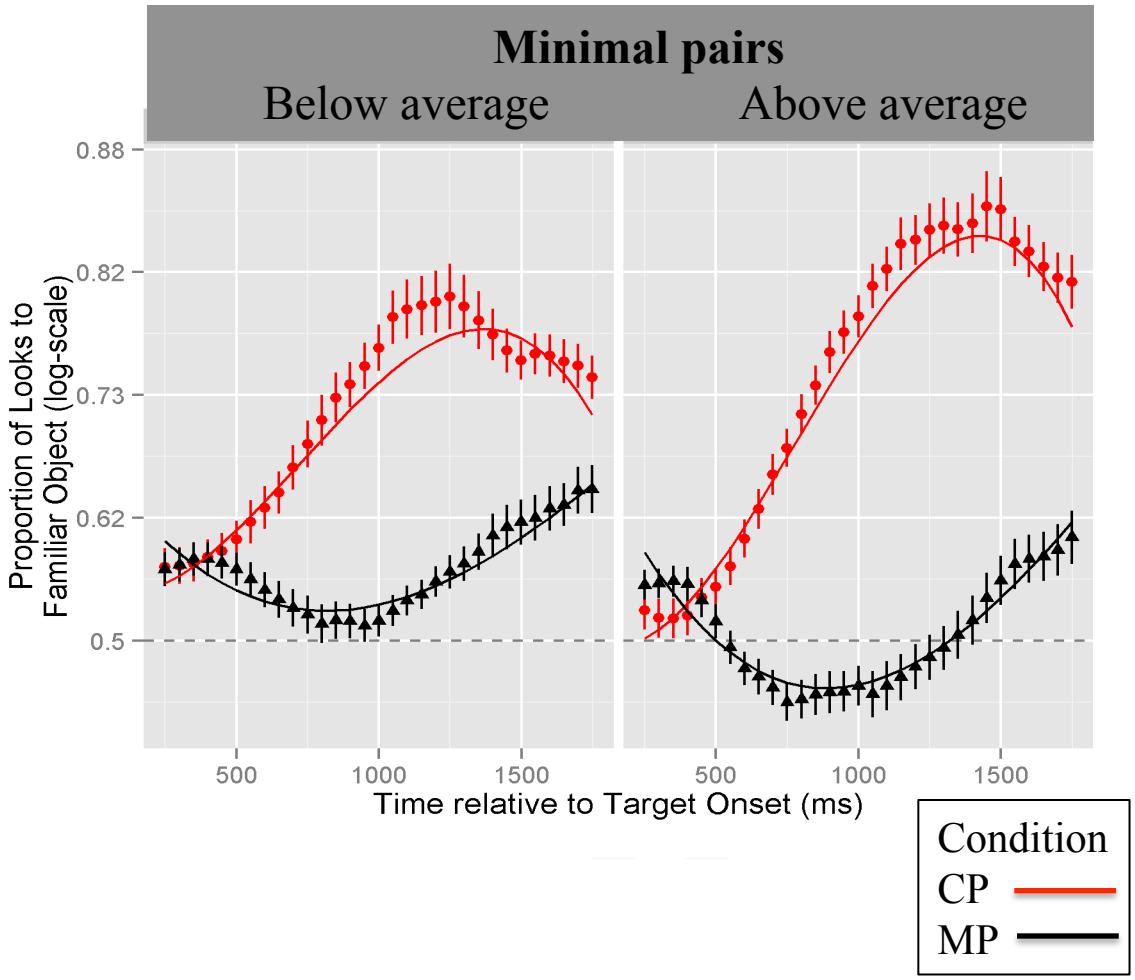
Subject-level variables

Results


Proportion of Looks to Familiar Image by Trial Type
Proportion of looks to familiar image
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
500
1000
1500
Time from target word onset (ms)
Conditions
CP
MP
NW

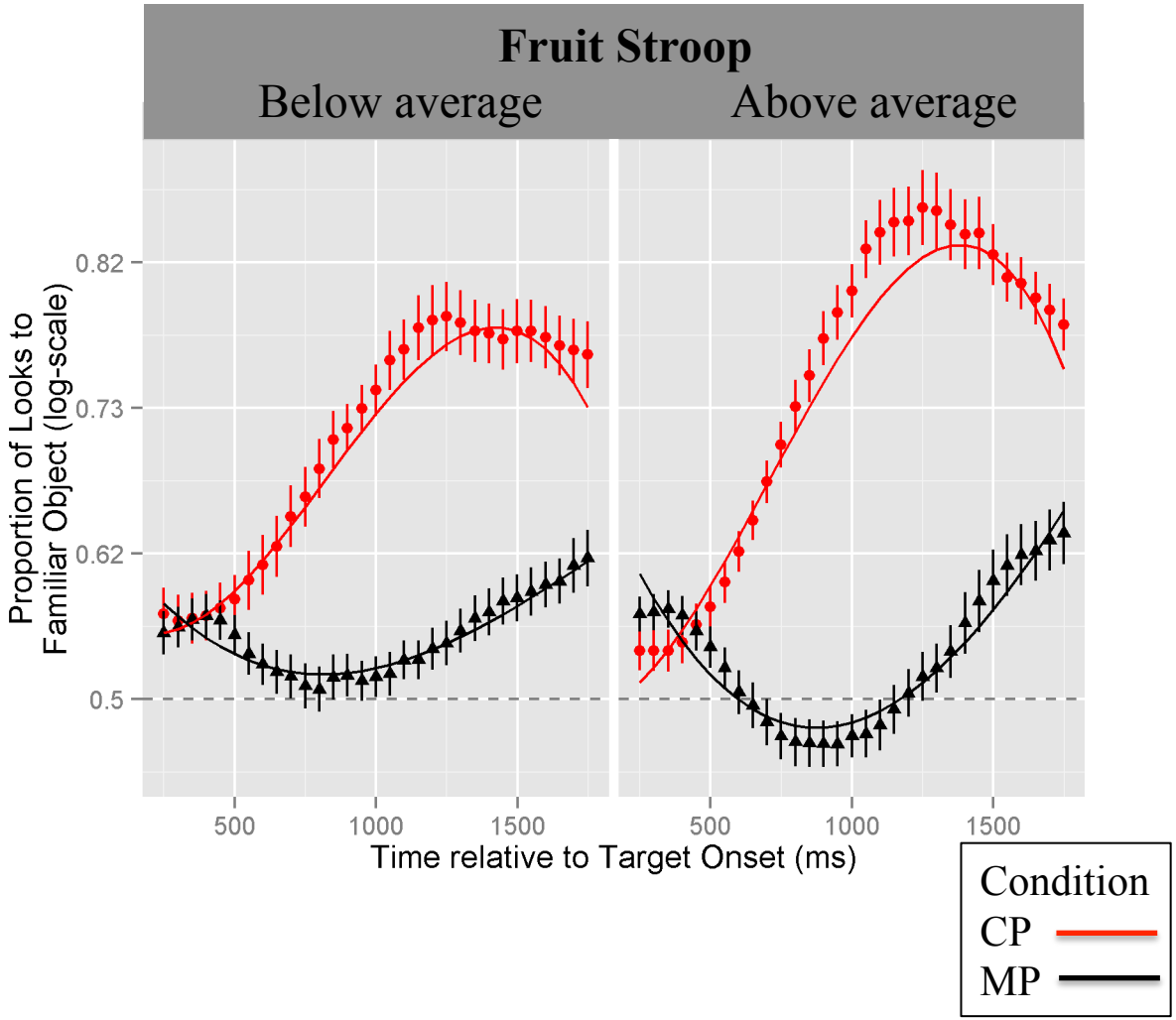
Results: CP and MP model

- Speech perception measure:
  - Significant predictor of speed of looking to familiar image in CP condition & to unfamiliar image in MP condition.



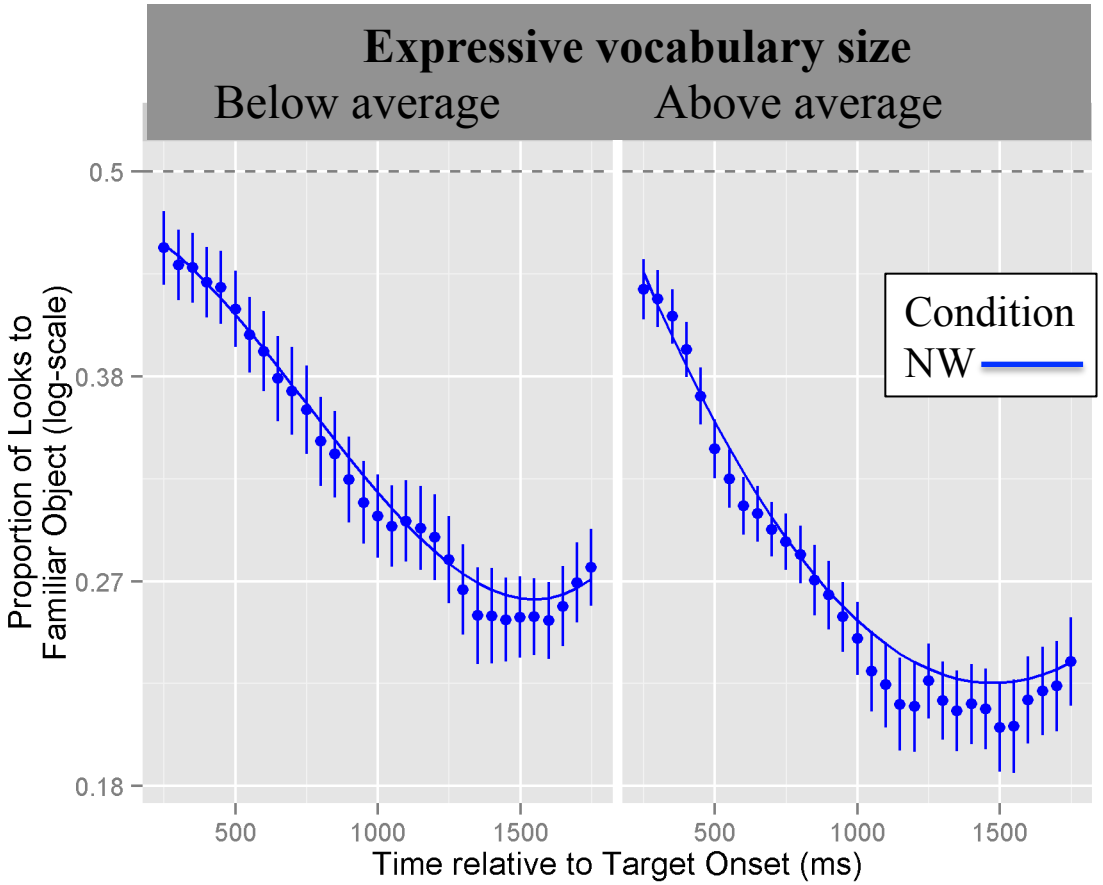
Results: CP and MP model

- Measure of inhibitory control:
  - Significant predictor of accuracy in CP and MP conditions.



Results: NW model

- Expressive vocabulary size:
  - –Significant predictor *only* of accuracy for NW condition.



Discussion: Summary

Summary of significant predictors for each condition

Condition	Speech perception	Inhibitory control	Vocabulary size
Correct production	yes	yes	no
Mispronunciation	yes	yes	no
Nonword	yes	no	yes

Discussion: Spoken word recognition in children

- Spoken word recognition involves:
  - Encoding the signal:
    - role of speech perception
  - Activating a lexical neighborhood
  - Choosing the correct item and inhibiting the others:
    - role of inhibitory control

Acknowledgments

- Multiple PI team: Mary E. Beckman and Ben Munson
- Research team (at UW): Ruby Braxton, Nicole Breunig, Michelle Erskine, Megan Flood, Allie Johnson, Kayla Kristensen, Franzo Law II, Michelle Minter, Amy Muczynoski, Alissa Schneeberg, Janet Schwartz, Dan Su, Tatiana Thonsevanh, and Nancy Wermuth
- Funding sources: NIH and NSF

- Participation of the children and cooperation from their parents

For all of which, a heartfelt:

謝謝　　thank you　　ευχαριστώ πολύ　　ありがとう