

Brain Maturation and Word Learning contribute to Vocabulary Variability Amongst Low Income Children

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Tackling the "Vocabulary Gap" Between Rich and Poor Children

Children from lower income homes may hear 30 million fewer

- Suk words by age three. ongst sch

Posted Feb 16, 2014

EDUCATION

Stanford Report, September 25, 2013

Poor Kids Language gap between rich and poor children begins in infancy, Stanford psychologists find

The White House children.

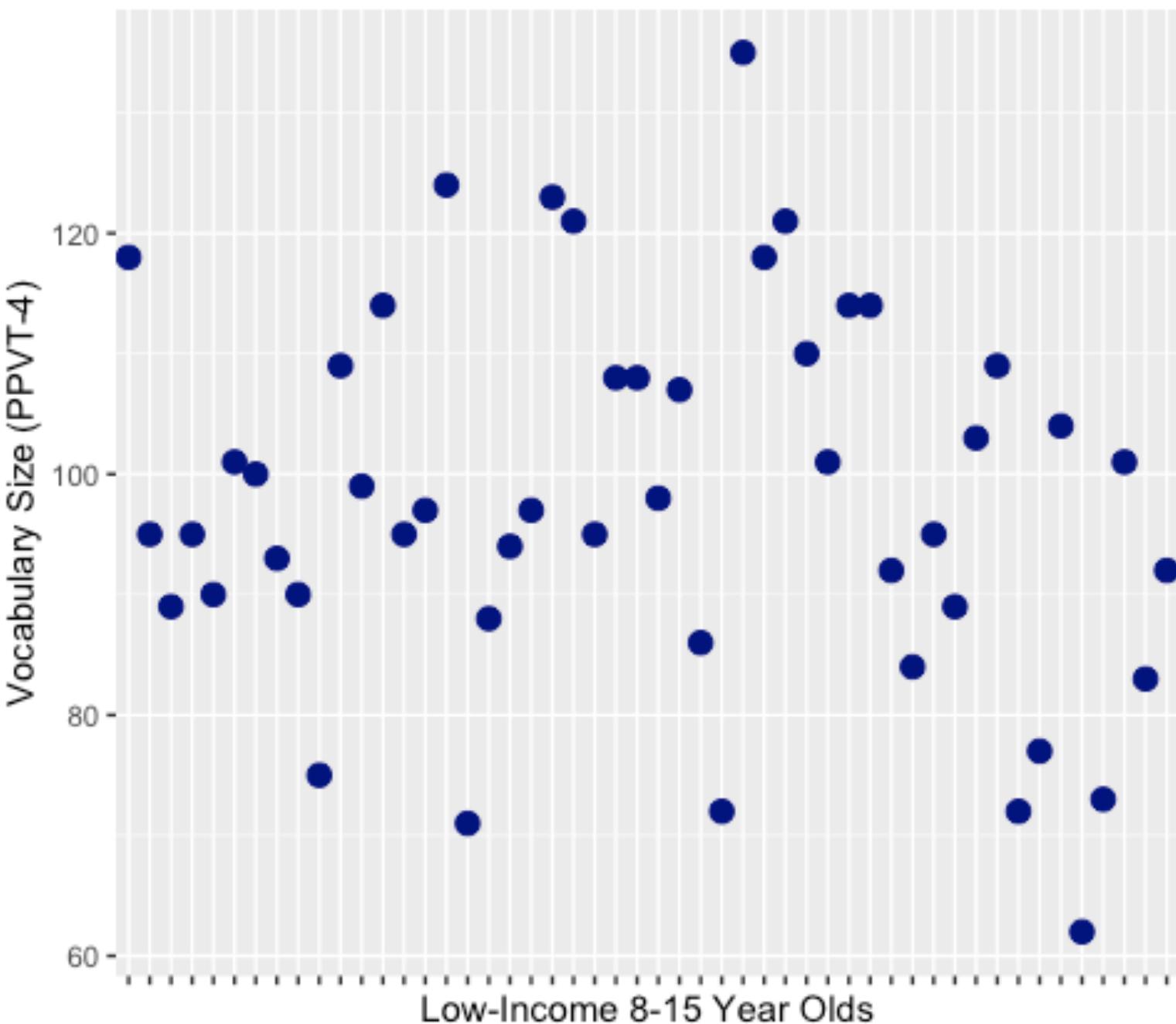
Students' voices
Research finds
By Eileen Fitzgerald

Research by Stanford psychologists reveals that 2-year-old children of lower-income families may already be six months behind in language development. Future work aims to devise intervention methods.

Resiliency in some low-income children's language skills

- Substantial income based differences in vocabulary amongst school-aged children
- However, striking individual differences exist **among** low-income children in their language skills.

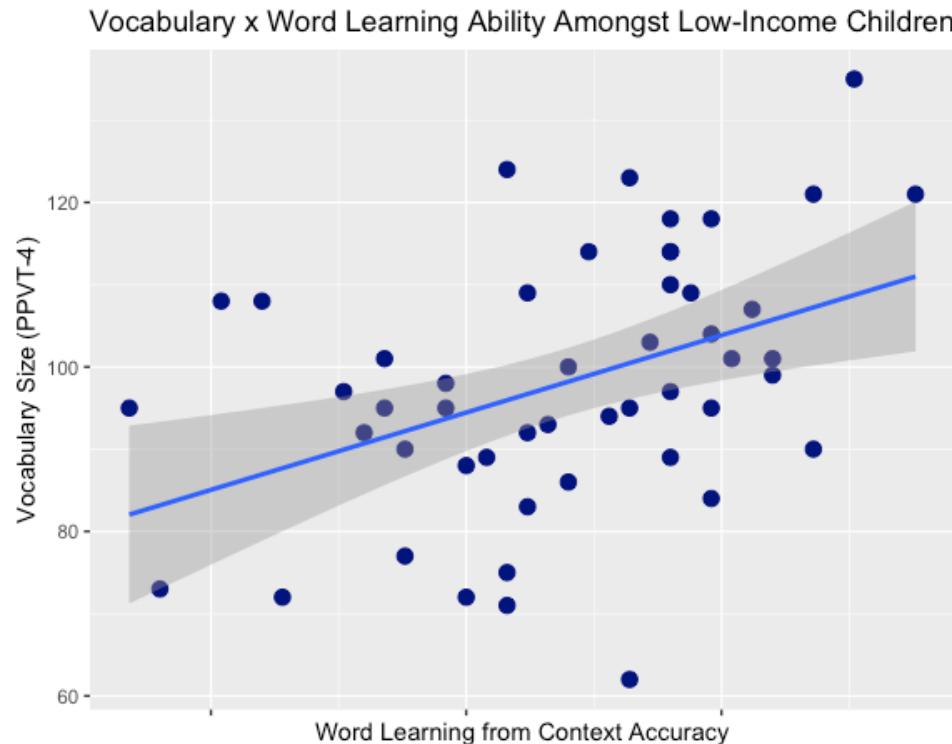
Vocabulary Variability Among Low-Income Children



Factors that may account for language variability within a low-income sample

- Early on:
 - Quality and quantity of the input
 - Number of conversational turns between adult and child
- During the school years:
 - Word learning from context

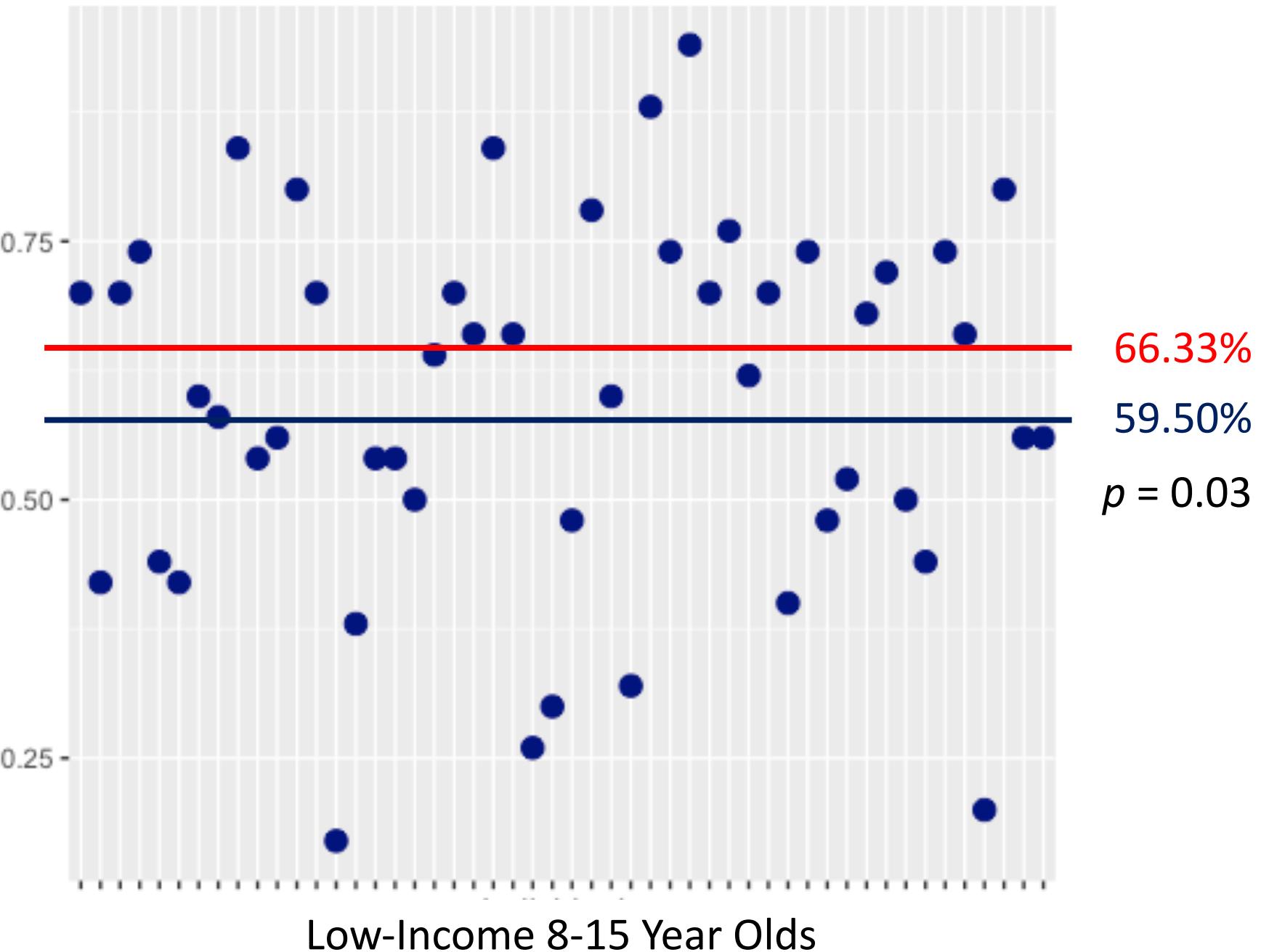
Hoff, 2013;
Hirsh-Pasek et al., 2015;
Romeo et al., 2018;
Pan et al., 2005
Cartmill et al., 2013;
Rowe, 2012;
Pace et al., 2017;
Fernald et al., 2012;
Weisleder & Fernald, 2013;
Hackman & Farah, 2009;
Schwab & Lew-Williams, 2016;



**What makes some low income kids more
resilient in their word learning ability than others?**

Word Learning Variability

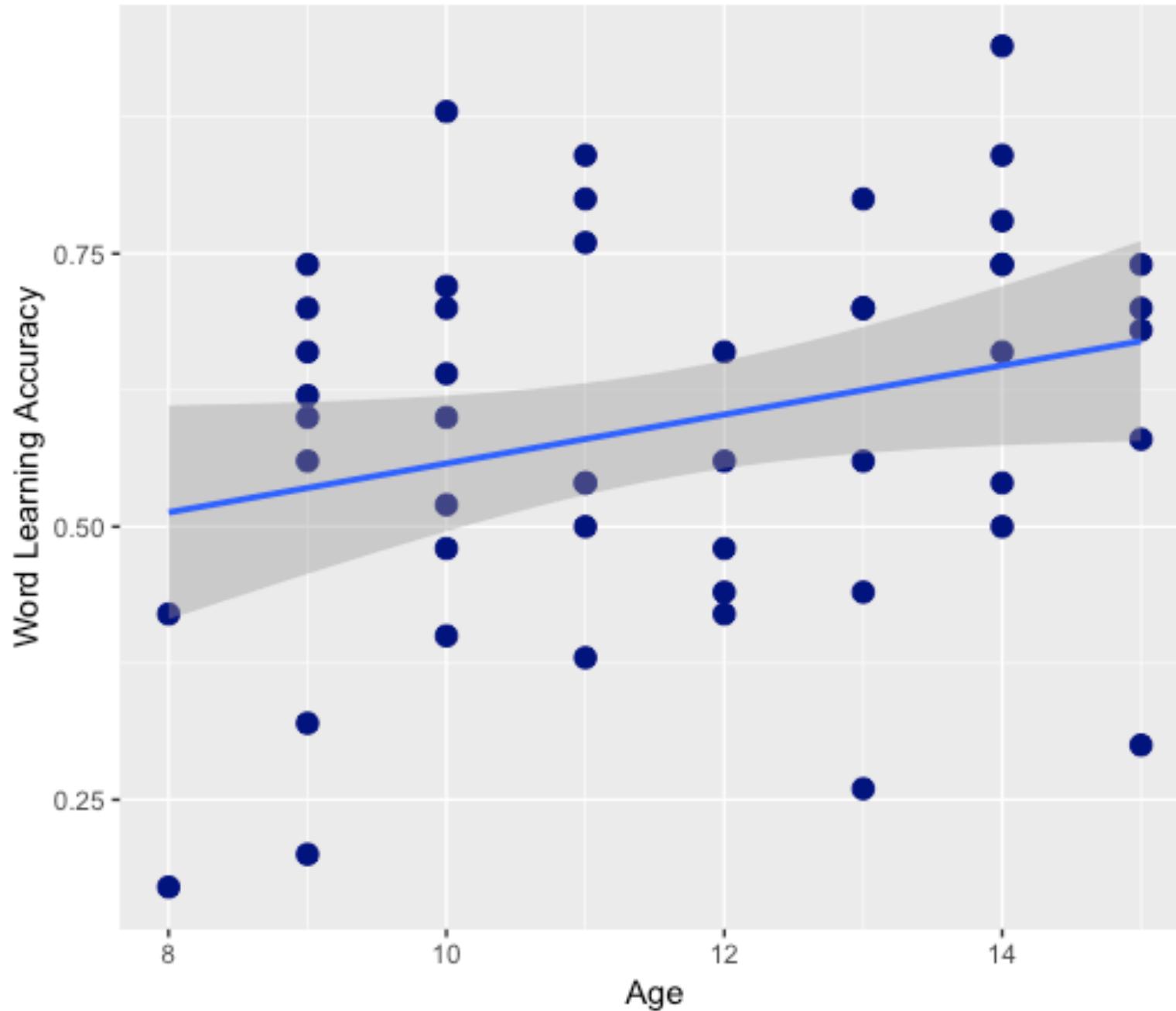
Word Learning from Context Task Accuracy



Demographic Information for children who qualify for Free & Reduced Lunch

Sample Demographics	
Number of Participants	50
Age	11.66 (2.12)
Word Learning from Context	59.5% (17.6%)

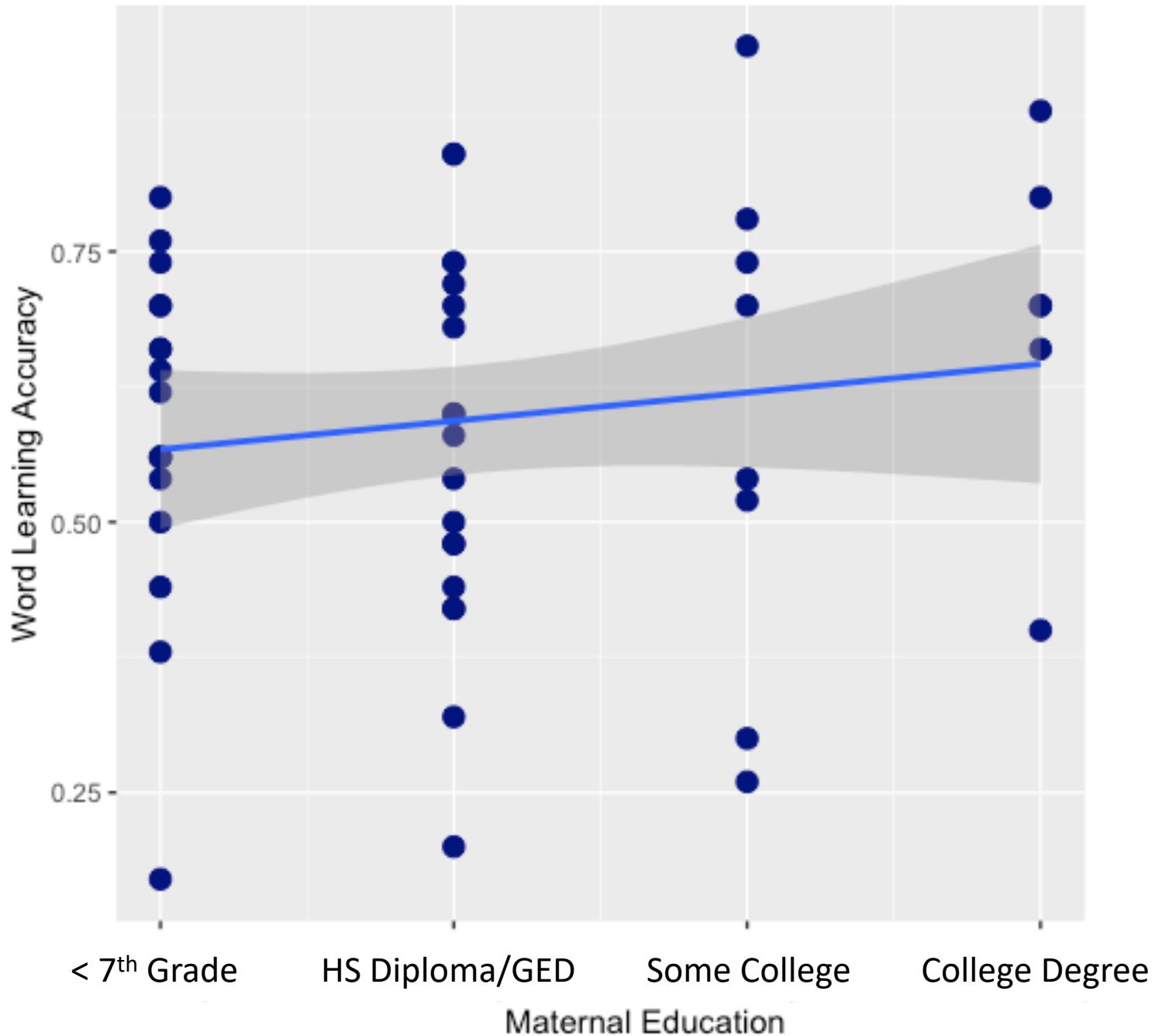
Word Learning Variability



The role of:
Age

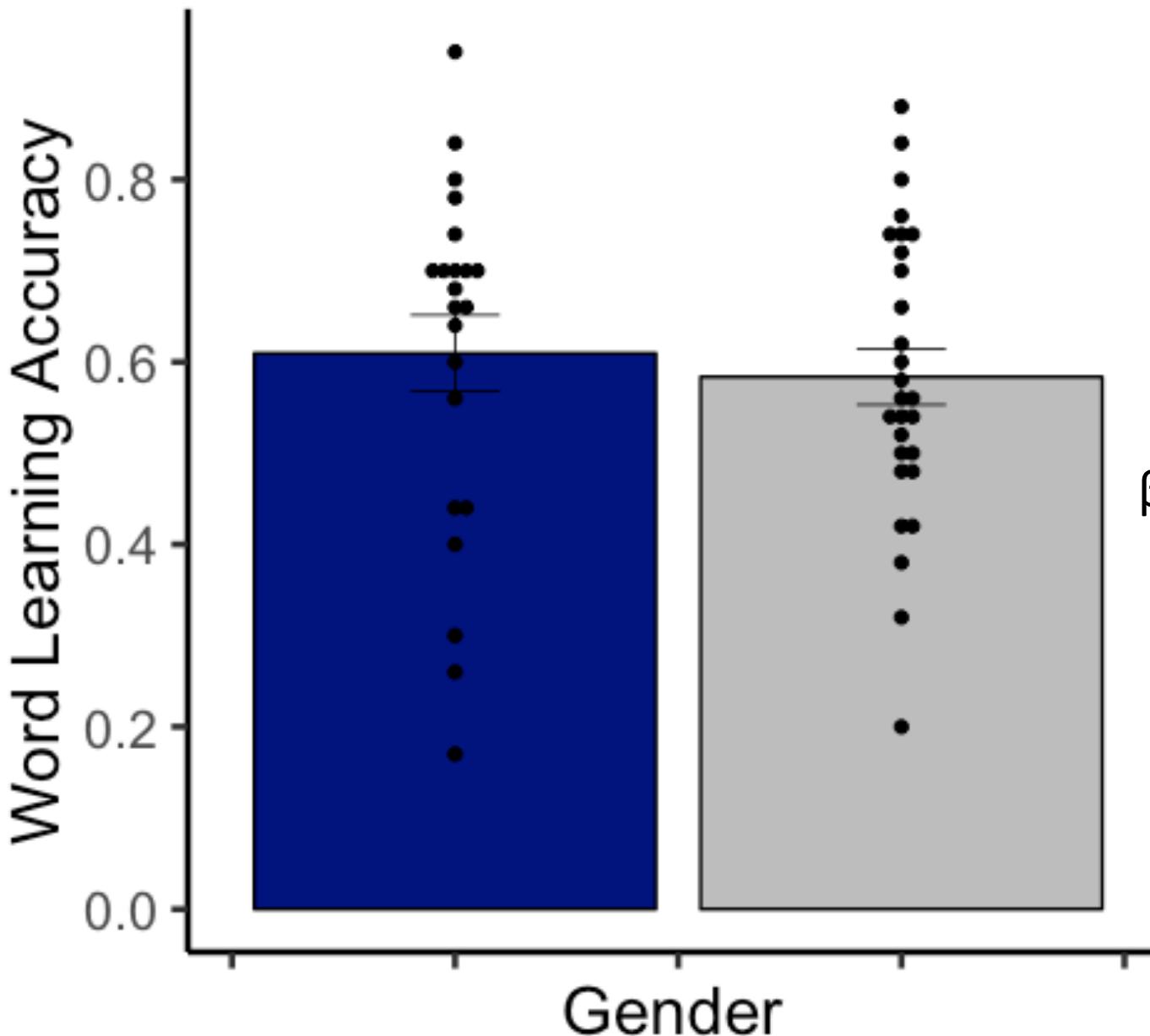
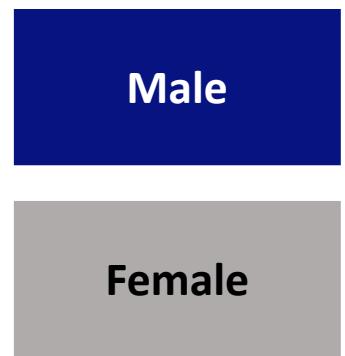
$$\beta = 0.02, SE = 0.01, p = .06$$

Word Learning Variability



The role of:
Maternal Education
 $\beta = -0.03, SE = 0.03, p = 0.30$

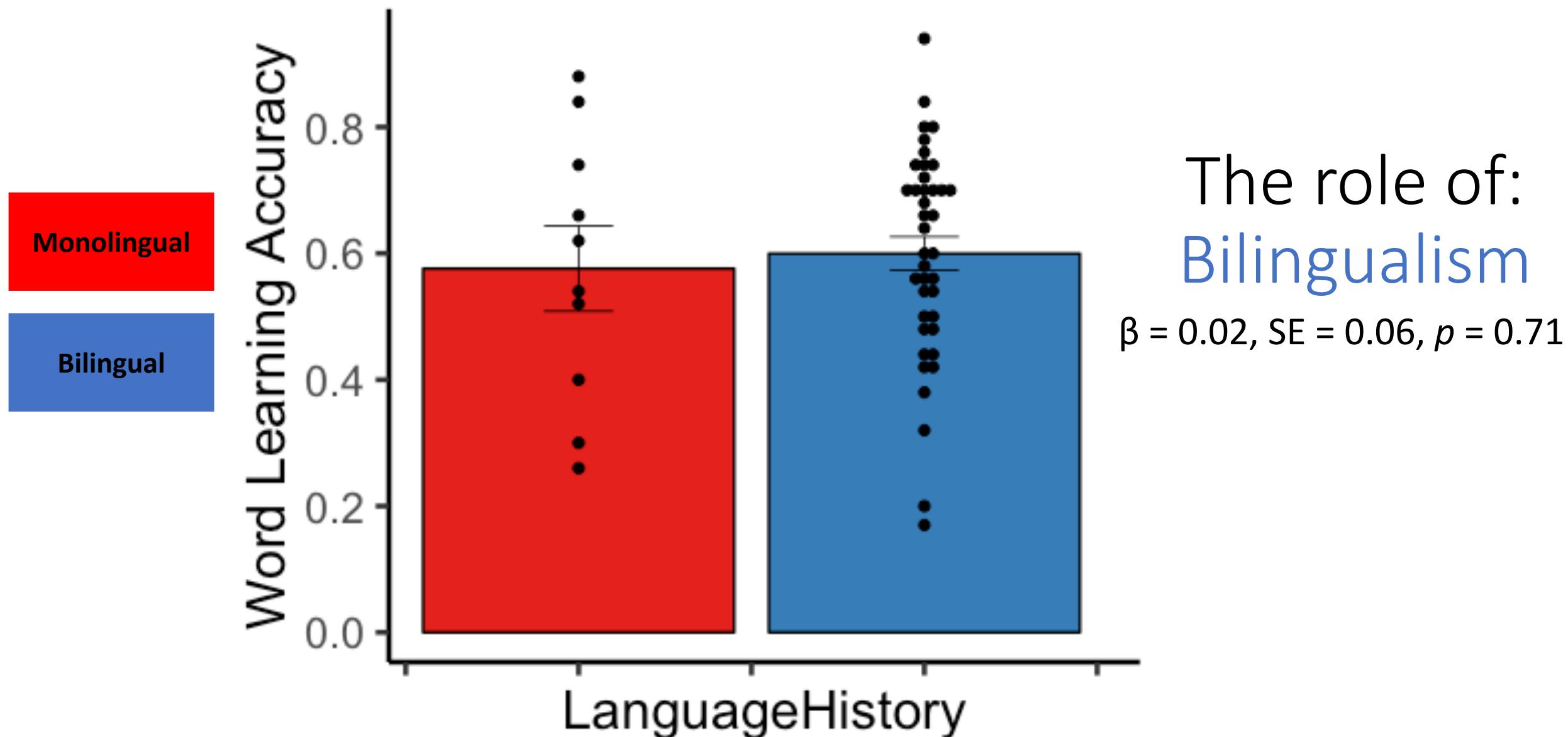
Word Learning Variability



The role of:
Gender

$$\beta = -0.02, SE = 0.05, p = 0.61$$

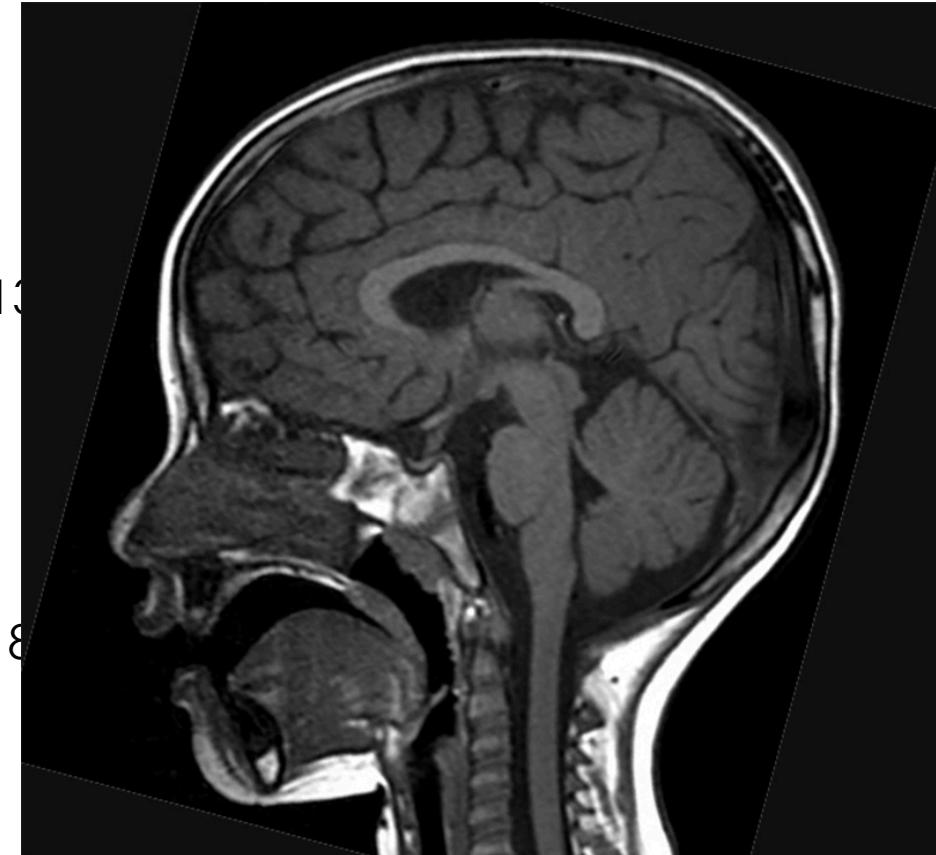
Word Learning Variability



Brain Development

- SES has been related to neural differences in:
 - Surface Area
 - Hippocampus
 - Amygdala
 - Prefrontal Cortex
 - Volume & Integrity of white matter tracts
 - Cortical Thickness
 - Resting state function

Noble, 2016
Brito & Noble, 2014
Mackey et al., 2015
Romeo et al., 2017; 2018
Ursache & Noble, 2016
Noble et al., 2006; 2012; 2013
Raizada et al., 2008;
Hanson et al., 2011;
Jednoróg et al., 2012;
Gianaros et al., 2007;
Chiang et al., 2011;
Ozernov-Palchik et al., 2018
Vanderwert et al., 2016;
Otero, 1994;
Otero et al., 2003;
Tomalski et al., 2013;
Marshall et al., 2004

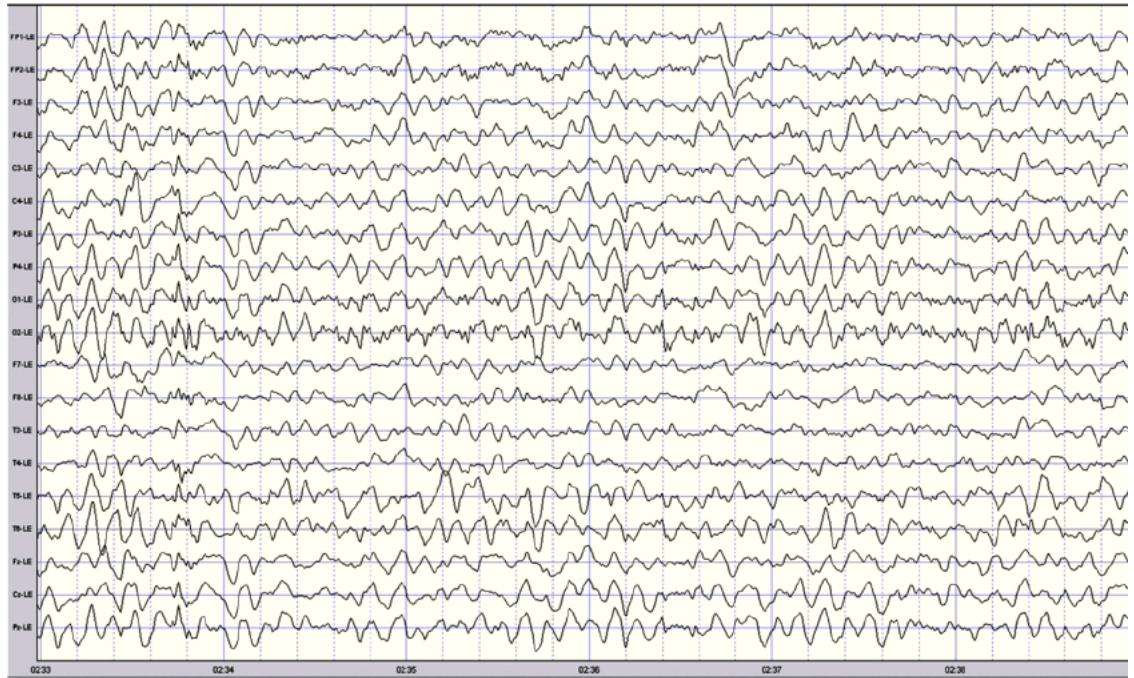


What is Resting State EEG?

- The brain is inherently active
- Better prepared for processing
- “Baseline” for all cognitive functions



How is Resting State EEG measured?



8 minutes alternating between eyes open and closed

What does Resting State EEG measure?

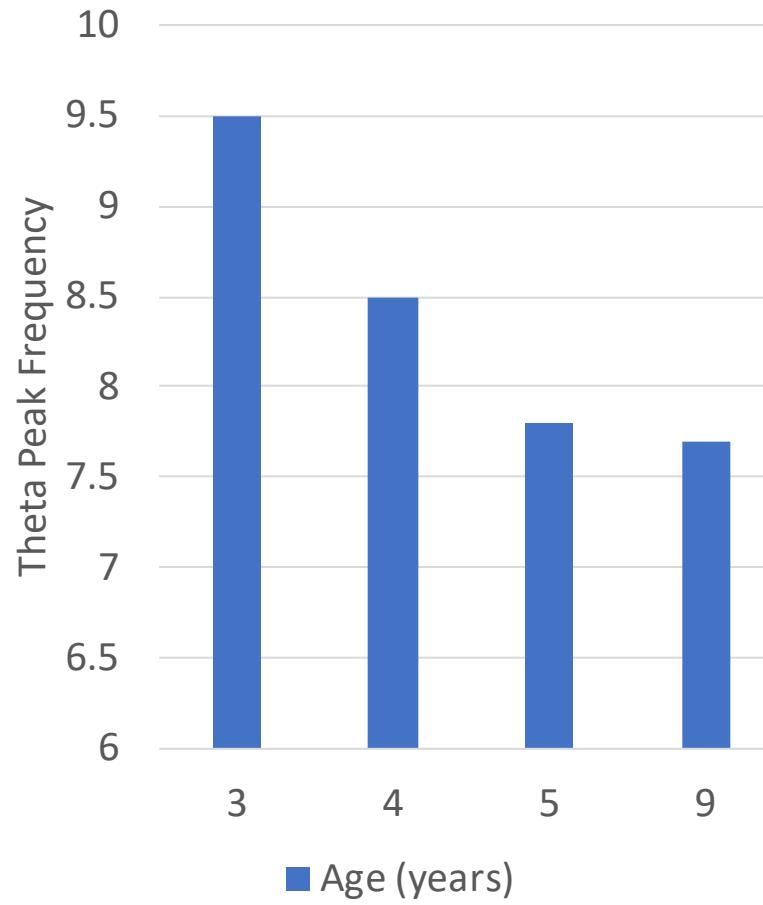
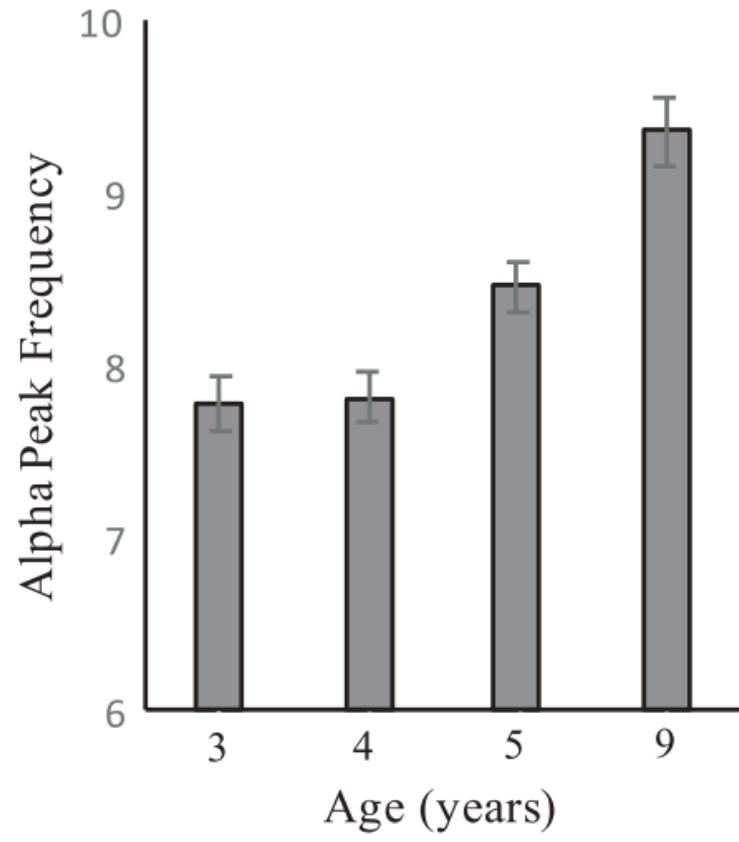
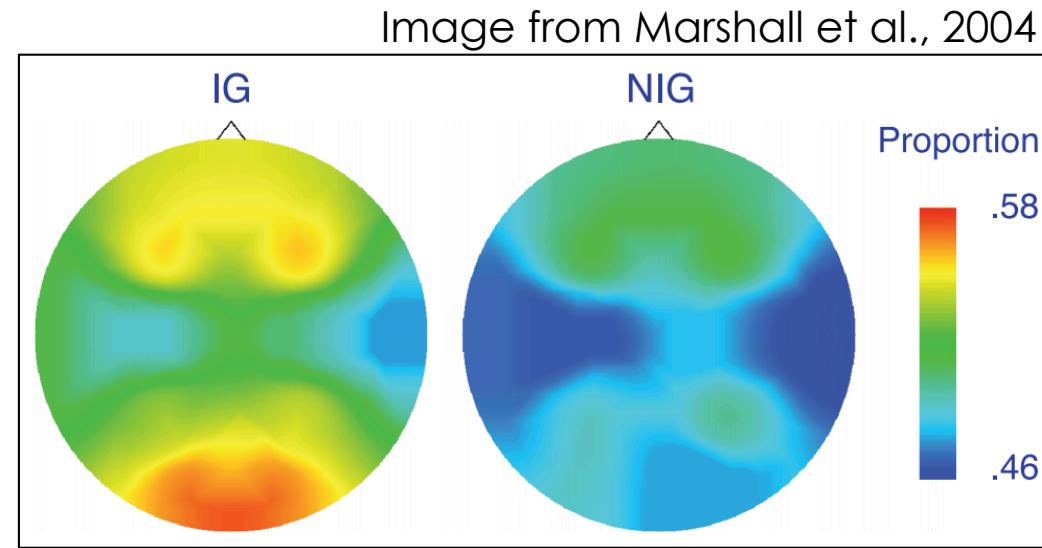


Image from Perone, Palanisamy & Carlson, 2017, Dev. Science

Resting State EEG

Theta



IG = Institutionalized
NIG = Never Institutionalized

↑ Theta (4-8 Hz)
↓ Alpha (9-12 Hz)

(Otero et al., 2003; Vanderwert et al., 2016;
Maguire & Schneider, under review)

What does Resting State EEG measure?

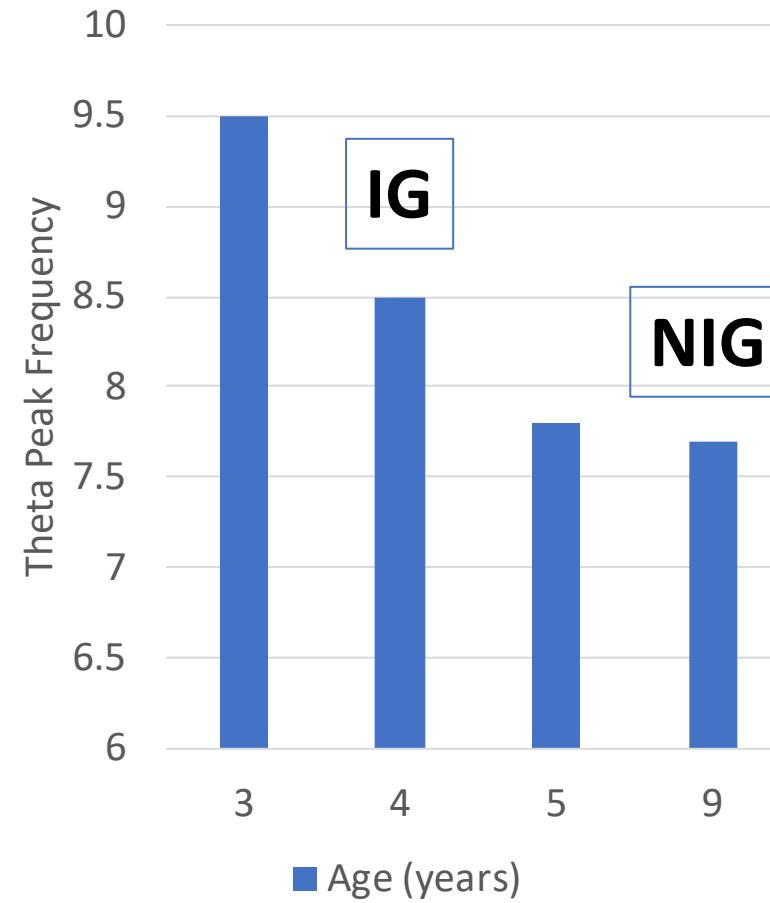
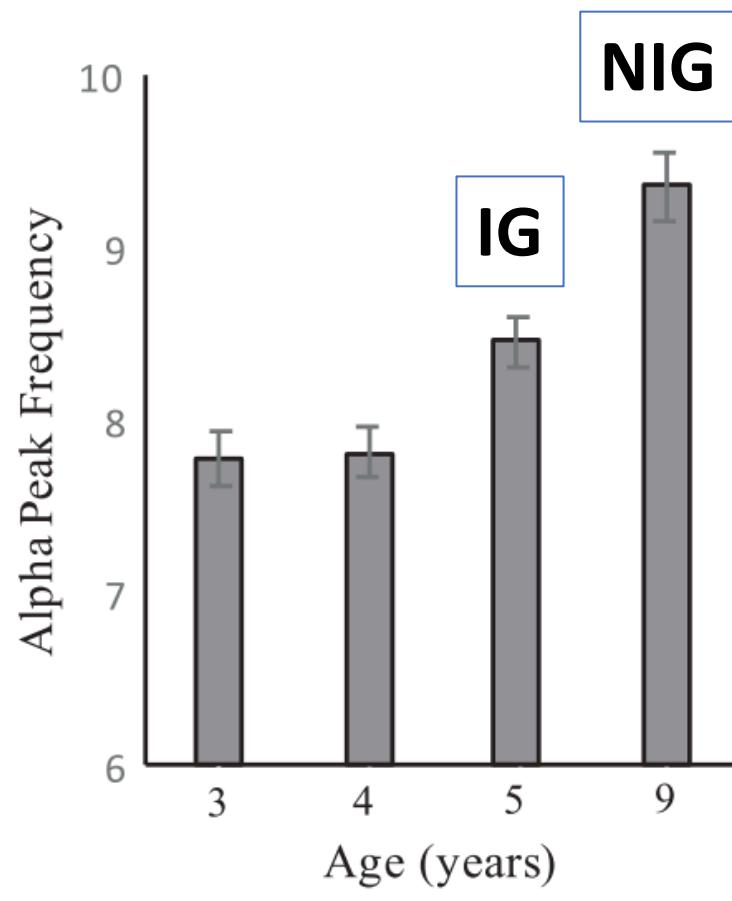


Image from Perone, Palanisamy & Carlson, 2017, Dev. Science

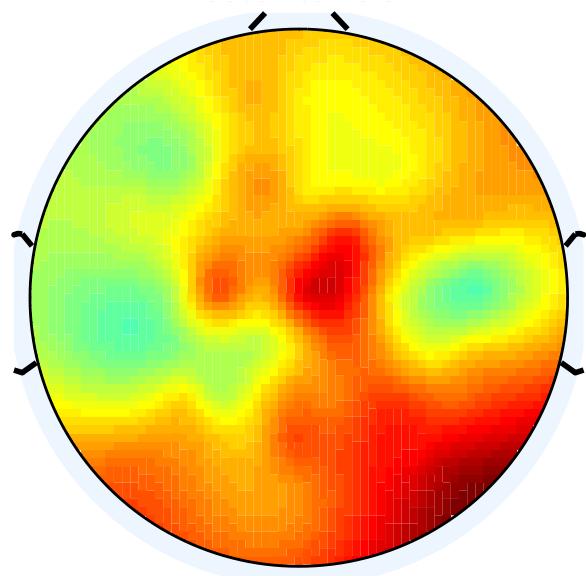
Maturational lag attributed to:
Inability to meet physiological needs
Differences in social and cognitive engagement

**Does resting state EEG contribute to why some
low income kids are more resilient in their word
learning ability than others?**

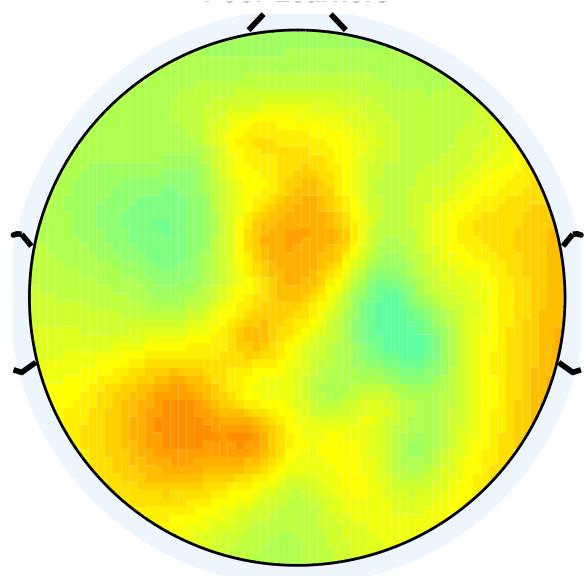
	Worse Learners	Better Learners	
Number of Participants	25	25	
Age			
Number of bilinguals			
Number of males			
Number with mothers who did not complete high school			
Word Learning (M+)			
Vocabulary (PPVT)			
Reading Comprehension (GORT ORI)			
Working Memory (Digit Span)			

Resting State Alpha

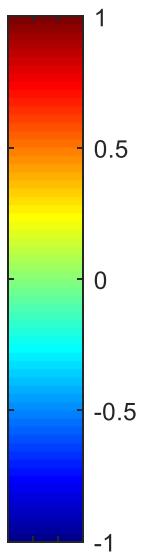
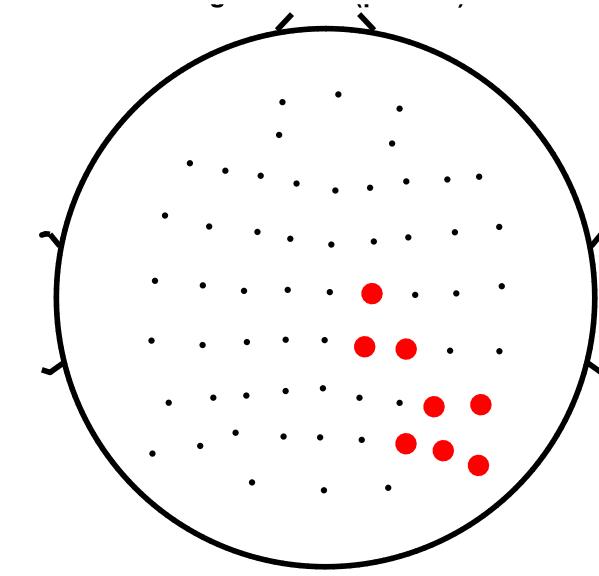
Better Learners



Worse Learners

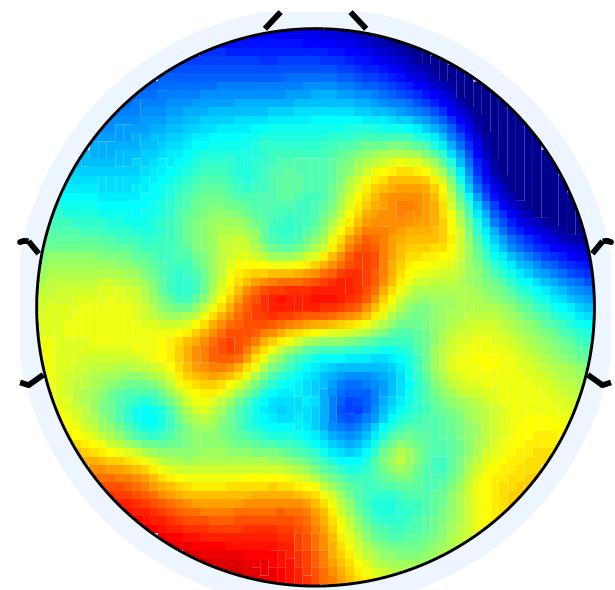


Significance ($p < 0.05$)

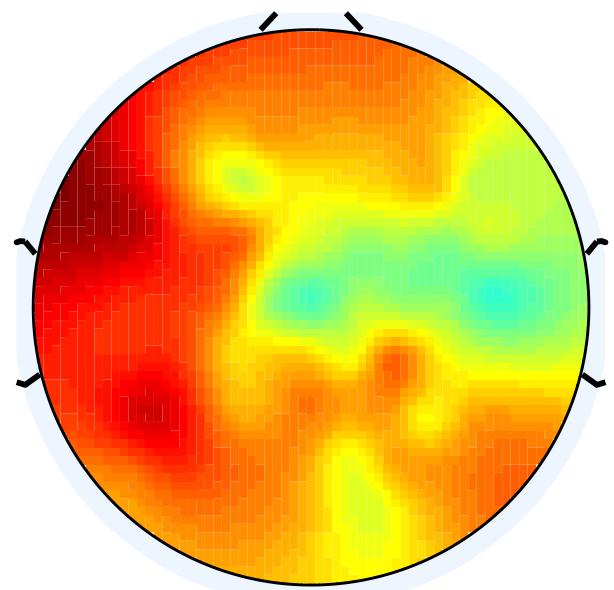


Resting State Theta

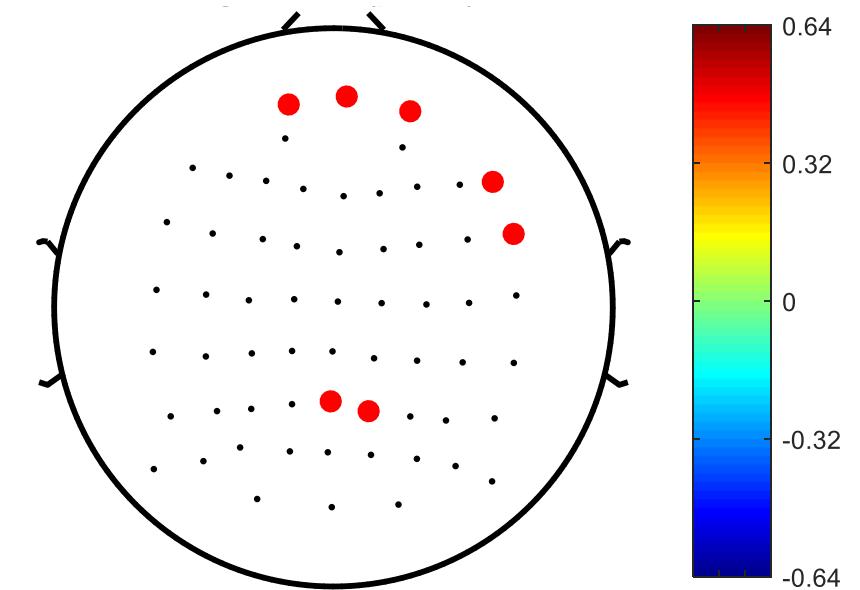
Better Learner



Worse Learner



Significance ($p < 0.05$)



Interpretation



Maturational delay may exist between better and worse word learners

Factors that do differ

	Worse Learners	Better Learners	
Word Learning (M+)	45% (12.24%)	73.76% (7.80%)	$t(48) = -9.82, p < .001$
Vocabulary (PPVT)	91.32 (13.4)	104.72 (15.26)	$t(48) = -3.30, p < .003$
Reading Comprehension (GORT ORI)	87.64 (11.76)	100.42 (16.33)	$t(48) = -3.15, p < .004$
Working Memory (Digit Span)	7.12 (1.81)	8.52 (2.43)	$t(48) = -2.31, p < .03$
Resting state Alpha	Increases	Lack Increase	$p < 0.05$
Resting state Theta	Decreases	Increases	$p < 0.05$

Factors that do not differ

	Worse Learners	Better Learners	
Number of Participants	25	25	
Age	11.24 (2.07)	12.08 (2.14)	$t(48) = -1.41, p = .16$
Number of bilinguals	20	20	$t(48) = 0.00, p = 1.00$
Number of males	8	14	$t(48) = 2.51, p = .09$
Number with mothers who did not complete high school	8	9	$t(48) = -.81, p = .42$ (maternal ed overall)

Interpretation



Maturational delay may exist between better and worse word learners groups



Not necessarily a causal relationship



Remains unknown what accounts for these neural differences



Future Research

- Longitudinal research
 - Clarify reasons for these neural differences
 - Understand the implications of such differences

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The Developmental Neurolinguistics Lab



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FOR COMMUNICATION DISORDERS



Poster Session 11:
3-106

“Exploring the complex relationship between
SES and Vocabulary in Grade School”

National Science Foundation
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