Impact of poverty on children's brains and the implications

Mandy J Maguire, PhD

Yvonne Ralph (Q&A and Discussion)

How does poverty impact children's brains? And how can neuroscience help inform interventions?

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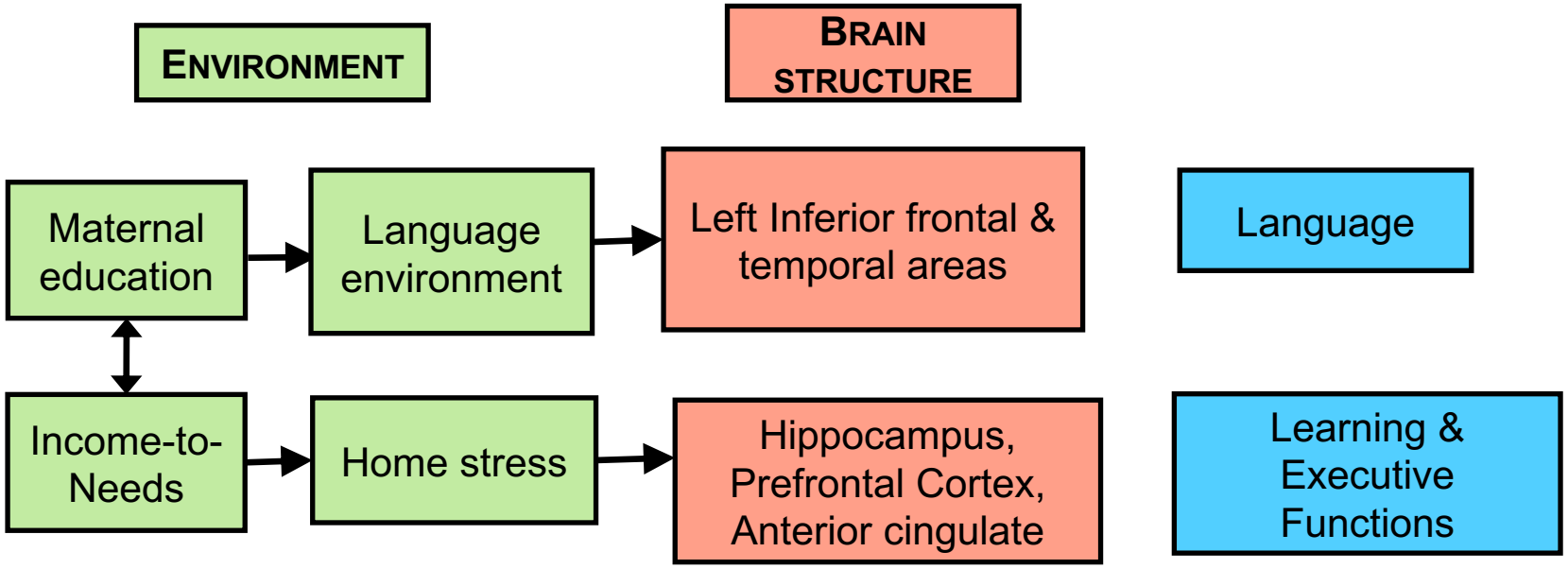
How does poverty impact brain development

- Children from low SES homes show differences in brain structure (Casey, et al., 2000; Noble et al., 2006; Kishiyama et al., 2009; Hackman et al., 2010).



How can neuroscience help inform interventions?

- Research in our lab
  - Alyson Abel, PhD San Diego State
  - Julie Schneider, PhD LSU
  - Yvonne Ralph, soon to be PhD
- How we are using that work in designing Playful Learning Landscapes in Dallas, TX
  - Yvonne Ralph

Implications of early vocabulary differences on the rate of vocabulary growth in school

Use behavioral and neural responses to identify why the vocabulary gap increases.

Grade school: Word learning from linguistic context

"All the animals capered with joy when they saw the whips going up in flames"

- *Animal Farm* (7th-10th grade)

"In Proctor's presence a fool felt his foolishness instantly – and a Proctor is always marked for calumny therefore"

– *The Crucible* (9th-11th grade)

- Dependent on: word knowledge, reading skills, working memory, executive functions (Gersten, et al., 2010; Nagy & Anderson, 1984; Nagy et al., 1985)

Are there implications of early poverty?

- Are success rates different for kids related to SES and if so, why?

Word Learning From Context

Goal: Study the behavioral and neural predictors of successful word learning

270 children ages 8-15 years of age

Example:

- The mean boy hid her dax.
- While reading, she fell asleep on her dax.
- On rainy days, I like to read a dax.

- Points to note:
  - Reading task
  - **All early learned words,** simple sentence structures.
    - Kids know the surrounding words

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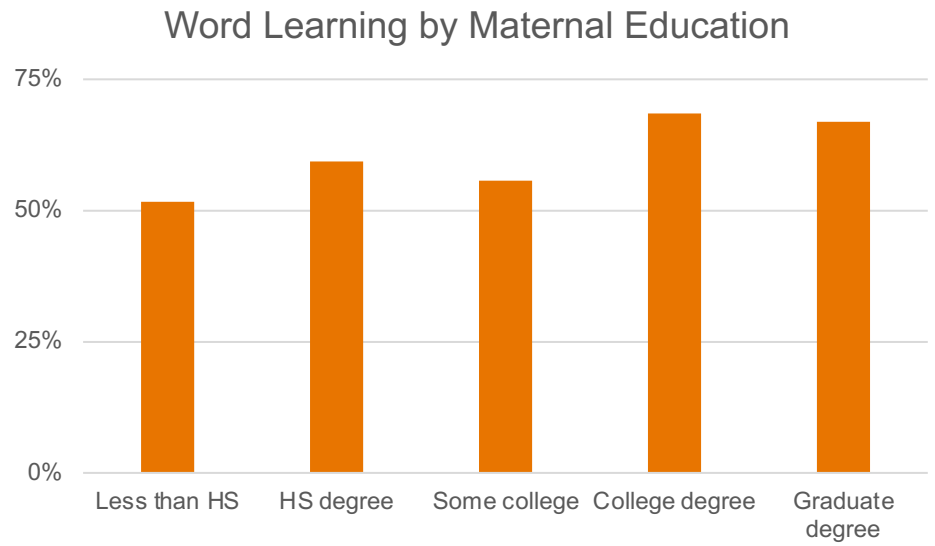
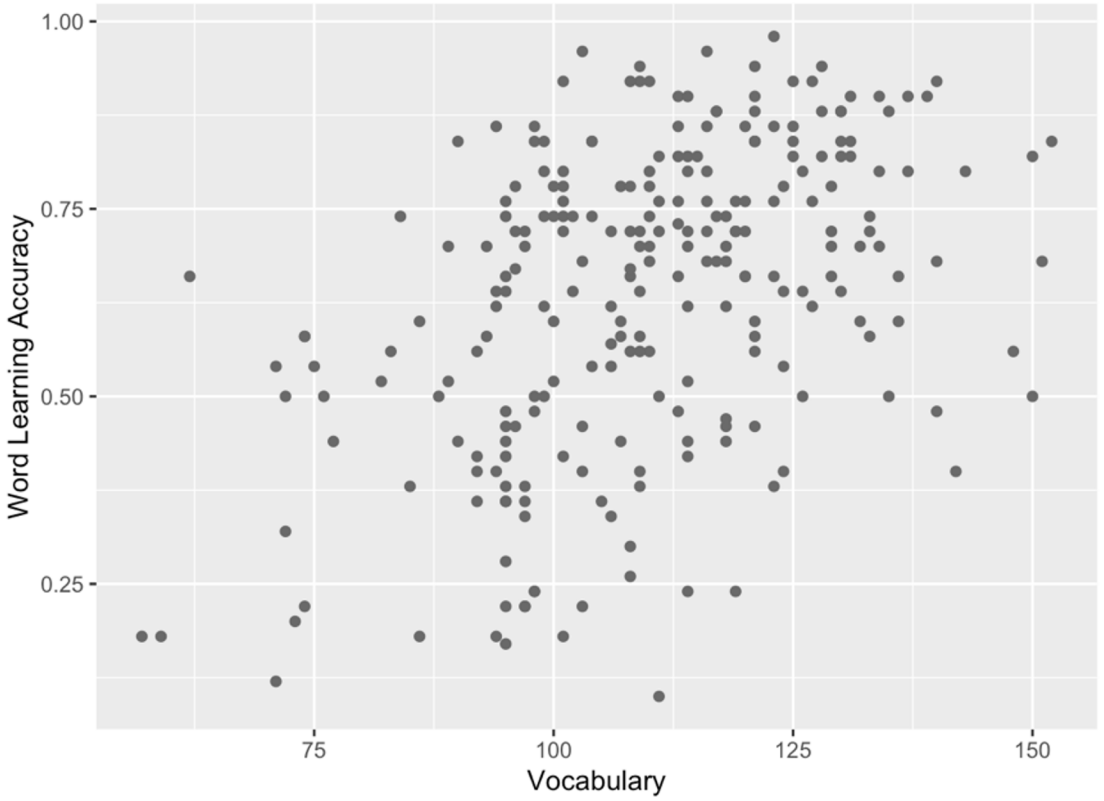


Variable	ME	Words Learned	Vocab
1. Maternal Education	-		
2. Perc. of Words Learned	.16	-	
3. Vocabulary	.47**	.47**	-

Maguire, et al (2018). *Journal of Experimental Child Psychology.*

Word Learning From Context



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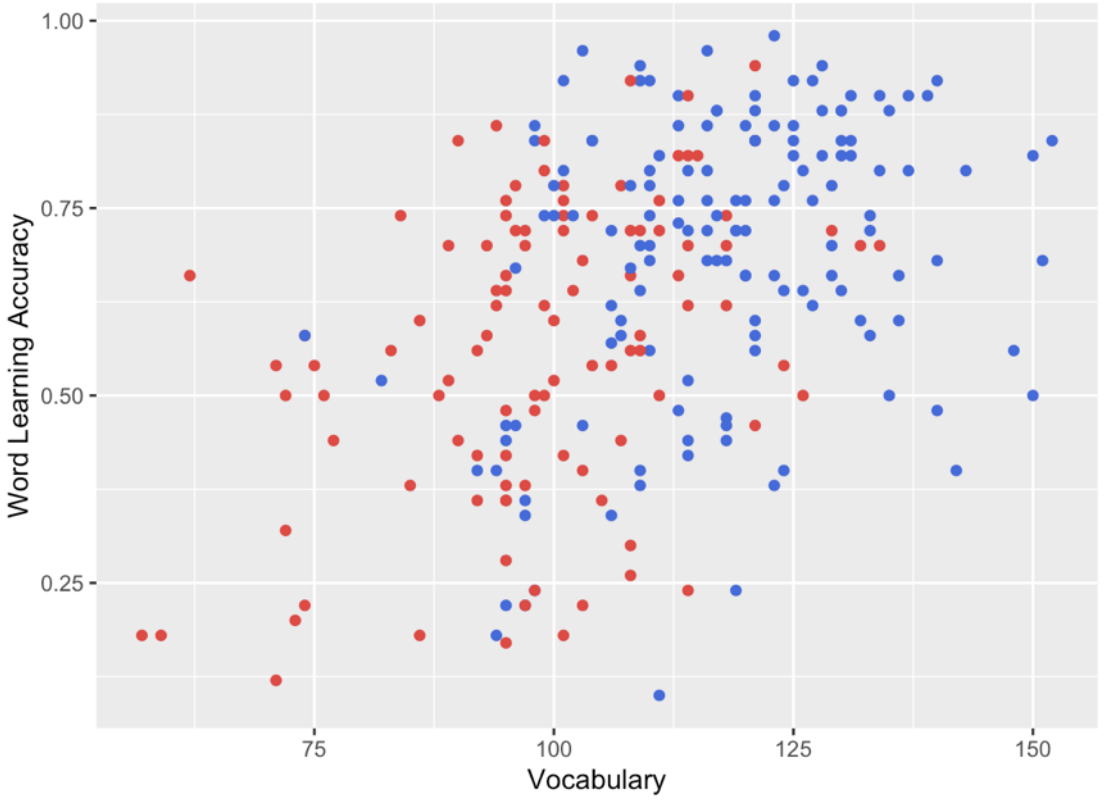

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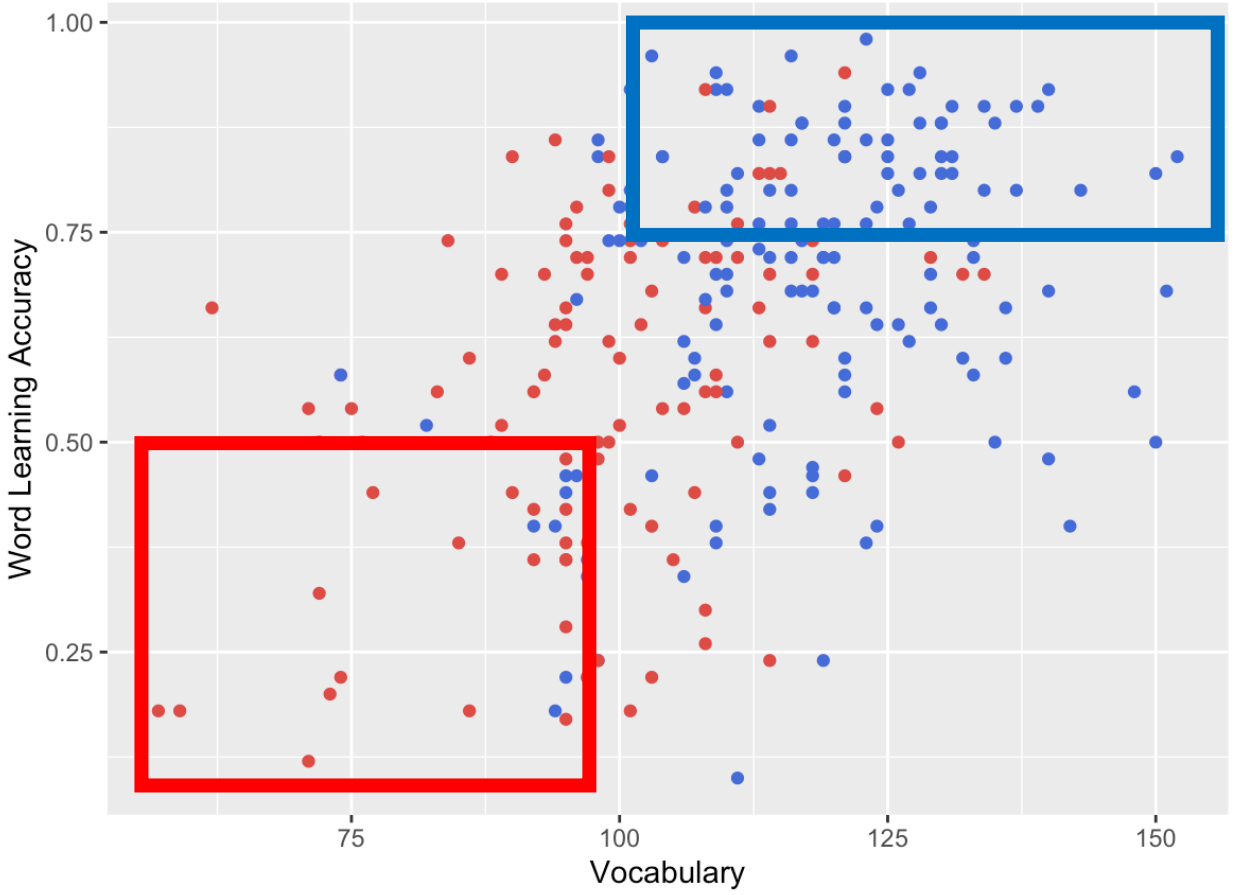
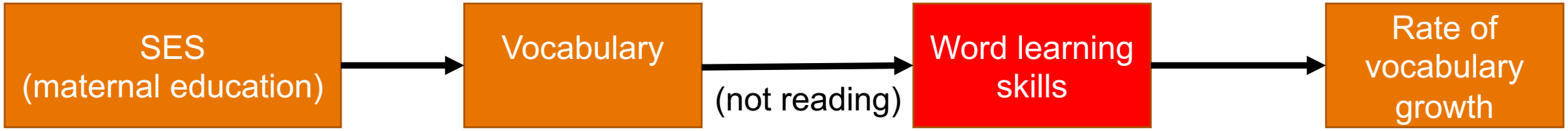
Clusters into 4 distinct groups (Jackie Nelson)



4 Groups:

- Group 1 (*n*=91) included primarily children from higher SES homes who perform significantly better than the average on all measures.
- Group 2 (*n*=31) included primarily children from very low SES homes, who perform significantly worse than the average on all measures (vocabulary, reading, working memory, and word learning).
- Group 3 (*n*=73) included primarily children from LSES homes who were older on average than the other groups (clustered around age 12). They displayed average written word learning, vocabulary and working memory, but below average reading comprehension.
- Group 4 (*n*=56) includes a group of young children (clustered around age 8.5) who perform poorly on all of the tasks despite being from high income homes.

Results and implications:



- Debunks 2 myths about why kids struggle with vocabulary growth:
  - Poor reading skills
  - They don't know the surrounding words – **They KNEW the words!**
- What can neuroscience tell us?
  - Structure – nothing
  - Function – **process**, strategy

EEG: Time Frequency Analysis

The mean boy hid her dax

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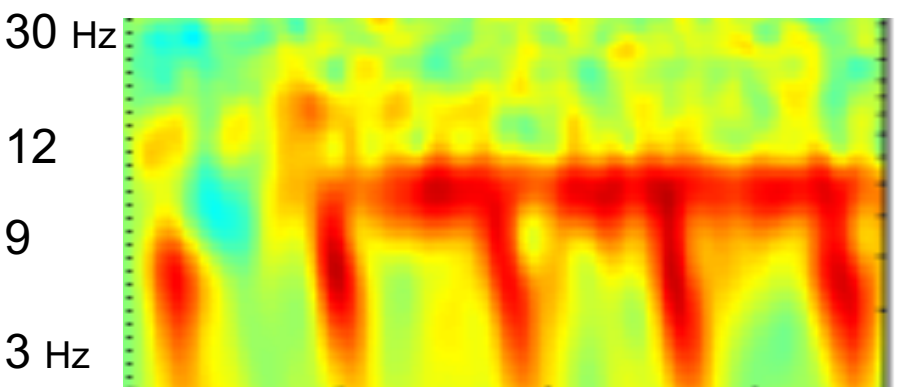

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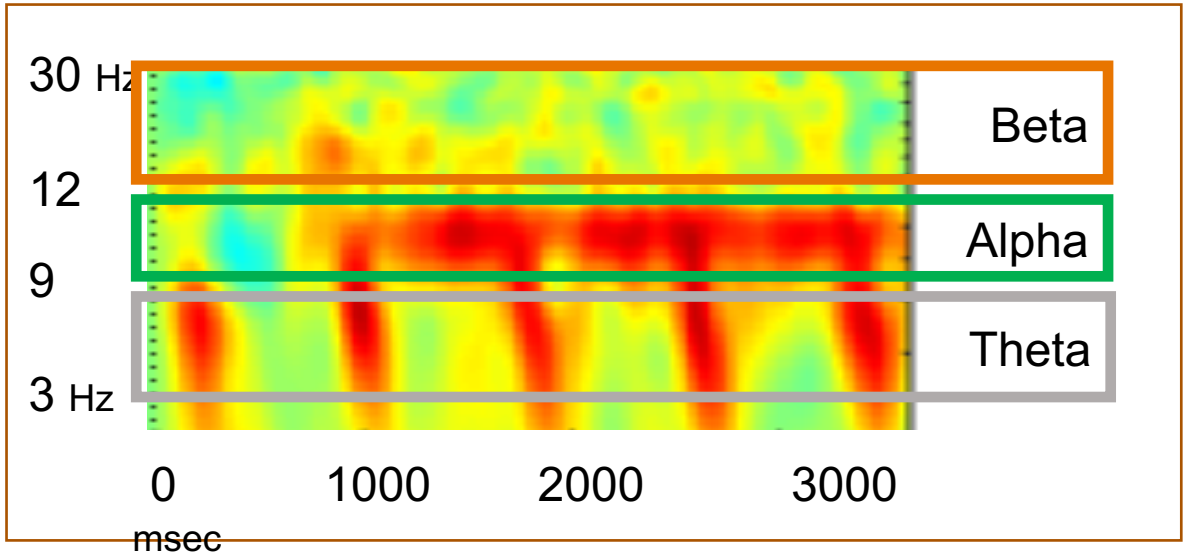
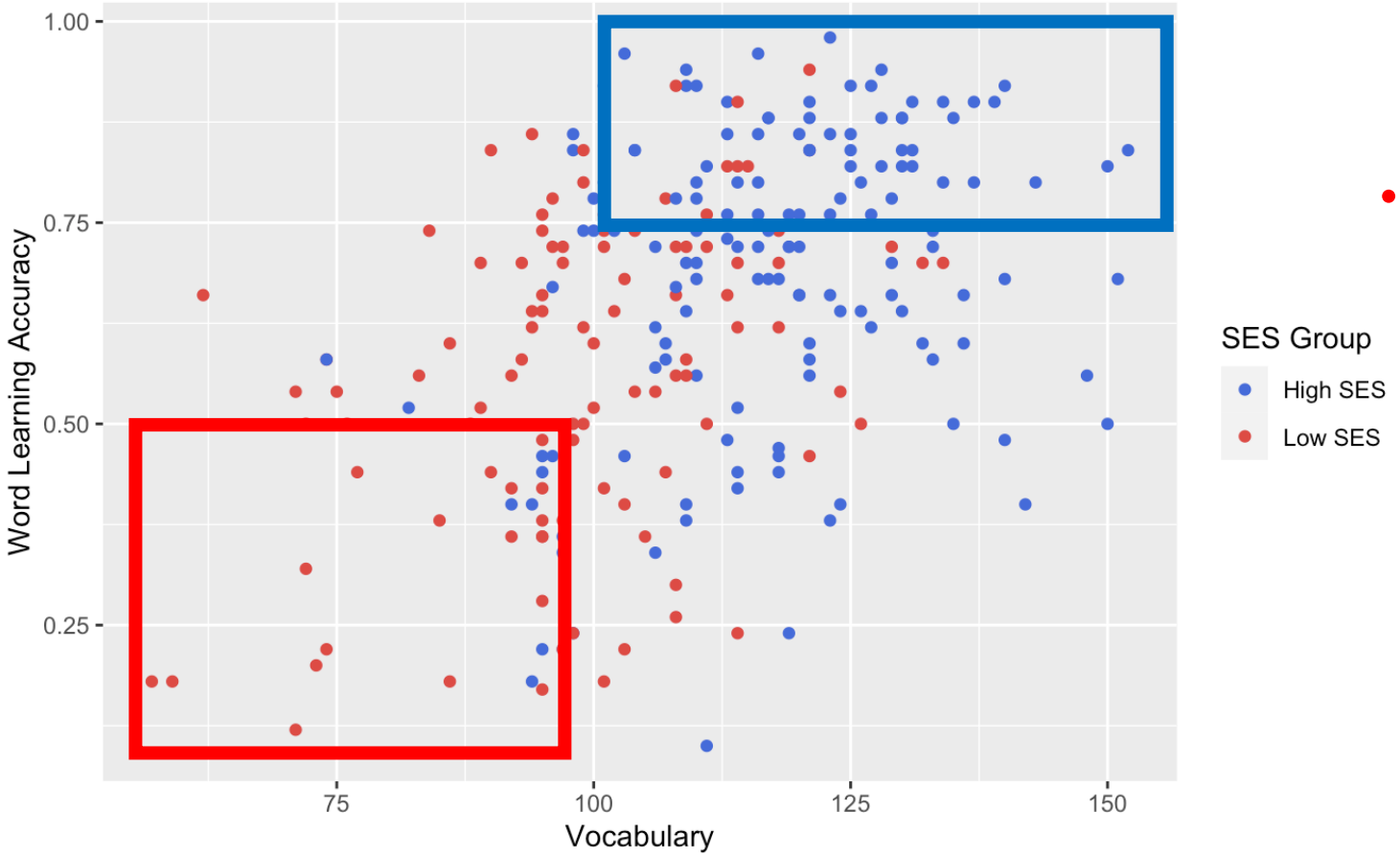


Beta (13-30 Hz) – Language Integration (Abel & Maguire, 2010; Bastiaansen et al., 2010; Hagoort et al., 2004: Weiss & Mueller, 2012; Schneider et al., 2017).

Alpha (9-12 Hz)– Working memory (Klimesch et al., 2008

Theta (4-8 Hz) – Word retrieval (Bastiaansen & Hagoort, 2006; Maguire et al., 2010)

Correlation between vocabulary and word learning



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- Group 2 (*n*=31) included primarily children from very low SES homes, who perform significantly worse than the average on all measures (vocabulary, reading, working memory, and word learning).

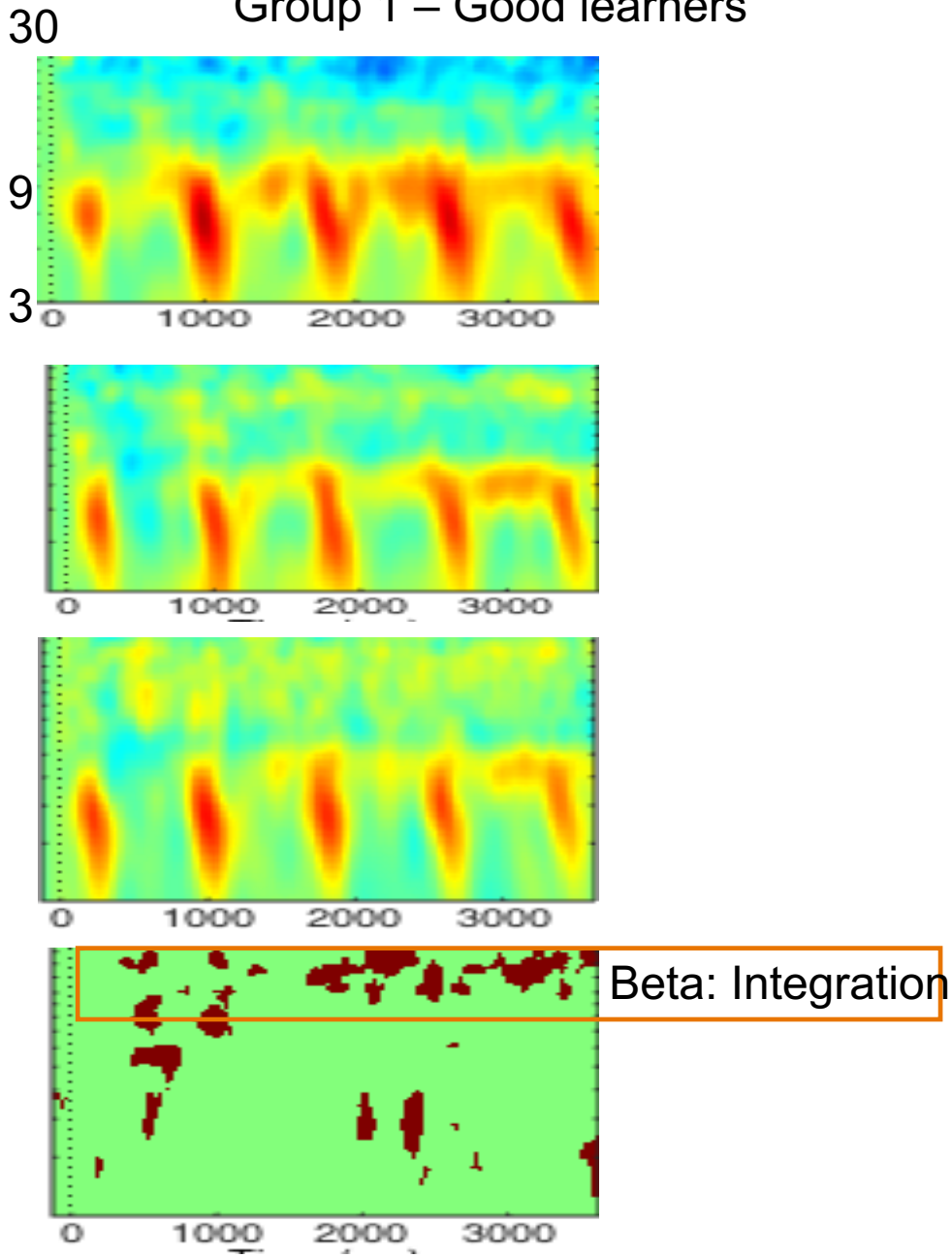
Group 1 – Good learners

Group 2 – poor learners

Sentence 1

Sentence 2

Sentence 3



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FC5

Implications for interventions?

- What successful kids are doing: **Integrating the language** as they go.
  - Not necessary learning more words
  - Learning relationships between words
- How can we apply this in Playful learning landscapes
  - Language isn't words in isolation
  - Active, playful ways to form connections between words – deep semantic networks
    - Make it effortless in real world situations,
    - Hop scotch, jumping stones.
- Dallas Library Renovation

Broader question: What is the effect of poverty on the brain and what are the implications?

- The effects can be profound and they are problematic to later learner
- Neuroscience can be incredibly informative about interventions,
- But, it is important to use ask questions in ways that seek answers

Thanks!

- Developmental Neurolinguistics Lab
  - Sonali Poudel
  - Tina Melamed
  - Dr. Carlos Benitez-Berrera

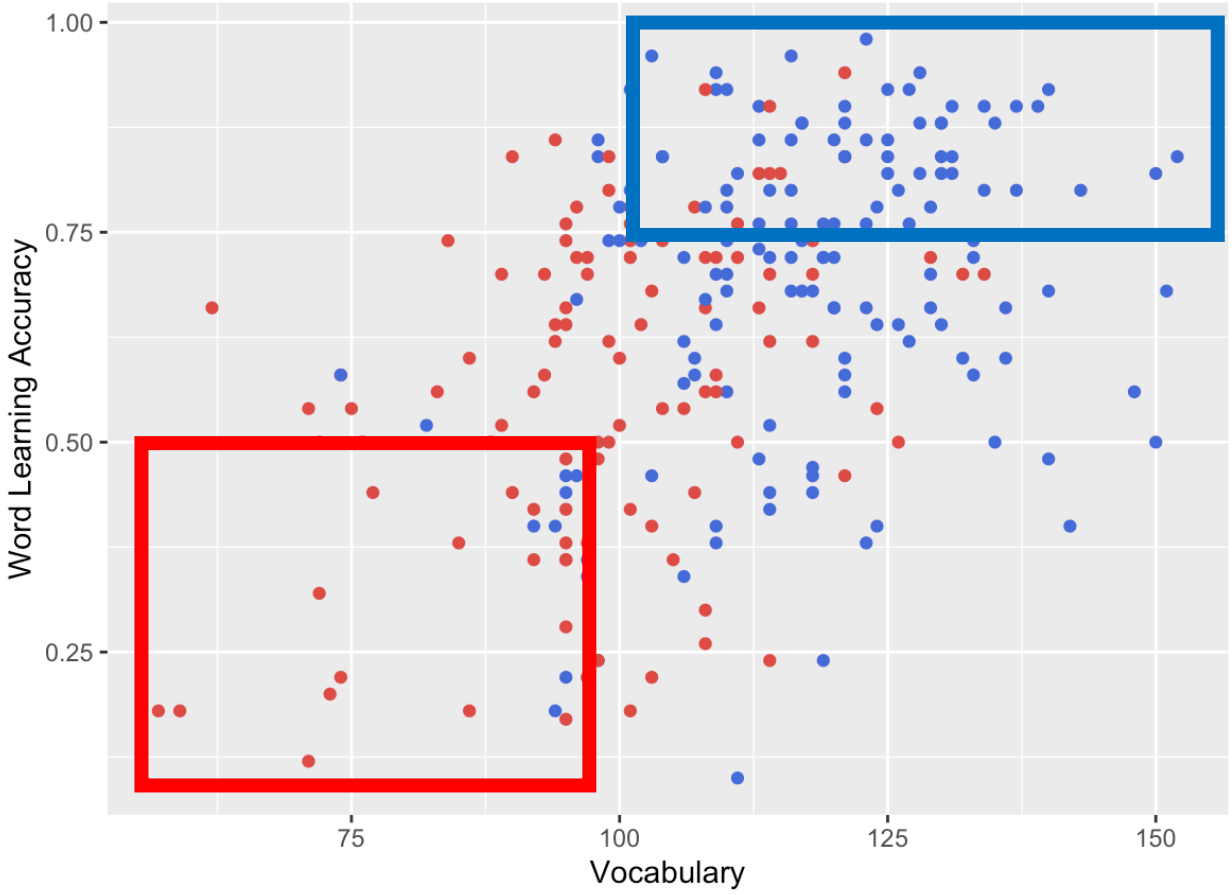
- Organizers of today's event: Pittsburgh Playful Collaborative, Brookings and Playful Learning Landscapes collaborative.

- Families who took part in the studies.

- National Science Foundation

Questions? Thoughts?

Correlation between vocabulary and word learning



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Behavioral Data

Participants. 68 children ages 8-15 years

SES

- Maternal Education at 5 levels, most predictive SES measure

Maternal Education	N (F,M)	Mean Age	Age Range	% Bilingual	Ethnicity	Vocabulary (PPVT	Reading comp (GORT)	Decoding (TOWRE – PDE)	Working memory (Digit Span)
Did not complete high school	11 (6, 5)	10.64 (2.38)	8 - 13 yr	100% (N=11)	100% Hispanic (N=11)	82.10 (15.46)	10.0 (5.87)	98.0 (10.99)	7.82 (1.25)
High School Diploma	5 (3,2)	12.60 (1.82)	11 - 15 yr	40% (N=2)	100% Hispanic (N=5)	102.0 (13.56)	8.4 (3.65)	87.40 (18.26)	8.00 (3.08)
Partial College	11 (6,5)	9.91 (2.12)	8 – 14 yr	9% (N=1)	36% Hispanic (N=4)	112.73 (15.65)	9.09 (2.17)	98.82 (6.95)	7.91 (2.66)
College Graduate	26 (17, 9)	11.31 (2.12)	8- 15 yr	15% (N=4)	30% Hispanic (N=7)	116.96 (13.62)	12.0 (6.31)	98.12 (14.012)	9.04 (3.24)
Graduate Degree (MA, PhD, MD, etc)	15 (6,9)	10.20 (1.89)	8 - 14 yr	7% (N=1)	20% Hispanic (N=3)	128.20 (19.50)	13.13 (3.27)	97.53 (23.33)	7.67 (2.47)
Total/average (SD)	68	10.86	8 - 15 **yr**	30% (N=23)	44% Hispanic (N=30)	112.05 (21.32)	11.19 (5.14)	97.29 (15.50)	8.28 (2.73)

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