

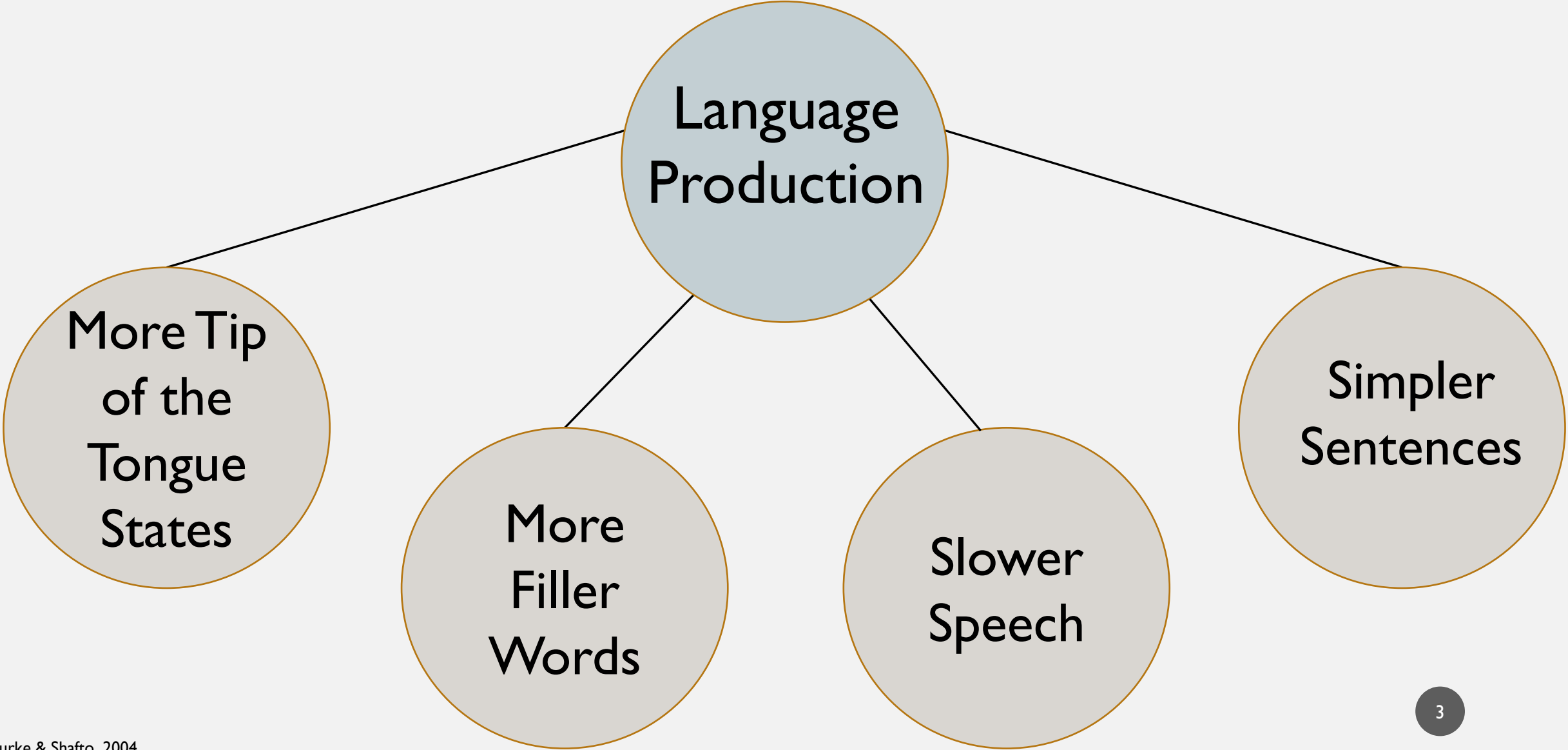
**PREDICTION IS PRODUCTION?**  
EXPLORING THE RELATIONSHIP BETWEEN  
LANGUAGE PREDICTION AND PRODUCTION  
IN YOUNGER AND OLDER ADULTS

Victoria H. Gertel  
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# OUTLINE

- Language Prediction and Production Background
- The Current Project
- Studies One and Two
  - Examined effects of sentence constraint on reading times with and without context
  - Interpretations
- Studies Three and Four
  - Examined effects of production with and without context
  - Interpretations
- General Discussion
- Conclusions

# LANGUAGE PRODUCTION



# LANGUAGE PREDICTION

- **Language Prediction** – A process during language comprehension in which individuals anticipate upcoming information.
- **E.g., “The boy peeled the large \_\_\_\_\_.”**

“banana”

“apple”

“cucumber”

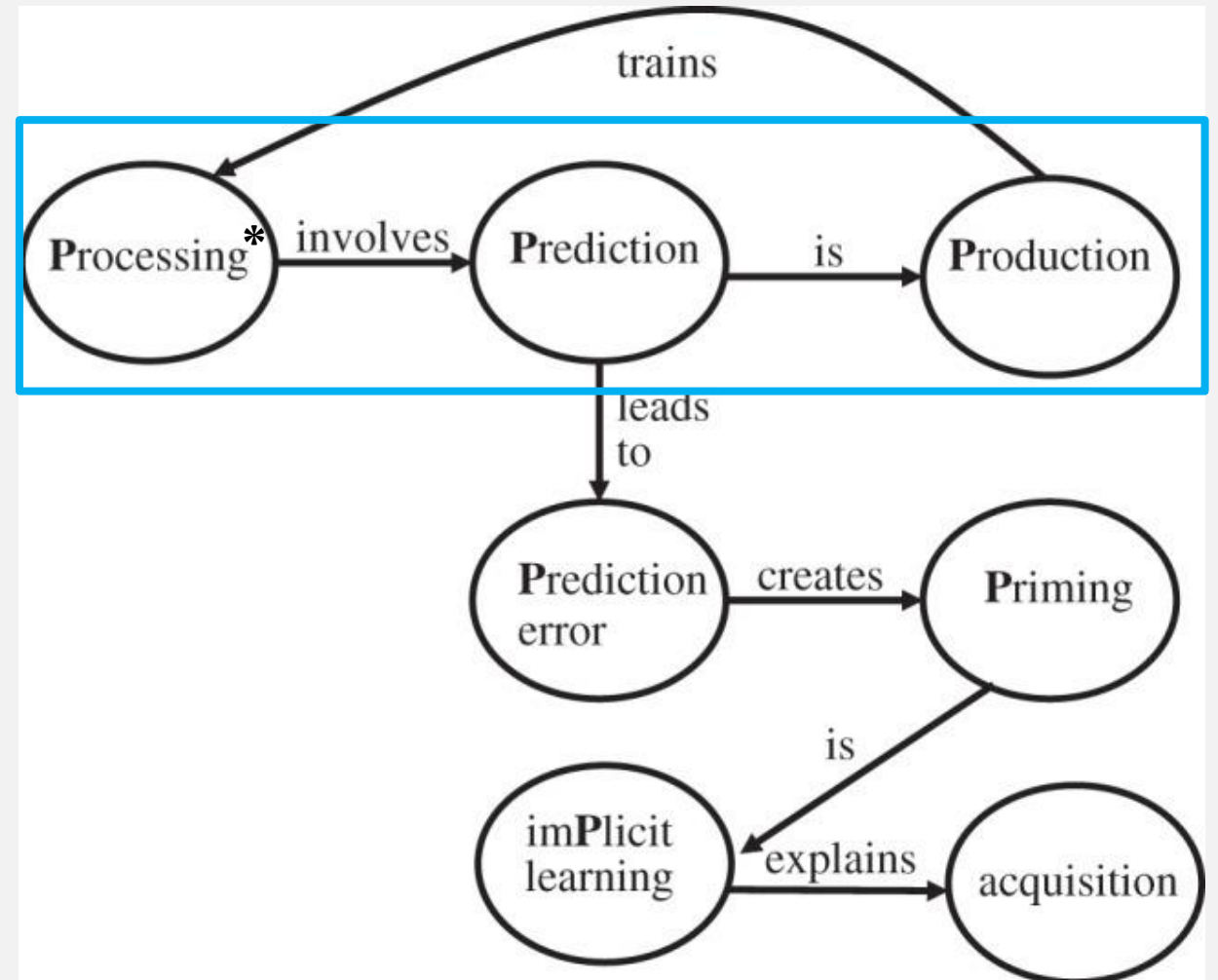
“orange”

“potato”

“computer”

# LANGUAGE PREDICTION AND PRODUCTION

- Prediction declines likely related to declines in cognitive resources (Federmeier, 2007; Federmeier et al., 2010; Huettig & Janse, 2016).
- Prediction declines also related to declines in language production (Dell & Chang, 2014; Federmeier, 2007; Federmeier & Kutas, 2005; Federmeier, et al., 2010).



\* Processing = language comprehension in this model

# PREDICTION IS PRODUCTION EVIDENCE

1. In toddlers, higher productive vocabulary = More Looks to the target in a preferential looking paradigm (Mani & Huettig, 2012).
2. In younger adults, higher production fluency (i.e., verbal fluency) predicted anticipatory eye gaze in Visual World Paradigm (Hintz, Meyer, & Huettig, 2017).
3. In an EEG study, participants whose language production system was occupied showed no N400 effect while participants in other conditions did show the N400 effect (Martin, Branzi, & Bar, 2018).

## ***Takeaway:***

1. Language production abilities are positively related to language prediction abilities.
2. When the language production system is otherwise engaged, prediction cannot occur.

# PREDICTION, PRODUCTION, AND AGING

- In an EEG study, older adults did not show the prefrontal positivity pattern (500 – 900 ms) associated with disconfirmed predictions that was observed in younger adults (Federmeier, Kutas, & Schul, 2010).
  - However, within older adults, those with higher categorical verbal fluency were more likely to show the pattern.
- In another study manipulating sentence constraint, for the highly constrained (i.e., more predictable) sentences, older adults showed a smaller, and delayed, N400 effect than the younger adults (Federmeier & Kutas, 2005).

# UNDERLYING MECHANISMS

- **Working Memory and Processing Speed:**
  - N400 latency in older adults predicted by reading span (Federmeier & Kutas, 2005)
  - Working memory and processing speed predict anticipatory gaze independent of age (Huettig & Janse, 2017)
- **Reading Experience:**
  - Trains the prediction system (Huettig & Guerra, 2019)
  - Improves verbal working memory (Huettig & Guerra, 2019)

# RESEARCH QUESTIONS

1. Is there a relationship between language prediction and language production?
2. Assuming there is a relationship, does it differ with age?

# MEASURING PREDICTION ONLINE

Predictable

The boy **peeled** the large **banana** while he was sitting in the cafeteria.

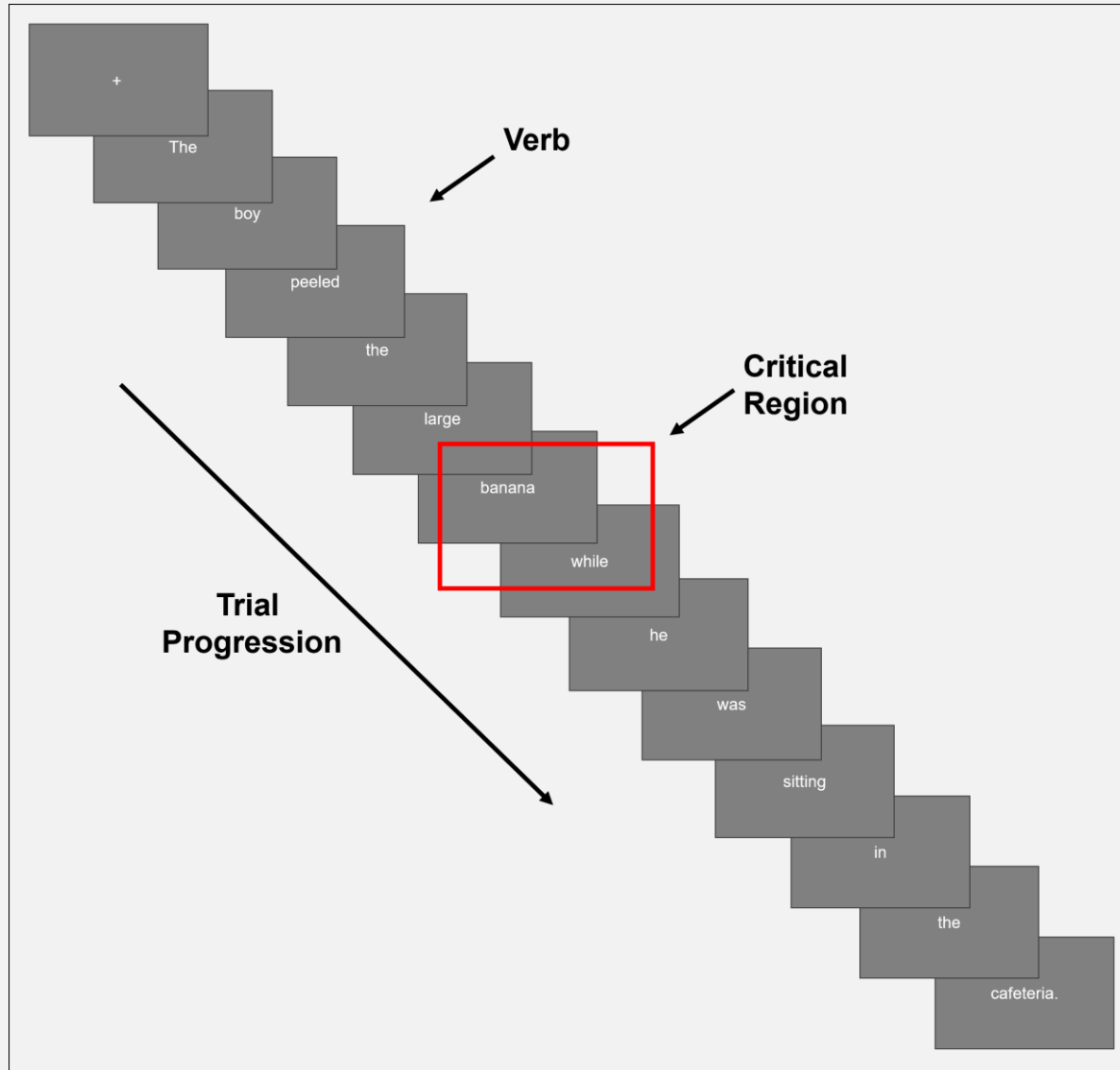
Non-Predictable

The boy **drew** the large **banana** while he was sitting in the cafeteria.

# THE CURRENT PROJECT

<b>Experiment</b>	<b>Aims</b>
Exp. 1 – Self-Paced Reading	Compare reading times for predictable and non-predictable sentences.
Exp. 2 – Self-Paced Reading with Context	Examine how context affects reading times. Compare reading times for predictable and non-predictable sentences when provided with additional context.
Exp. 3 – Blocked Self-Paced Reading	Examine the effect of anticipating production on reading times, picture naming accuracy, and reaction times.
Exp. 4 – Blocked Self-Paced Reading with Context	Examine how additional context influences the effect of anticipating production on reading times, picture naming accuracy, and reaction times.

# STUDIES 1 AND 2



## Other Measures

- Language Production Measures
- Working Memory Measures
- Processing Speed Measures
- Reading Experience Measures

# STUDIES 1 AND 2 RESULTS

## Language Production:

- Study 1 = Younger and older adults did not significantly differ
- Study 2 = Younger adults had better language production abilities

## Language Prediction:

- No evidence of prediction occurring
- Reading times at the critical region did not differ across sentence types

## Language Prediction and Production:

- Language Production (offline) did not predict reading times

## Mediation Analyses:

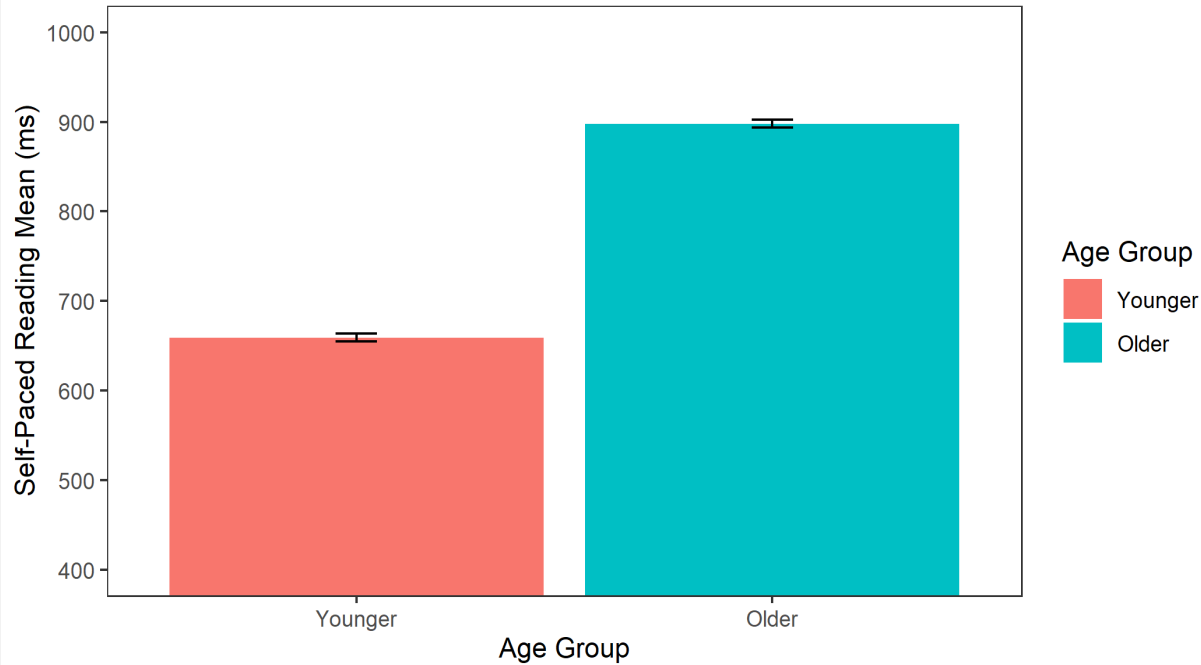
- No effect of study 2 did (not significantly) mediating effect of reading experience to study 1.

# STUDIES 1 AND 2 RESULTS

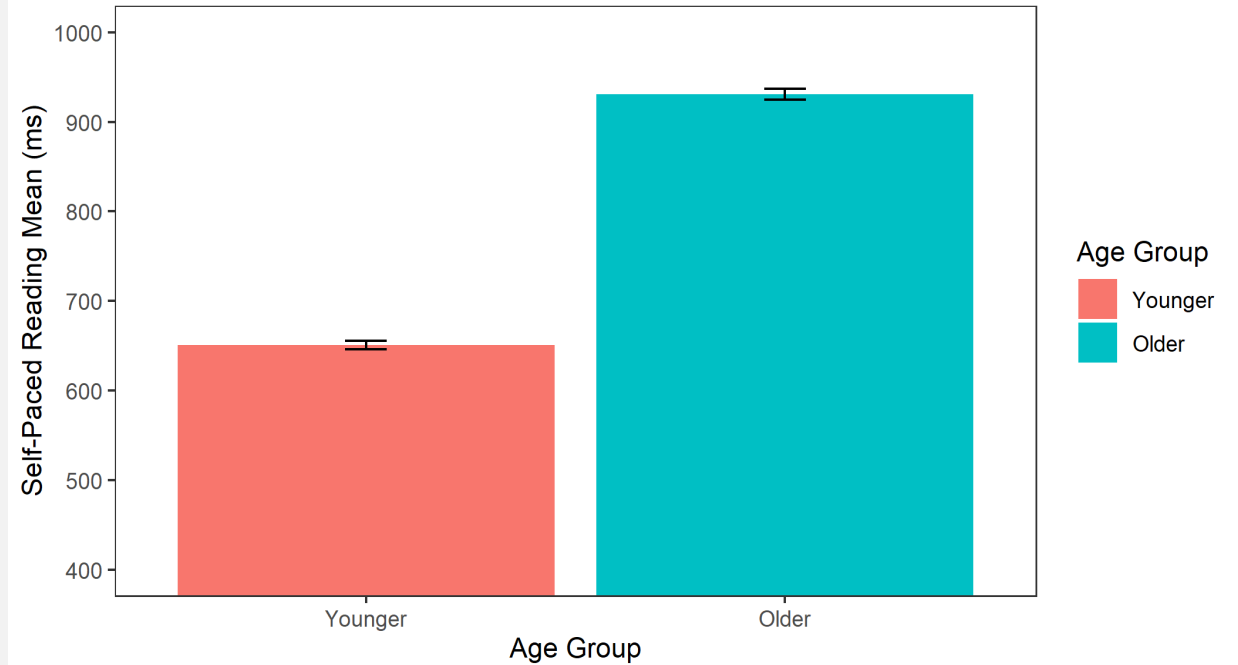
Younger adults had faster reading times than older adults

- Possibly effect of processing speed or motivation

Study 1: Younger Adults Exhibited Faster Reading Times at the Critical Region



Study 2: Younger Adults Exhibited Faster Reading Times at the Critical Region



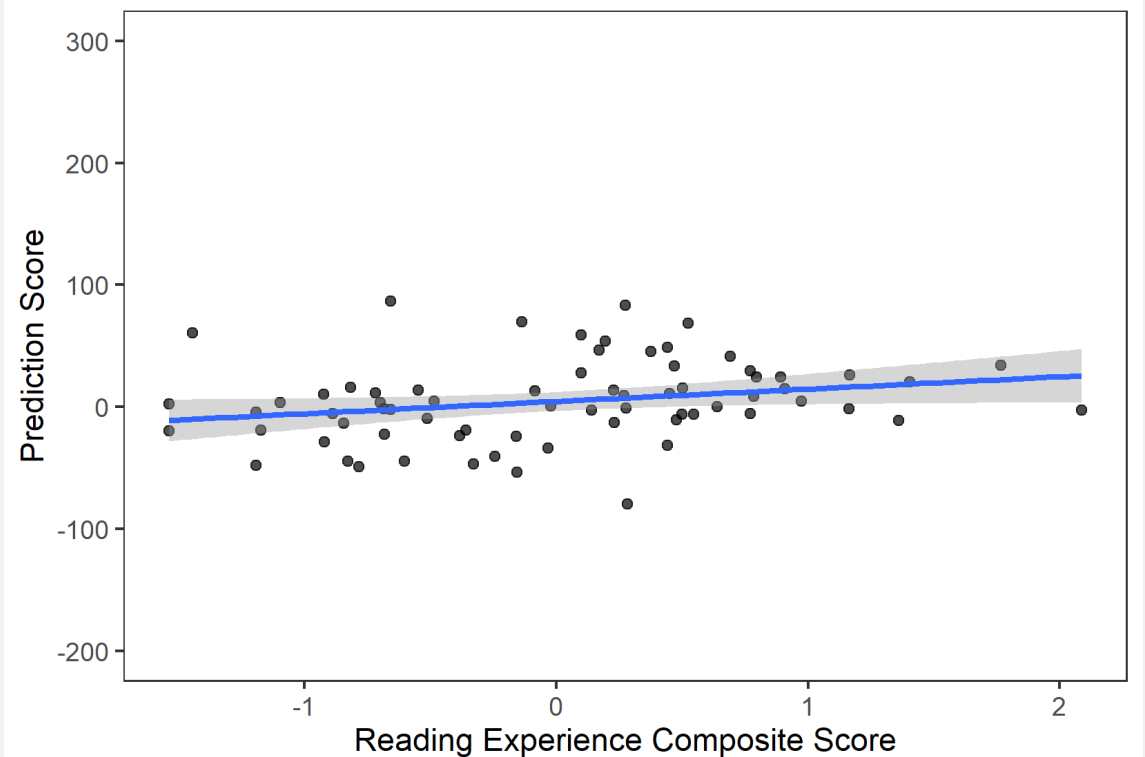
# STUDIES 1 AND 2 RESULTS

Higher working memory and more reading experience associated with higher prediction scores.

Study 2: Working Memory Main Effect on Prediction Score



Study 2: Reading Experience Main Effect on Prediction Score



# STUDIES 1 AND 2 RESULTS

## **Language Production:**

- In study 1, the older adults performed like younger adults

## **Language Prediction:**

- Self-paced reading alone might not encourage prediction or be able to adequately detect prediction

## **Language Prediction and Production:**

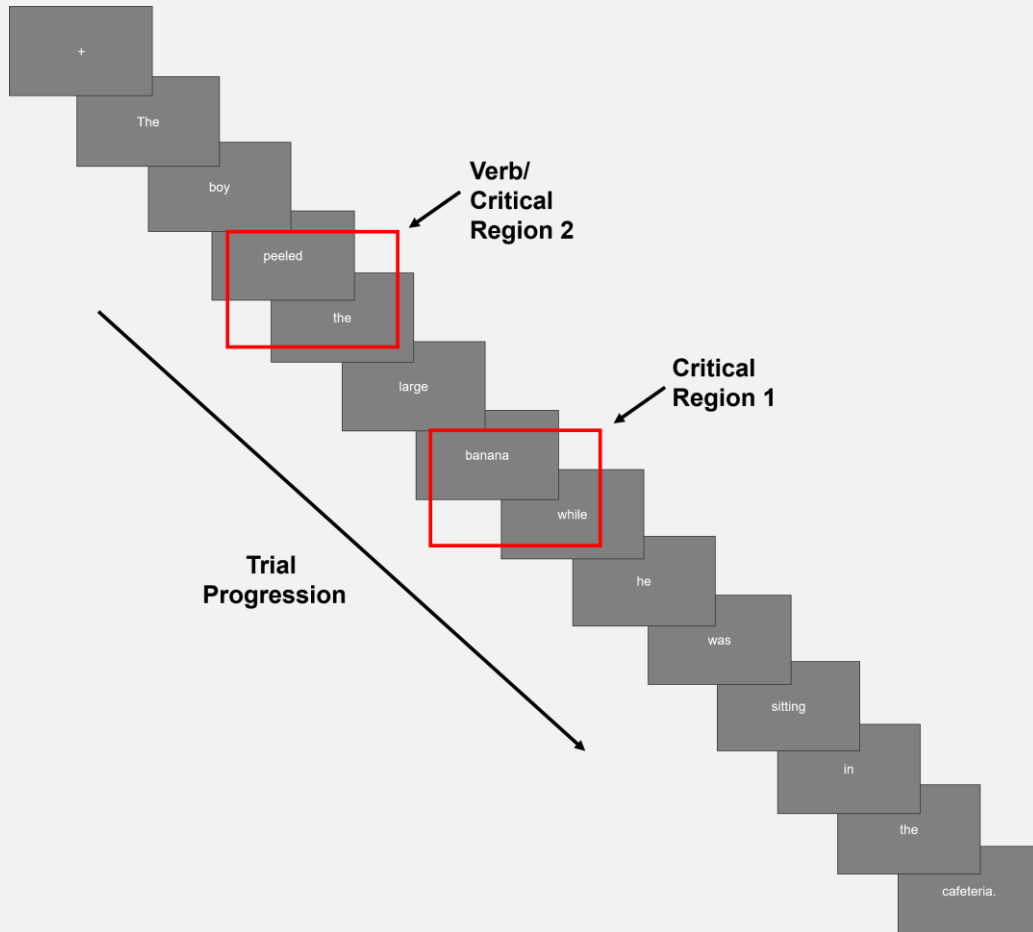
- No evidence for prediction, so unsurprising that production doesn't predict reading times

## **Effect of Context:**

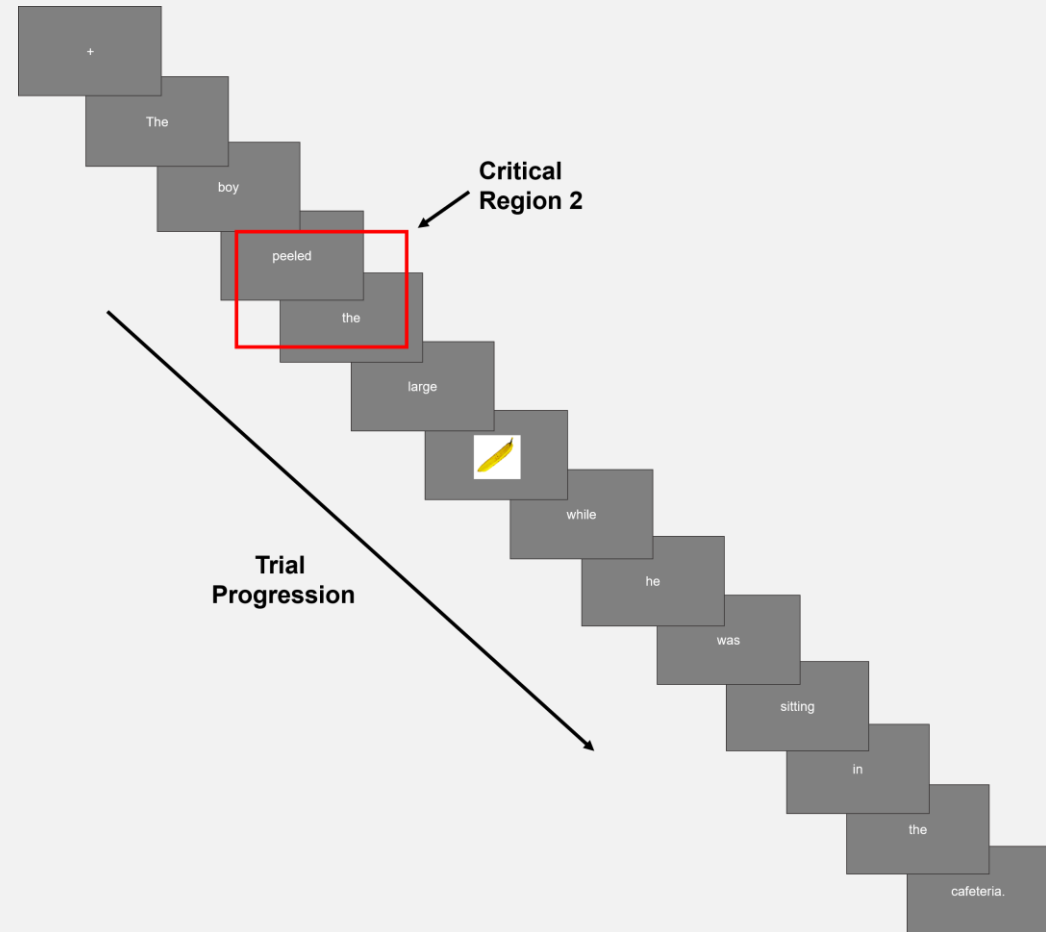
- No evidence for prediction, but possibly related to individual differences

# STUDIES 3 AND 4

## Block 1: Comprehension



## Block 2: Production



# STUDIES 3 AND 4 RESULTS

## Language Production:

- Younger adults had better language production abilities

## Language Prediction (Block I):

- Study 3: No evidence of prediction in the comprehension-only block
- Study 4: Predictable sentences had faster critical region reading times than non-predictable reading times in the comprehension-only block

## Language Prediction and Production:

- Language Production (offline) did not predict reading times in either block, nor naming response times or accuracy

## Mediation Analyses:

- No effect of moderator did (not significantly) mediating effect of reading experience) to study 3.

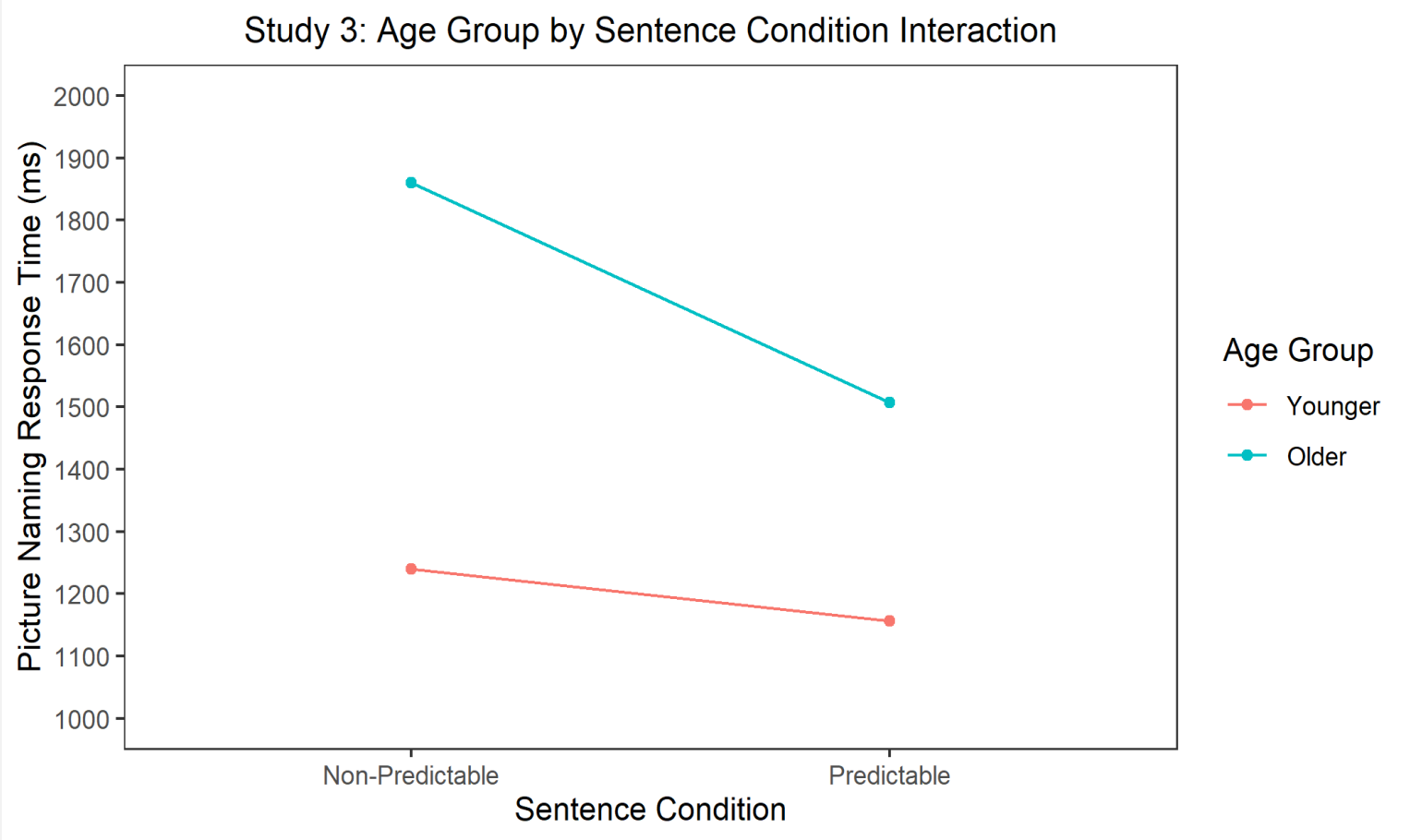
## STUDIES 3 AND 4 RESULTS

### **In Both Studies:**

1. Verb critical region reading times were faster in block 2
2. Predictable Items were named faster than non-predictable items
3. Younger adults named items faster than older adults

# STUDIES 3 AND 4 RESULTS

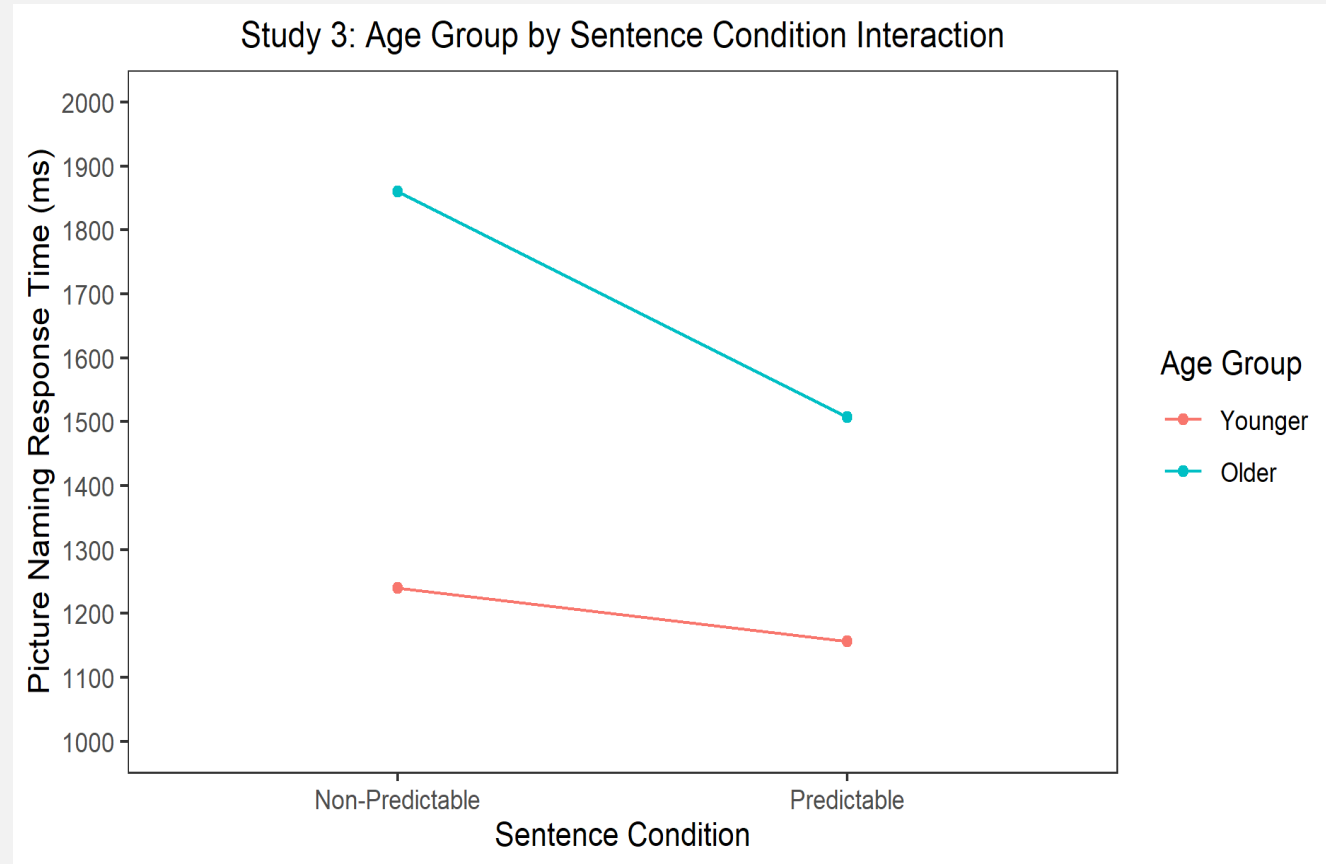
- Older adults showed greater differences in response times between sentence conditions
  - Predicting vs. Not Predicting or Effect of Error Monitoring?



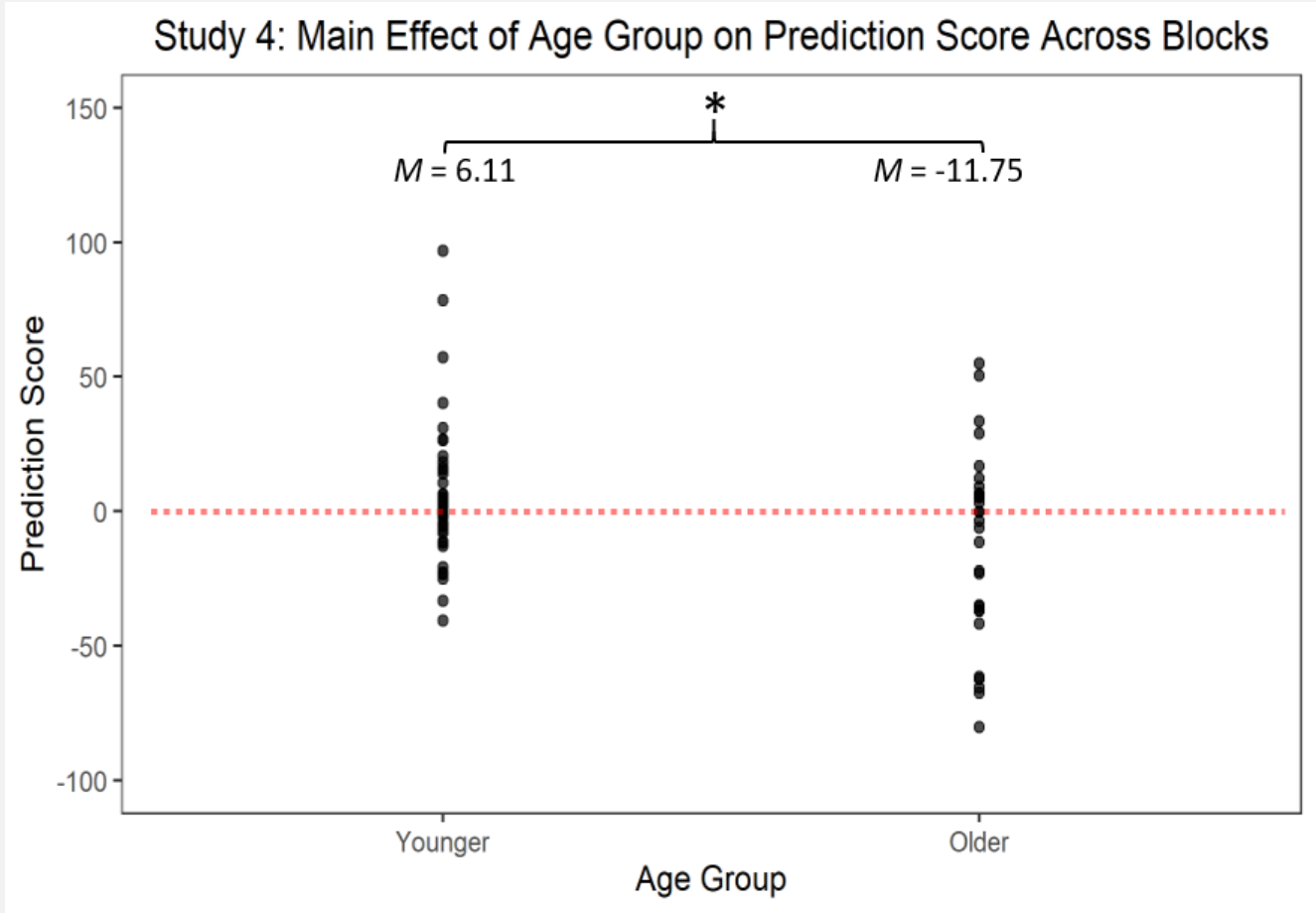
# STUDIES 3 AND 4 RESULTS

- **Interaction Not Observed in Study 4**

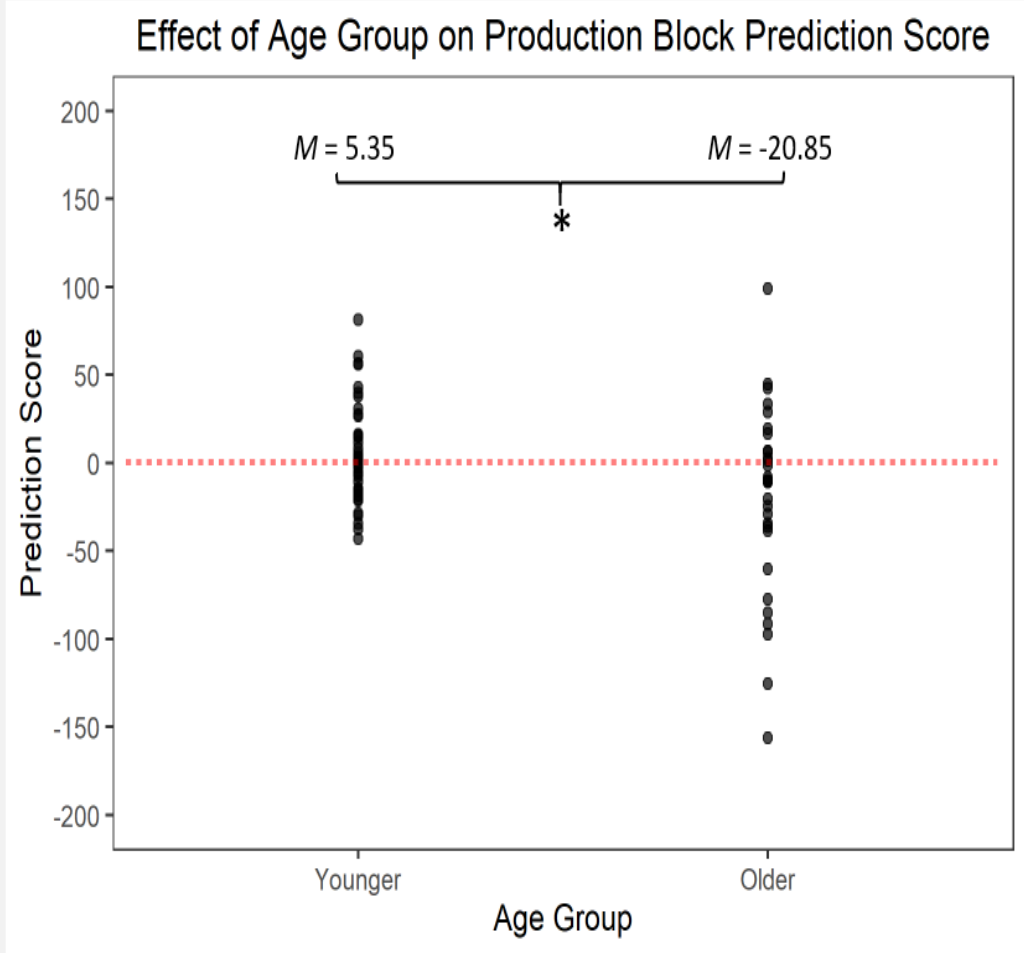
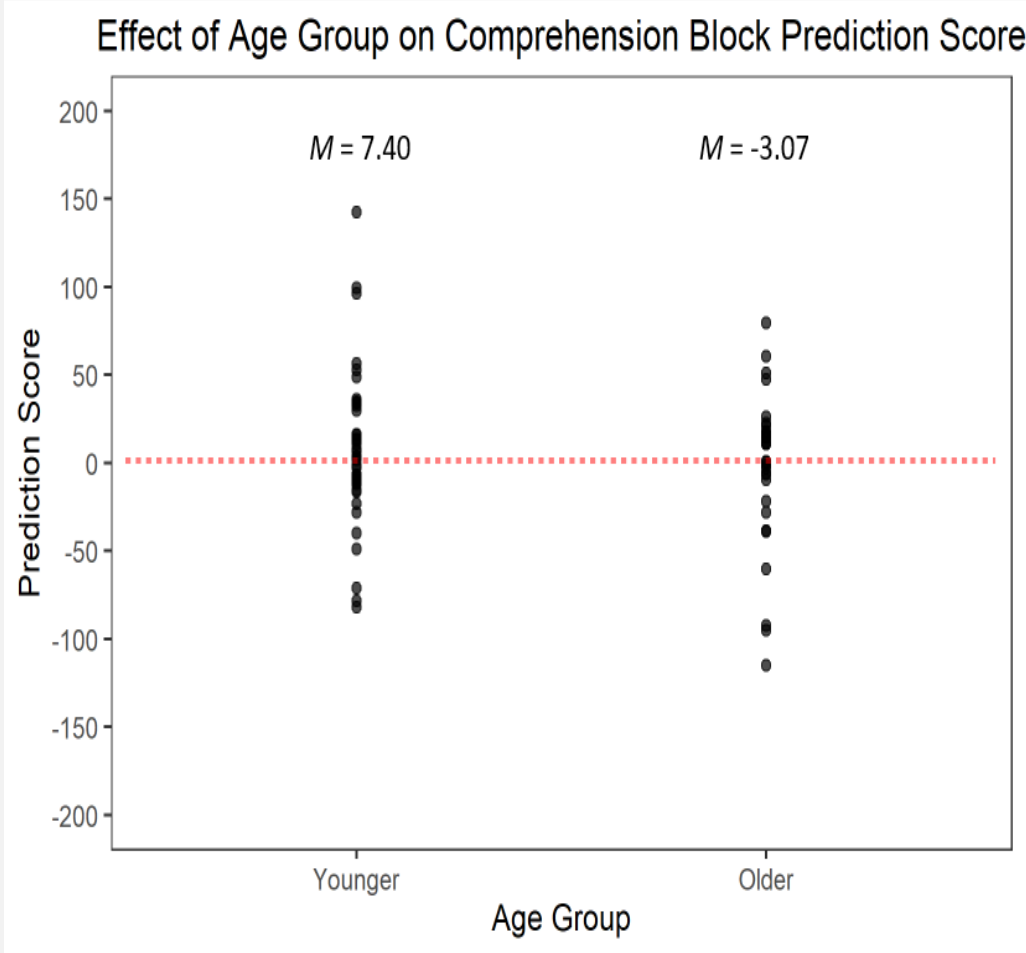
- However, there was a main effect of sentence type on accuracy
- Greater prediction during non-predictable sentences?
- Less time needed for error monitoring?



# STUDIES 3 AND 4 RESULTS



# STUDIES 3 AND 4 RESULTS



## GENERAL DISCUSSION

- No effect of language production composite score, even on language production measures
- Limited prediction effects
- No moderation effects

# CONCLUSIONS

## **Prediction is Production?**

- Evidence that giving participants the expectation to produce encourages prediction
- Evidence that younger and older adults both show a relationship between the prediction and production, but older adults do show some behavioral differences, possibly due to general declines cognition.

# THANK YOU

## **Advisor/Chair: Dr. Michele Diaz**

### **Committee:**

- **Dr. Nancy Dennis**
- **Dr. Giuli Dussias**
- **Dr. Frank Hillary**
- **Dr. Chaleece Sandberg**

### **Language and Aging Lab**

- **Dr. Hossein Karimi**
- **Dr. Haoyun Zhang**
- **Dr. Sara Troutman**
- **Dr. Jonathan Wright**
- **Abby Cosgrove**
- **Yi-Ting Hsueh**

## **Undergraduate RAs**

- **Hannah Wood**
- **Taylor Jordan**
- **Erik Thiele**

## **Graduate Students/Lab Managers**

- **Brendan Baker**
- **Amanda Eads**
- **Mary Henderson**
- **Ryan O'Donnell**
- **Hannah Merseal**
- **Allison Link**

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QUESTIONS