

# Children's comprehension of negation: When can you say “no” to a toddler?

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June 2015



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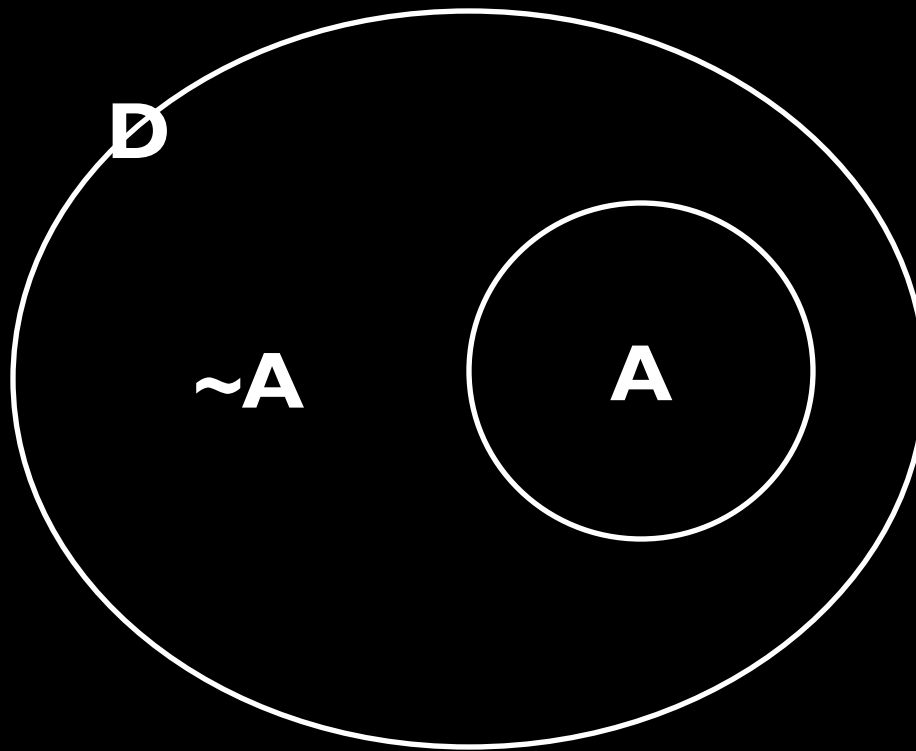


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# Negation



# Negation

- Abstract
  - Picks out the complement set
- A conceptual and linguistic universal
- Challenging to process
- Strange pattern of acquisition

# Developmental mystery

- Production
  - 1-year-olds produce negation, but in limited ways  
(Bloom, 1970; Pea, 1980; McNeill & McNeill, 1968; Drozd, 1995)
- Online Comprehension
  - 2- to 4-year-olds have surprising difficulty understanding negative utterances
  - Nordmeyer & Frank, 2014

# Children's Online Comprehension

Nordmeyer & Frank (2014)



“See these boys?”

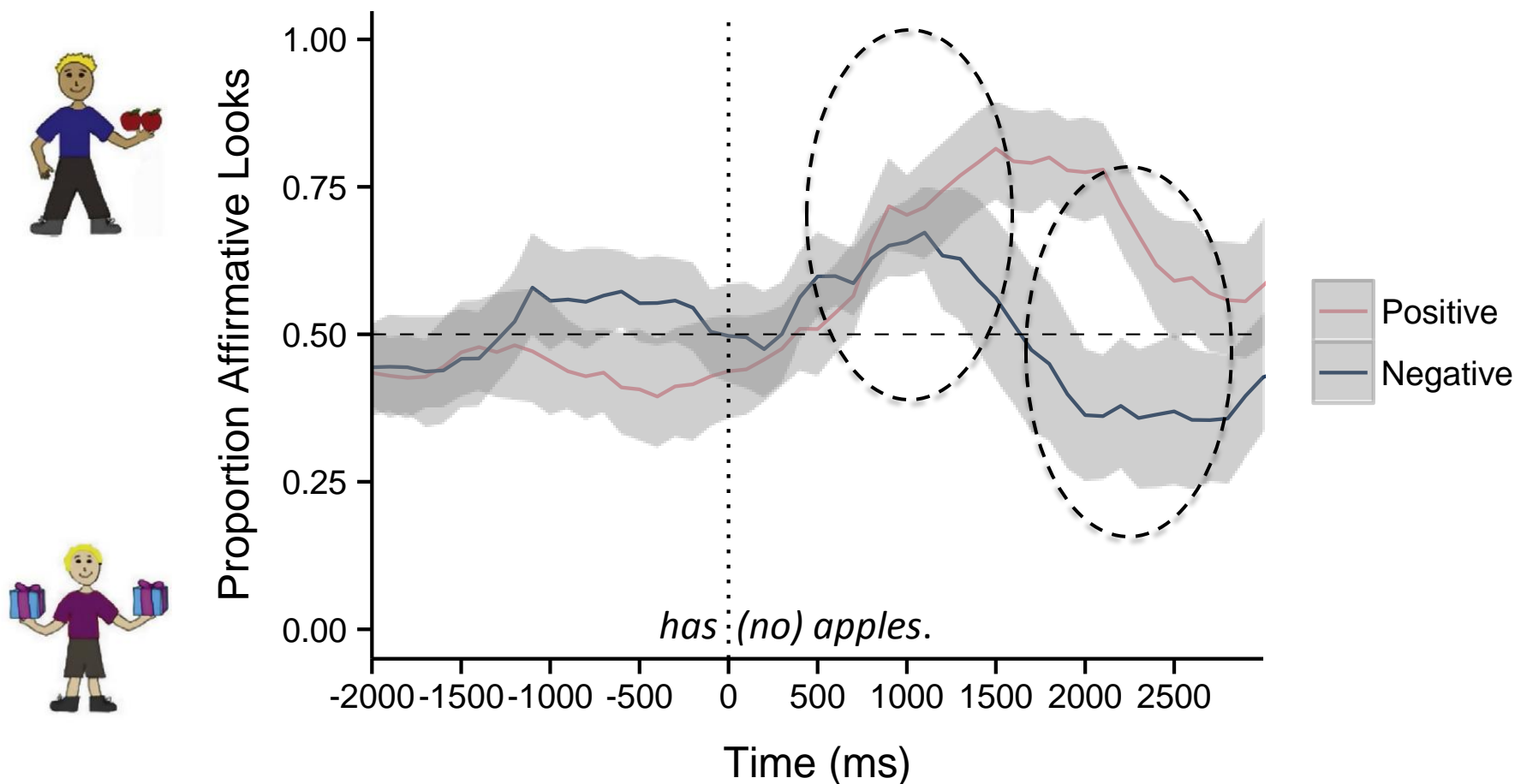


*Look at the boy who **has** apples.  
Look at the boy who **has no** apples.*

# Children's online comprehension

Nordmeyer & Frank (2014)

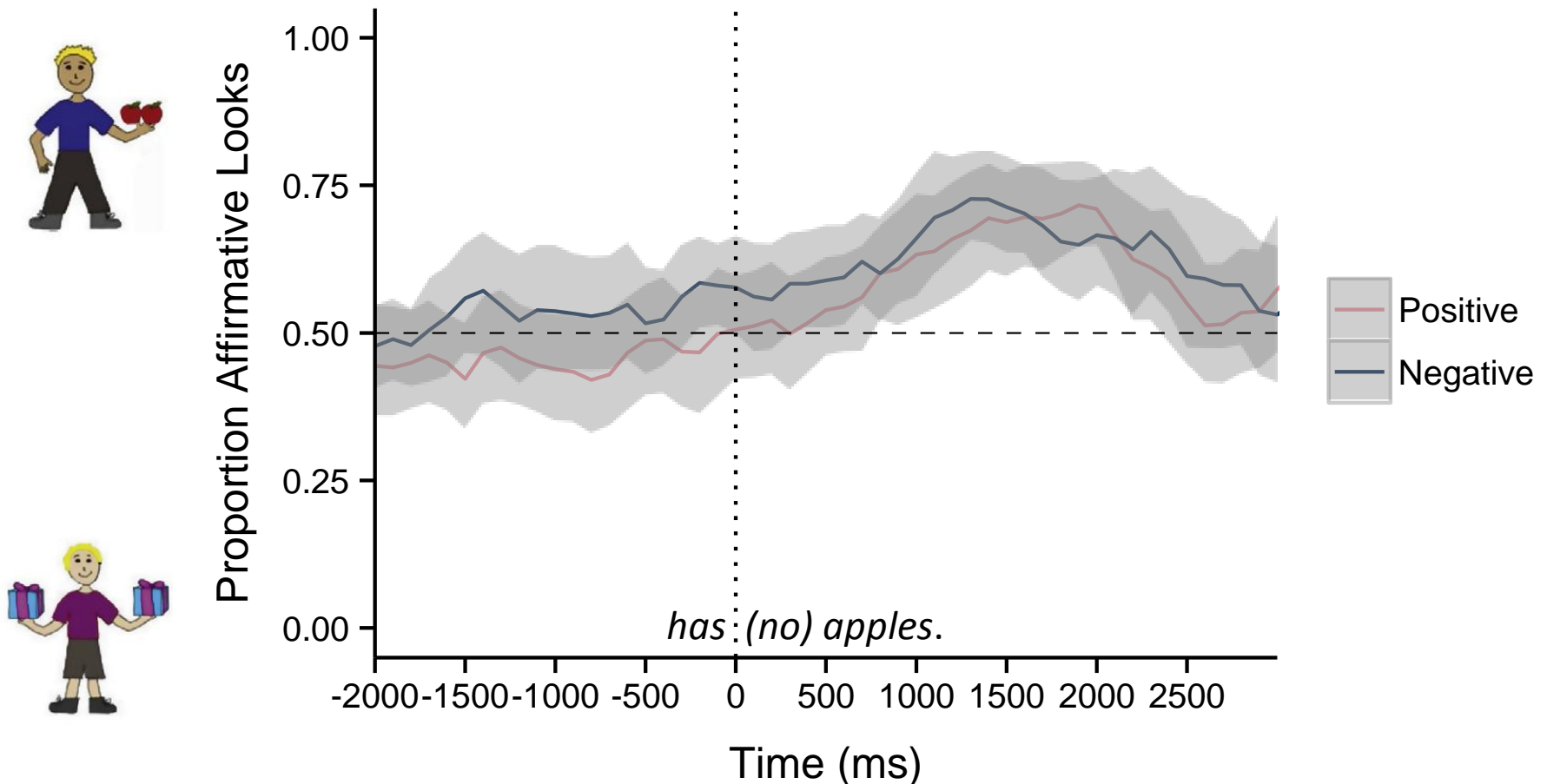
4 year olds



# Children's online comprehension

Nordmeyer & Frank (2014)

2 year olds (24-35m)





# Hypotheses

Children's poor comprehension could be due to:

- **H1: Inhibitory demands**
  - Construct negative via affirmative, then inhibit
  - => processing of negation necessarily difficult
- **H2: Inability to fill in weak pragmatic contexts**
  - Negation implies consideration of polar question
  - If QUD is clearly established then rapid processing of negation

## Evidence for inhibitory account: negation involves construction of affirmative

- Simplest interpretation of Nordmeyer & Frank (2014)
- Adults slower to interpret negated utterances (Clark & Carpenter, 1974)
- Adults *seem* to initially construct affirmative counterpart of negated utterance

(Kaup, Yaxley, Madden, Zwaan & Ludtke, 2007; Ludtke, Friedrich, De Filippis & Kaup, 2008; Fischler et al., 1983; Kunios & Holcomb, 1992; Staab, 2007)

# Evidence for inhibitory account

Kaup, Lüdtke & Zwann (2006)





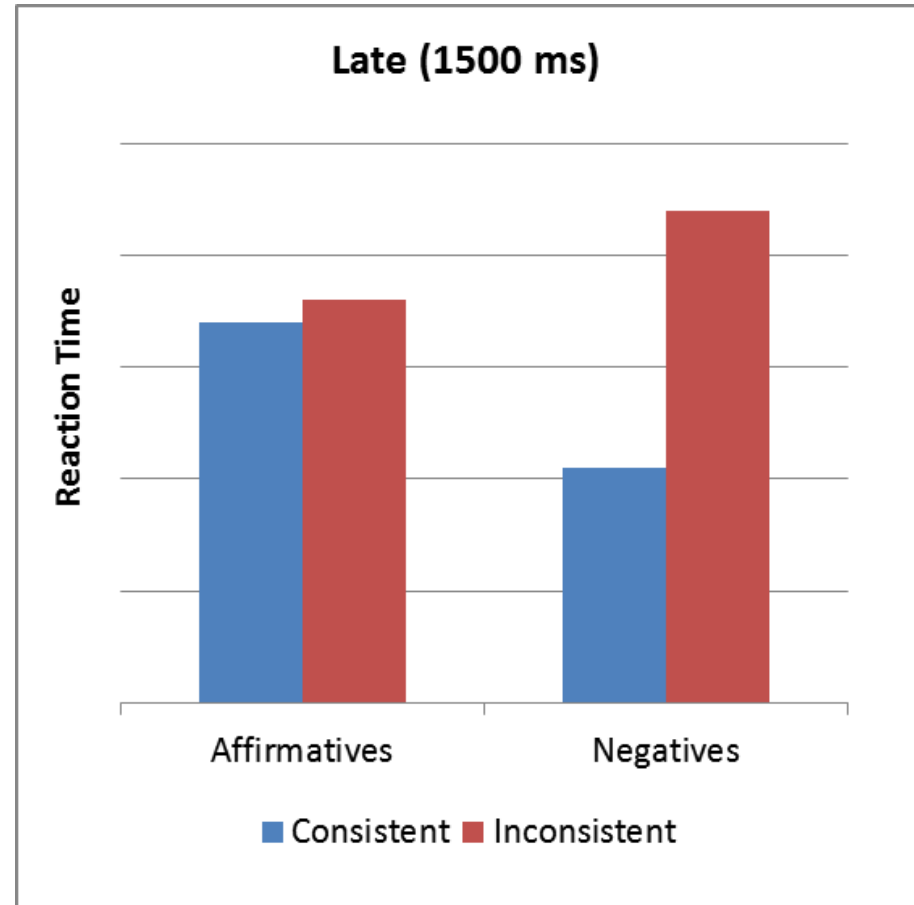
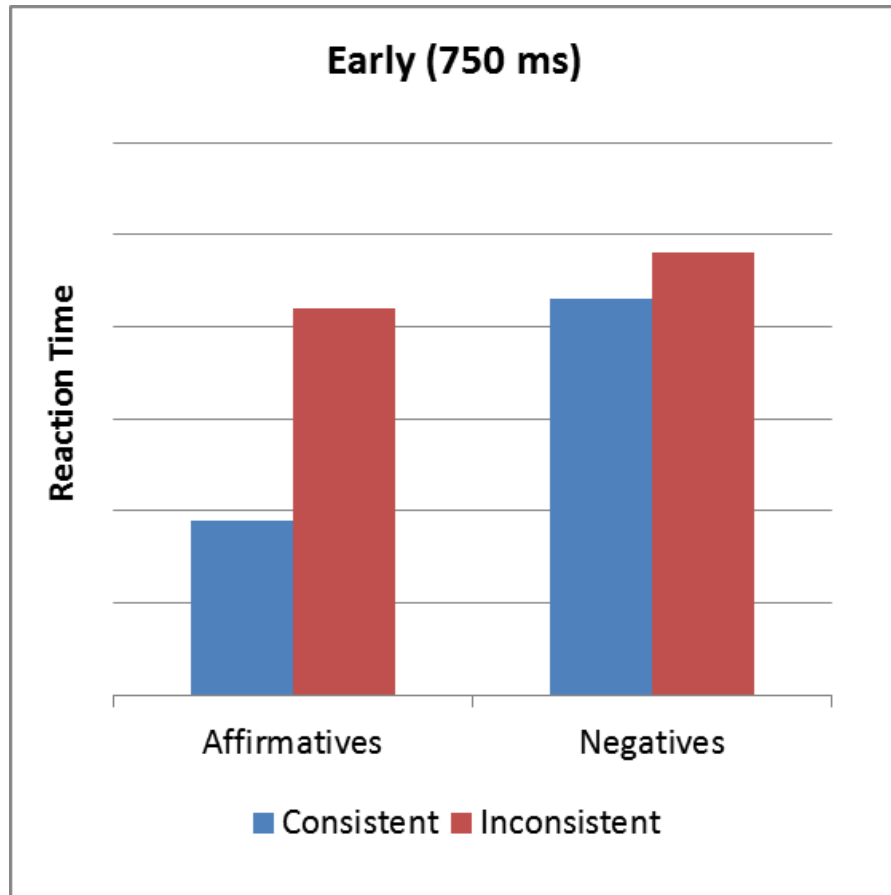
	Negated/Alternate	Actual
The umbrella was closed. The umbrella was not open		
The umbrella was open. The umbrella was not closed.		

Fig. 1. Sample materials.

# Kaup, Lüdtke & Zwann (2006)



# Evidence for pragmatic hypothesis

Tian, Breheny & Ferguson (2010)

Non cleft

Jane didn't cook the spaghetti

← QUD:  
Did (or didn't) she cook it?

Cleft

It was Jane who didn't cook the spaghetti

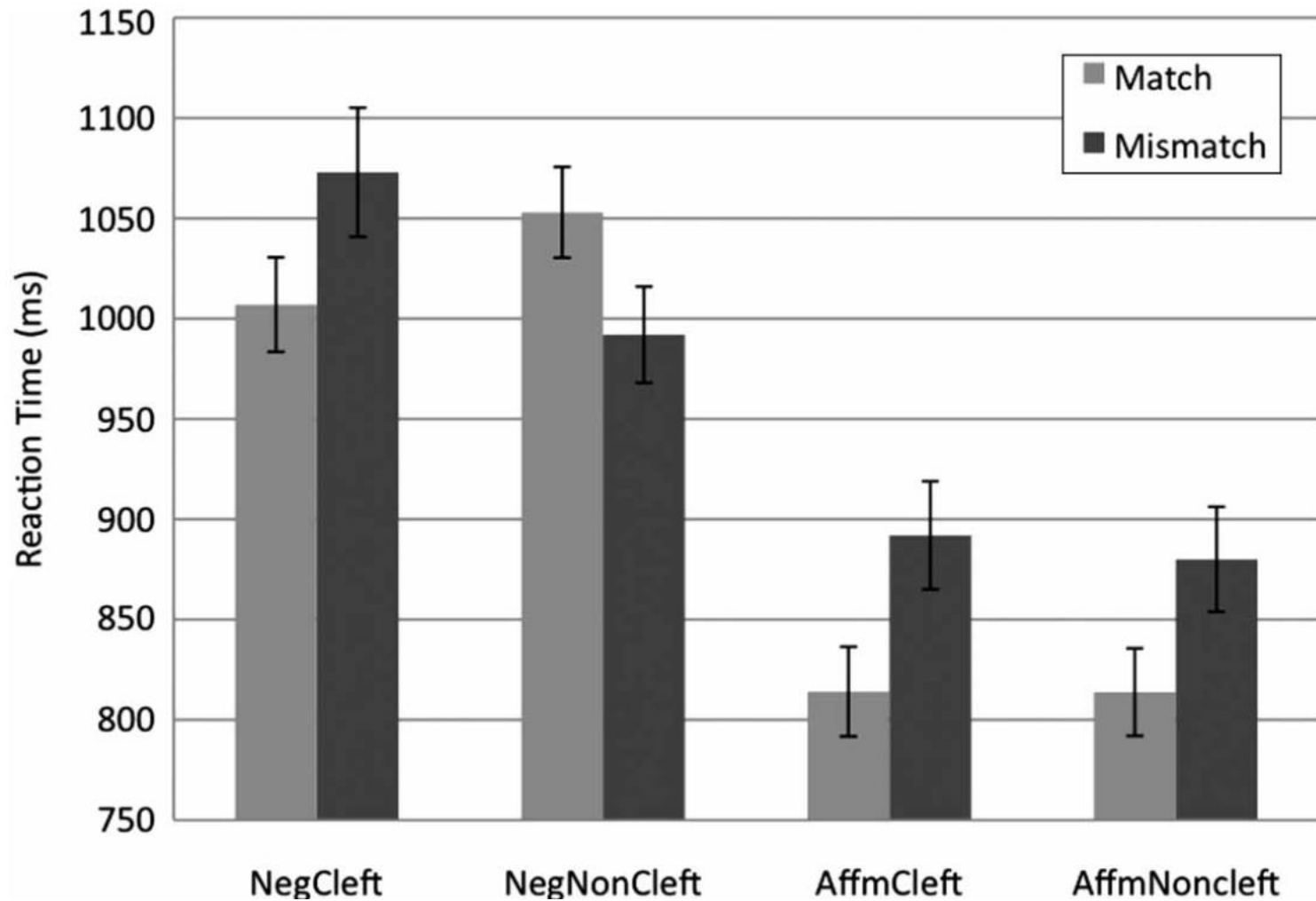


QUD:

Who didn't cook the spaghetti?



# Tian, Breheny & Ferguson (2010)



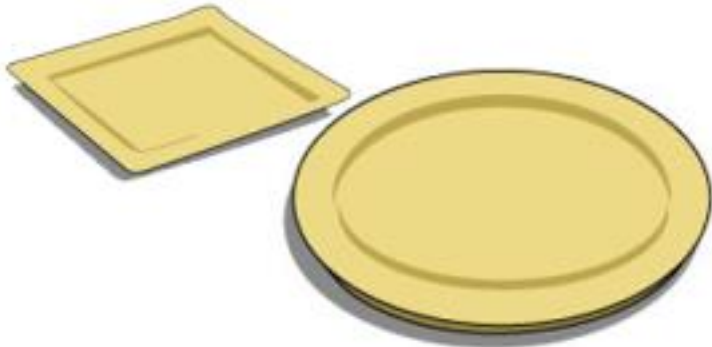
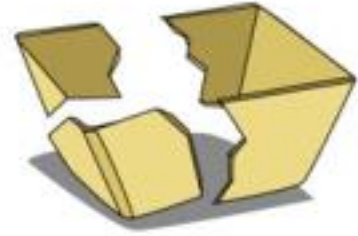
# Goals of Study 1

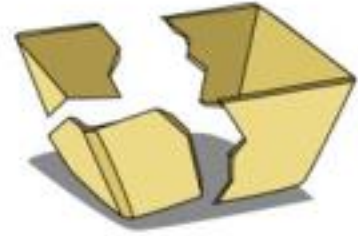
- Use a method with finer temporal resolution
  - Picture response data ambiguous
- Provide supportive discourse context look at processing pattern in
  - Adults
  - 4 & 5 year olds
  - 3 year olds

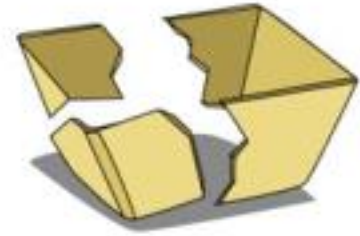


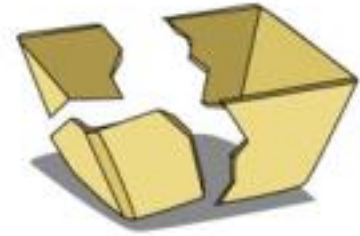


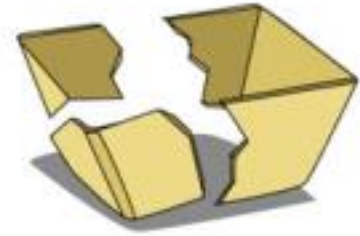




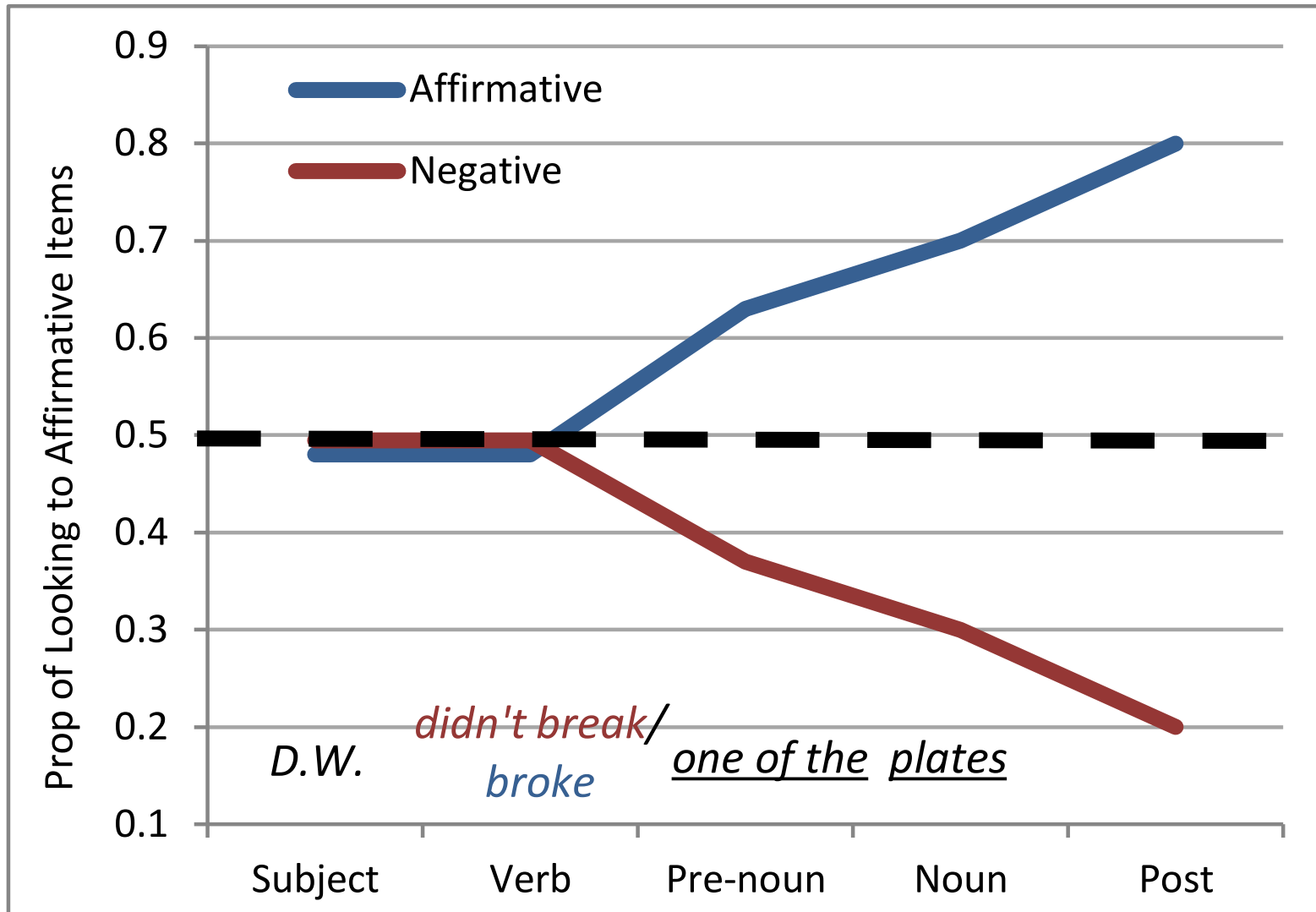




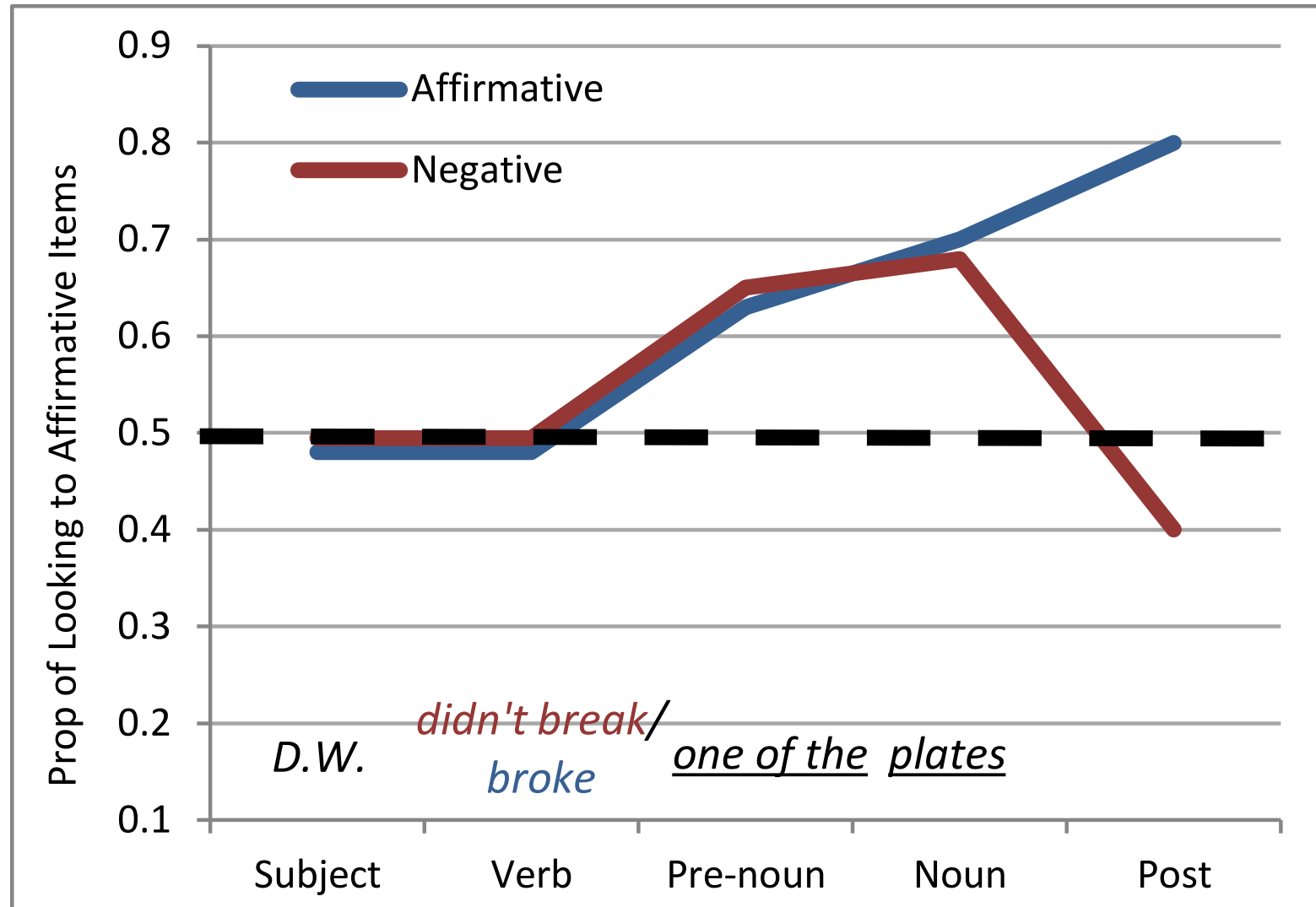




# Incremental prediction

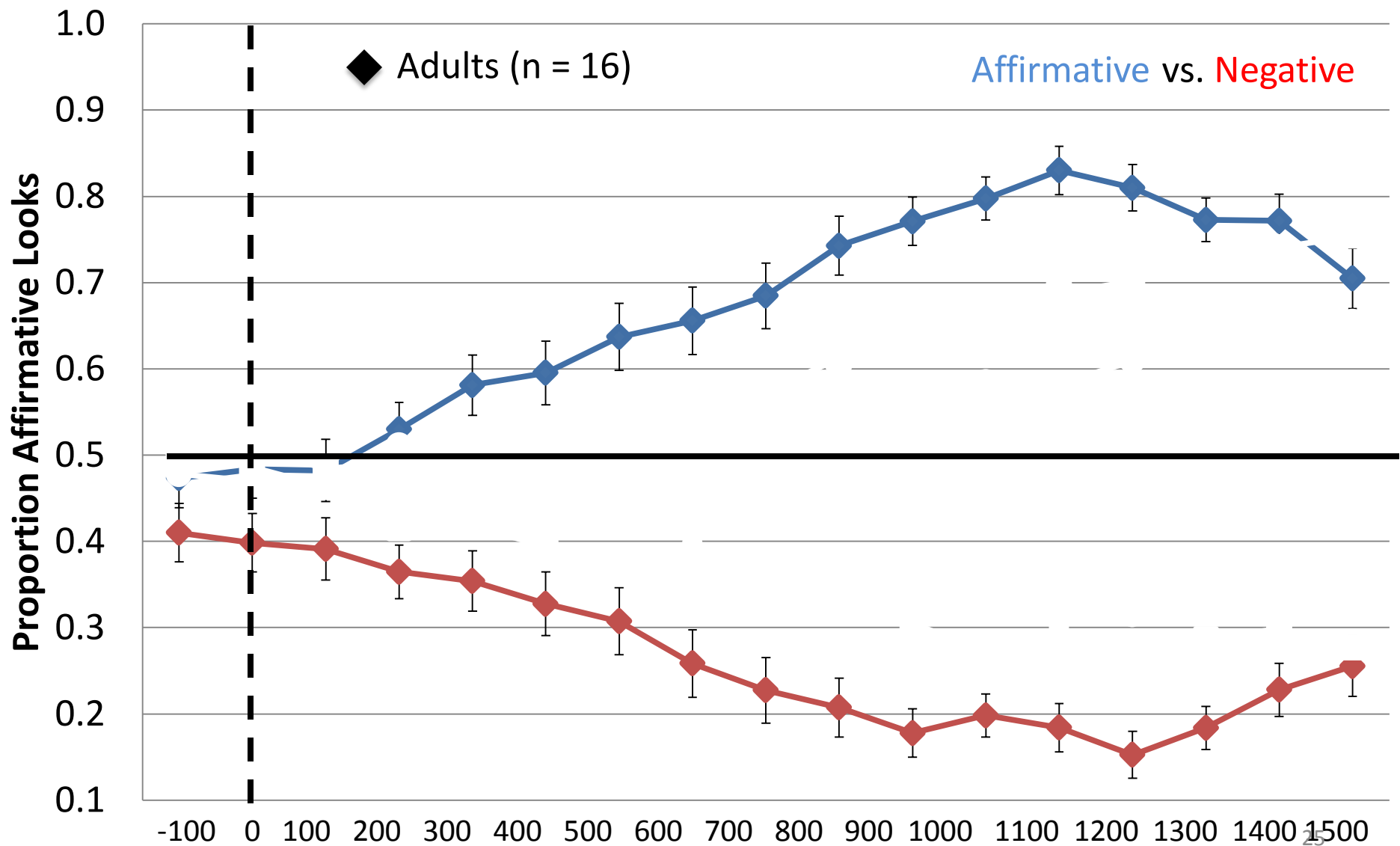


# Inhibitory prediction

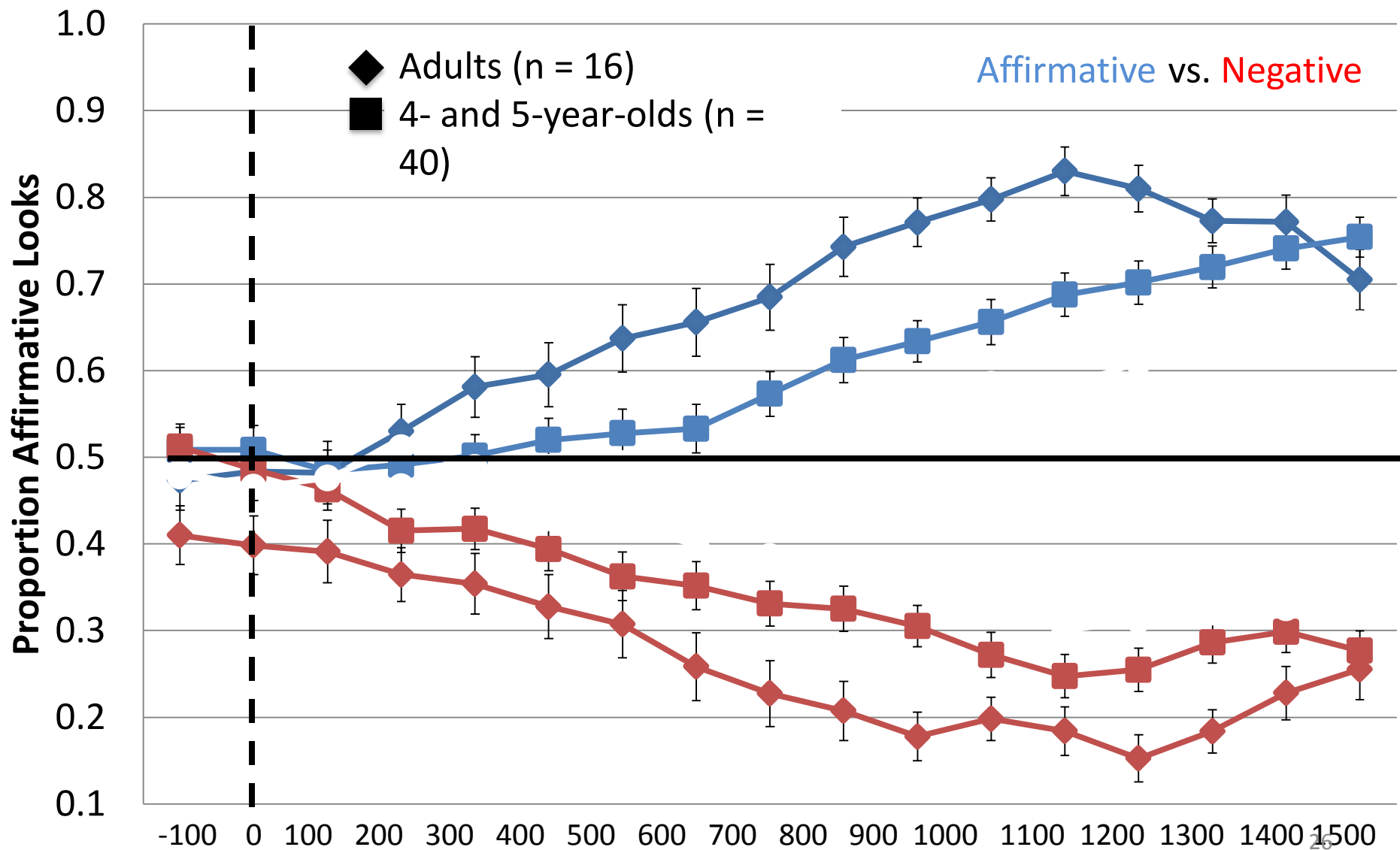




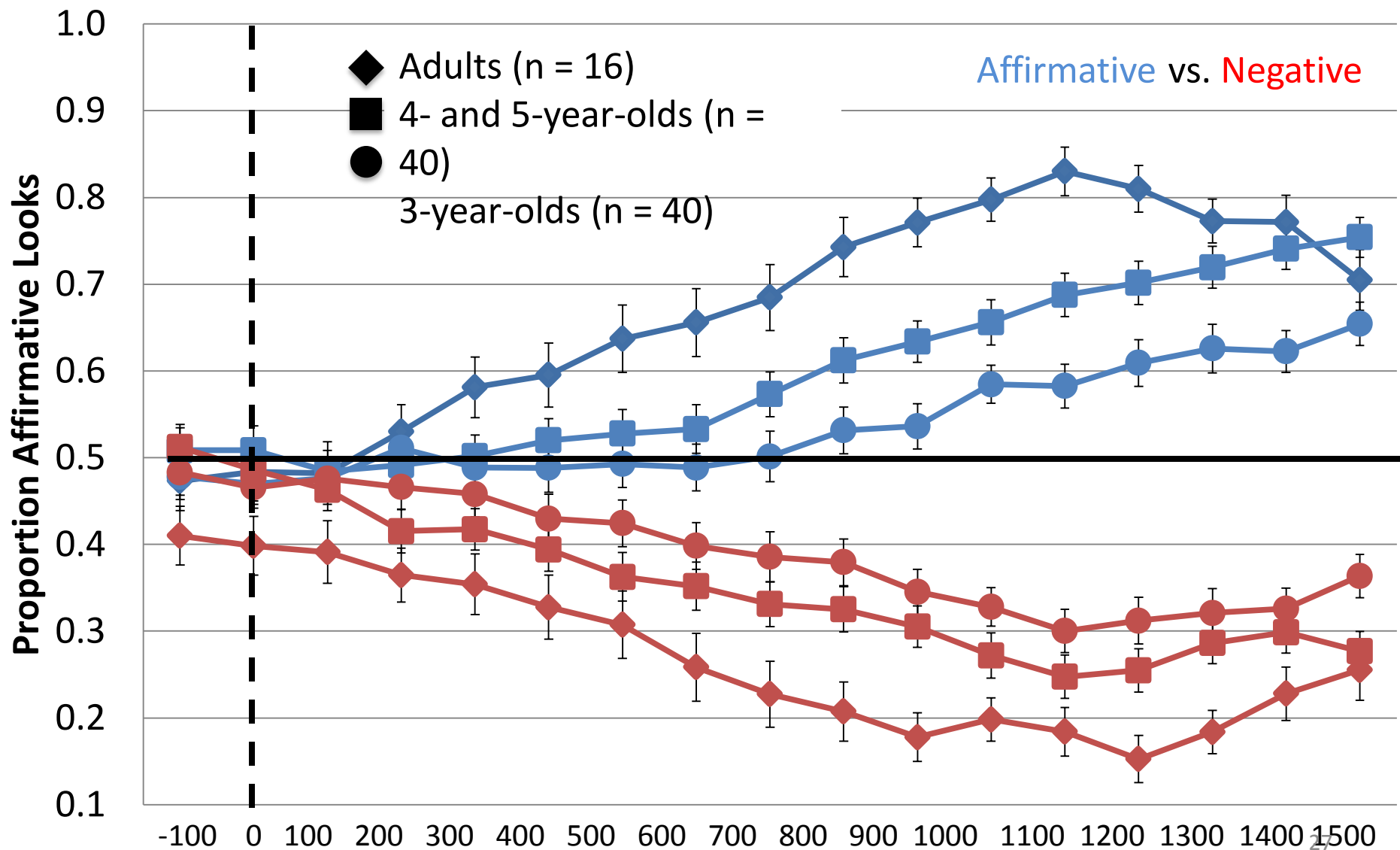
# Results



# Results



# Results



OK. How about two year olds?

Need to simplify task...

# Study 2

## 3-year-olds

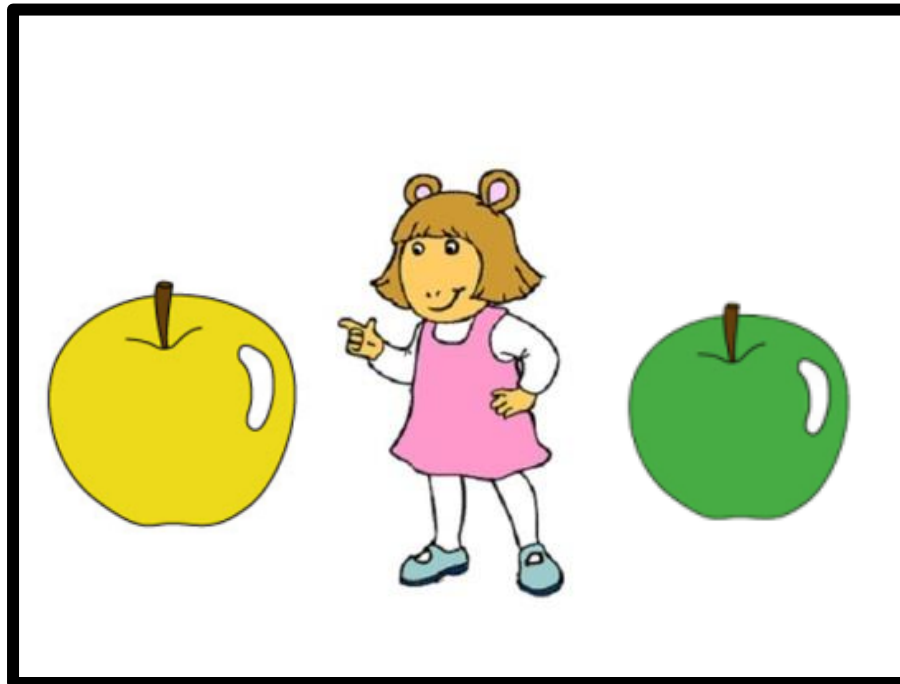
- 36-48 mos (n = 16)  
 $M = 42$  mos
- PPVT (vocabulary)  
 $M = 113, SD = 12.6$

## 2-year-olds

- 28-33 mos (n = 28)  
 $M = 31$  mos
- PPVT (vocabulary)  
 $M = 101, SD = 22.6$

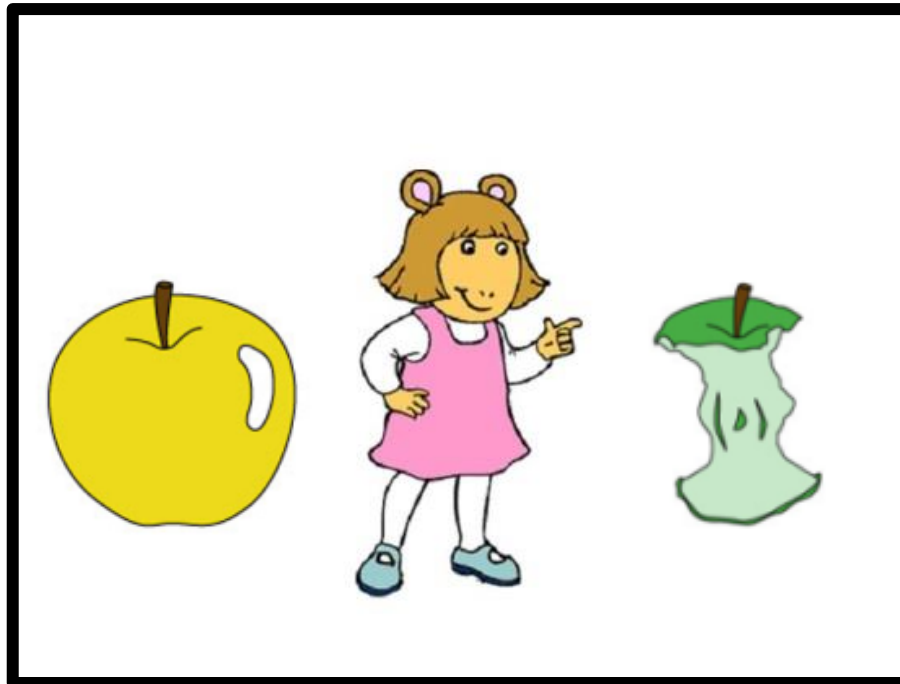
# Study 2

DW likes to eat fruits and vegetables.



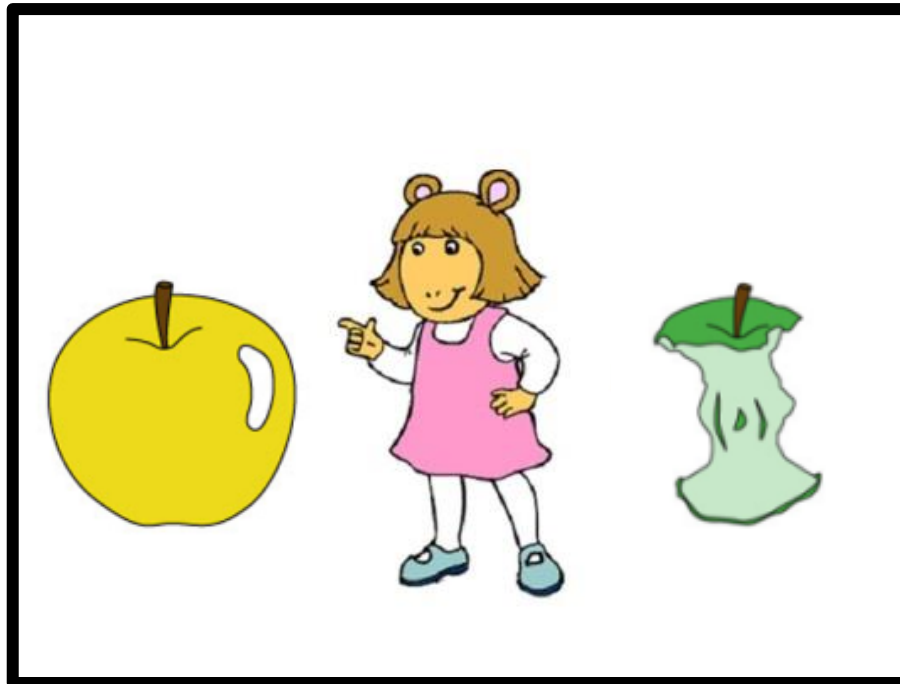
# Study 2

Look! She ate the little apple.



## Study 2

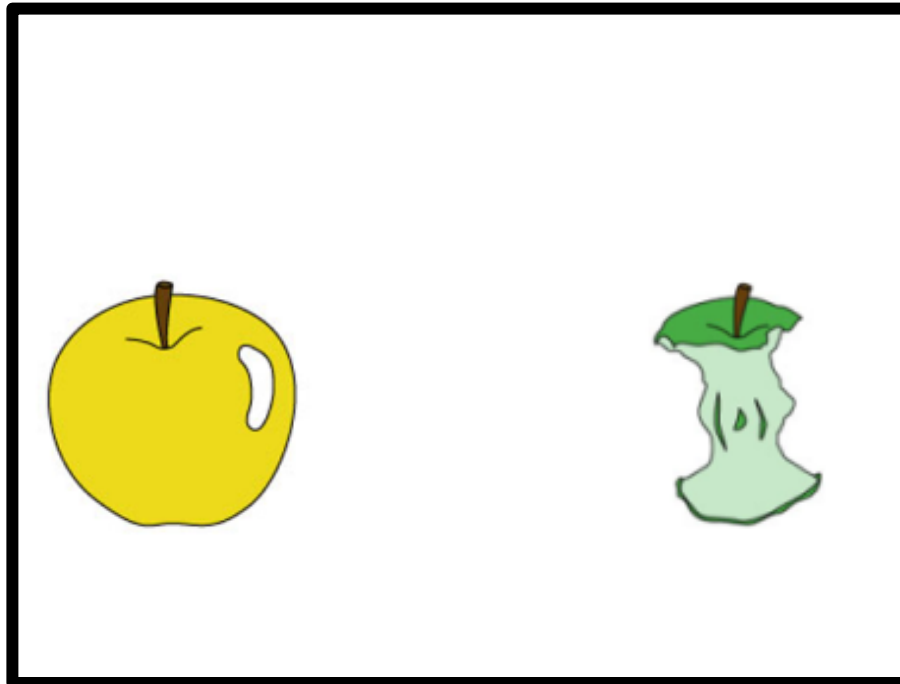
She was going to eat the other apple too, but she had a banana instead.





# Study 2

- Oh, I know what happened!
- *DW ate/didn't eat one of the apples.*
- Which one was it? Can you show me?



# Study 2

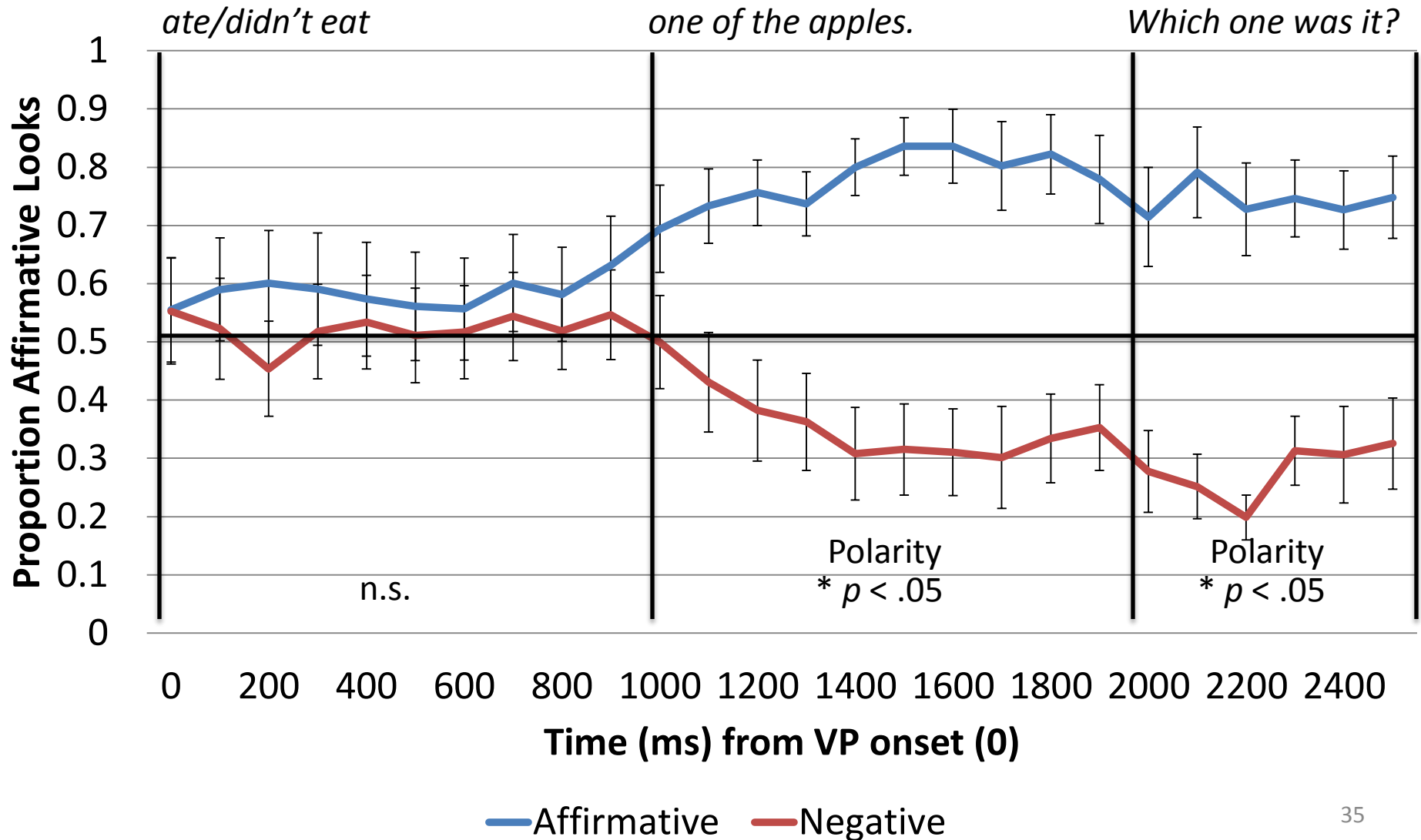
## 3-year-olds

- 36-48 mos ( $n = 16$ )  
 $M = 42$  mos
- PPVT (vocabulary)  
 $M = 113, SD = 12.6$

## 2-year-olds

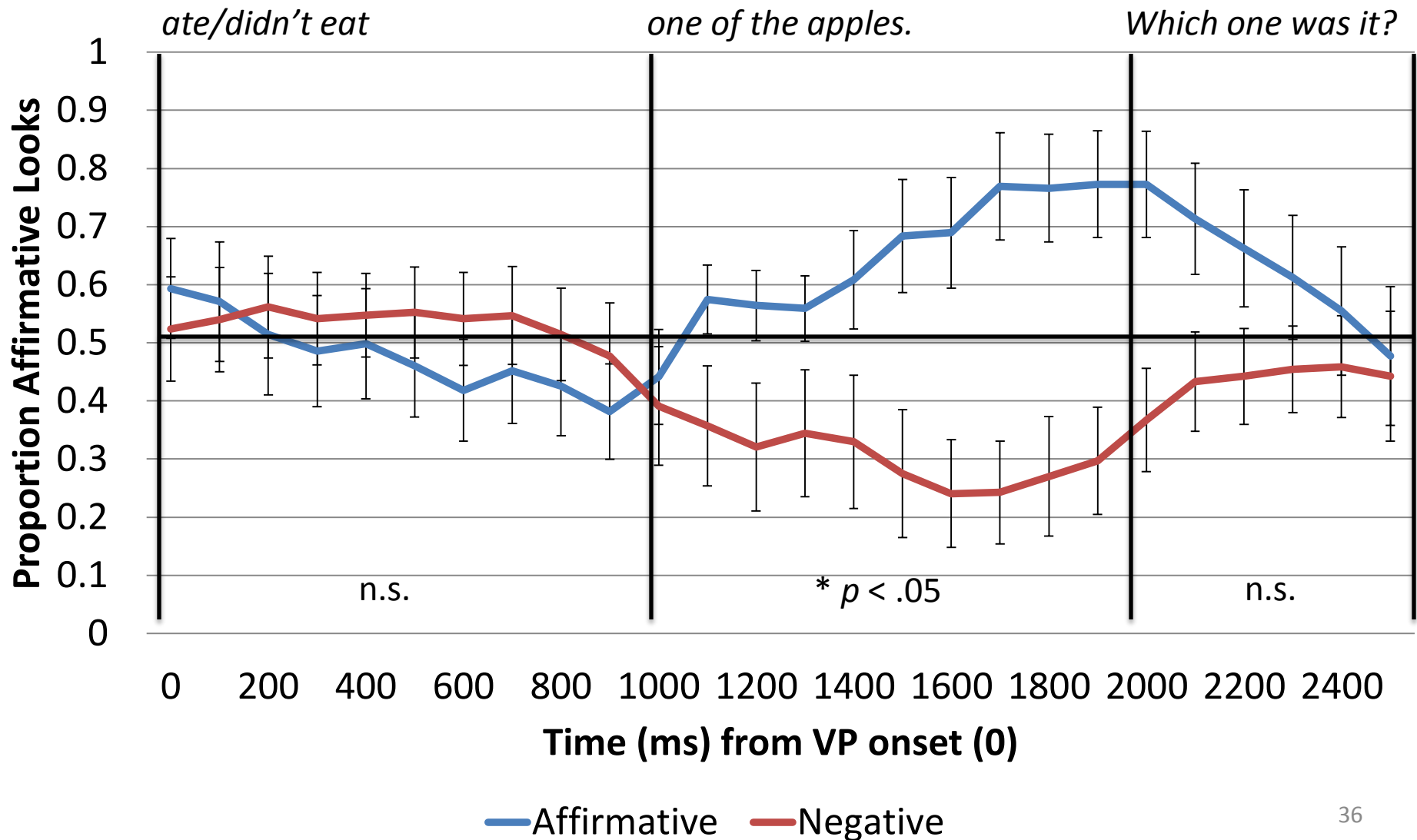
- 28-33 mos ( $n = 28$ )  
 $M = 31$  mos
- PPVT (vocabulary)  
 $M = 101, SD = 22.6$

# Study 2: 3-year-olds



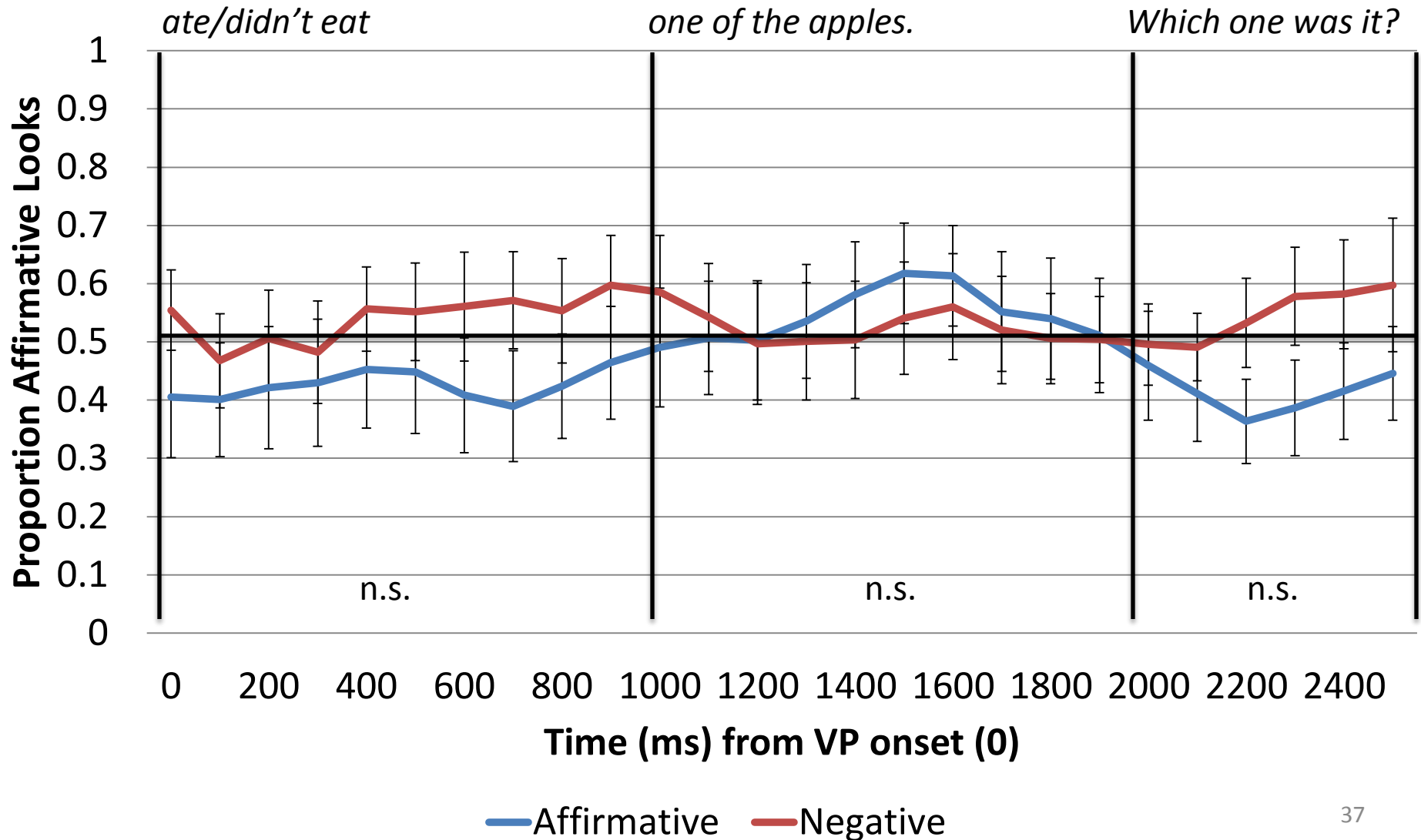
# Study 2

## 2-year-olds, high vocabulary



# Study 2

## 2-year-olds, low vocabulary



# Study 3 - Design Modifications

## Poor understanding of task?

More practice trials

## Interference from similar referents?

apple vs. apple -> apple vs. banana

## Explicit question hard to understand?

*DW ate one of the apples. Which one was it?*

-> *Show me the one DW ate.*

## Difficulty switching from affirmative to negative?

Randomized → Blocked

{A-N-N-A; N-A-N-A} → {A-A-A-A; N-N-N-N} OR {N-N-N-N; A-A-A-A}

# Study 3 - Participants

## 3-year-olds

- 36-48 mos
  - $n = 16$
  - $M = 42$  mos

- PPVT  
 $M = 123, SD = 14.6$

## 2-year-olds

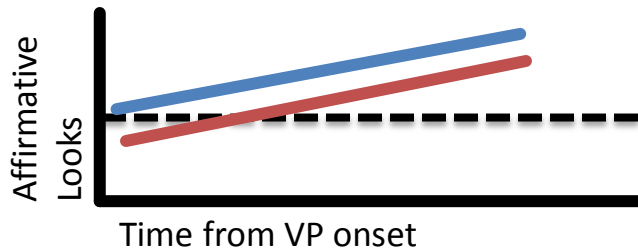
- 28-33 mos
  - $n = 28$
  - $M = 31$  mos

- PPVT  
 $M = 112, SD = 12$

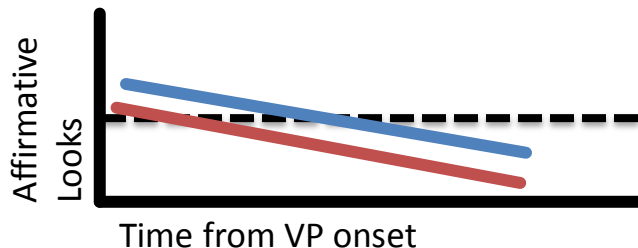
# Blocked Design Predictions

## Perseveration Effect

- Affirmative first => incorrect response for negative

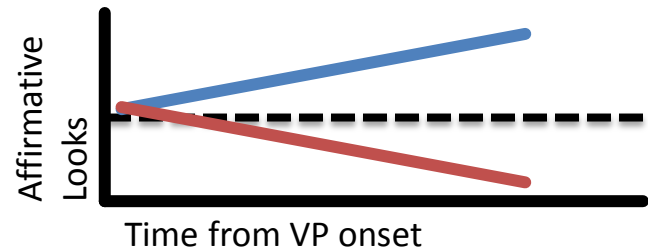


- Negative first => incorrect response for affirmative

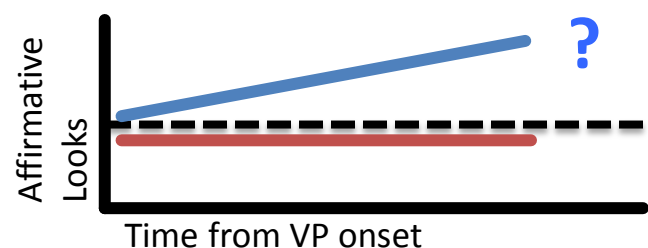


## Scaffold Effect

- Affirmative first => correct response for negative



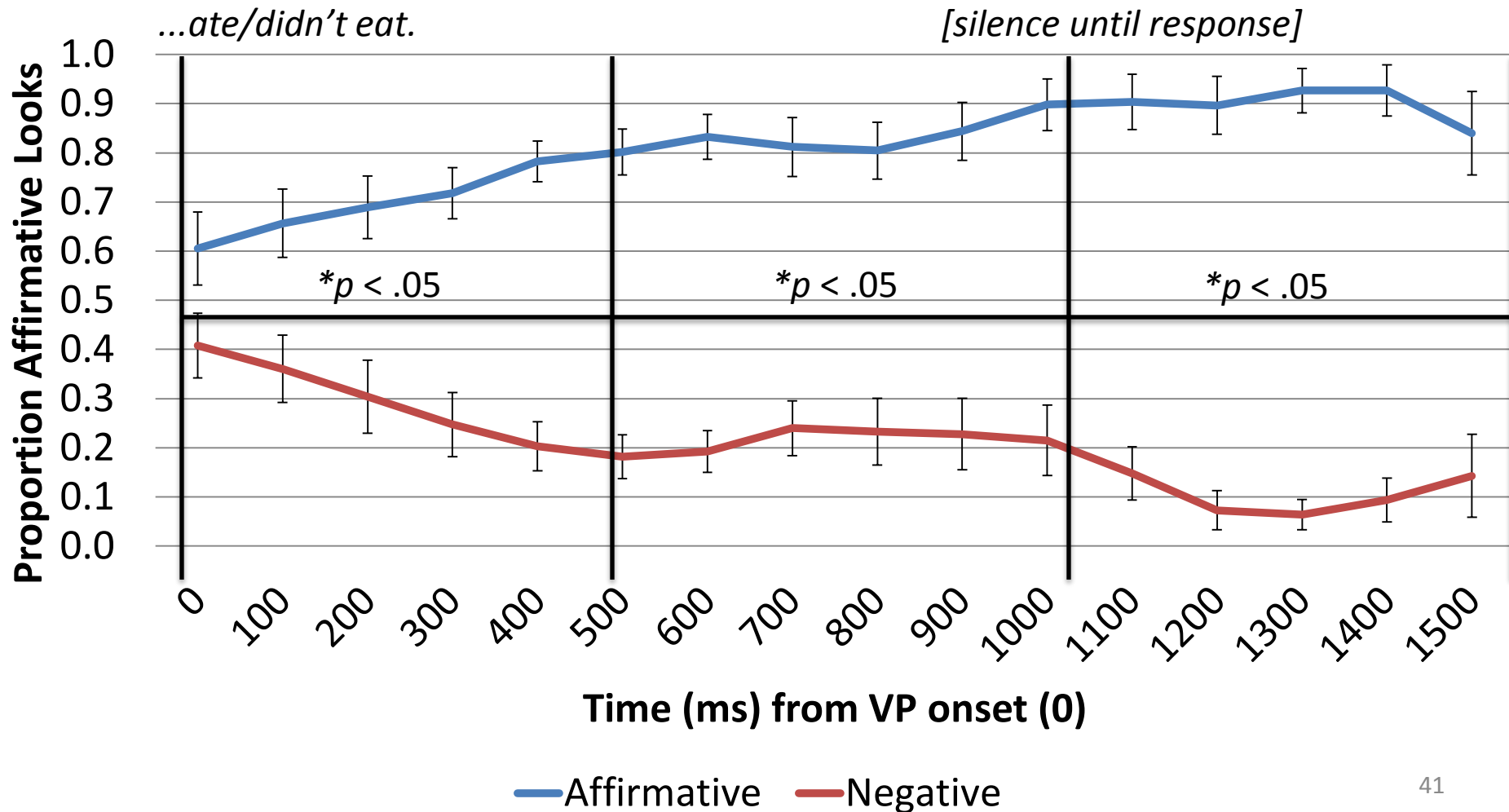
- Negative first poor but no effect on affirmative (?)





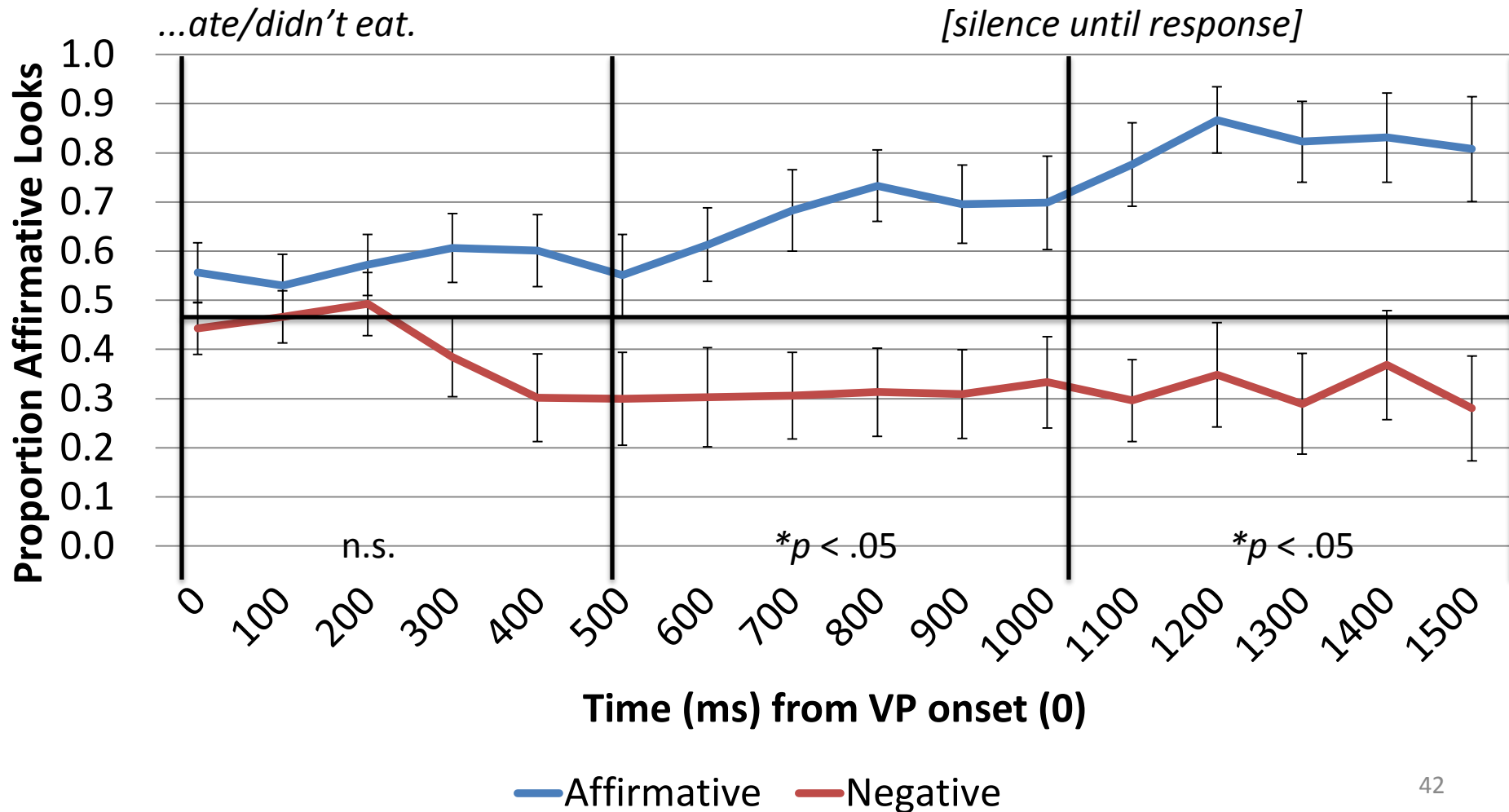
# Study 3

## 3-year-olds



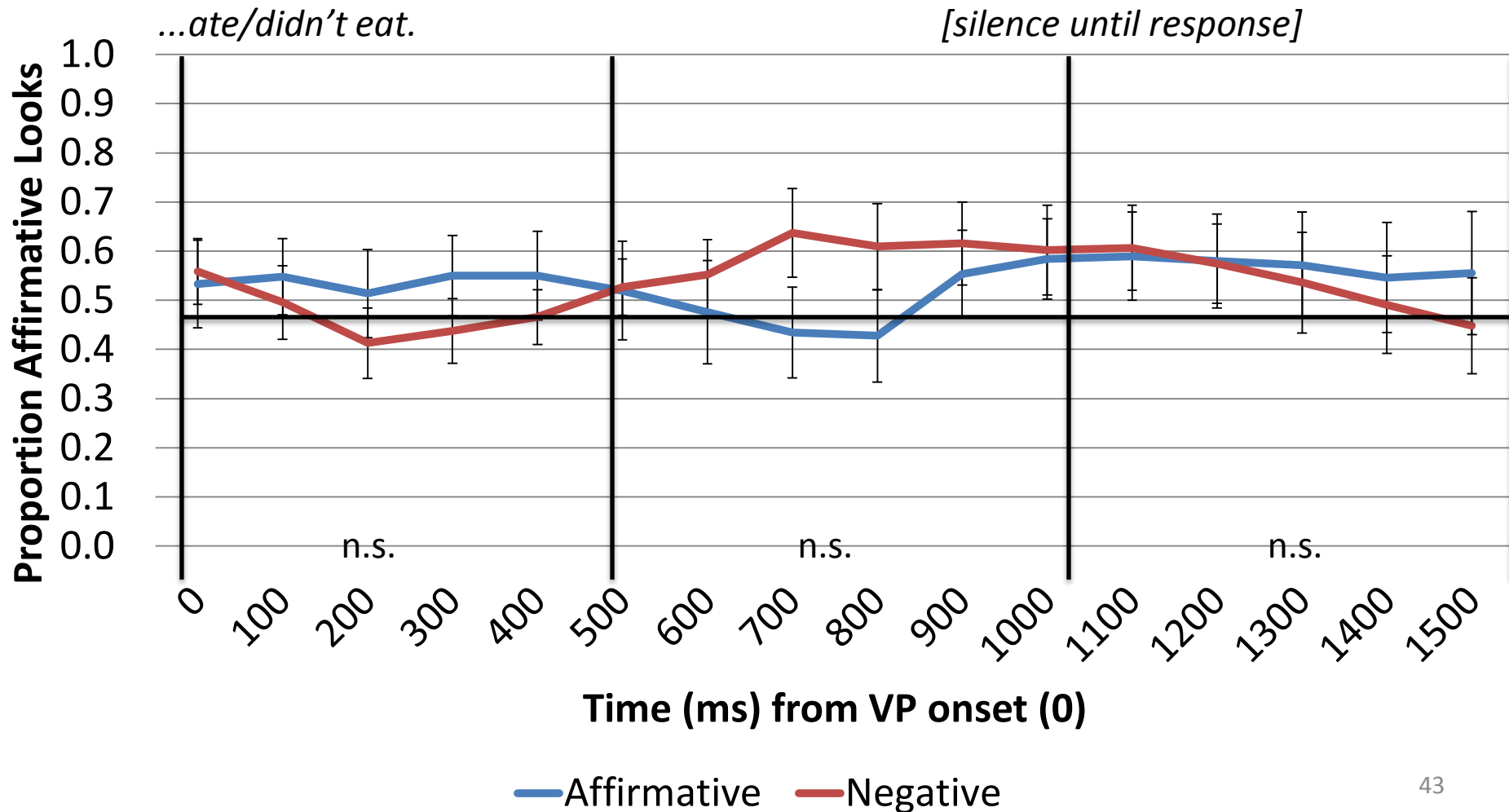
# Study 3

## 2-year-olds, affirmative first

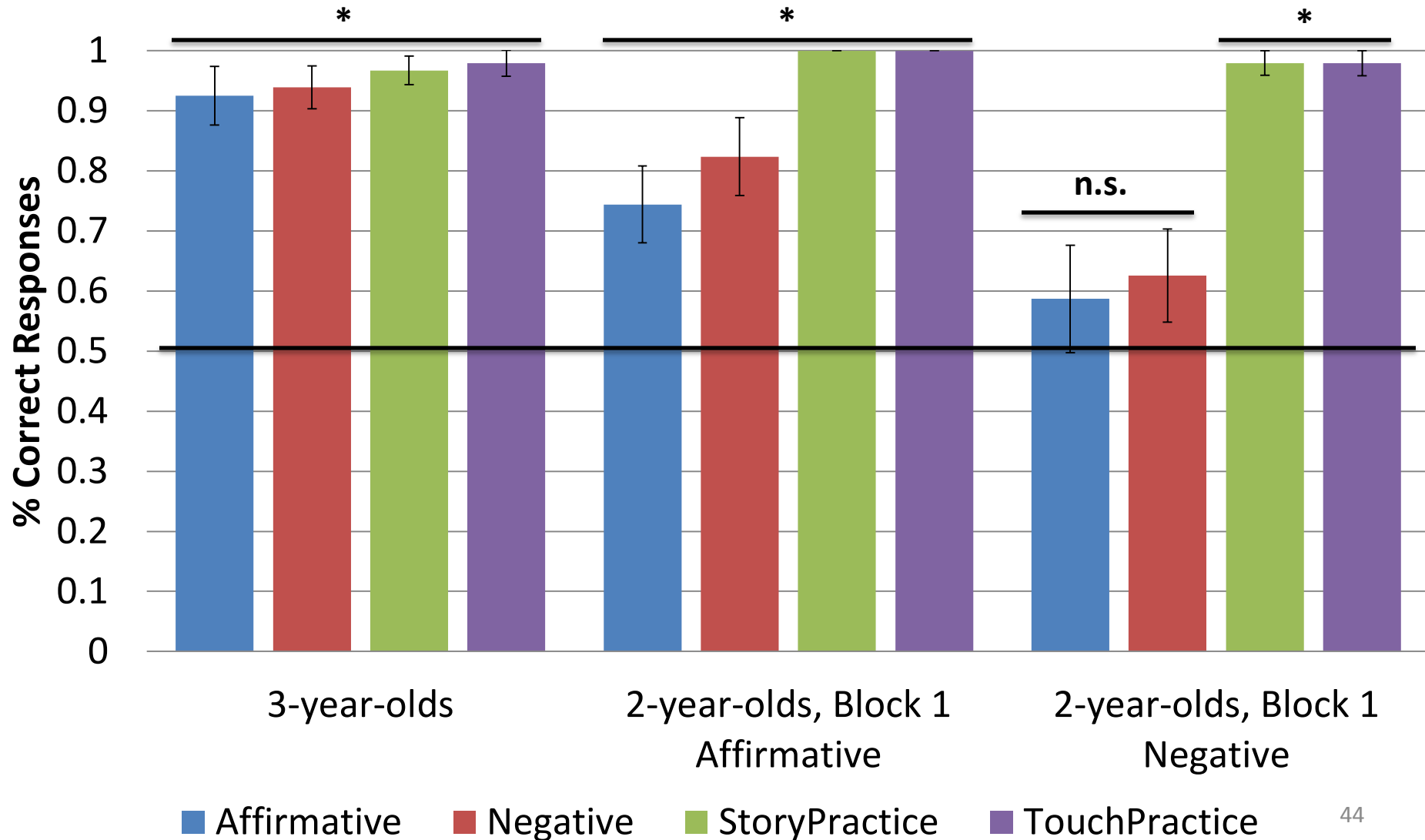


# Study 3

## 2-year-olds, negative first



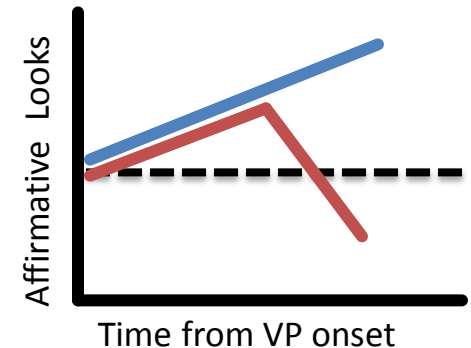
# Study 3 - Picture Selection Accuracy



# Conclusions

**Children's difficulties not (solely) due to failure to inhibit affirmative interpretation.**

Children no worse on negatives than affirmatives.



Children don't perseverate on the affirmative form in a blocked design (Study 3).

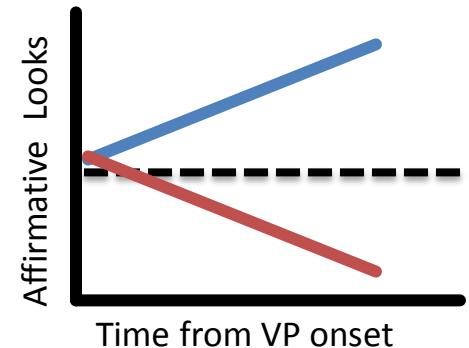
# Conclusions

**Children's difficulties not (solely) due to insufficient pragmatic support.**

We tested both age groups within the same discourse contexts.

3 year olds showed incremental symmetric interpretation

But many 2.5 year olds were unable to interpret both forms in a randomized design (Study 2)

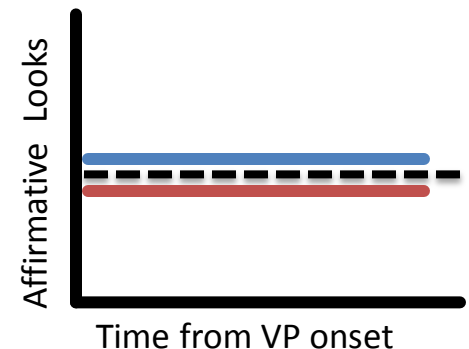
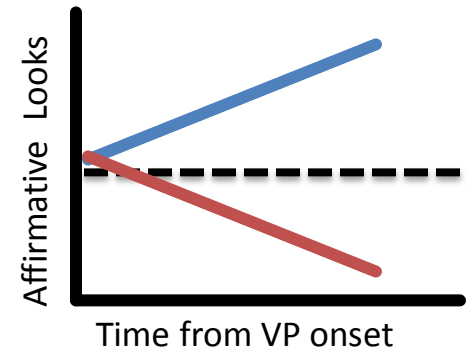


# Conclusions

**At 2.5 children may have difficulty accurately building this semantic structure.**

Building the affirmative representation scaffolds the negative (Study 3).

Failure to interpret negatives interferes with interpreting affirmatives (Study 2 & Study 3).



# Why are they failing at affirmatives after negatives?

- Not due to inattention
- Not due to perseveration
- Children work harder on aff trials after hearing neg (greater pupil dilation)
- Does affirmation get actively represented in this context (as an operator)
- Are these representations intrinsically difficult to construct?



So when (and how) do children  
acquire negation?

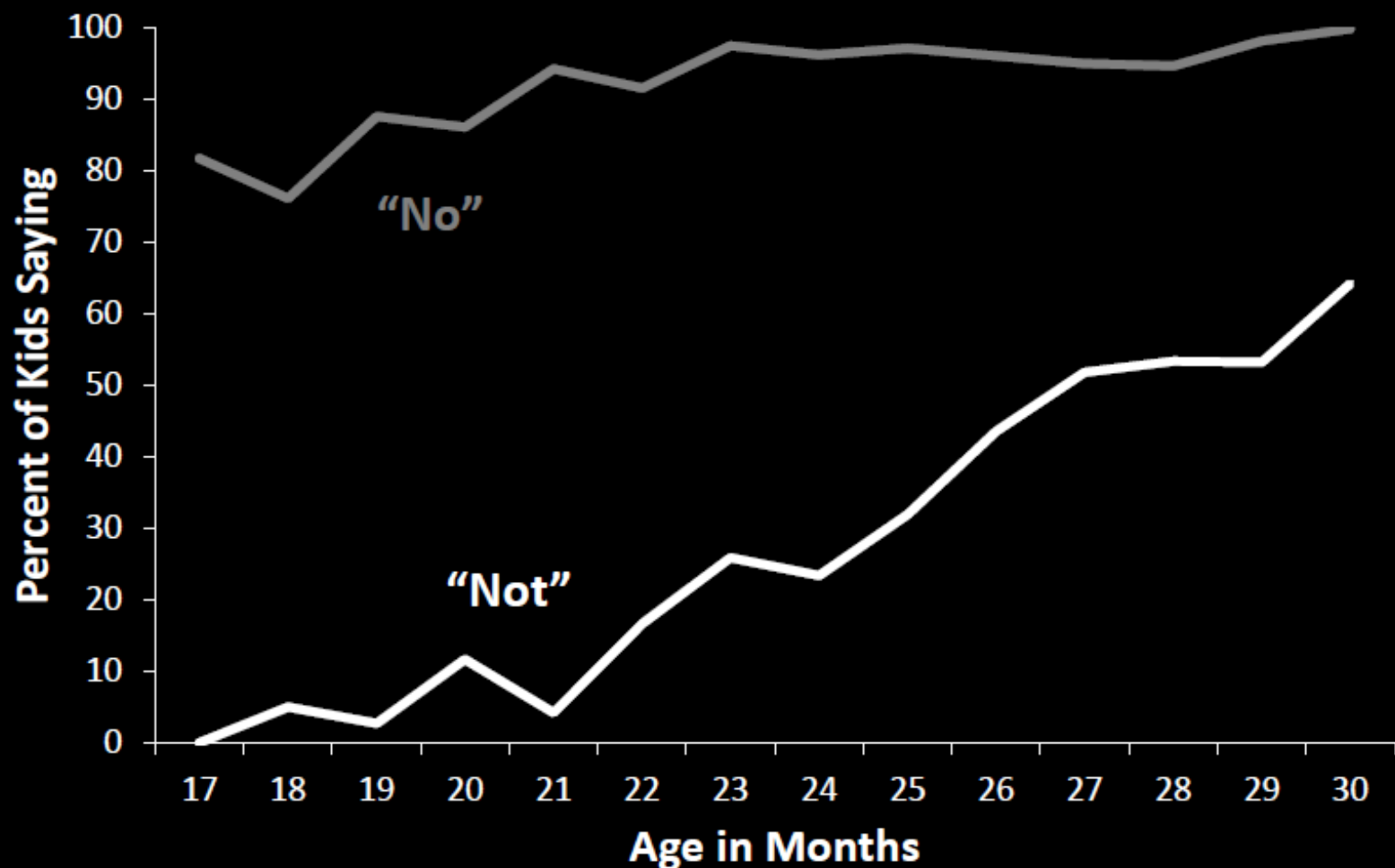
- Does logical negation precede verbal negation?
  - Does the word label a pre-existing concept?
- Or does language build the logical operator?
  - How could word learning help fix the concept?

Do kids understand verbal negation fully  
when they first learn the word?

OR

Is there a gap?

# Production



# Early Production of Negation

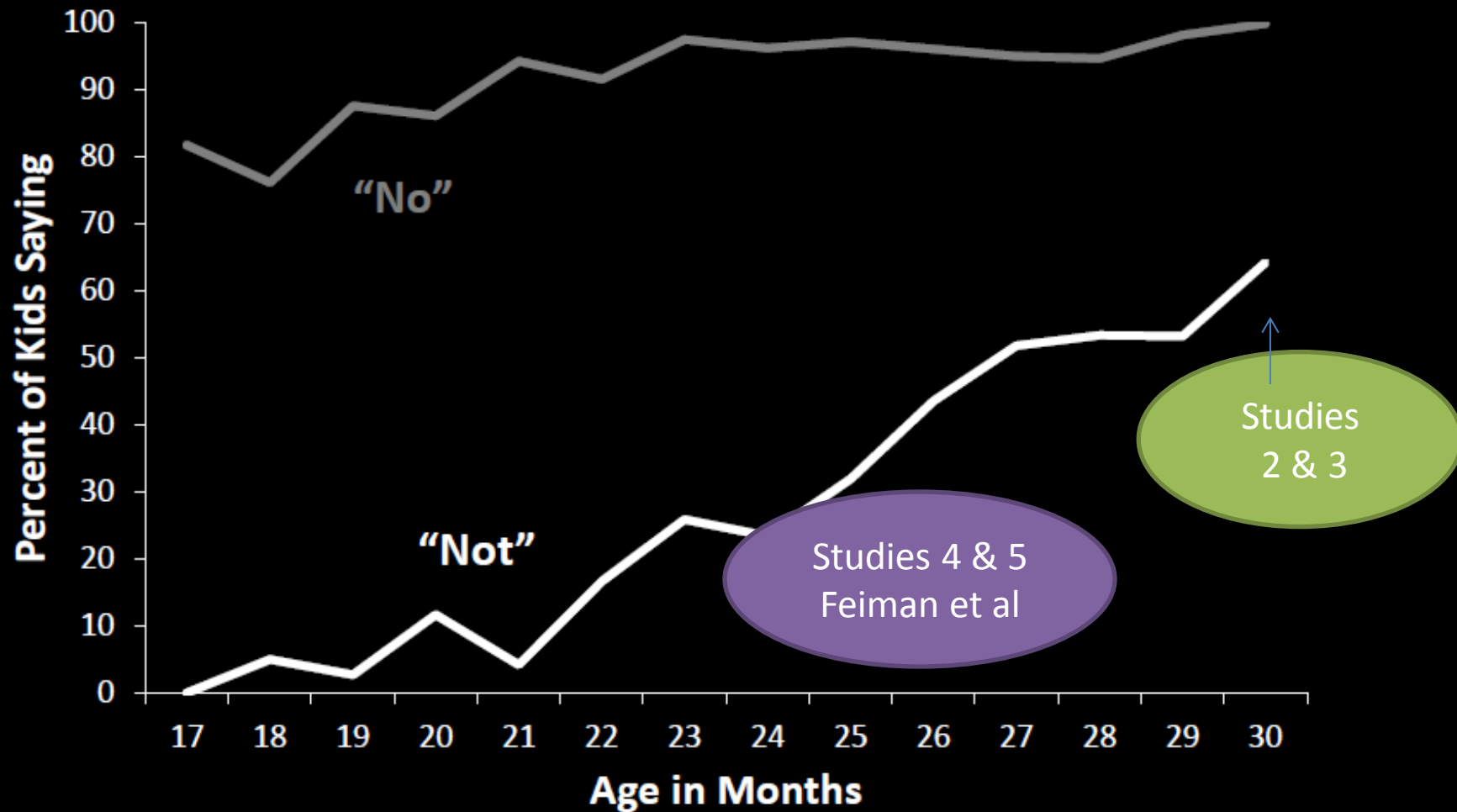
- 1-year-olds produce negation (Pea, 1980)
- Early uses more restricted (Bloom, 1970; McNeill & McNeill, 1968)
  - Rejection

“No pajamas!” = I don’t want to put on pajamas!
  - Nonexistence

“No apples!” = There are no more apples!
  - Denial emerges later

“No funny!” = That’s not funny!
- Perhaps full meaning of negation emerges gradually?

# Production



# Study 4

- Maximally supportive discourse
  - affirmative alternative has been introduced
- No real story to follow or question to answer
- Minimally distracting display
  - Remove affirmative action during test

“Look! They’re dancing!”





“Now it’s different! John is dancing!”



**Affirmative Trial**

“Now it’s different! John is not dancing!”



**Negative Trial**

“Where’s John? Look at John!”



“What’s John going to do next? He’s going to jump! Look at John, he’s going to jump!”

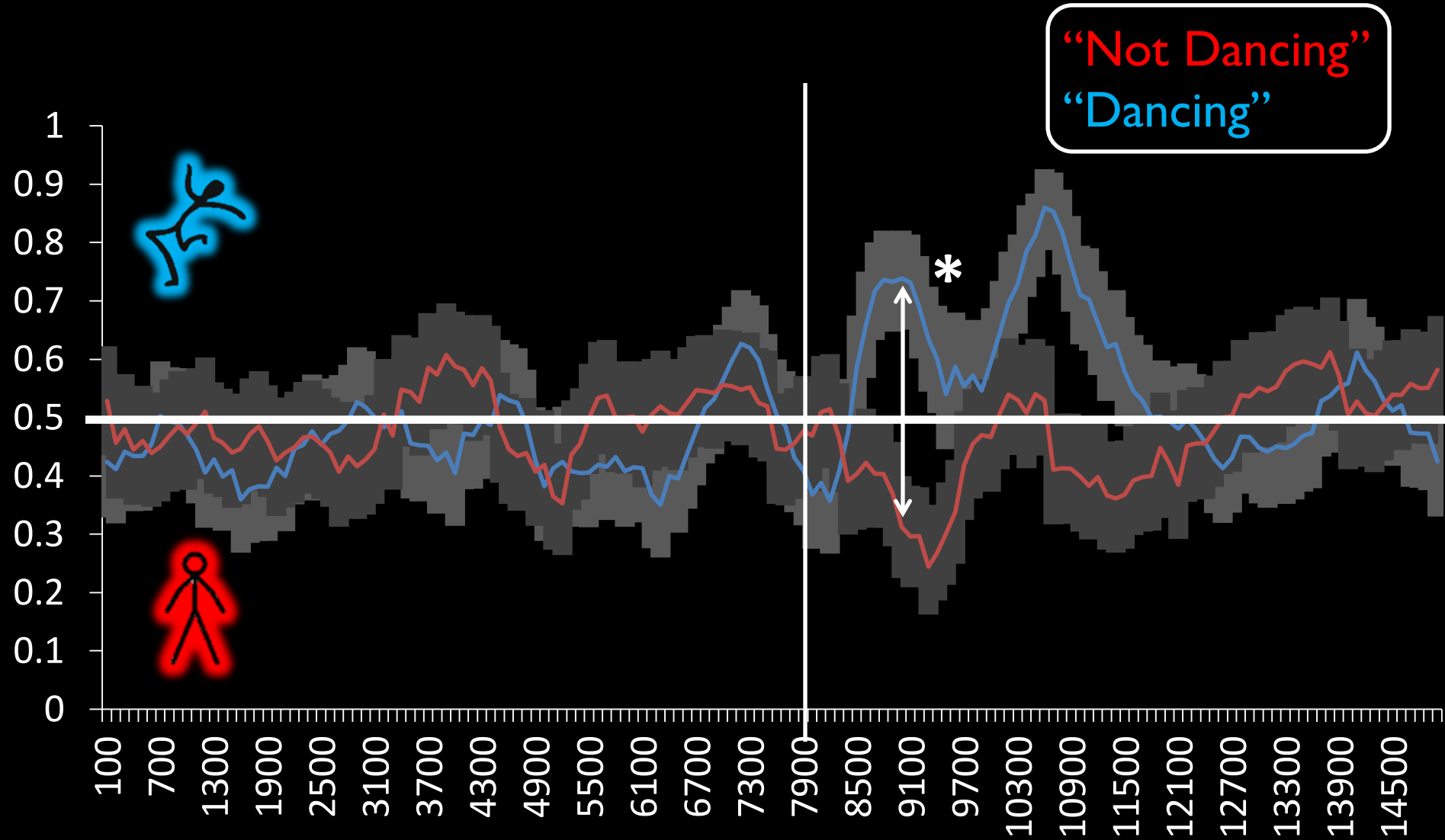


# Methods

- 3 negative trials & 3 affirmative trials
  - Alternating
- Older 2 year olds (most produce “not”)
  - 30-35 months (N=27)
- Younger 2 year olds (few produce “not”)
  - 24-28 months

# Older 2's succeed

“Now it's different! John is (not) dancing!”

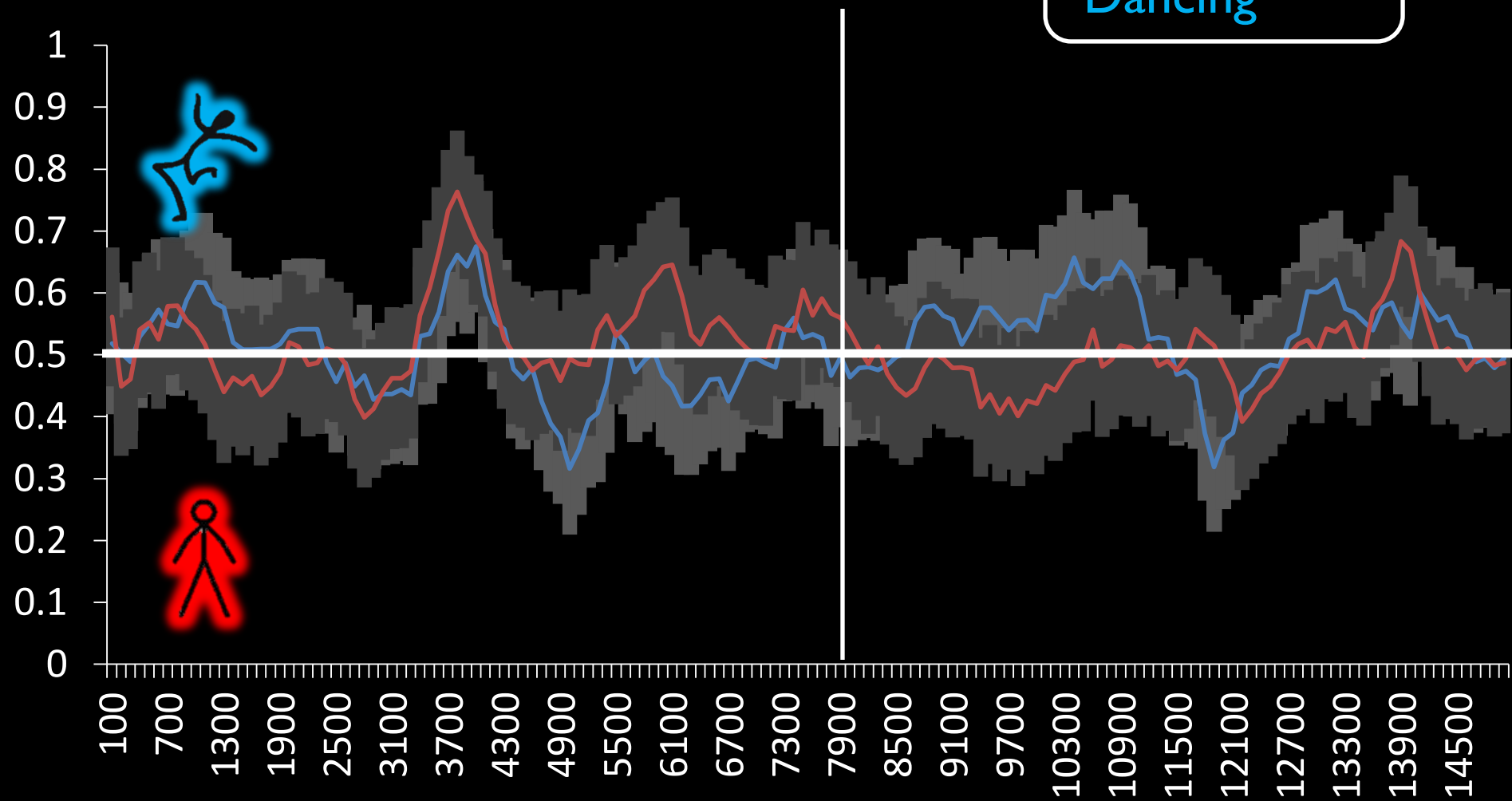


# Younger 2's fail on both

“Now it’s different! John is (not) dancing!”

“Not Dancing”

“Dancing”



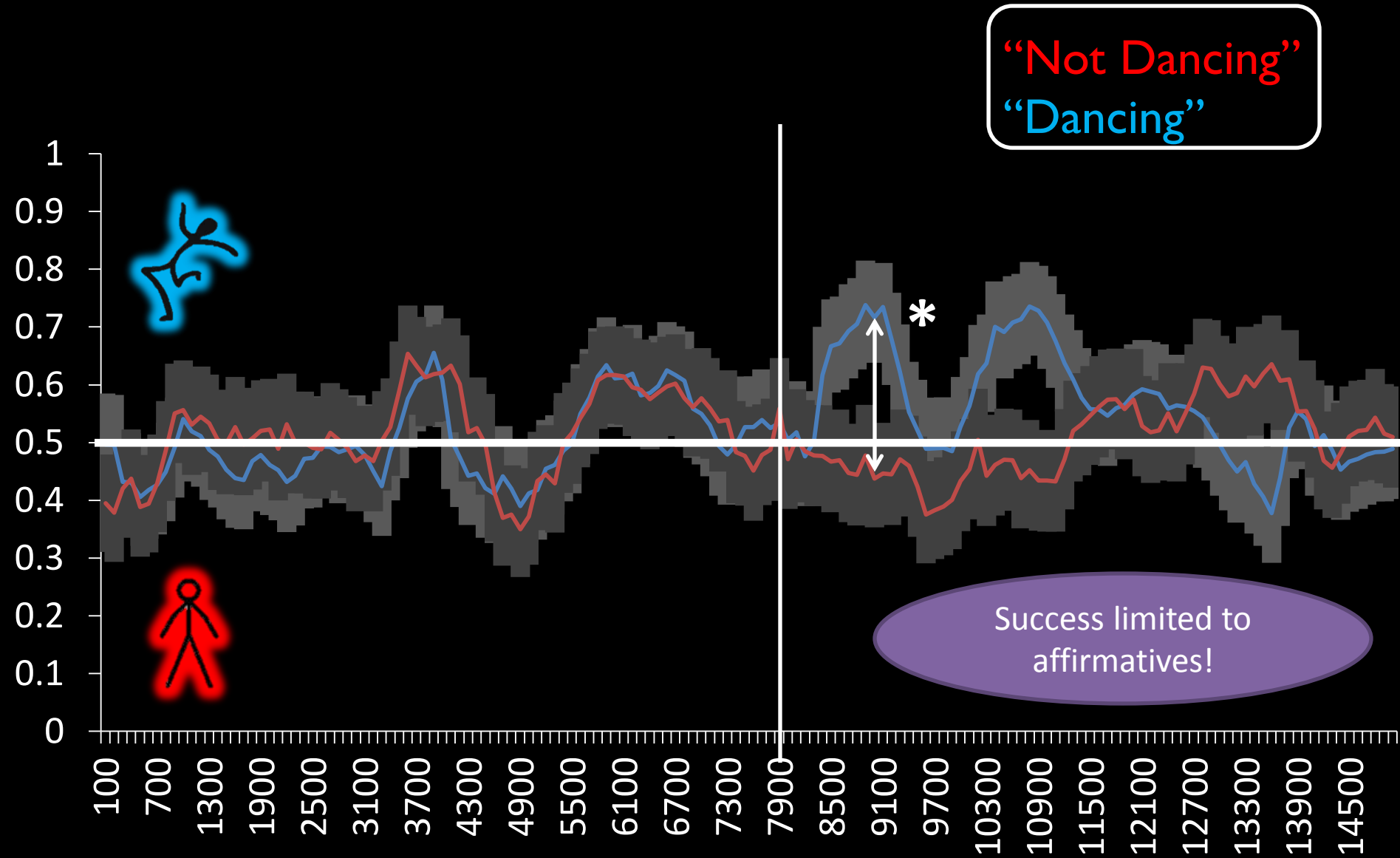
# Maybe it's interference?

- Switch to a blocked design
- Study 5: 24-28 m.o. (N=32)



# Young 2's

“Now it’s different! John is (not) dancing!”



# So far....

- Older two's (30-35)
  - correctly interpret negatives and affirmatives
- Younger two's (24-28)
  - limited success with affirmatives
  - fail to incrementally interpret negation
- Why?
  - Because they can't?
  - Because they're not motivated by passive viewing task?

# Feiman & Carey

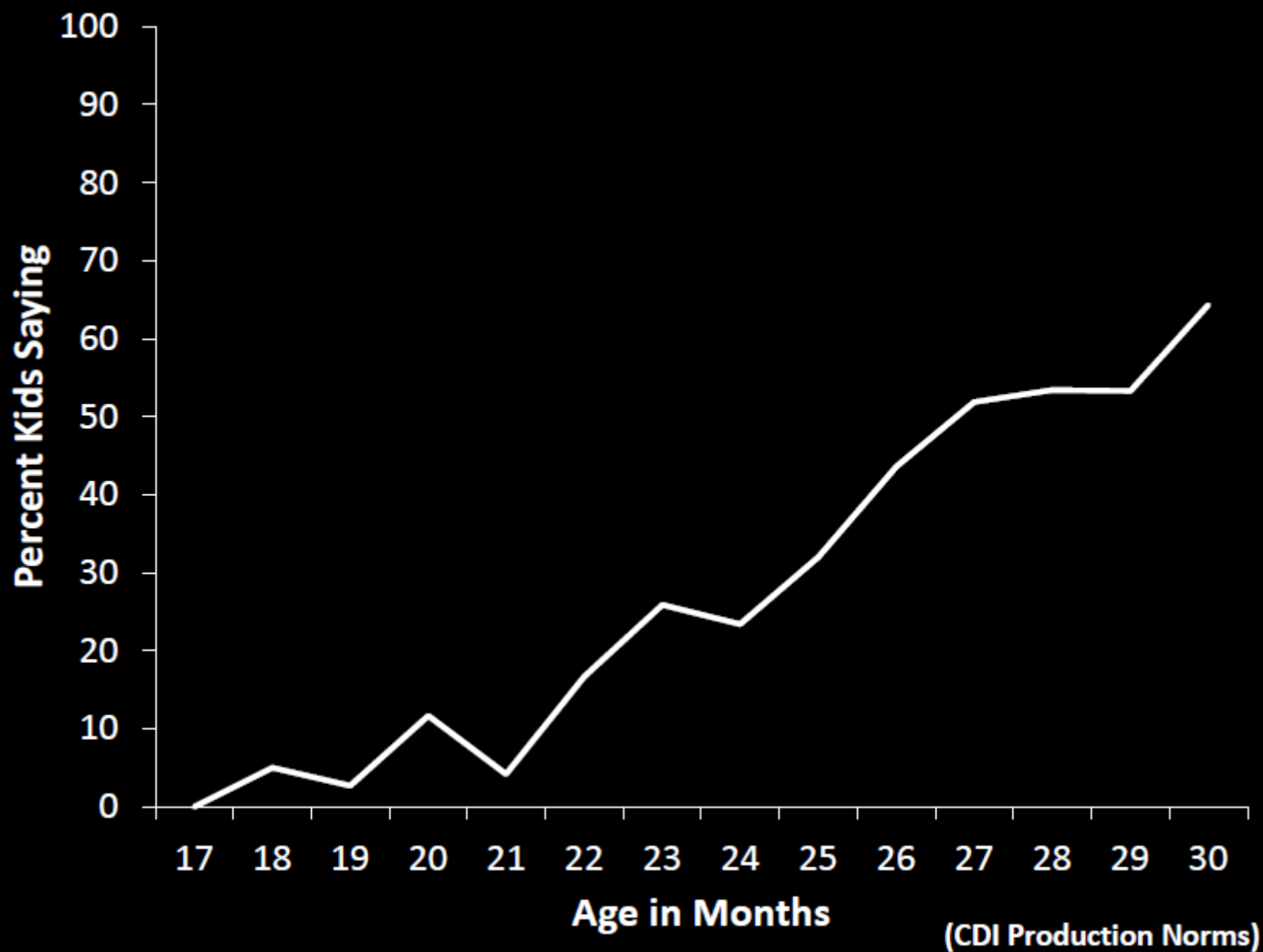
- Use an offline measure with:
  - Strong pragmatic support
  - Clear motivation to interpret utterance
  - Finer-grained age groups
  - Test for success in identifying the referent

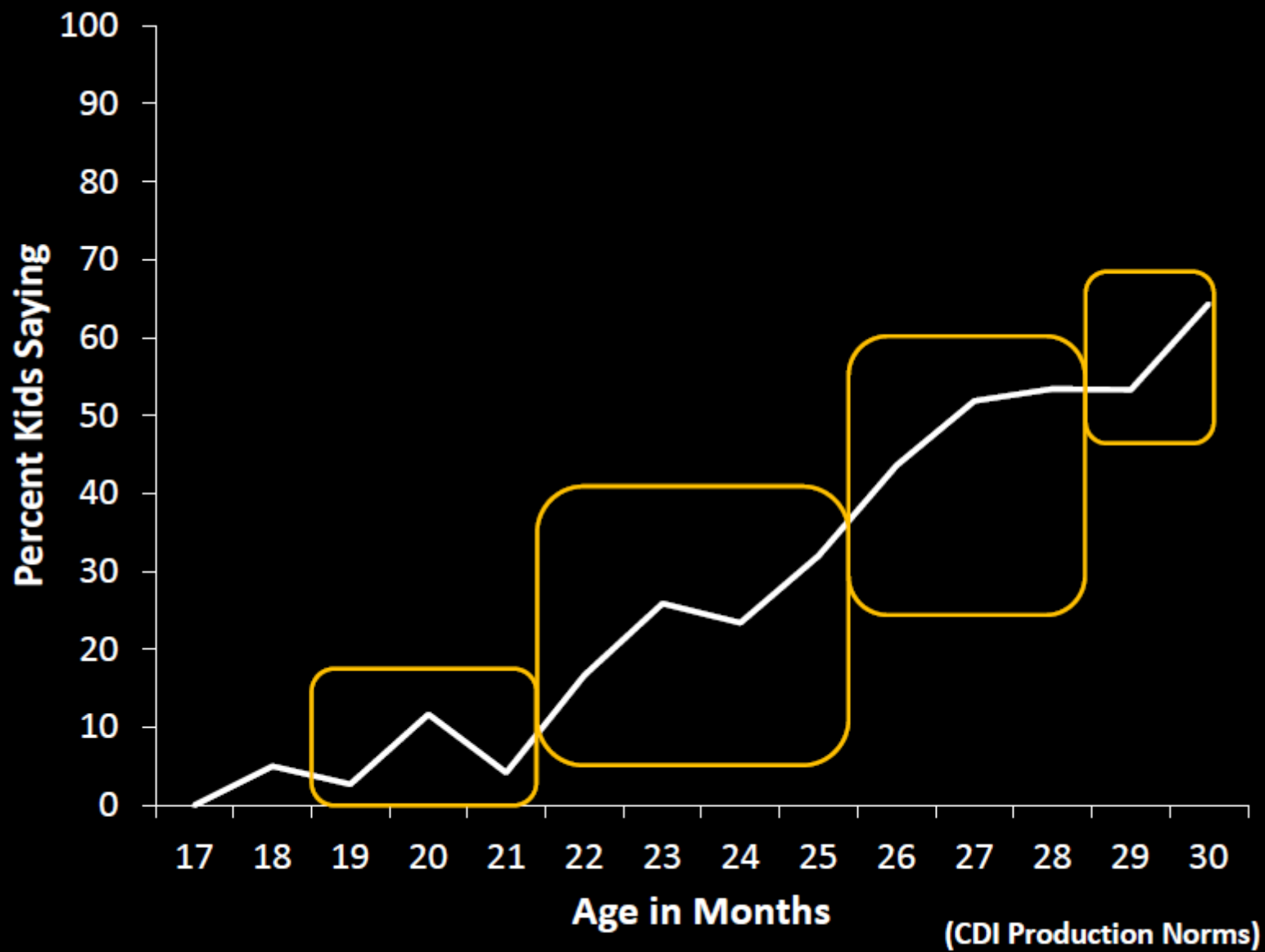




“It’s (not) in the truck. Can you find it?”



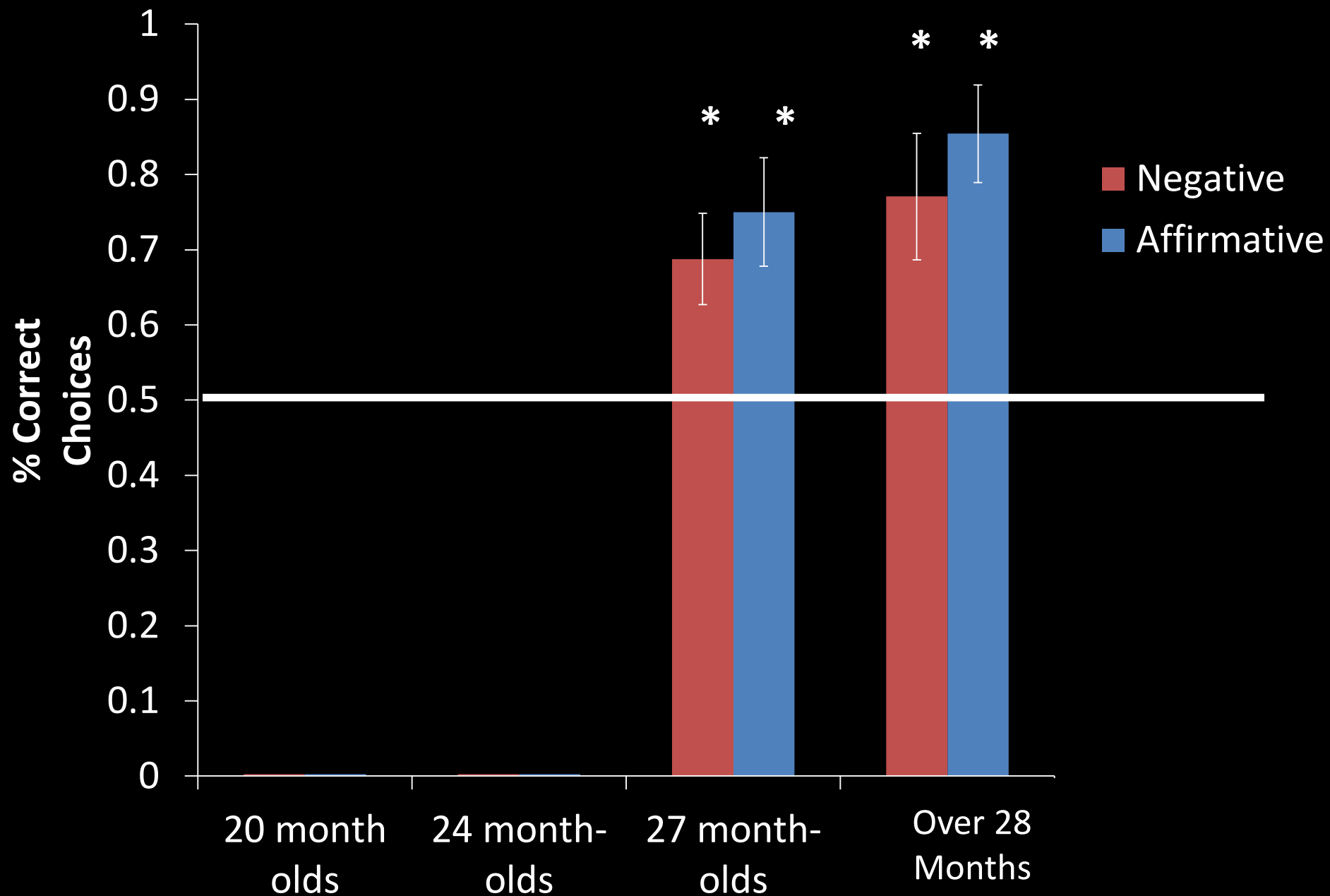


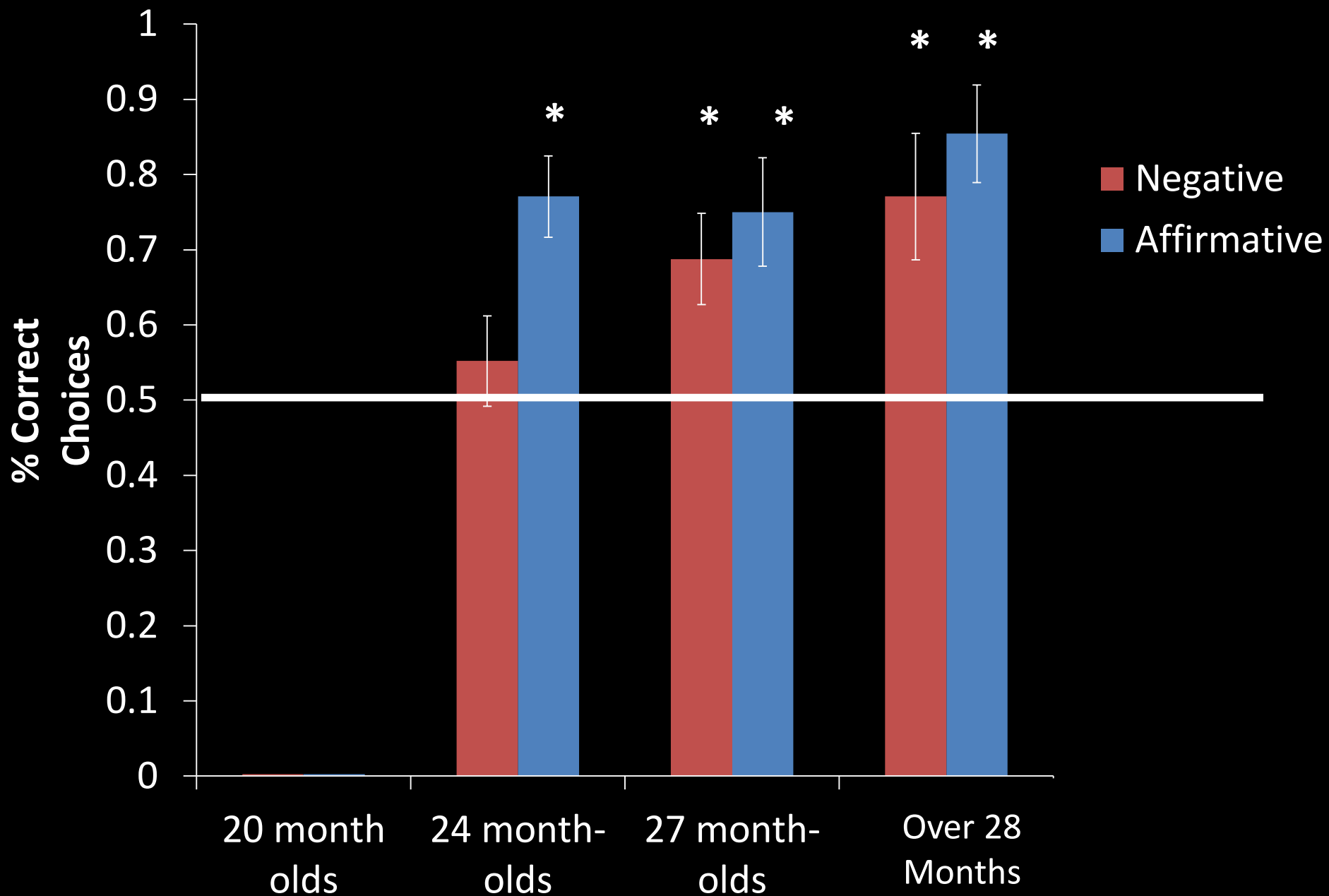


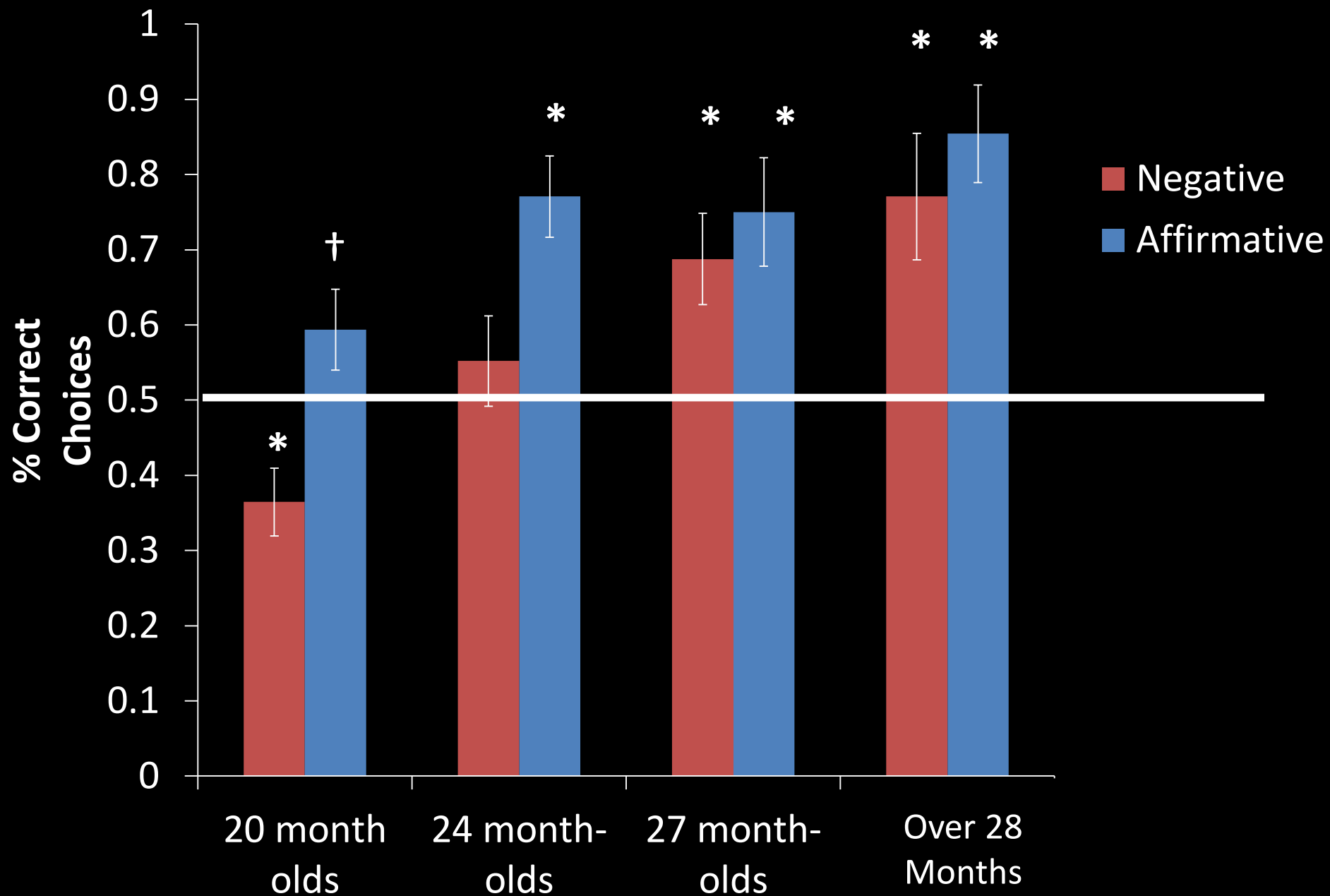


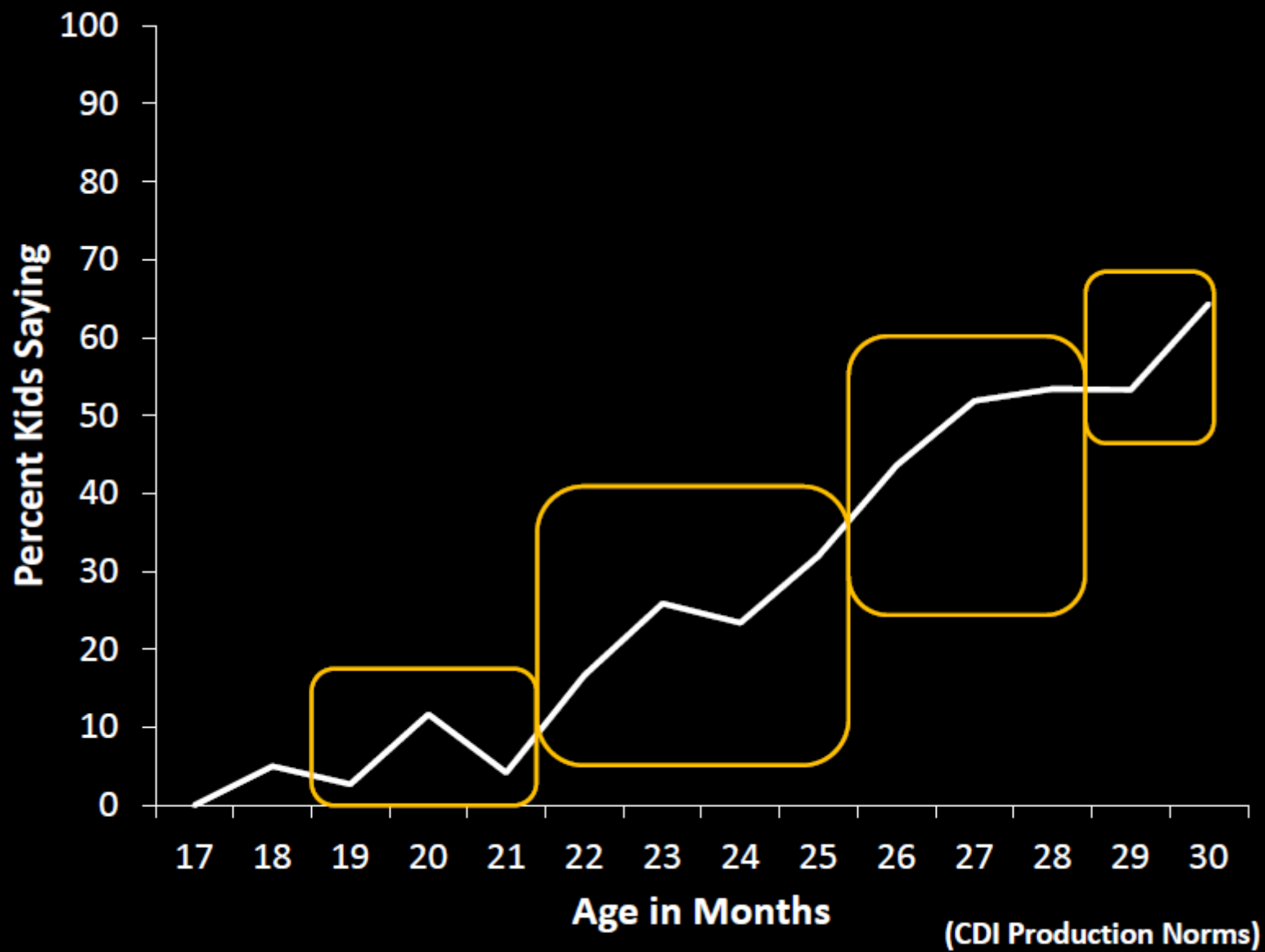
# Methods

- 4 Negative trials
- 4 Affirmative trials
- 4 age groups
  - 20 m.o. (N=24)
  - 24 m.o. (N=24)
  - 27 m.o. (N=24)
  - 29+ (N=11)

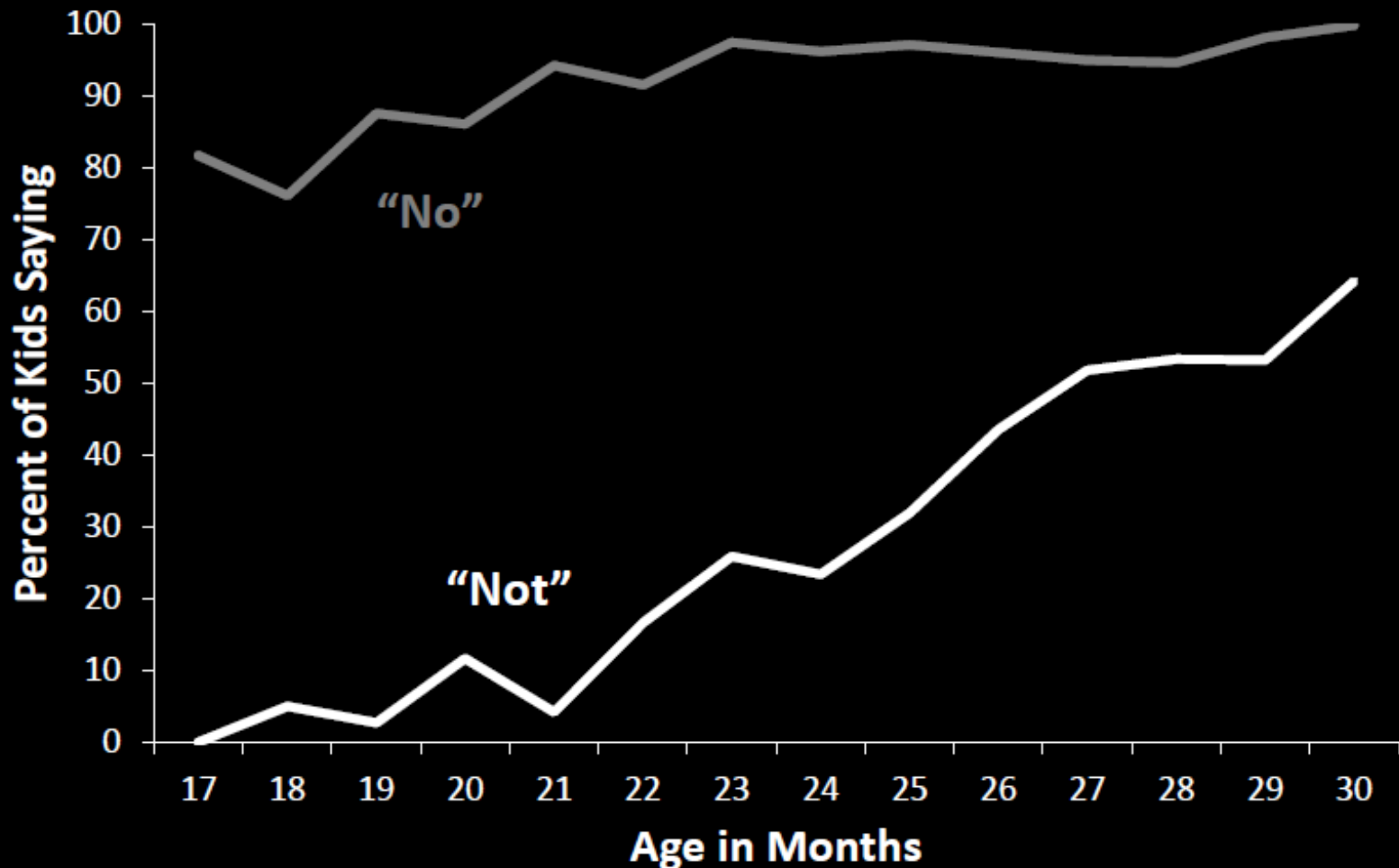








# Is “Not” harder than “No”?



Parent: (to Experimenter) “Is it in the truck?”

Experimenter “No, it’s not!/Yes, it is!”

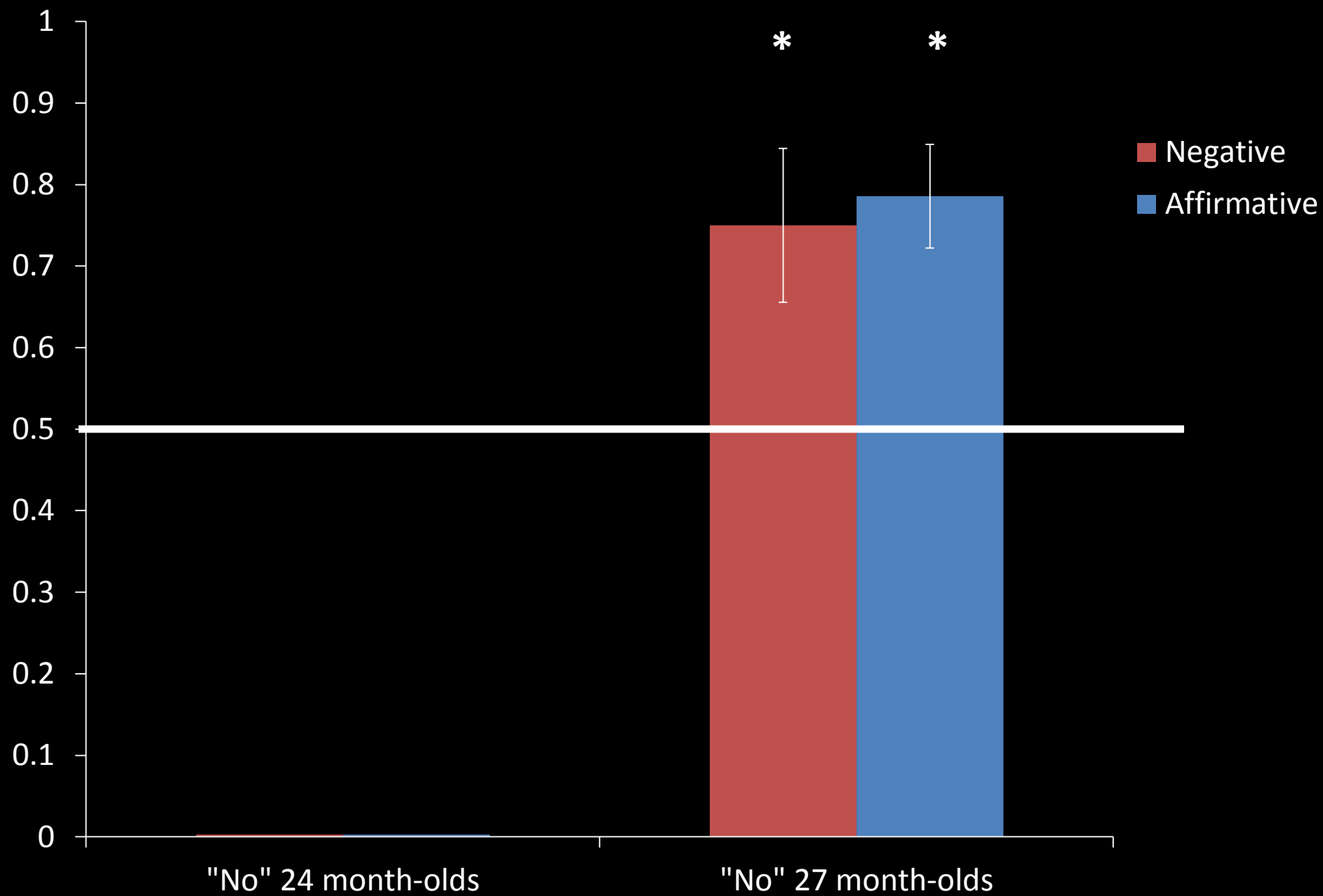
Parent: (to Child) “Can you find the ball?”

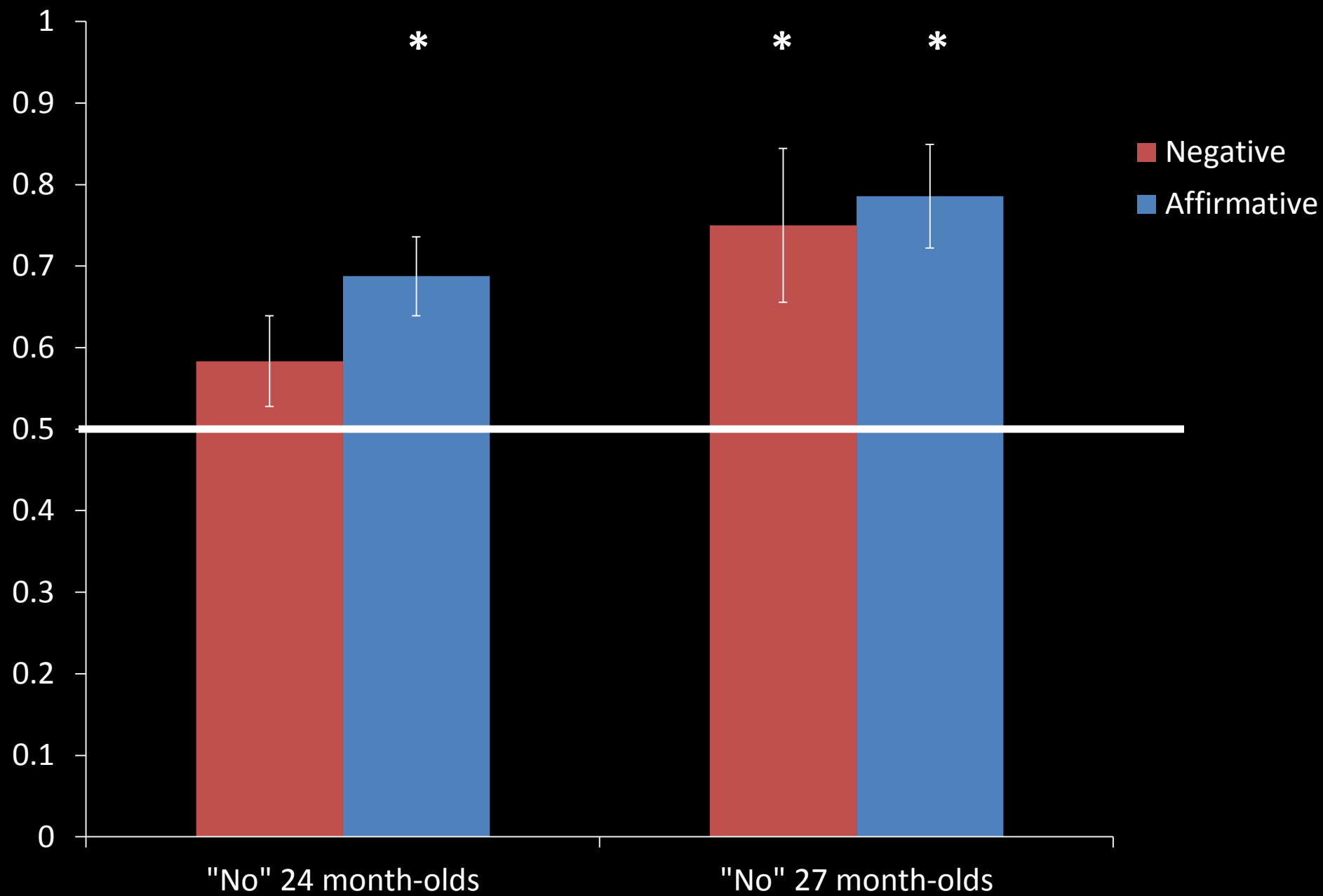


# Methods

- 4 Negative trials
- 4 Affirmative trials
- 24-26 m.o. (N=24)
- 26-28 m.o. (N=14)











“Look at the bucket!”

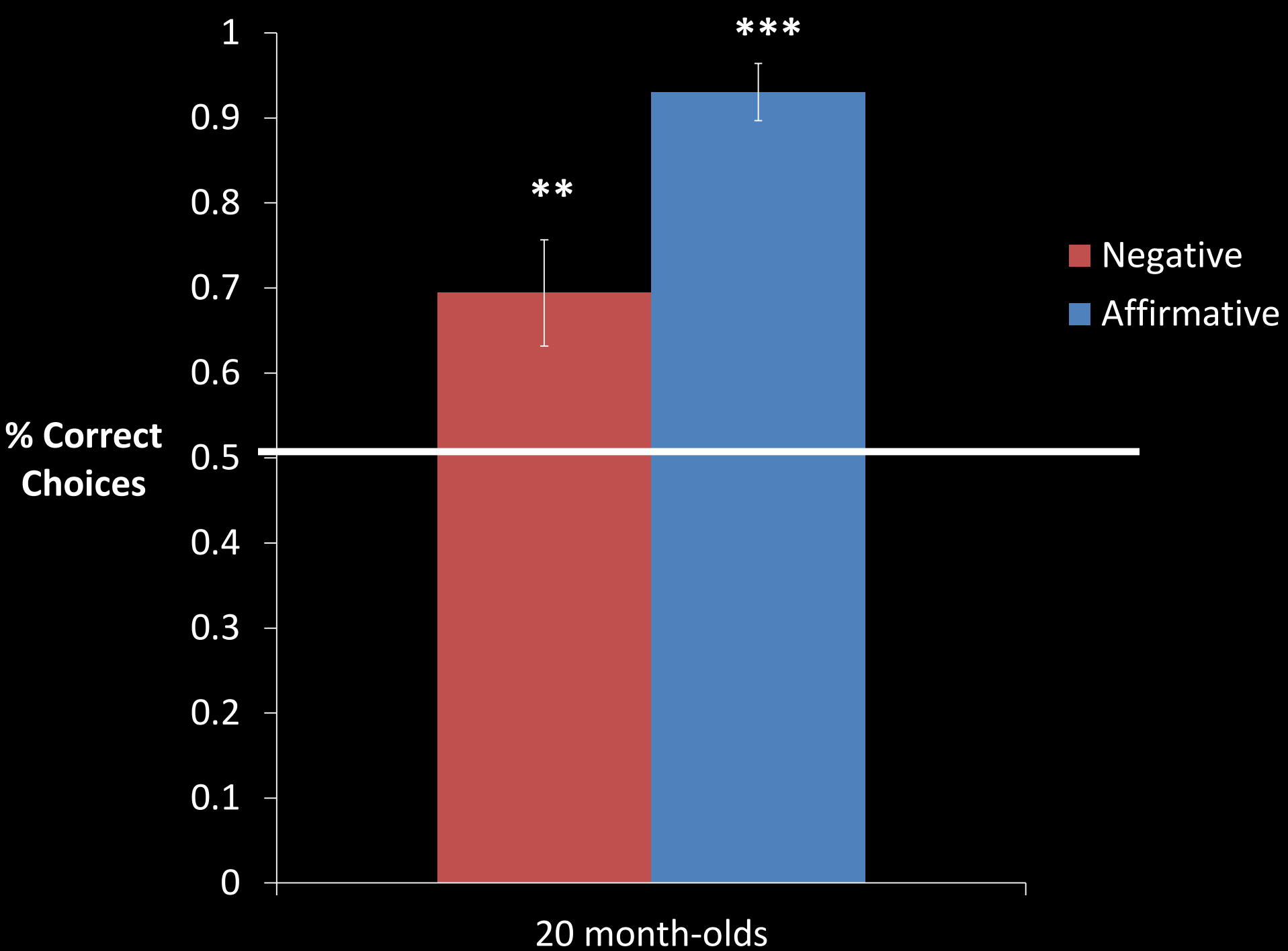


“Look at the bucket!”



# Methods

- 4 Negative trials & 4 Affirmative trials
- 19-21 m.o. (N=24)
- Counterbalanced side, target container, block order





# Bucket Task

- Failures on verbal negation tasks before 27 months (see also Austin et al.)
- Both with “no” and “not”
- Not due to deficits in inhibitory control
  - Success with non-verbal buckets at 17 months
- Perhaps the early meaning of “no” is rejection (not truth-functional negation)?

# Acquiring Negation

- If logical negation is present before 27 months, then why is understanding of verbal negation so delayed?
- If success on the non-verbal tasks does not rely on logical negation, perhaps the logical operator only emerges around 27 months.

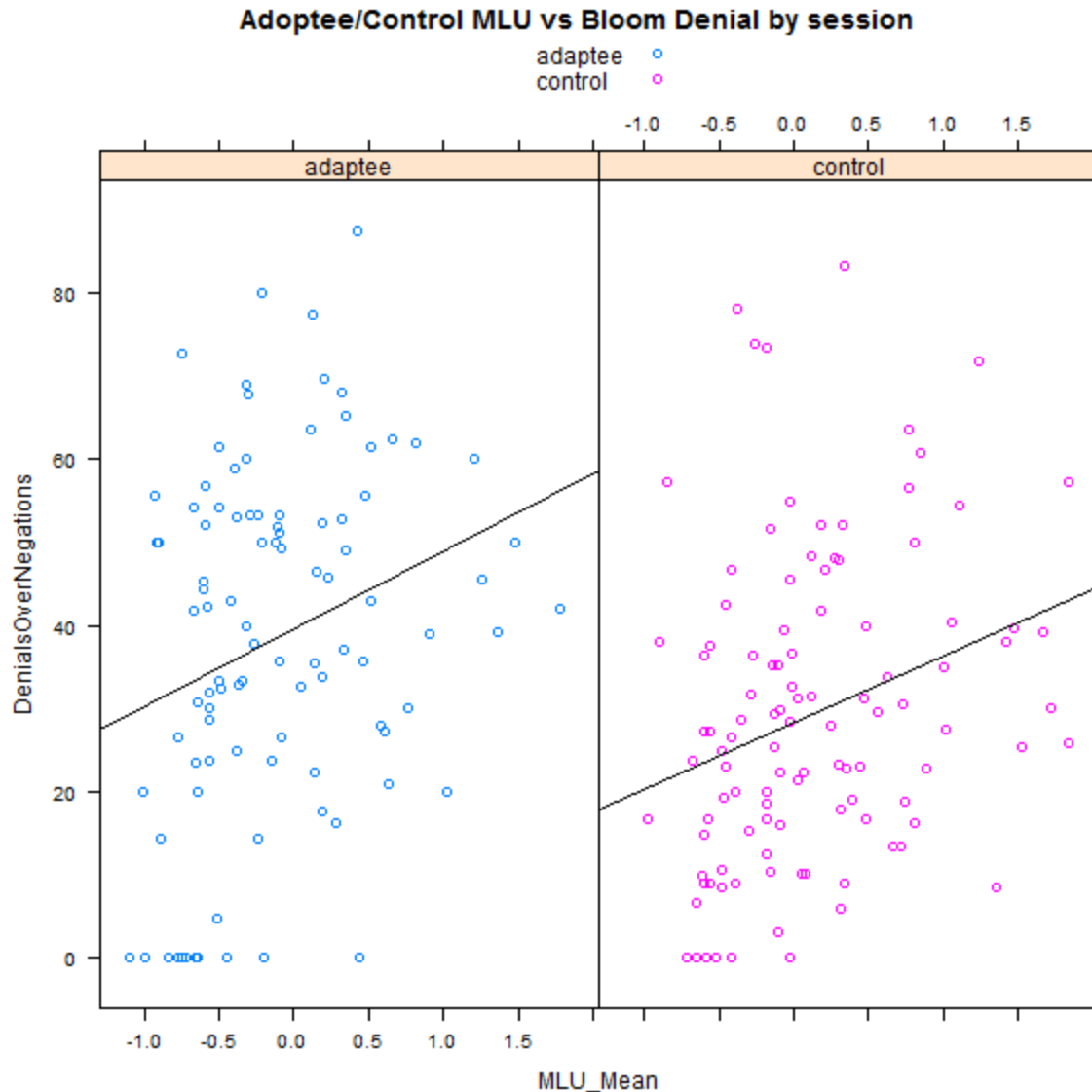
# Developing a concept of negation

- Induced from evidence?
  - Learned through its conceptual role?
  - What hypothesis wouldn't presuppose negation?
- Abstraction over module-internal representations?
- Innate?
  - Why so late?

# Tentative evidence for developmental change

- If full negation awaits on late maturing representations or cognitive development
- Then older language learners should show precocious use of denial (truth functional negation)
- Internationally adopted children
  - 2;6-5;0 when acquire English
  - Show most of the same patterns in acquisition
  - Corpus analysis (ala Bloom)

# Preliminary Findings



- Both groups more denials as MLU increases
  - Language learning
- But adoptees use denial more at earliest MLU
  - Conceptual change?

Thanks!