Development of Language and Pragmatics:

Understanding children's successes and failures

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XPRAG.de 2014

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There are two reasons for this. First, it is very easy to say something stupid or confusing when writing in bullet points. Second, I would like to make sure that you have the correct citation for any of the research that I describe, since much of it is currently under review or in preparation.

Plan of Action

I. A broad sketch of central issues in language acquisition
II. Children's language comprehension
III. Understanding children's pragmatic failures

I. a broad sketch of language acquisition

With a focus on central theoretical issues

A. Space of theories

Defining our terms

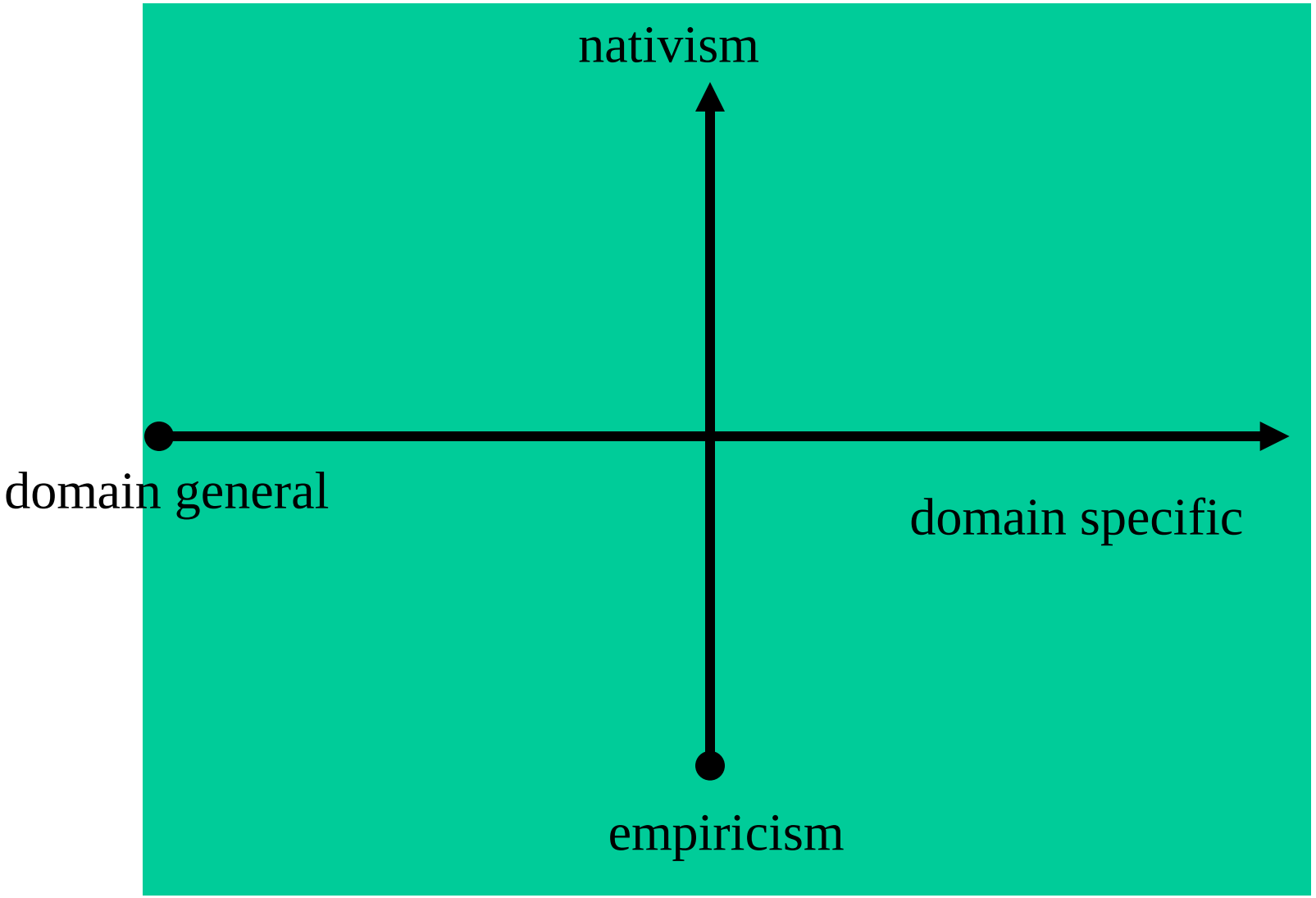
Dimension 1

- Nativism: claim that ability is largely determined by genetic (innate) factors
- Empiricism: claim that ability is largely based on learning

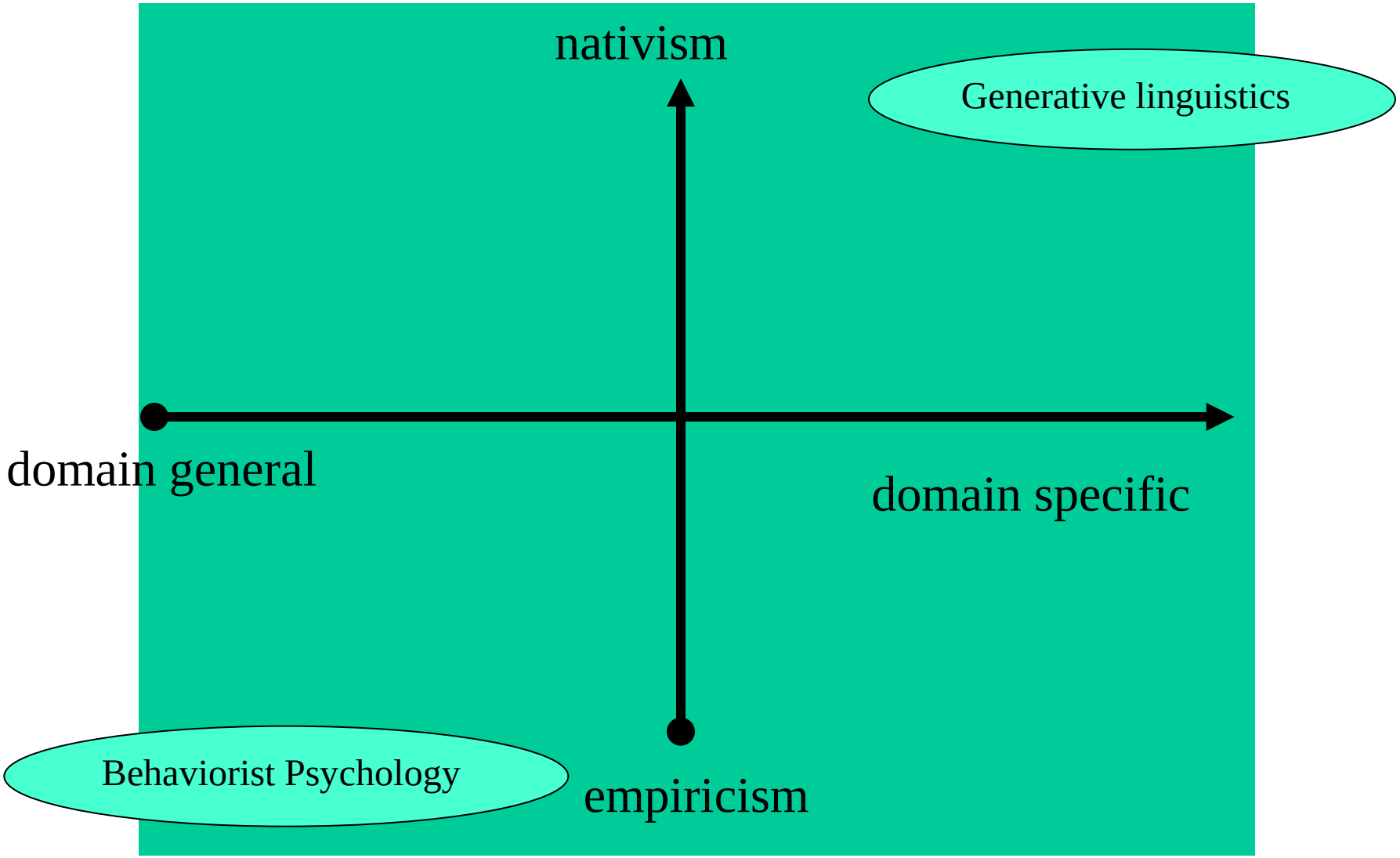
Dimension 2

- Domain-specific: unique to one domain of functioning
- Domain-general: used across many/all domains
- Can refer to the genetic factors, the learning mechanisms/developmental precursors, or the process in adult, representation

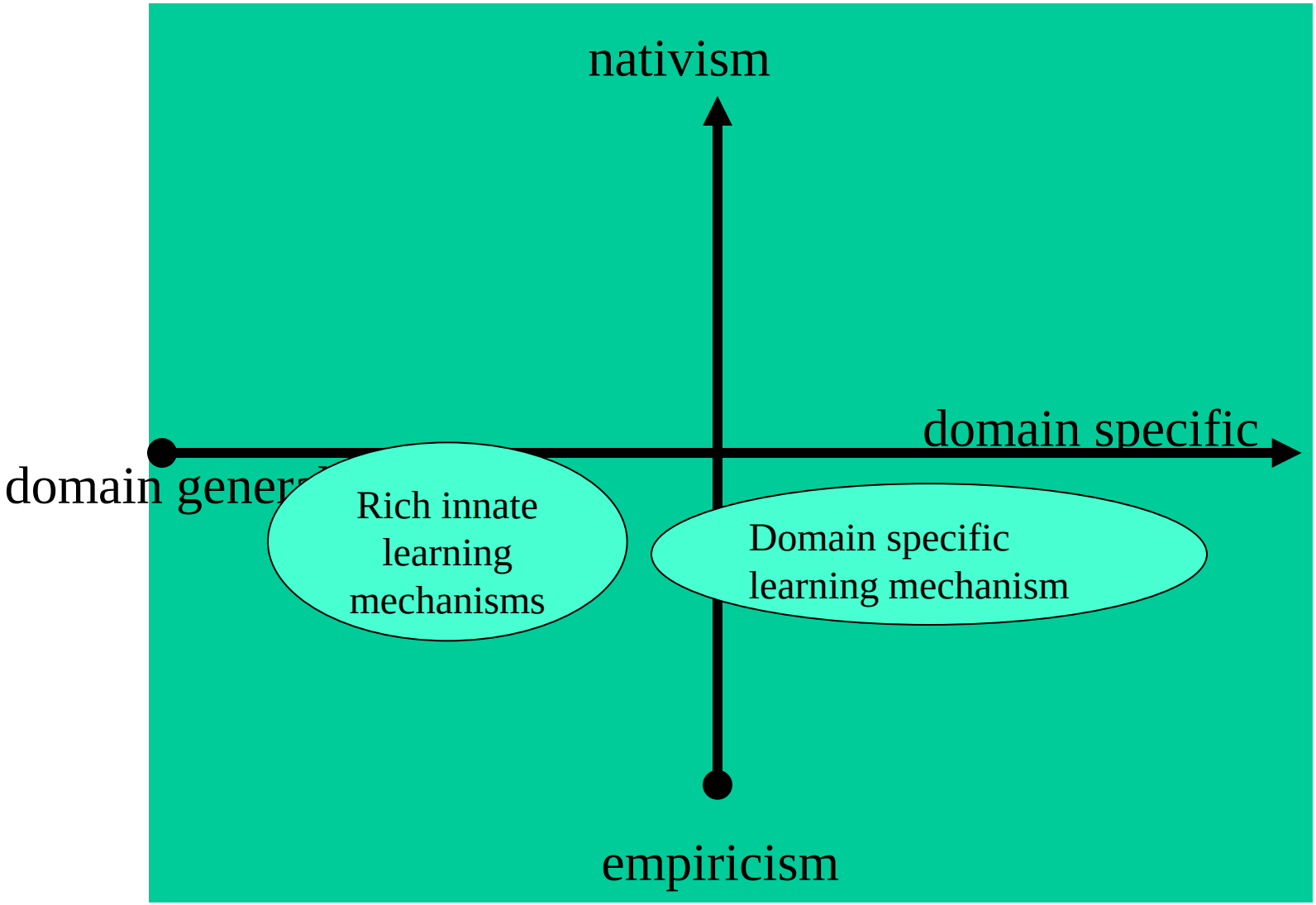
Two core issues in language acquisition



Theory space circa 1985



New options (2014)



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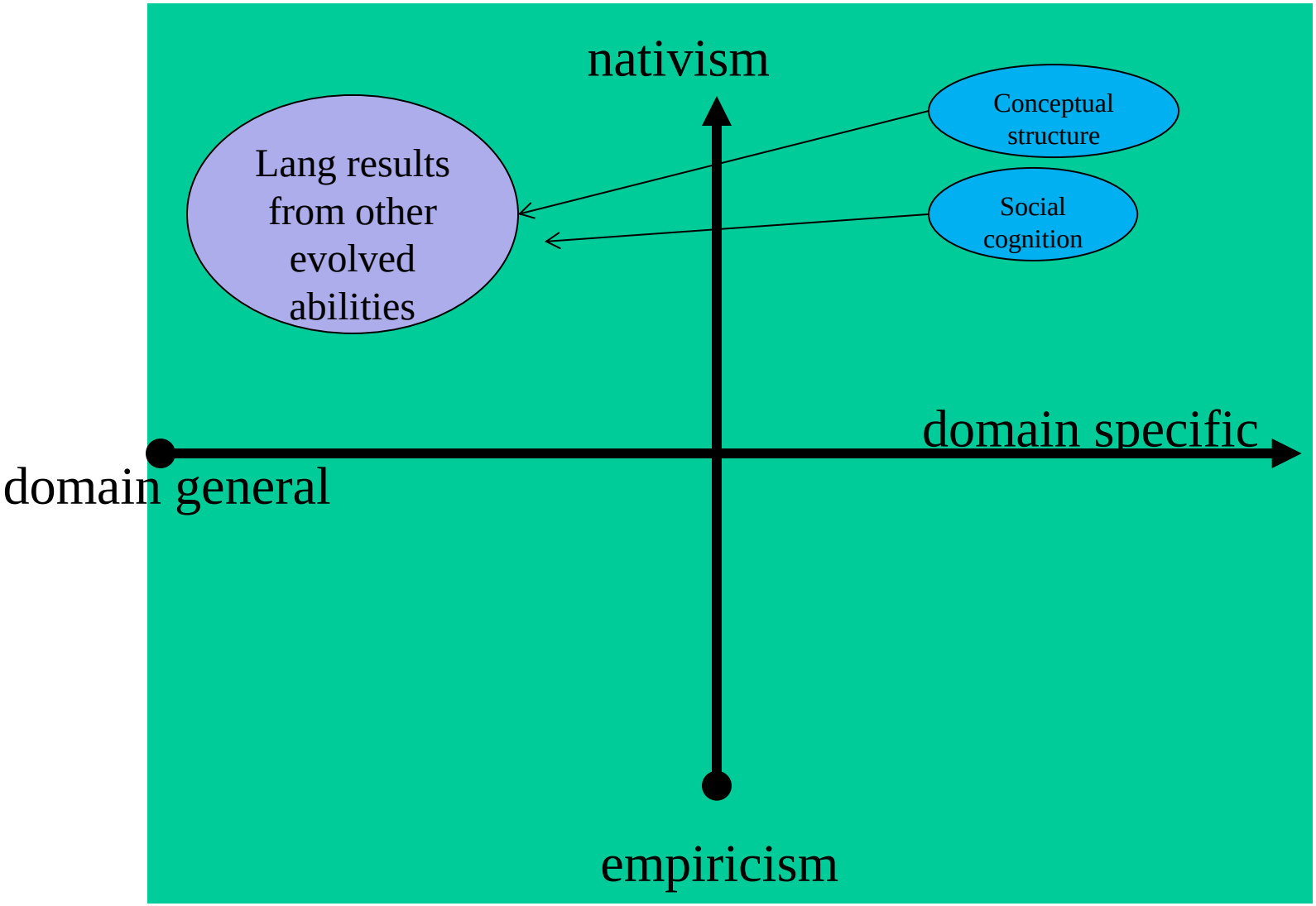
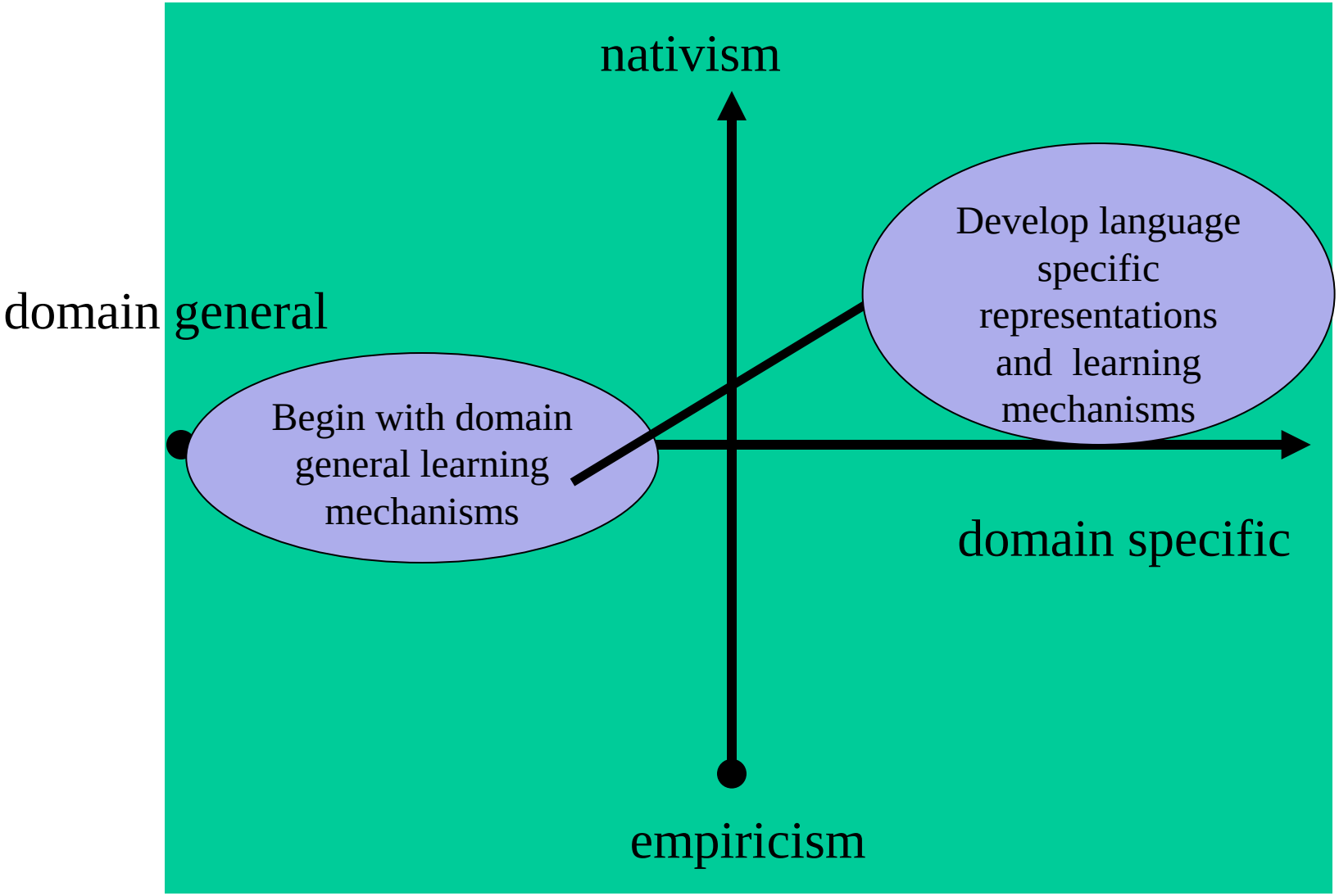


Many theorists argue that domains differentiate over development



To me:

A high degree of nativism is necessary to account for data

Domain-specificity is empirical question

B. Children can create much of language on their own

Home Sign

Most deaf infants are born to hearing parents.

Some are not exposed to a sign language and cannot hear spoken language.

These children communicate to their families with gestural systems

Goldin-Meadow and Mylander

Home signers, 1-4 years of age

Profound hearing loss

No exposure to ASL, very little English

Language videotaped and analyzed

Signs and Meanings

Around 1 year children begin producing signs

Deitic gestures: points that indicate objects

- Point to referent
- Point to similar object
- Point to a gesture: common device in signed languages

Characterizing gestures: iconic indicate actions or attributes

Sequences are systematic

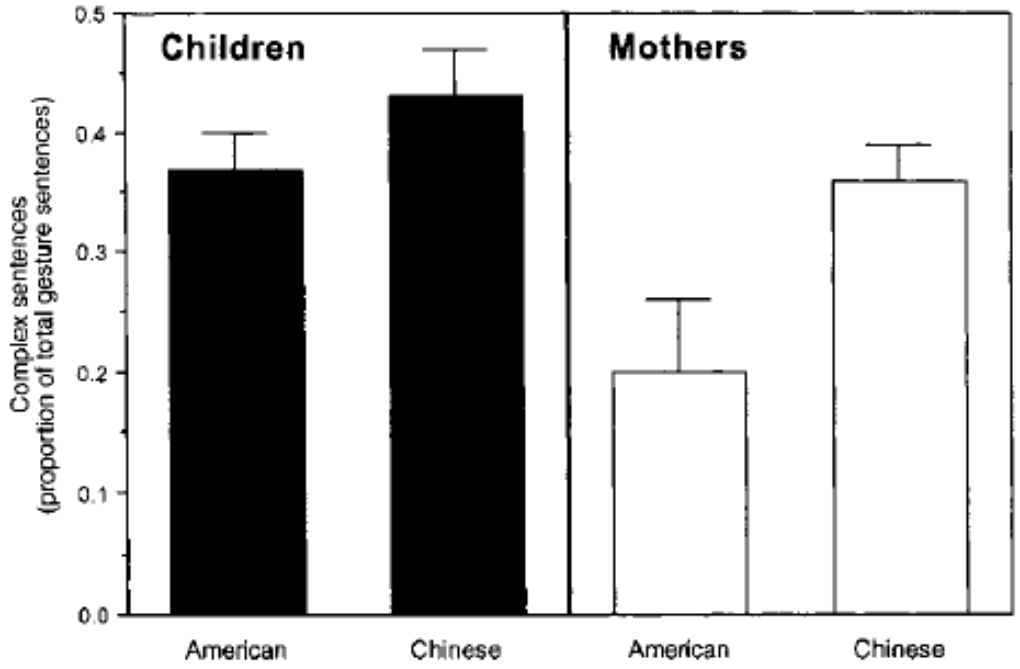
By 2 years children combine gestures in 2-3 sign sentences.

Home sign predicates take the same maximal number of arguments as natural language predicates

- *I sleep*
- *You eat, cookie eat, cookie eat you*

Home sign systems use word order to indicate participant roles, with the orders varying across children

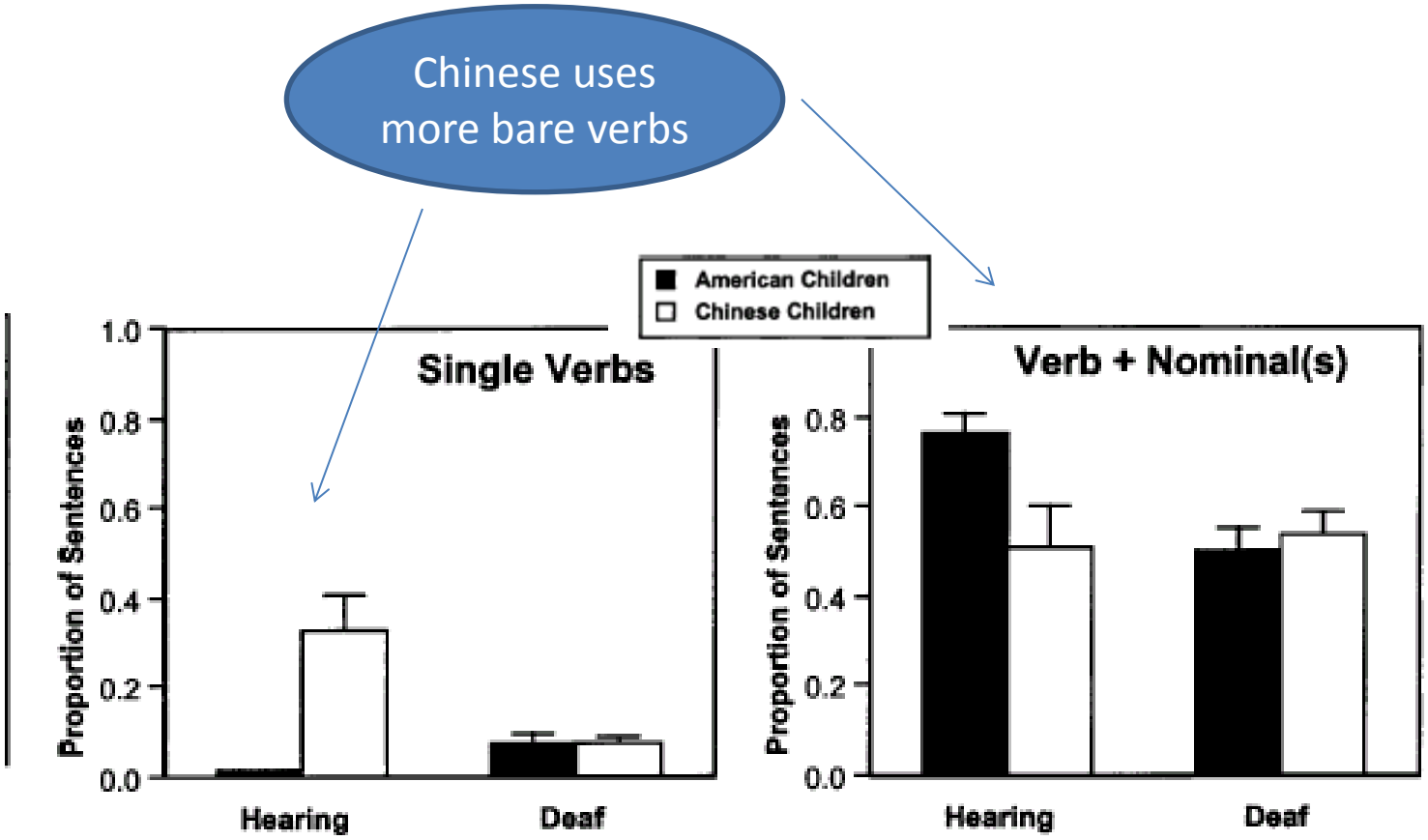
Who is creating the language? The mother or the child?



Child's language is more complex

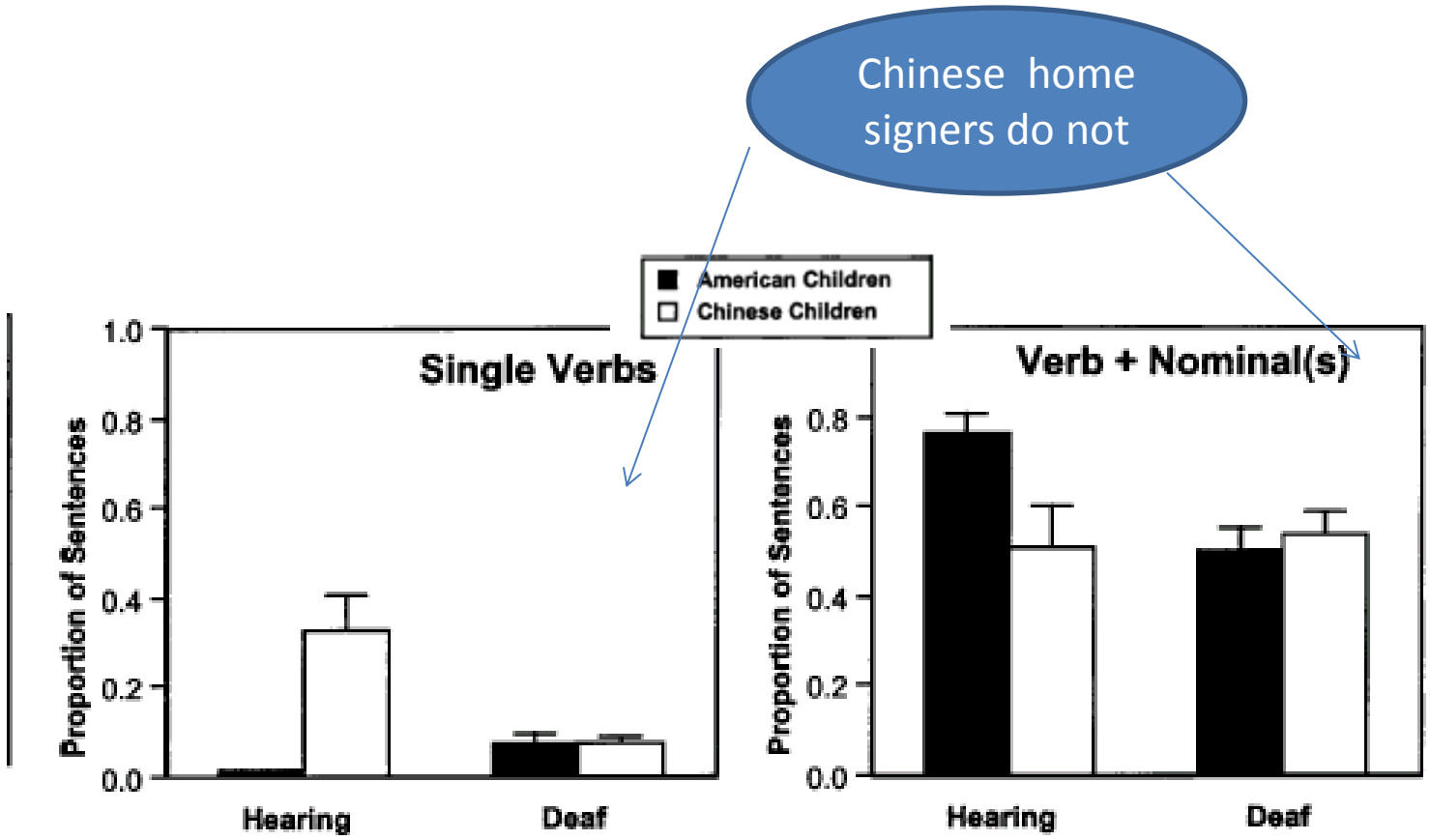
Goldin-Meadow & Mylander, 1998

Home sign is not shaped by the language of community



Zheng & Goldin-Meadow, 2002

Home sign is not shaped by the language of community



Zheng & Goldin-Meadow, 2002

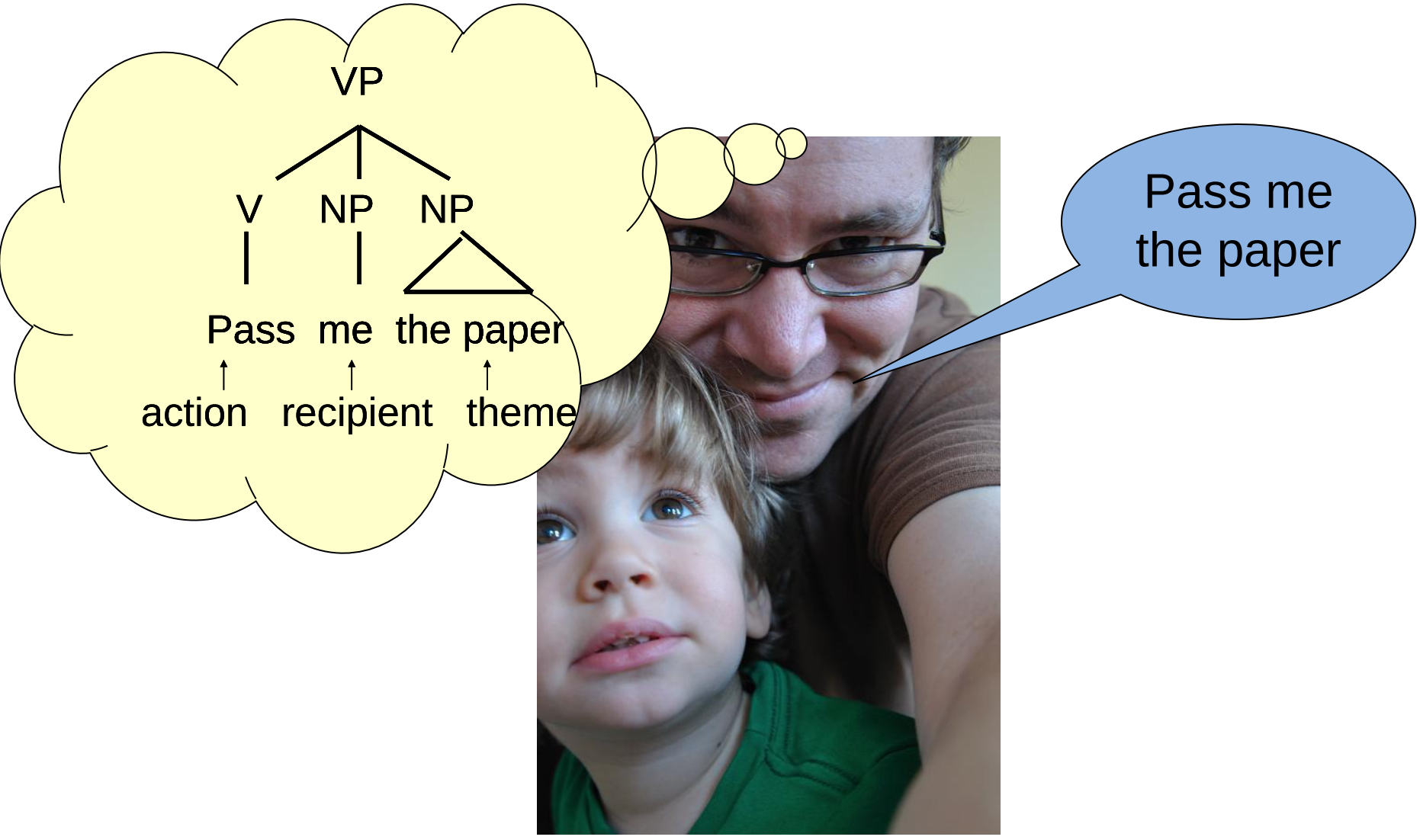
NSL Narrative

C. Abstraction emerges early

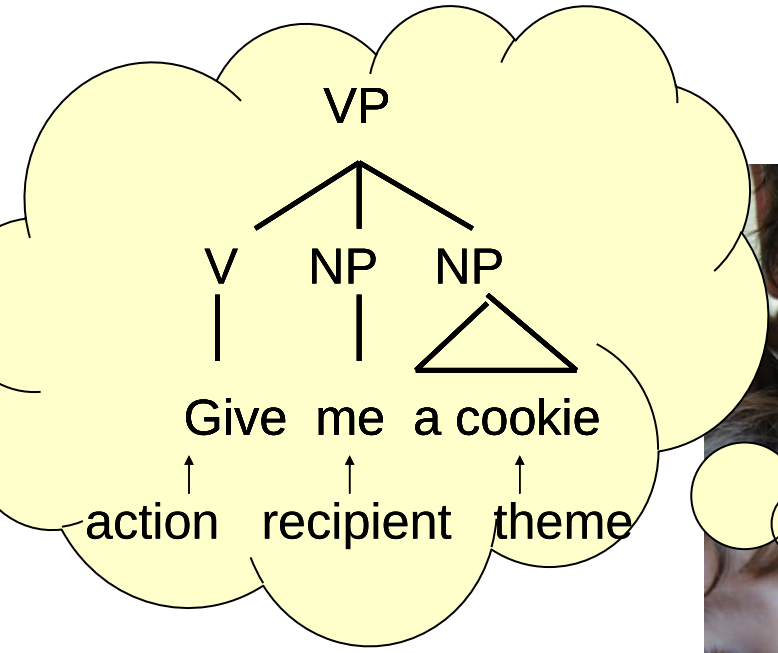
Example: Structural Priming

Malathi Thothathiri
George Washington University

Adults: broad, syntactic and semantic abstractions



What representations lurk behind children's utterances?



Give me a cookie!

Adult-like abstract structures?

What representations lurk behind children's utterances?

Give (me) (a cookie)

GIVE GIVEE GIVEN

Give me a cookie!

Item-Based Frames?

(Tomasello, 1992)

How do we tell the difference?

- Both theories can account for spontaneous verb use
- Do children generalize knowledge to novel verbs?
  - Production they *often* do not
  - Comprehension: 1.5-2.5 year olds clearly do
- Issues of interpretation
  - Does the child treat novel verbs as novel (translation)?
  - Are these representations invoked for known verbs?
- Solution: priming studies

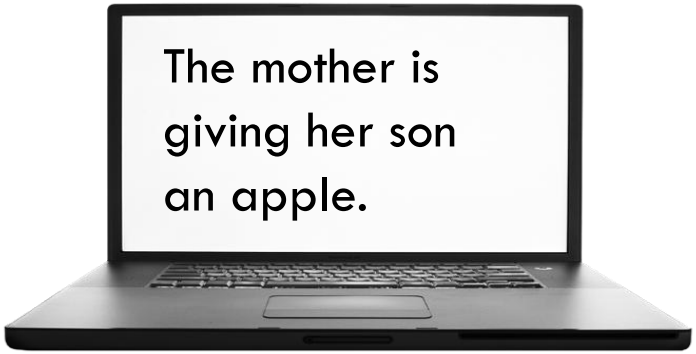
Structural Priming

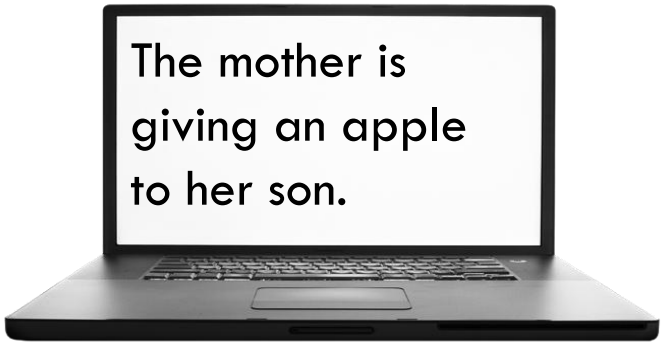
- Datives: Verbs of transfer (give, show).

- Dative alternation
  - Double-Object Dative (DO)
    Give the boy the truck: **Recipient-First**
  - Prepositional Dative (PO)
    Give the truck to the boy: **Theme-First**

Structural Priming

PRIME





TARGET

The woman is giving the man a book.

The woman is giving a book to the man.

Structural Priming

PRIME

The mother is giving her son an apple.

The mother is giving an apple to her son.

Within-Verb Priming

TARGET

The woman is giving the man a book.

The woman is giving a book to the man.

Structural Priming

PRIME

Across-Verb Priming

TARGET

The woman is giving the man a book.

The woman is giving a book to the man.

Priming and Representation

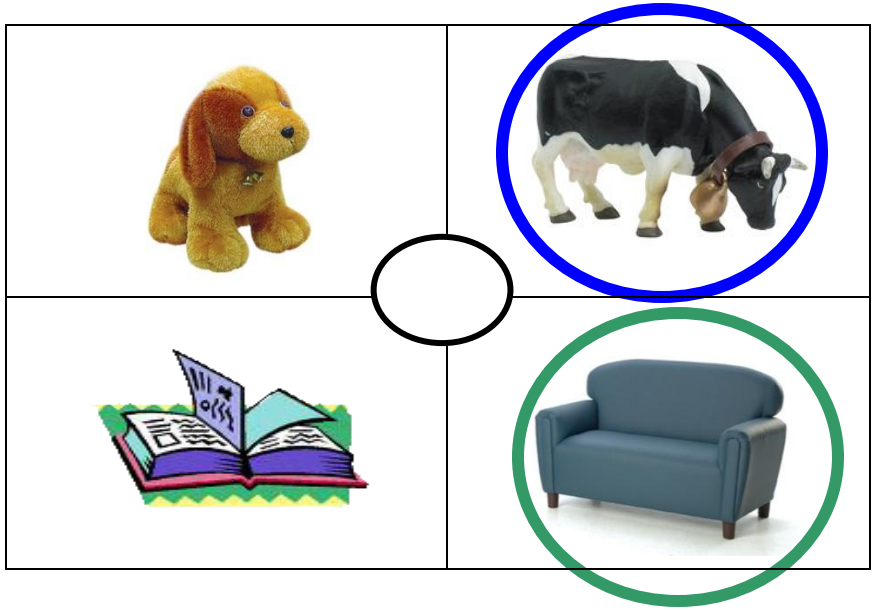
- Item-Based Frames →
  Within-verb priming only

- Abstract Generalizations →
  Within-verb + Across-verb priming

Comparison: 4 year olds and 3 year olds
(M=4;0, M=3;1)

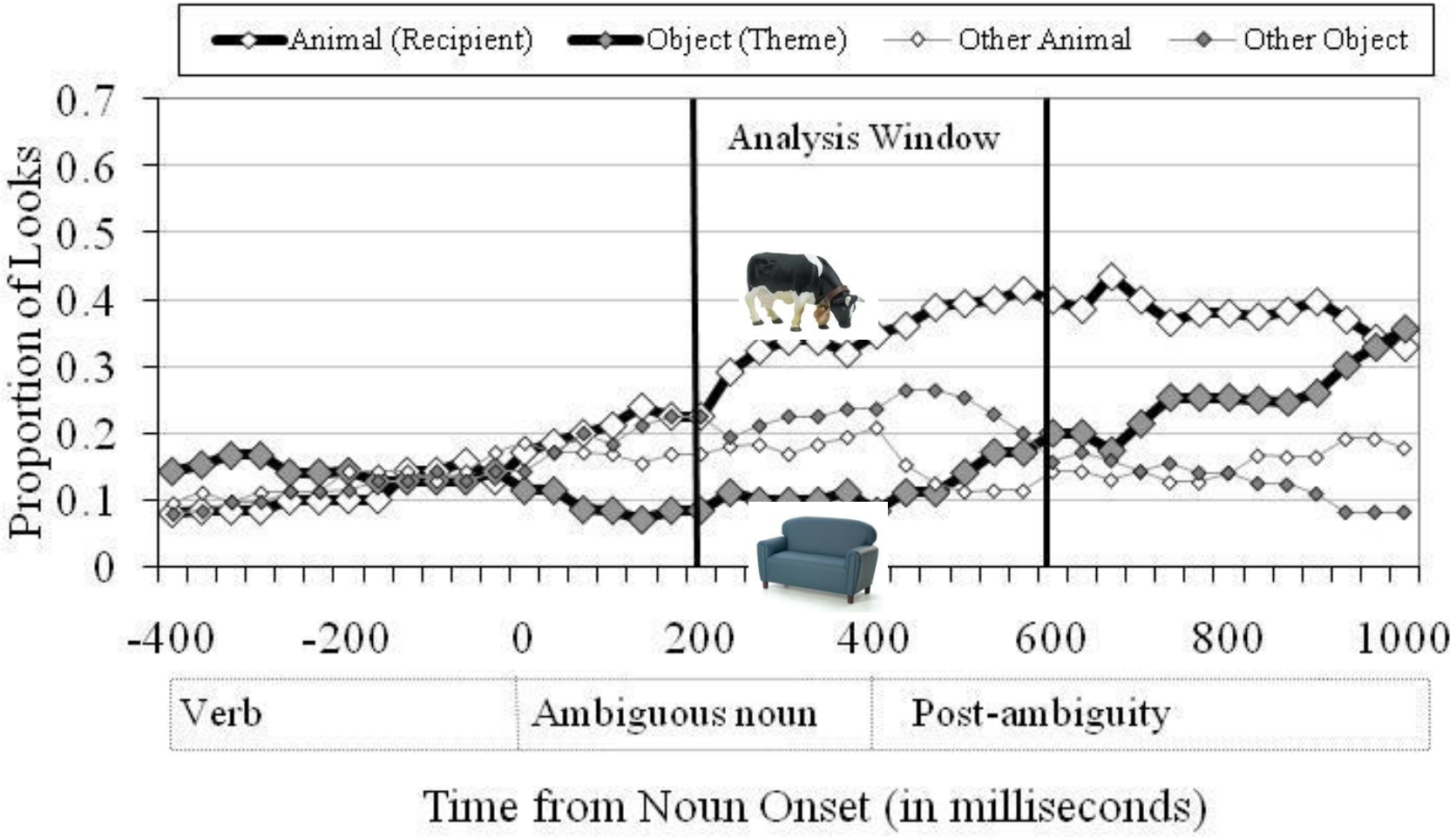
Design

Prime: *Pass the lion the ball* or *Pass the ball to the lion*

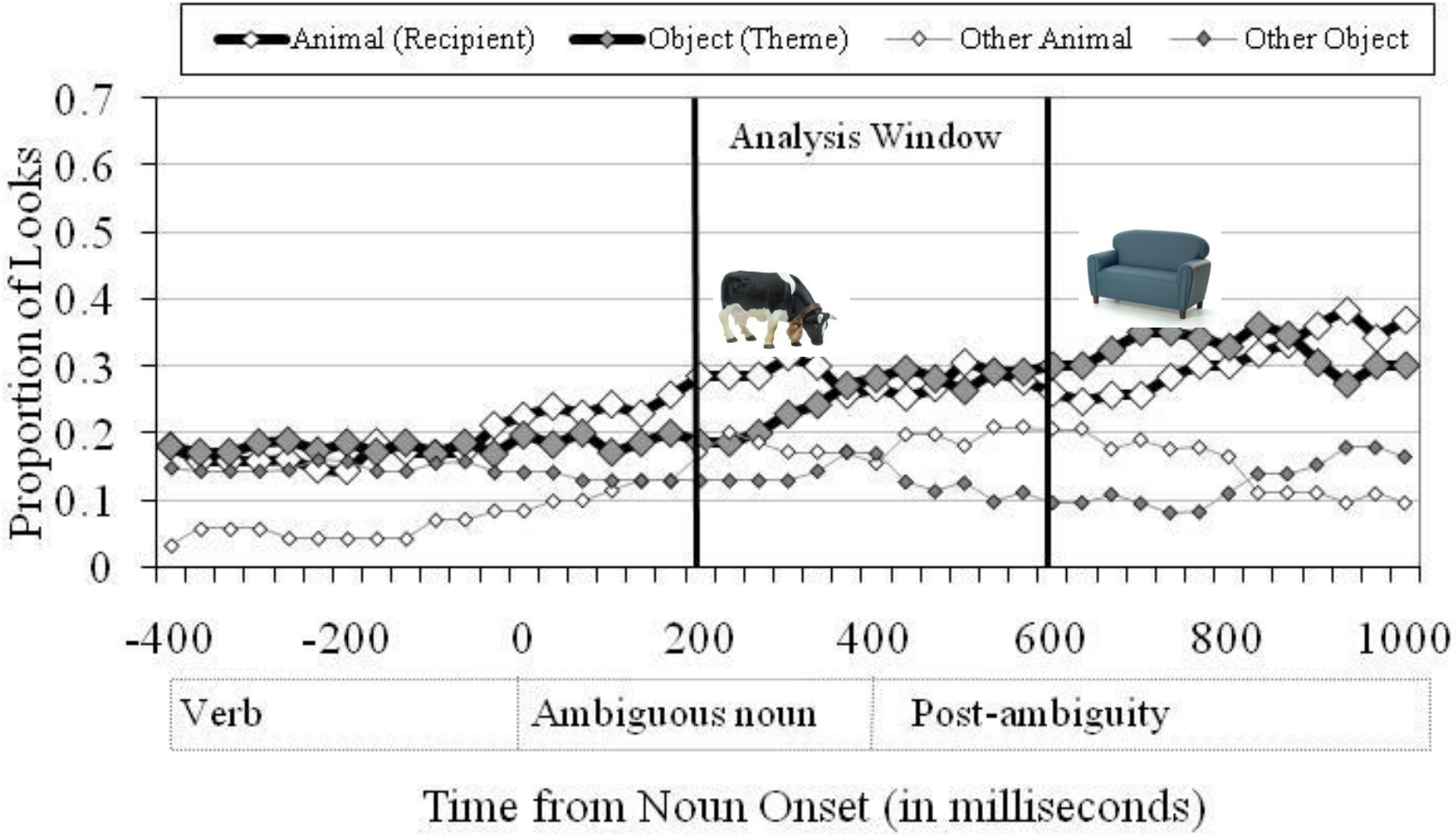


Target: *Pass the **cow** the book* or
*Pass the **couch** to the dog*

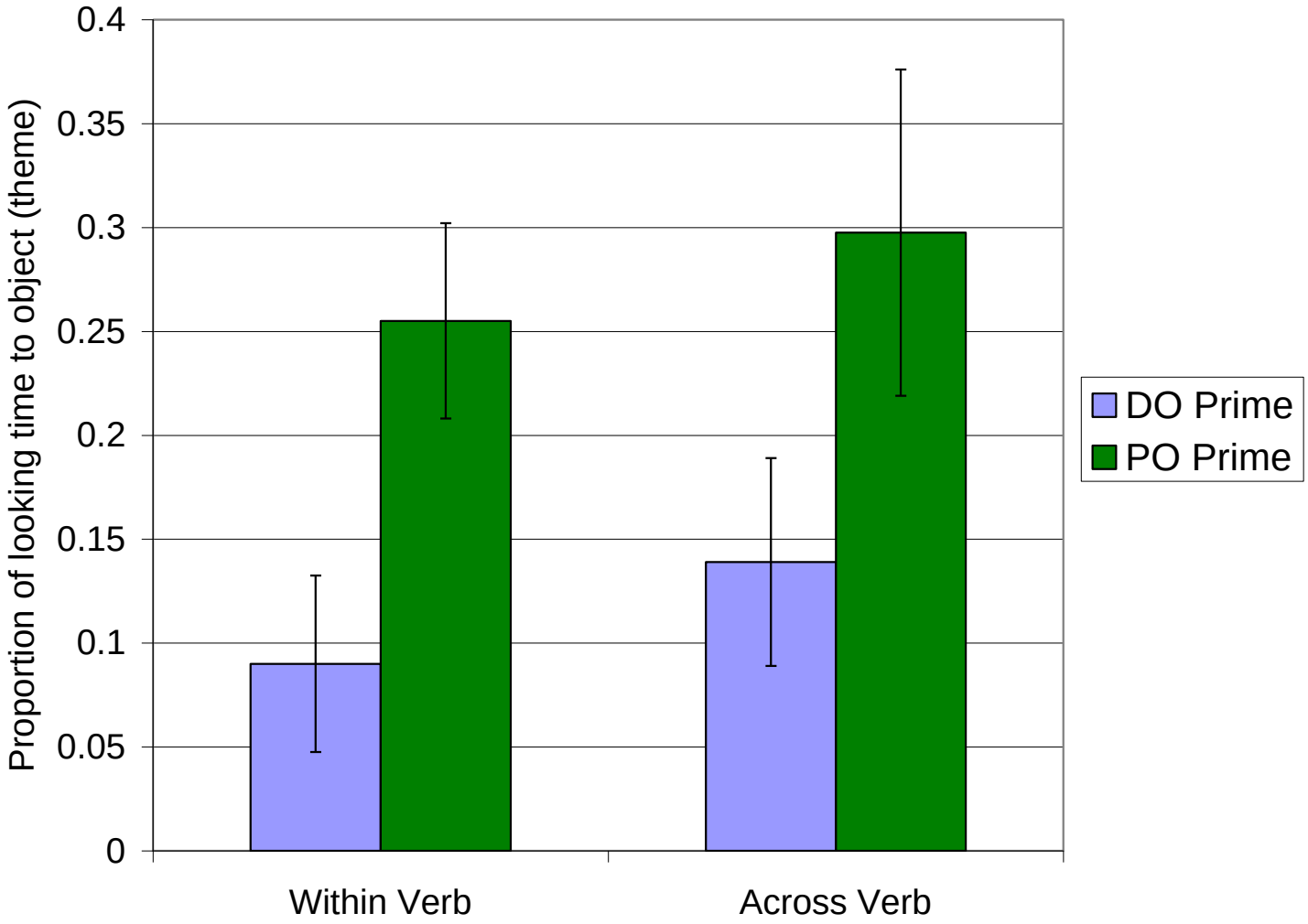
Double Object Primes
4 year olds



Prepositional Object Primes (4 year olds)



Structural priming present at 4 and 3



Thothathiri & Snedeker, 2008a

Convergence across many labs!

Rowland, Chang, Ambridge, Pine & Lieven (2012)

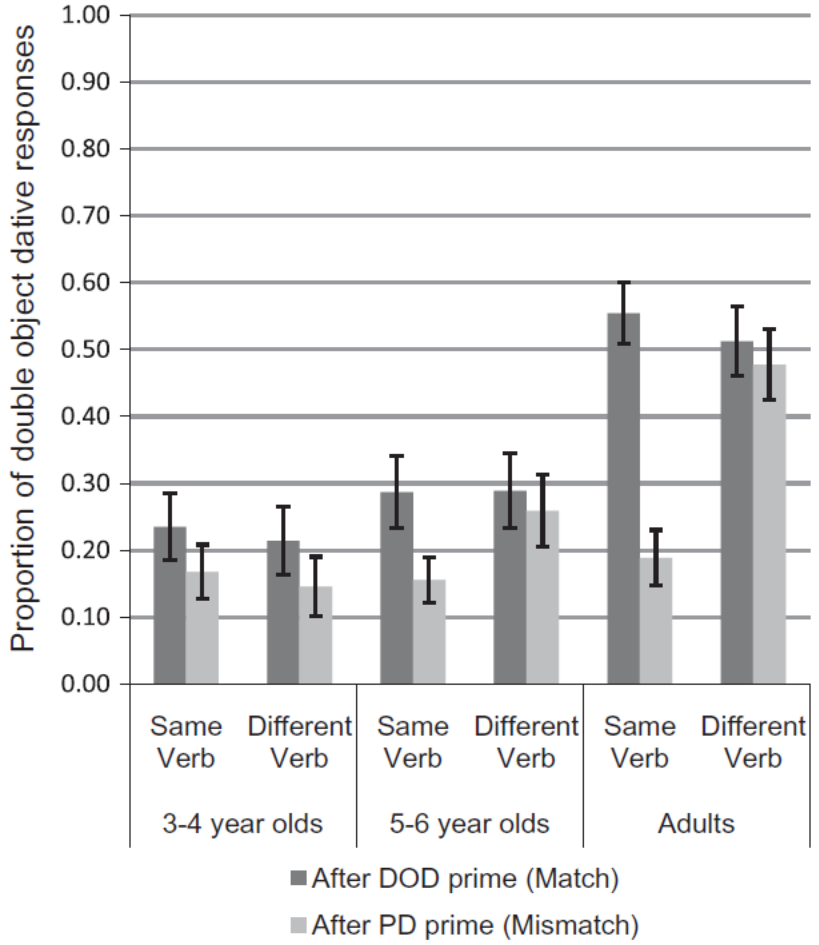


Fig. 1. Mean proportion of datives that were double object datives after DOD and PD primes (SE in error bars).

Convergence across many labs!

Rowland, Chang, Ambridge, Pine & Lieven (2012)

"First, there was a small but significant abstract structural priming effect across all age groups, but this effect was larger in younger children than in older children and adults.

Second, adding verb overlap between prime and target prompted a large, significant increase in the priming effect in adults (a lexical boost), a small, marginally significant increase in the older children and no increase in the youngest children."

- Abstract (broad) representations dominate early processing
- More lexical (specific) representations develop over time

- Evidence for innate syntax?
  - No, it doesn't tell us what the relevant domain is or developmental history
  - Suggests word based theories won't work

D. Infants have rich social cognitive abilities which they apply to language

Infants represent false beliefs

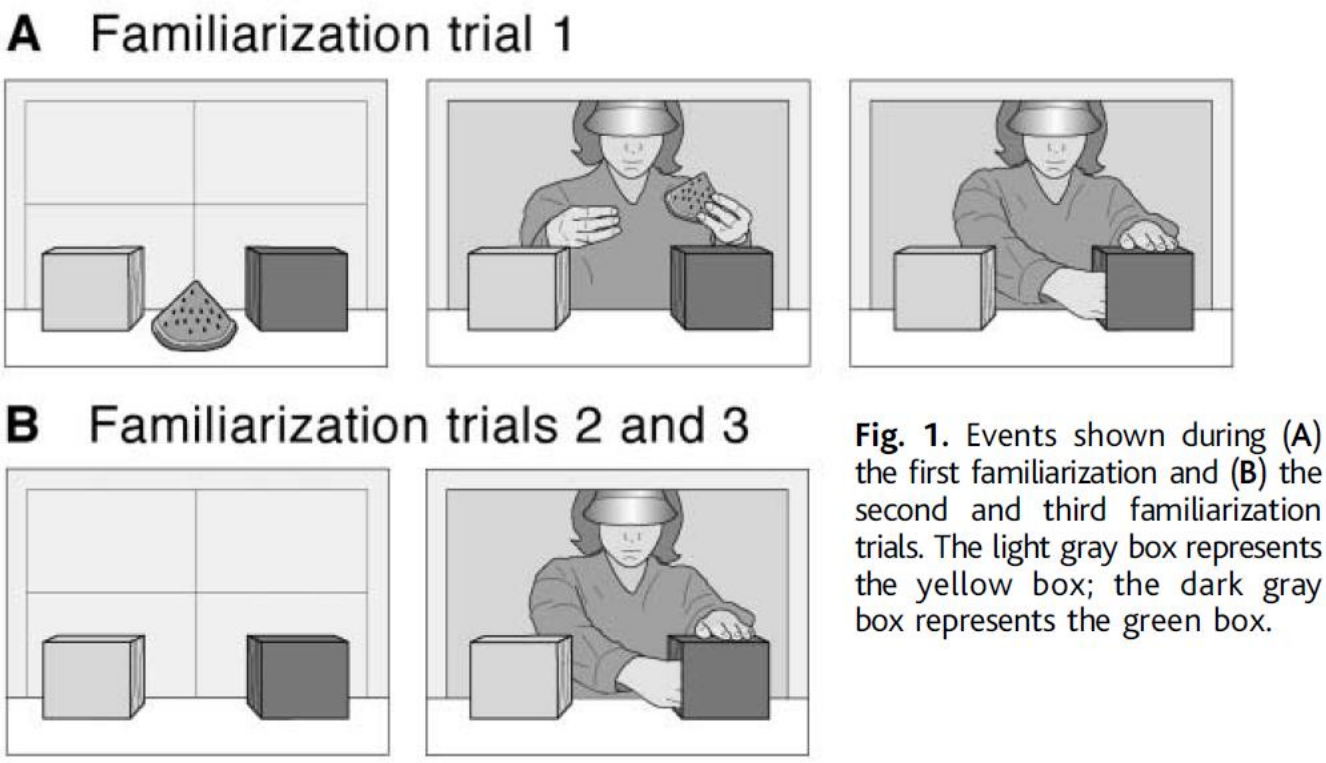
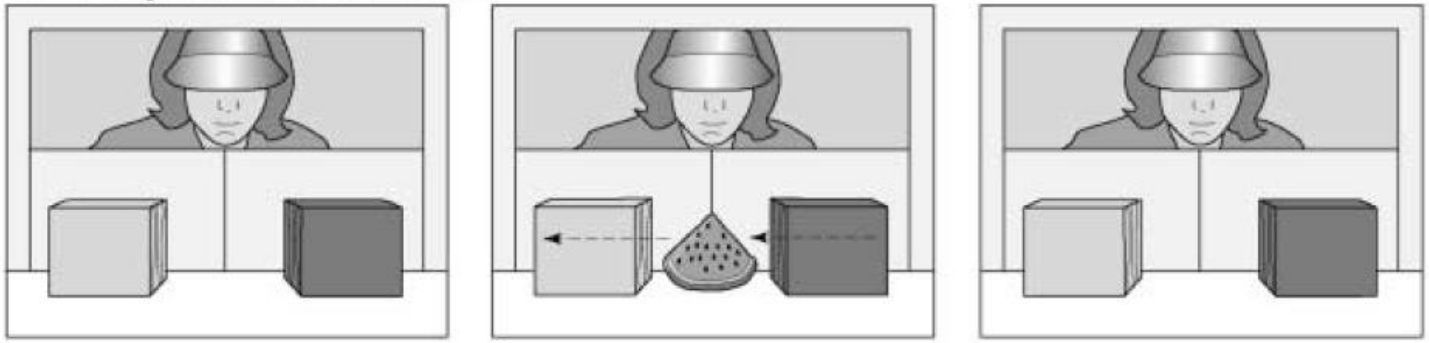


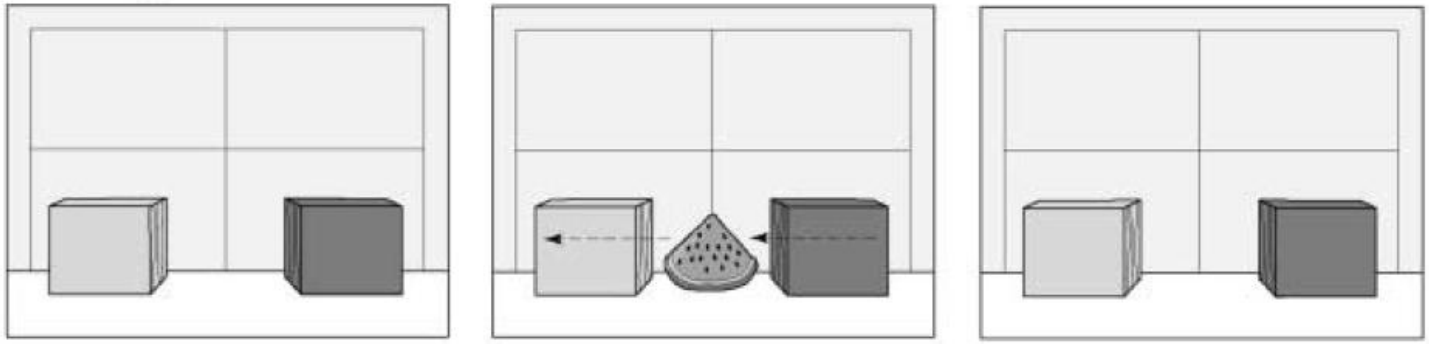
Fig. 1. Events shown during (**A**) the first familiarization and (**B**) the second and third familiarization trials. The light gray box represents the yellow box; the dark gray box represents the green box.

Onishi & Baillargeon, 2005

B TB-yellow condition



C FB-green condition



Infants represent false beliefs

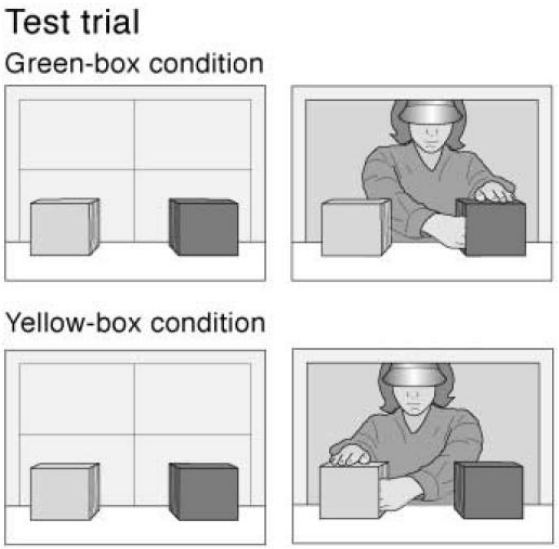


Fig. 3. Events shown during the test trial.

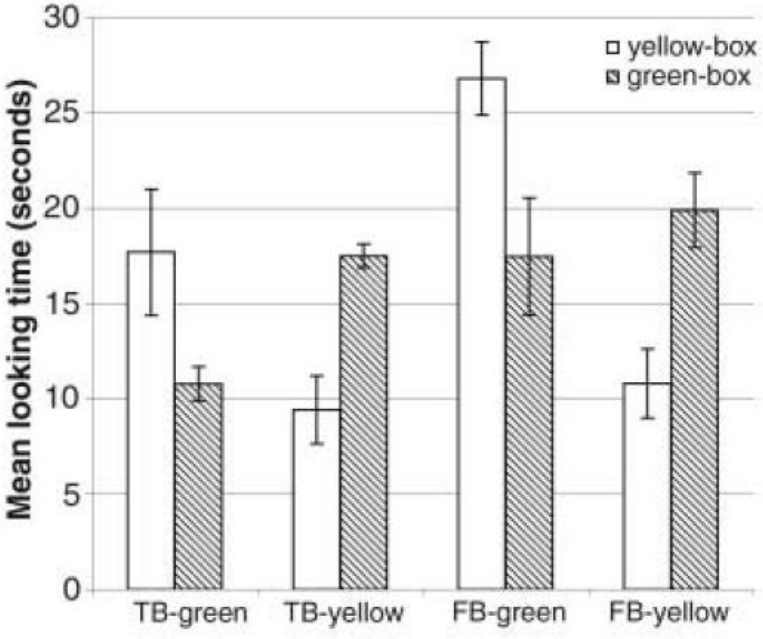


Fig. 4. Mean (±SE) looking times during the test trial (after the actor reached into the green or yellow box) in the four belief conditions.

Onishi & Baillargeon, 2005

Understanding intentions and pedagogy

- Early imitation sensitive to understanding of goals and constraints (head-bop)
- Ostensive communication and language leads to conceptual encoding (kind based)

Gergely Csibra and many others

Intention reading in word learning/reference resolution

- Toddlers link label to what speaker is looking at (Baldwin, 1991/1993)
- Use speakers intentions to rule out accidental referents (Tomasello)
- Keep track of what is novel to another person

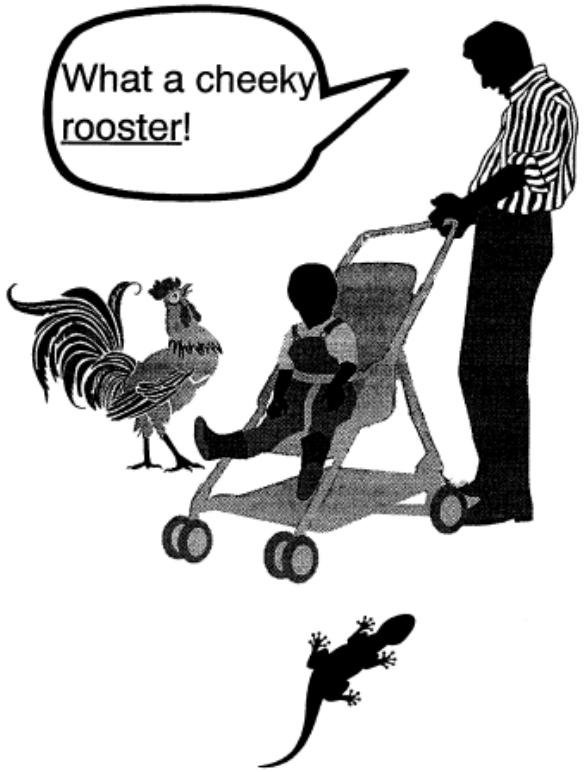


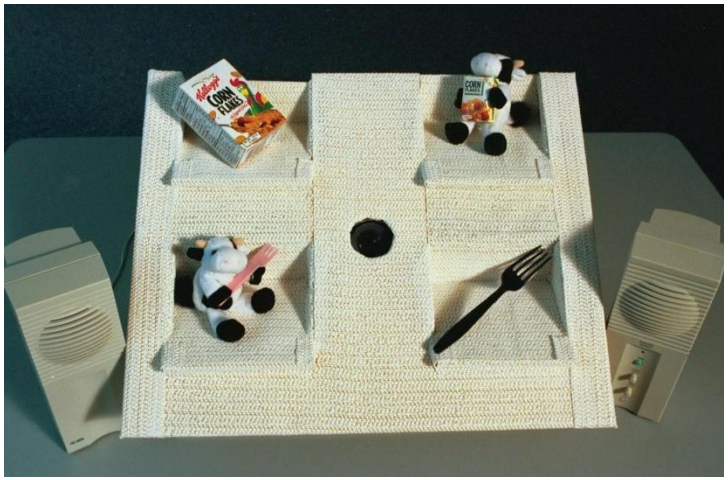
Figure 1 Child and adult (speaker) are both looking at different objects at the time the speaker uses a novel word to name a novel object. From Baldwin (1995).

Picture: Baron-Cohen et al., 1997

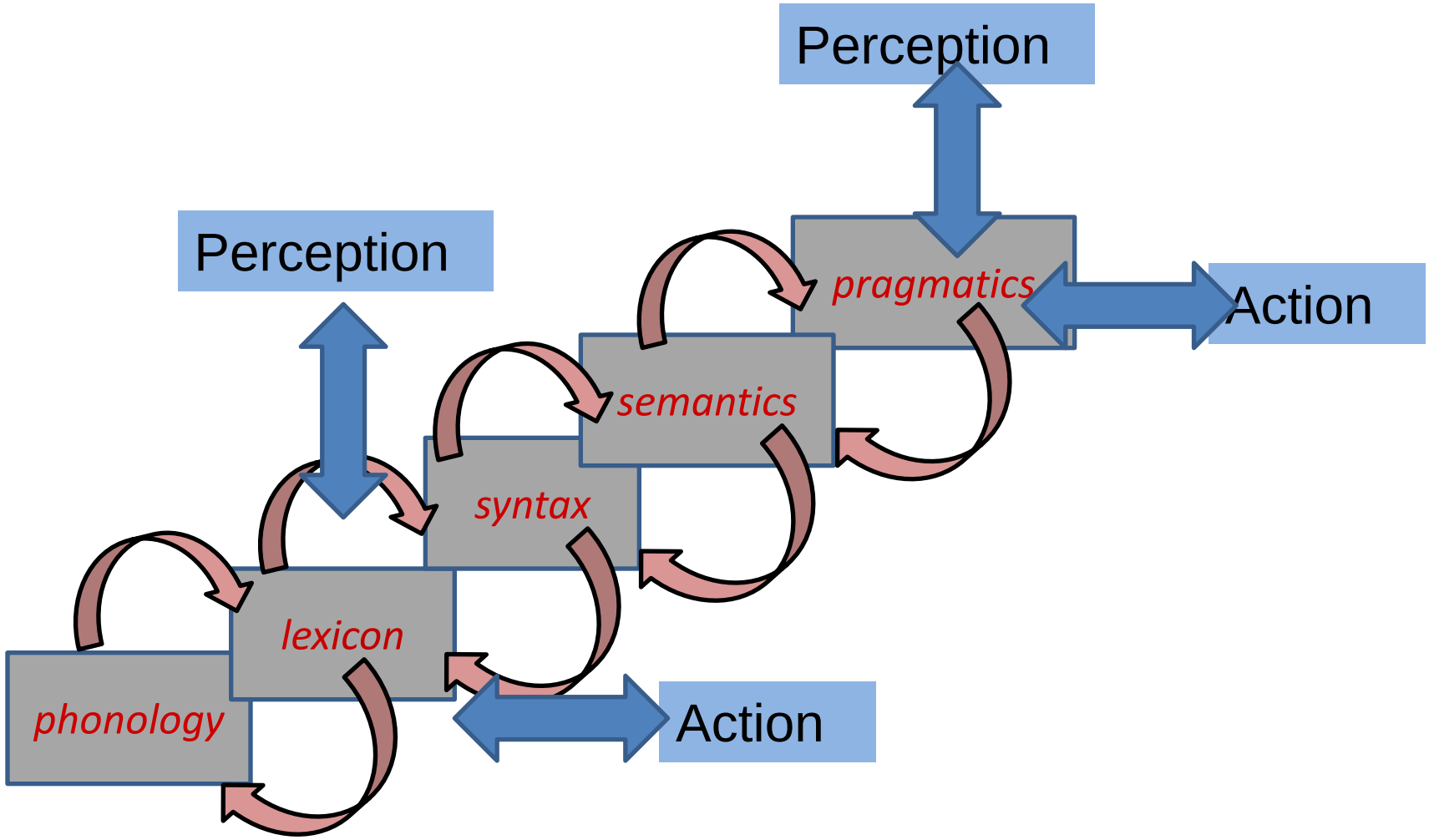
II. The development of language processing

With an emphasis on what children do poorly

Study of children's online comprehension is blossoming



21st century standard model processing



21st CSM applies to children too

1. Series of linked representations
   - Syntactic priming/early abstraction
2. Incremental cascaded processing
   - Phonosemantic priming at 5 (and 2)
3. Interactive processing
   - Lexical and syntactic cues to parsing
4. Predictive processing
   - Thematic prediction
5. No walls around language
   - Eye-movements, implicit naming
6. Flexible system
   - Priming and perseveration

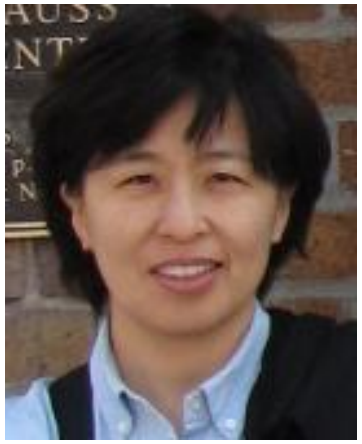
But young children are different from adults

A. Slower, noisier processing
B. Perseveration
C. Failures to revise
D. Difficulty using top-down constraints

A. Children are slower and noisier

Test case: Negation

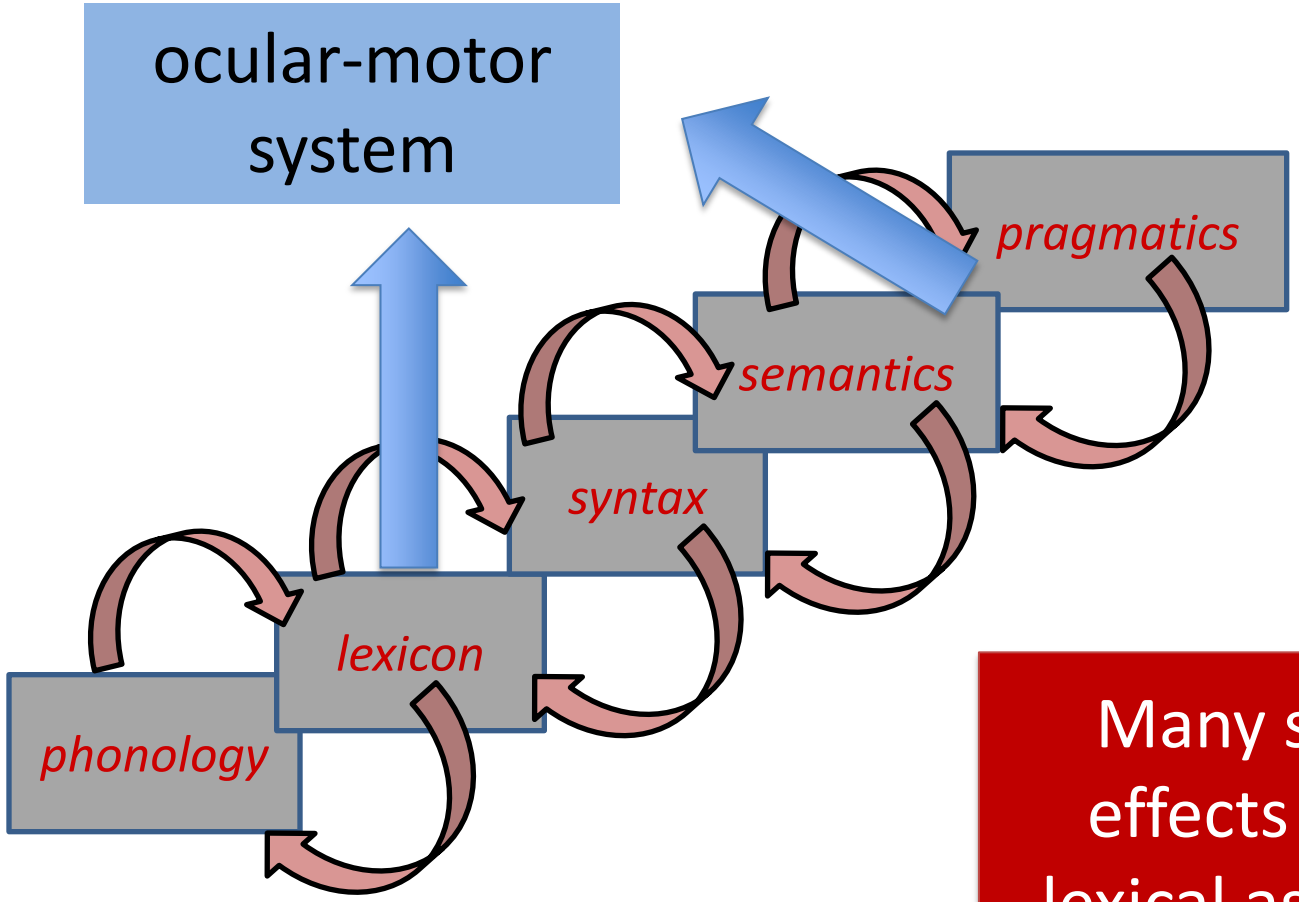
Roman Feiman
Harvard



Miseon Lee
Hanyang University

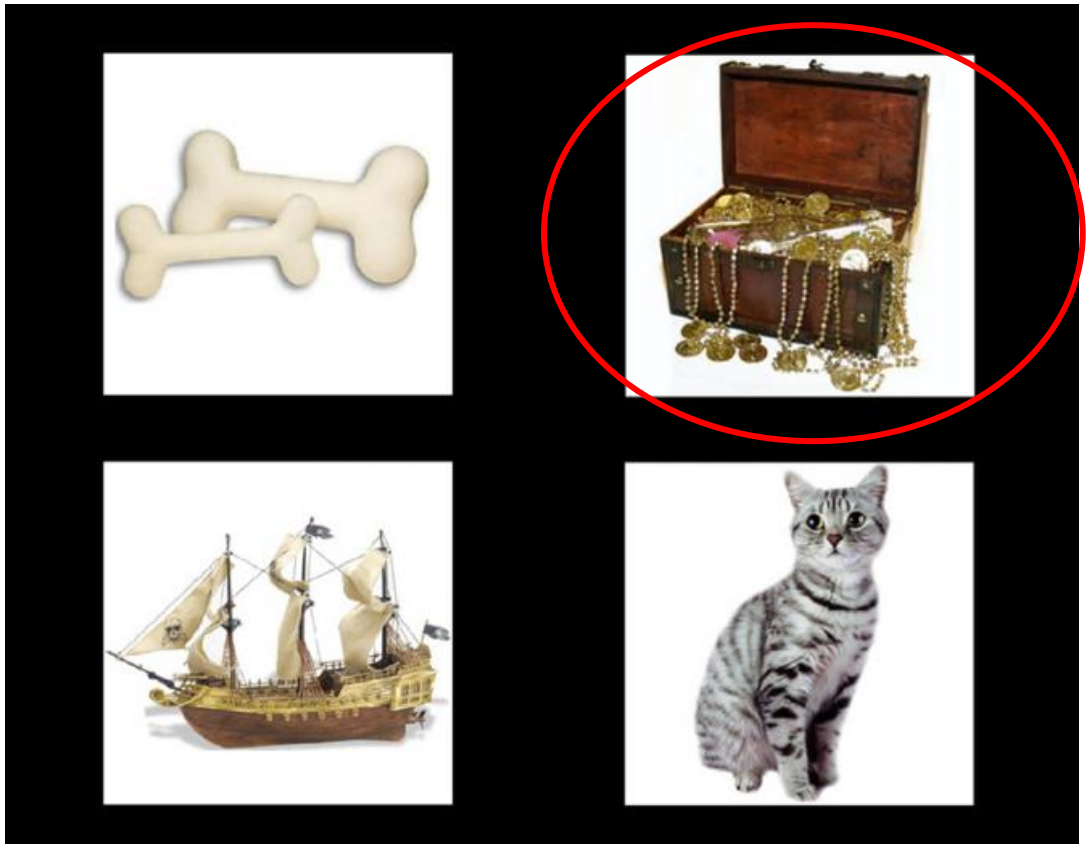
Tracy Brookheyser
Harvard

Is the visual-world paradigm sensitive to combinatorial meaning?



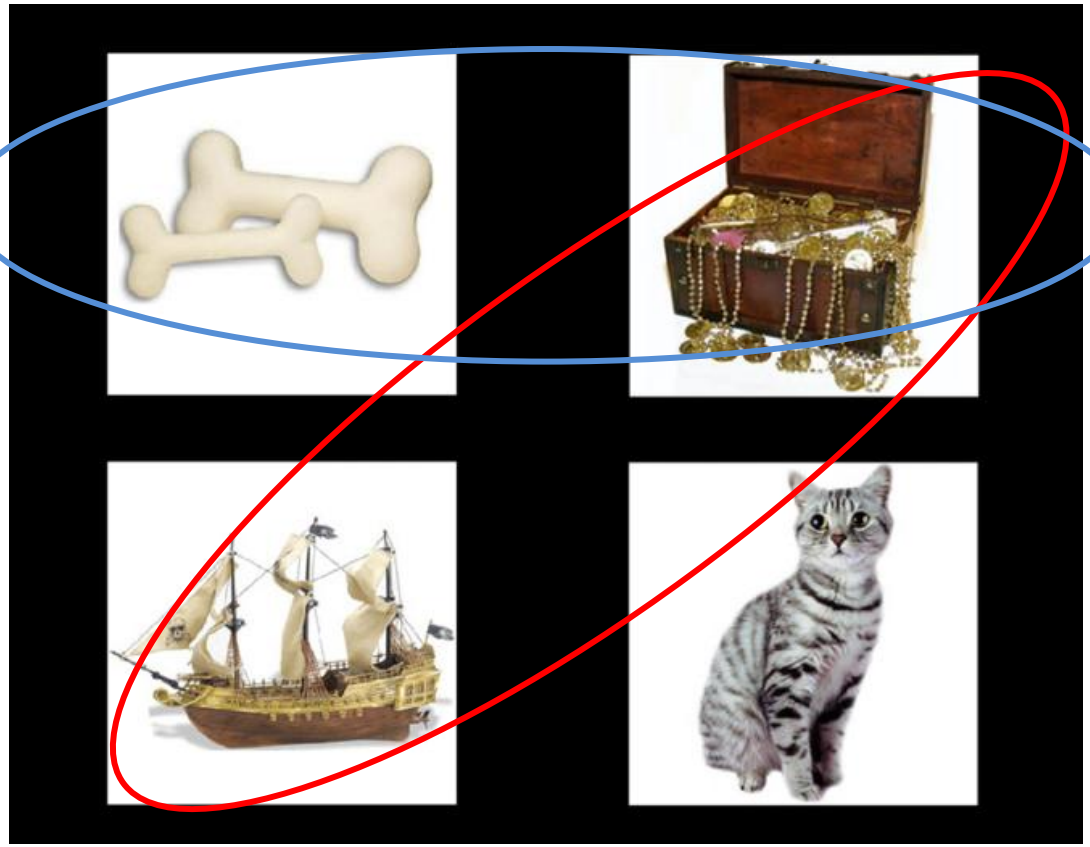
Many semantic effects could be lexical associations

Example: Borovsky, Elman & Fernald (2012)



"The pirate hides the treasure"

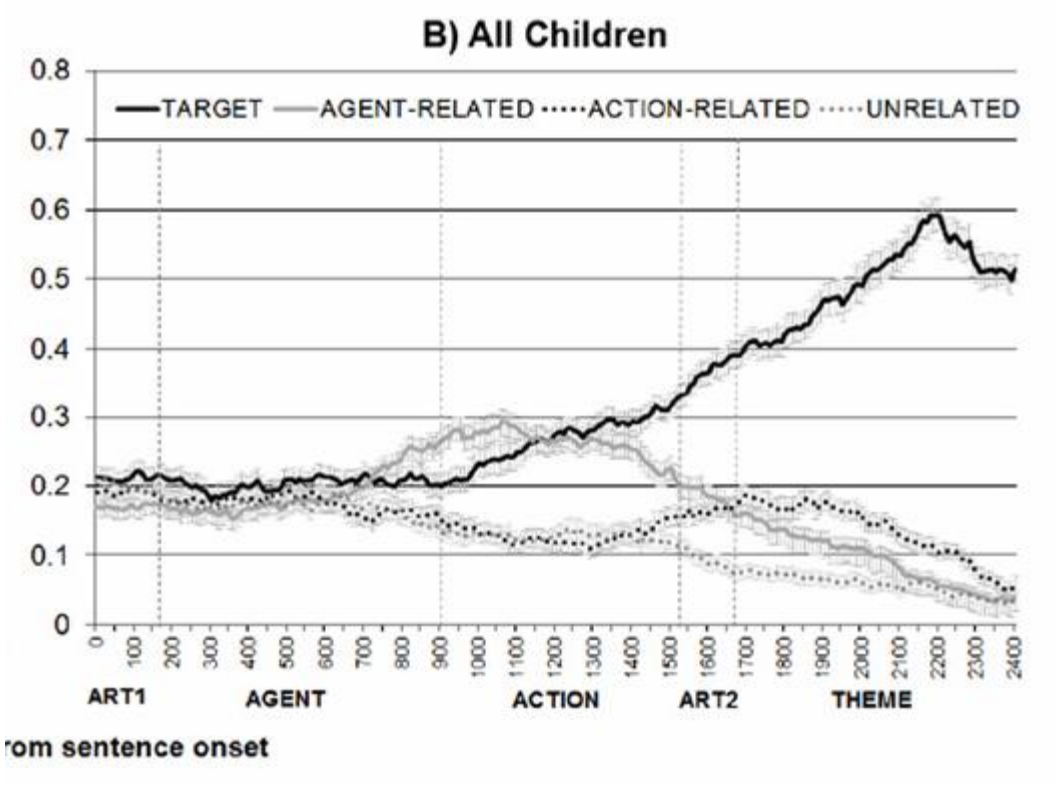
Must use information from subject & verb



"The pirate hides the treasure"

Children can use multiple constraints on prediction

(Borovsky, Elman & Fernald, 2012)



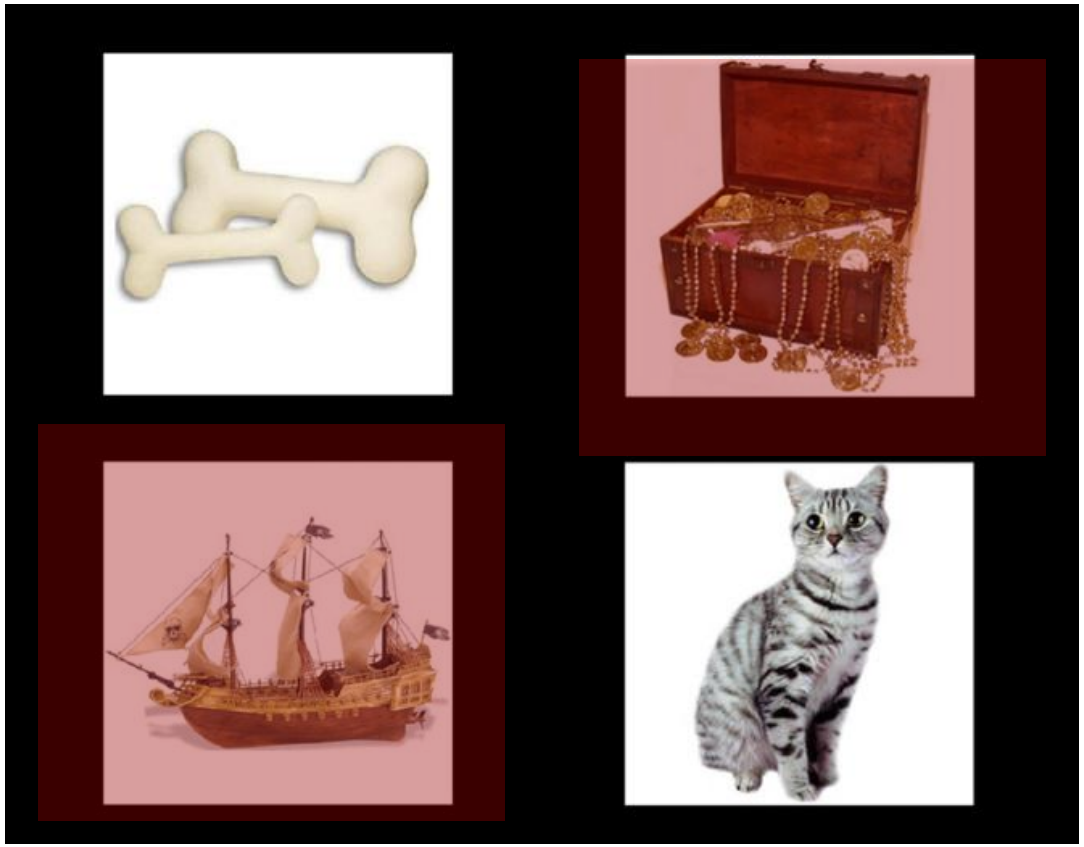
Is this semantic composition?

Or just overlapping associations?

Over-additive effect : Target > agent + action prime

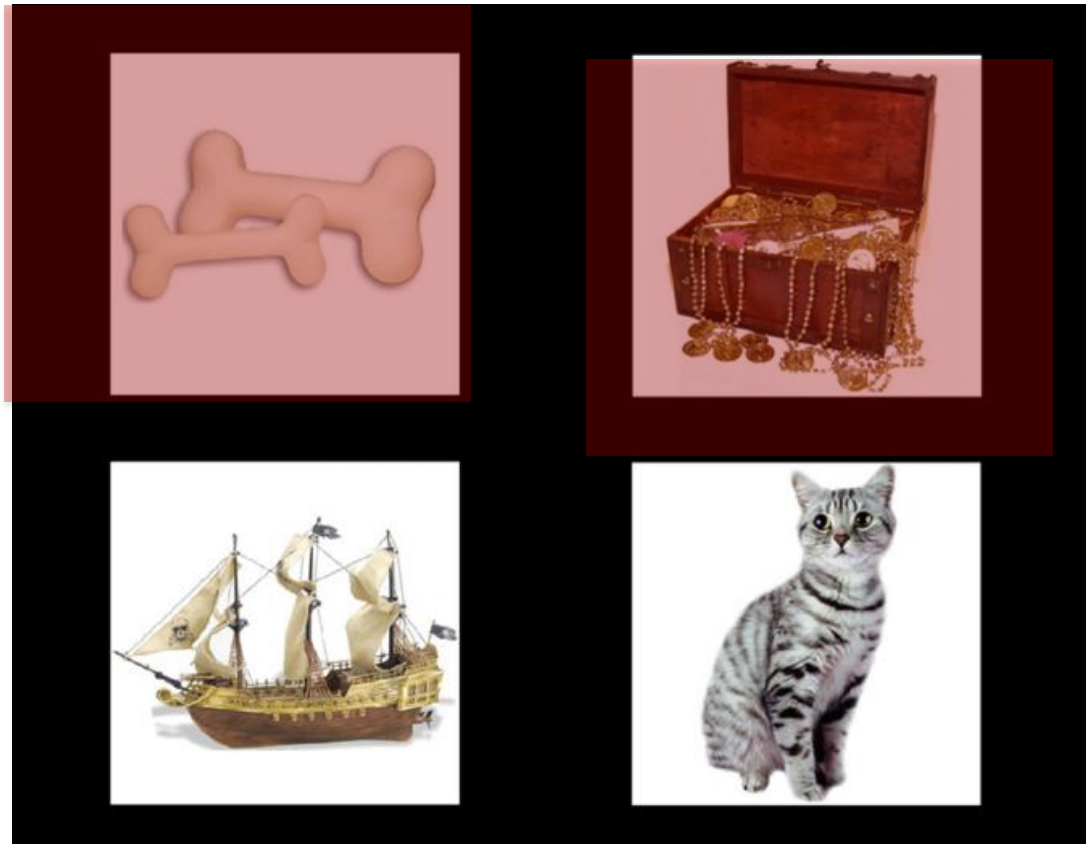
But what is the mapping hypothesis for how associative constraints combine?

But it need not involve composition



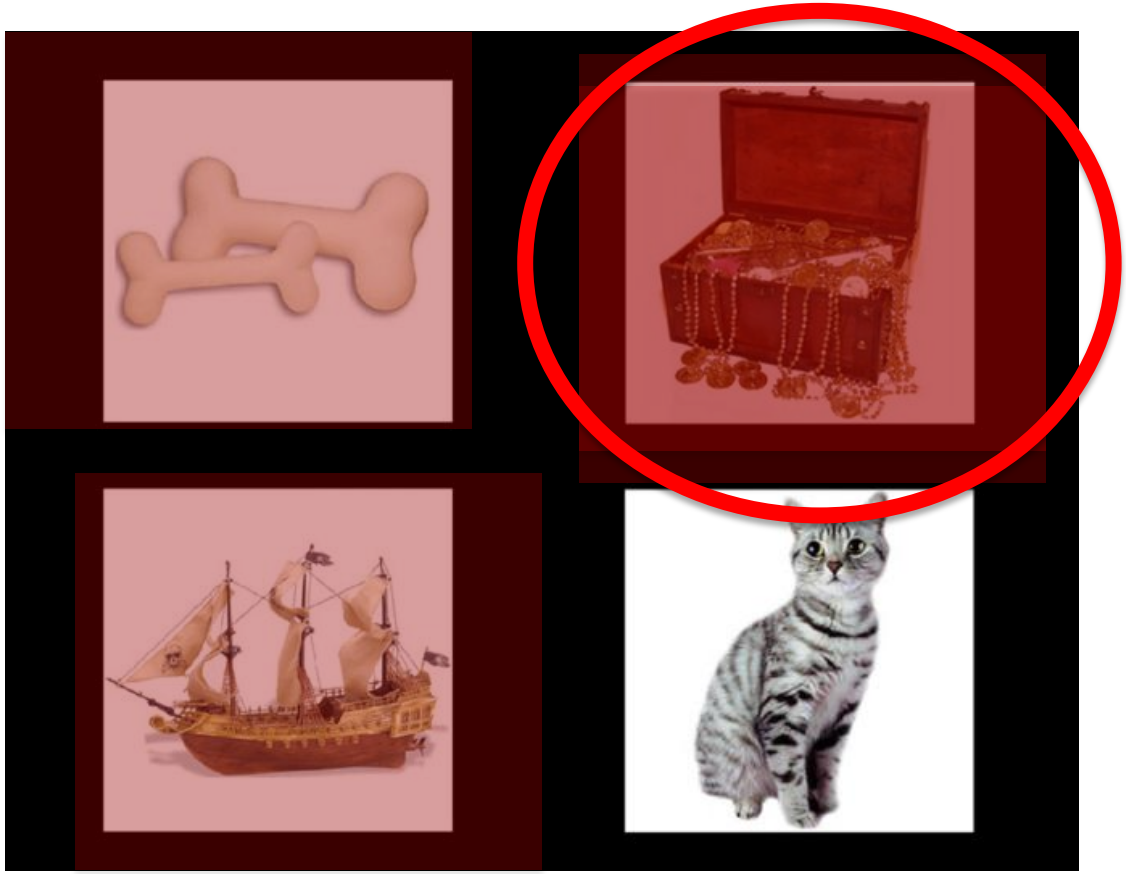
Pirate Association Strength

But it need not involve composition



Hiding Association Strength

But it need not involve composition



Combined Association Strength

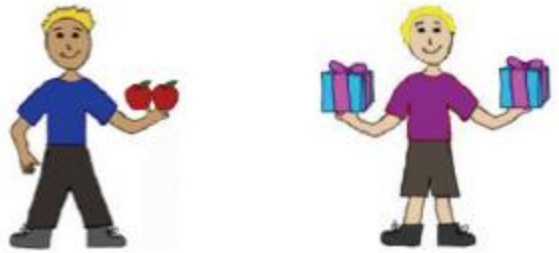
Incrementality at higher level….

- Lexical storage could support stable associations
  - Facilitating incremental processing
- Are higher-level representations constructed incrementally?
- Negation as test case
  - Reverses the usual pattern of association
- Adult negation processing
  - Negatives initially treated as affirmatives in weak contexts[1]
  - But not in rich discourse contexts[2]

1. Kaup et al., 2007; Fischler et al., 1983; Kunios & Holcomb, 1992; Ludke et al., 2008.
2. Nieuwland & Kuperberg, 2008; Tian, Breheny & Ferguson, 2010.

Children bomb many negation tasks

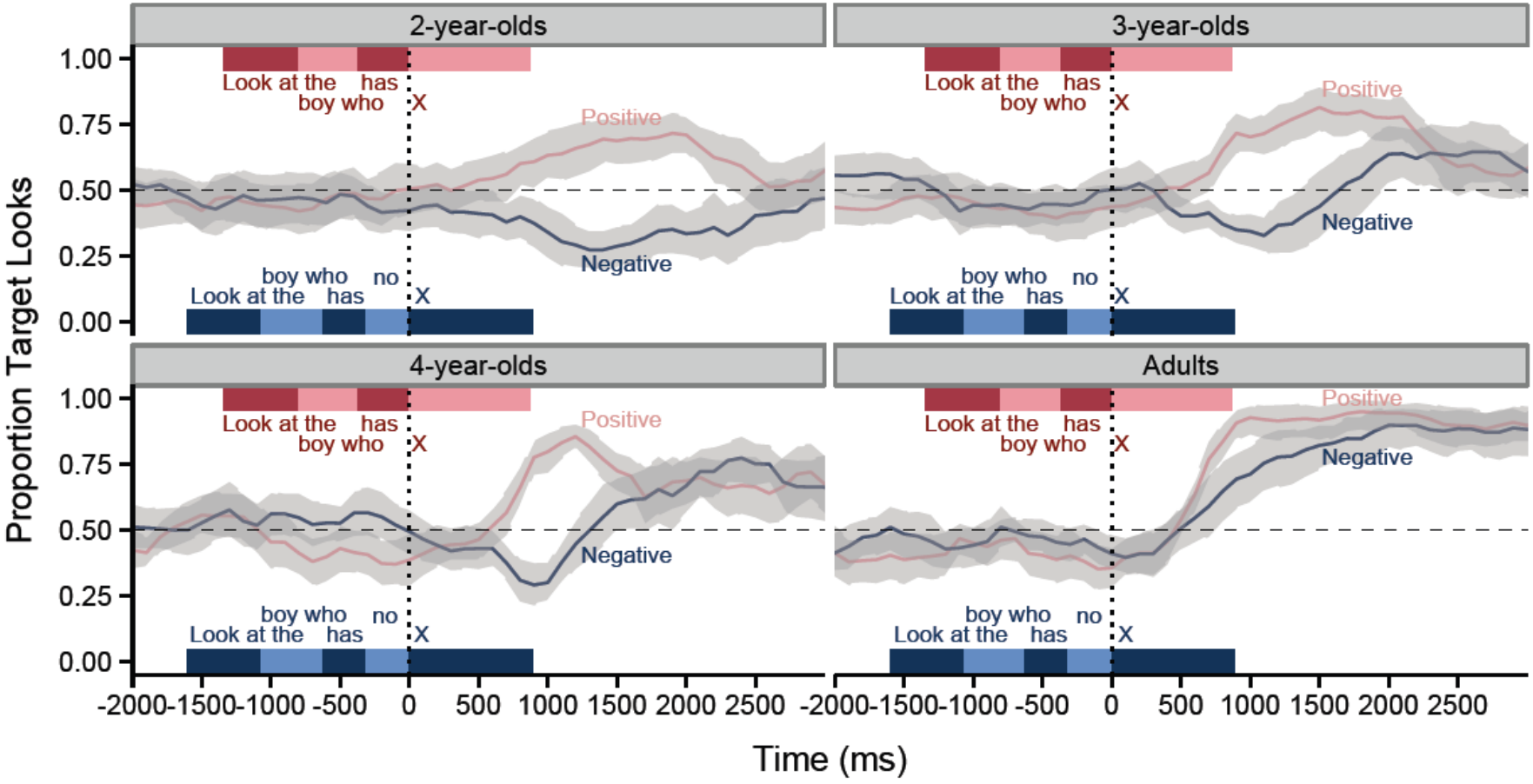
"See these boys?"



"Look at the boy who has apples"
"Look at the boy who has no apples"

Nordmeyer & Frank, 2013/under review

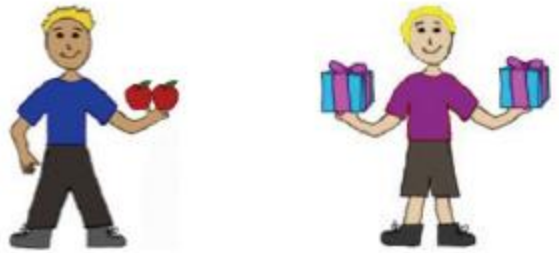
Children bomb many negation tasks



Nordmeyer & Frank, 2013/under review

But maybe this is due to difficulty interpreting infelicitous uses of negation

"See these boys?"



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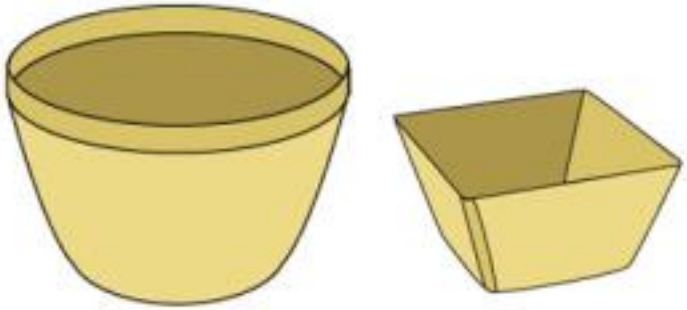
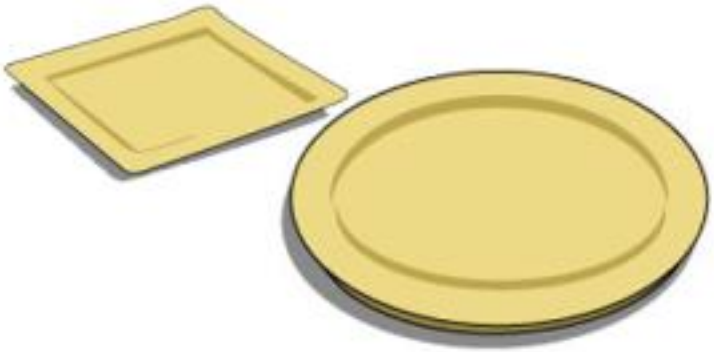
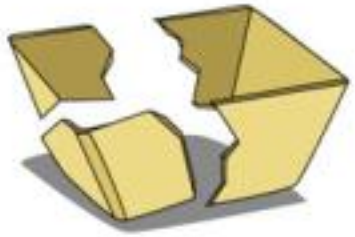
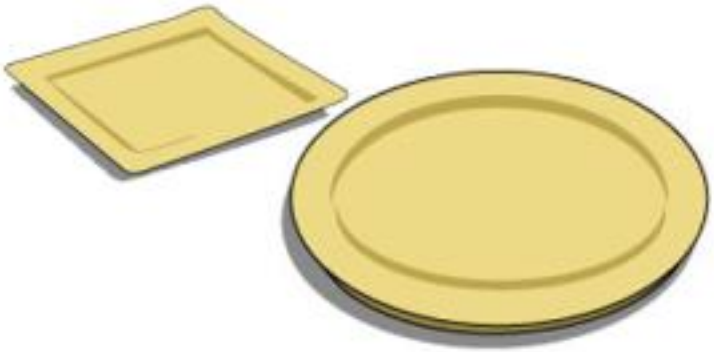
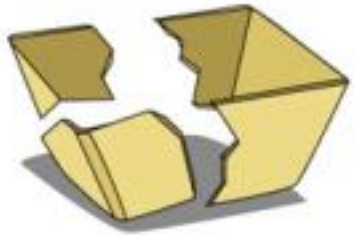
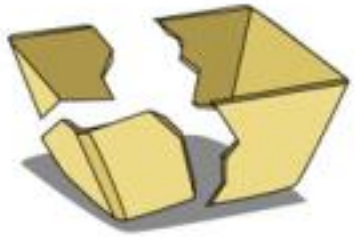


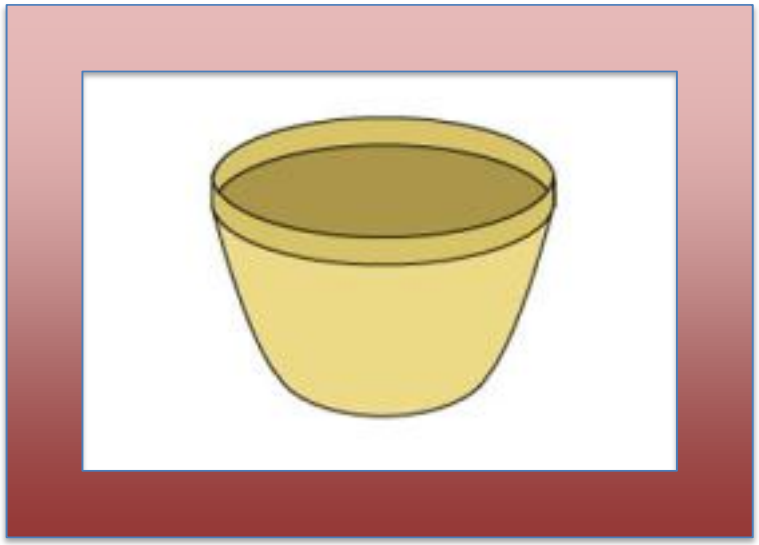




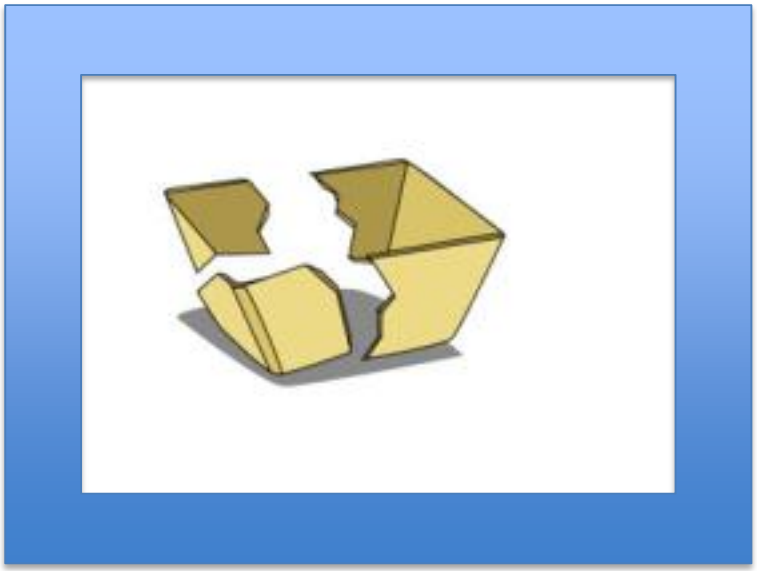




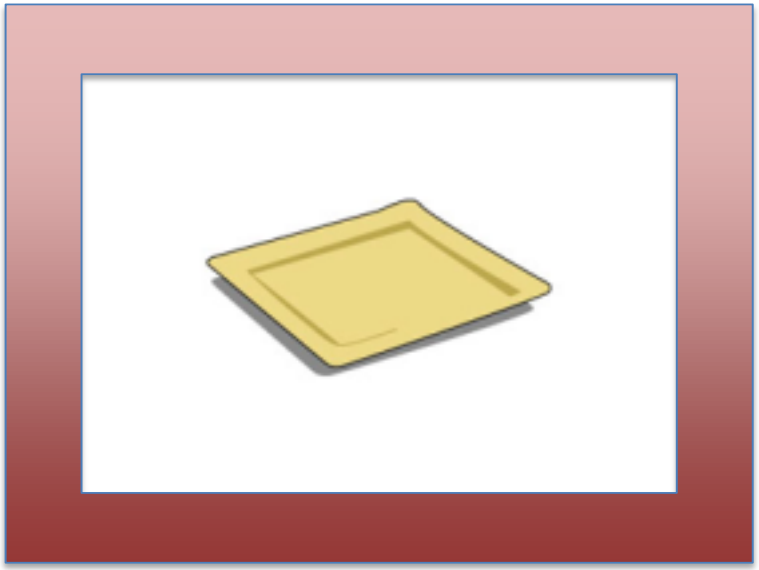


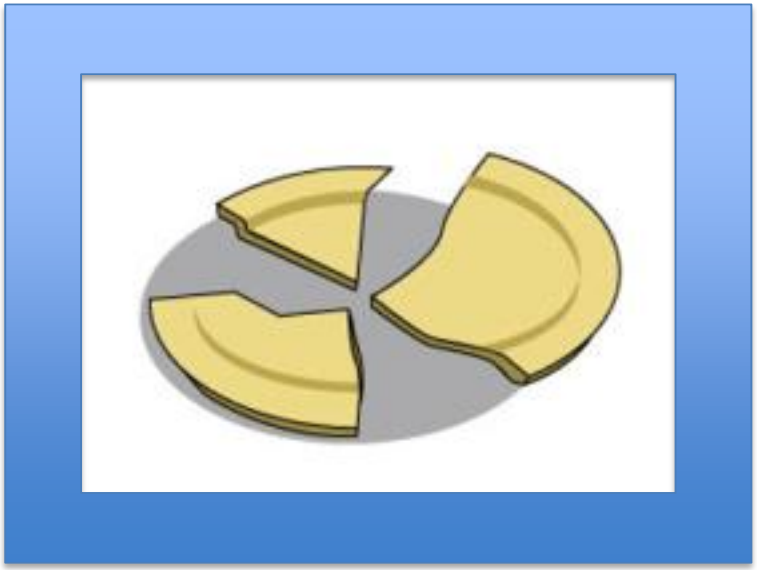


Negative

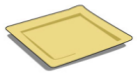


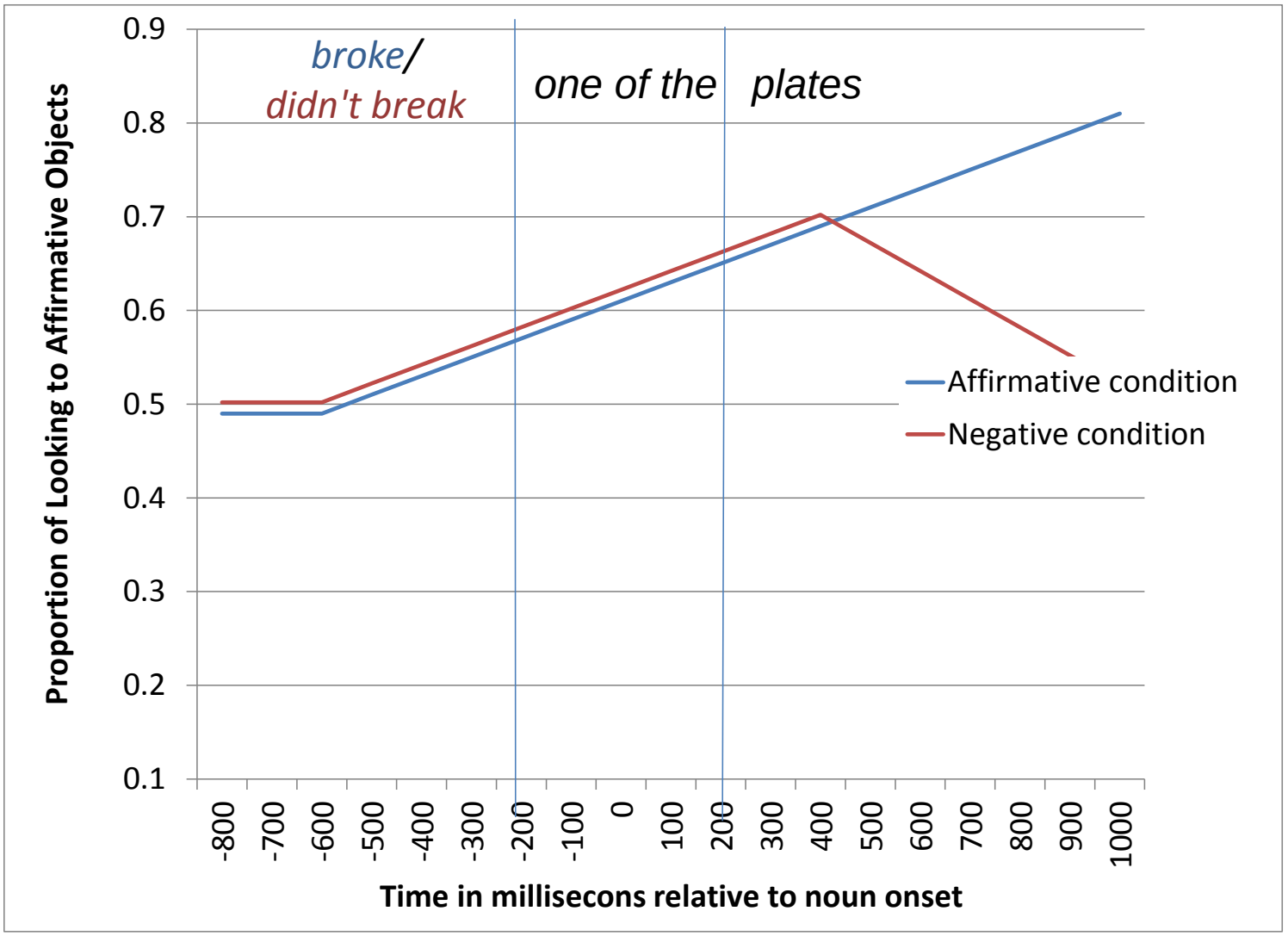
Affirmative



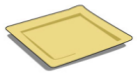


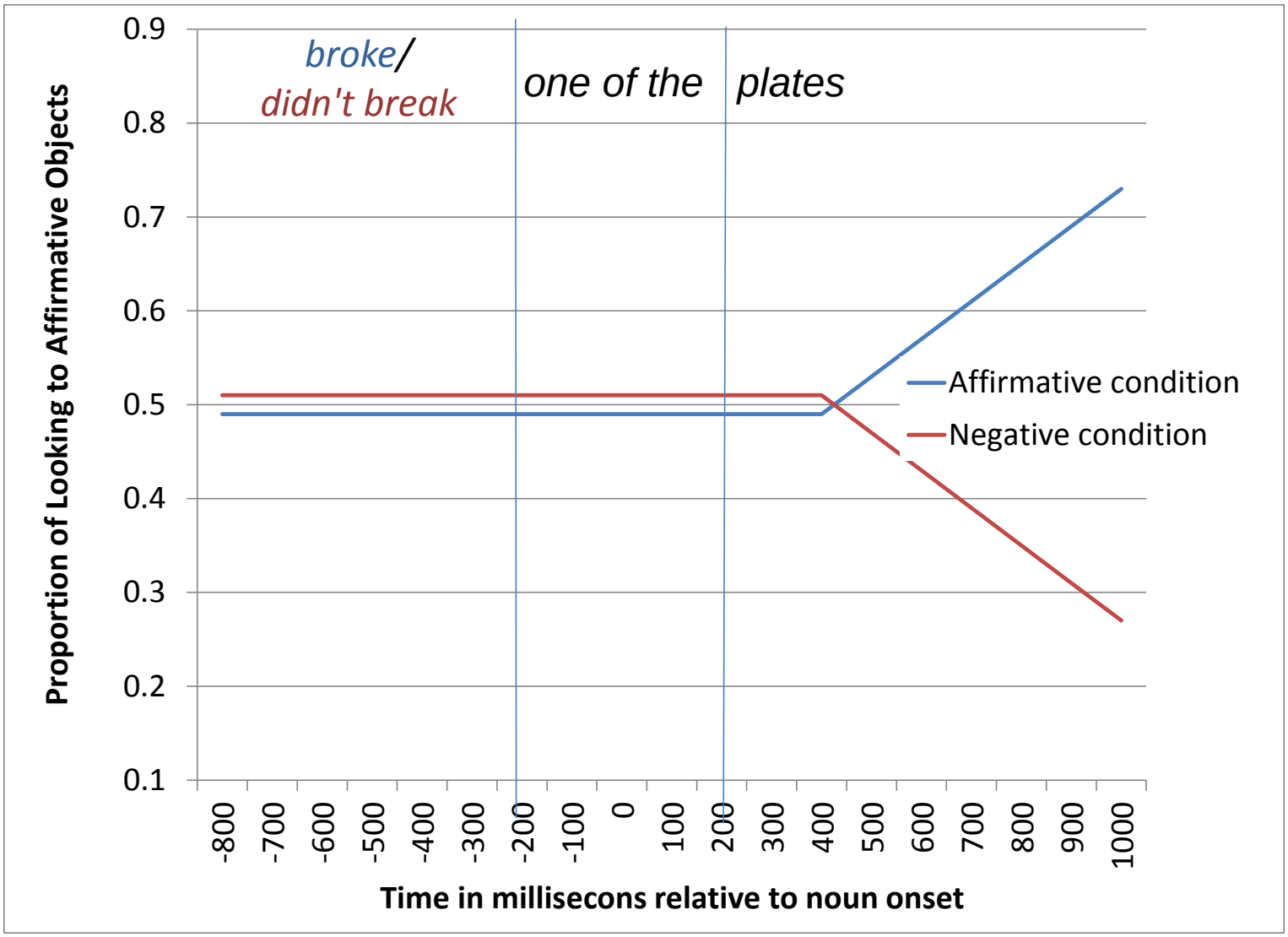
Prediction: associative processing



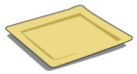


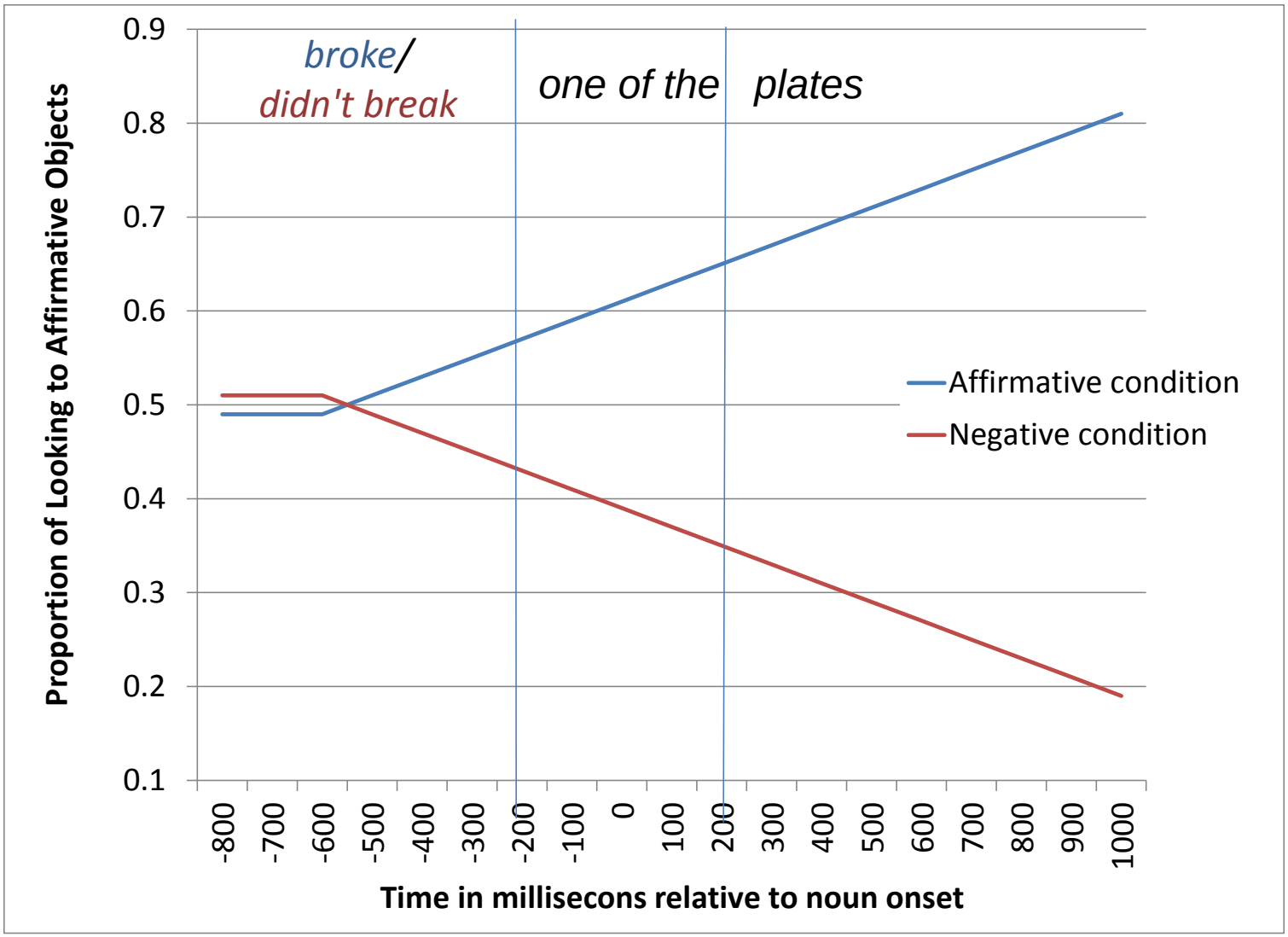
Prediction: wait for full proposition



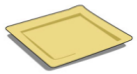


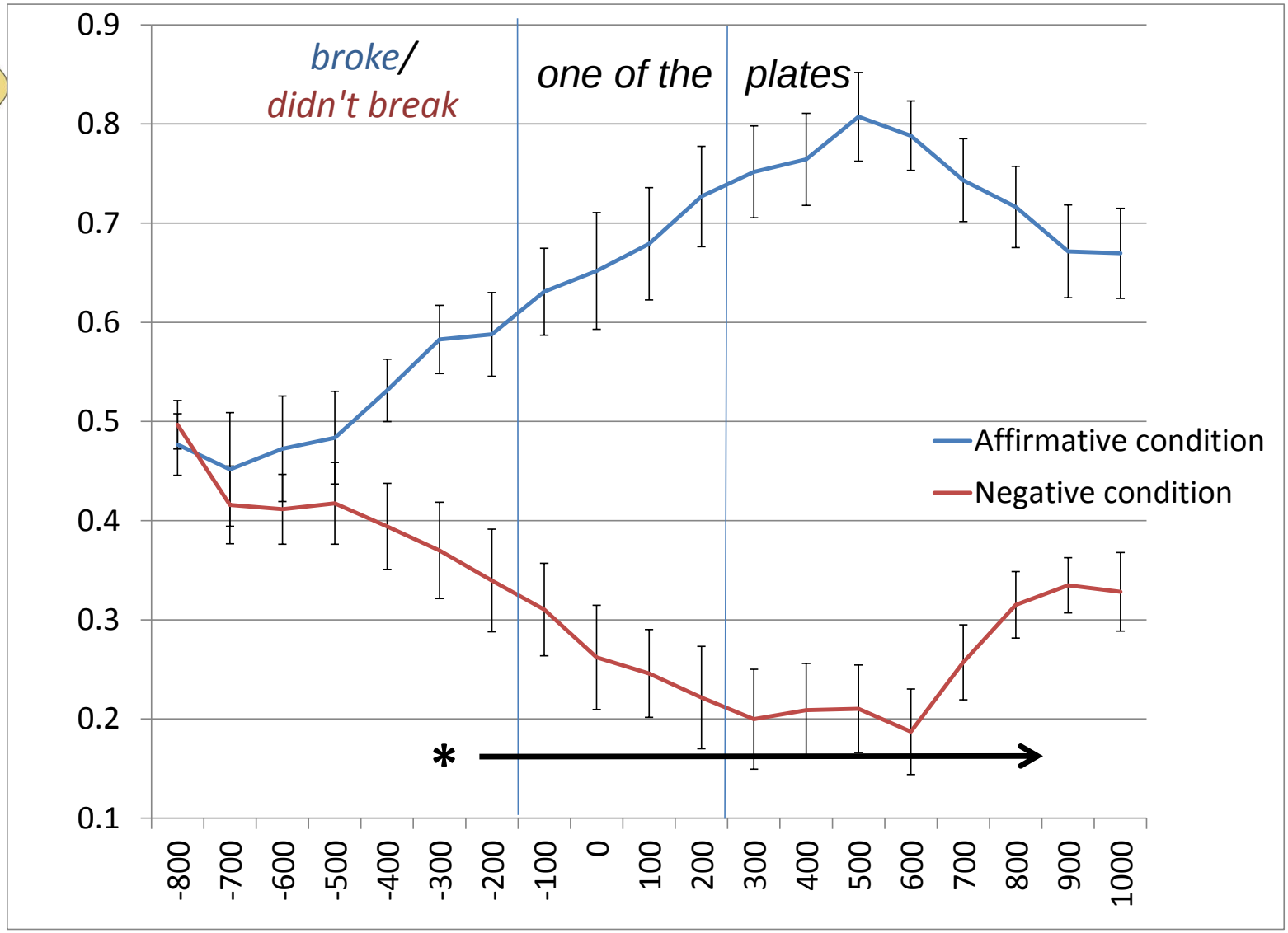
Prediction: incremental semantics





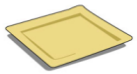
Adults are incremental

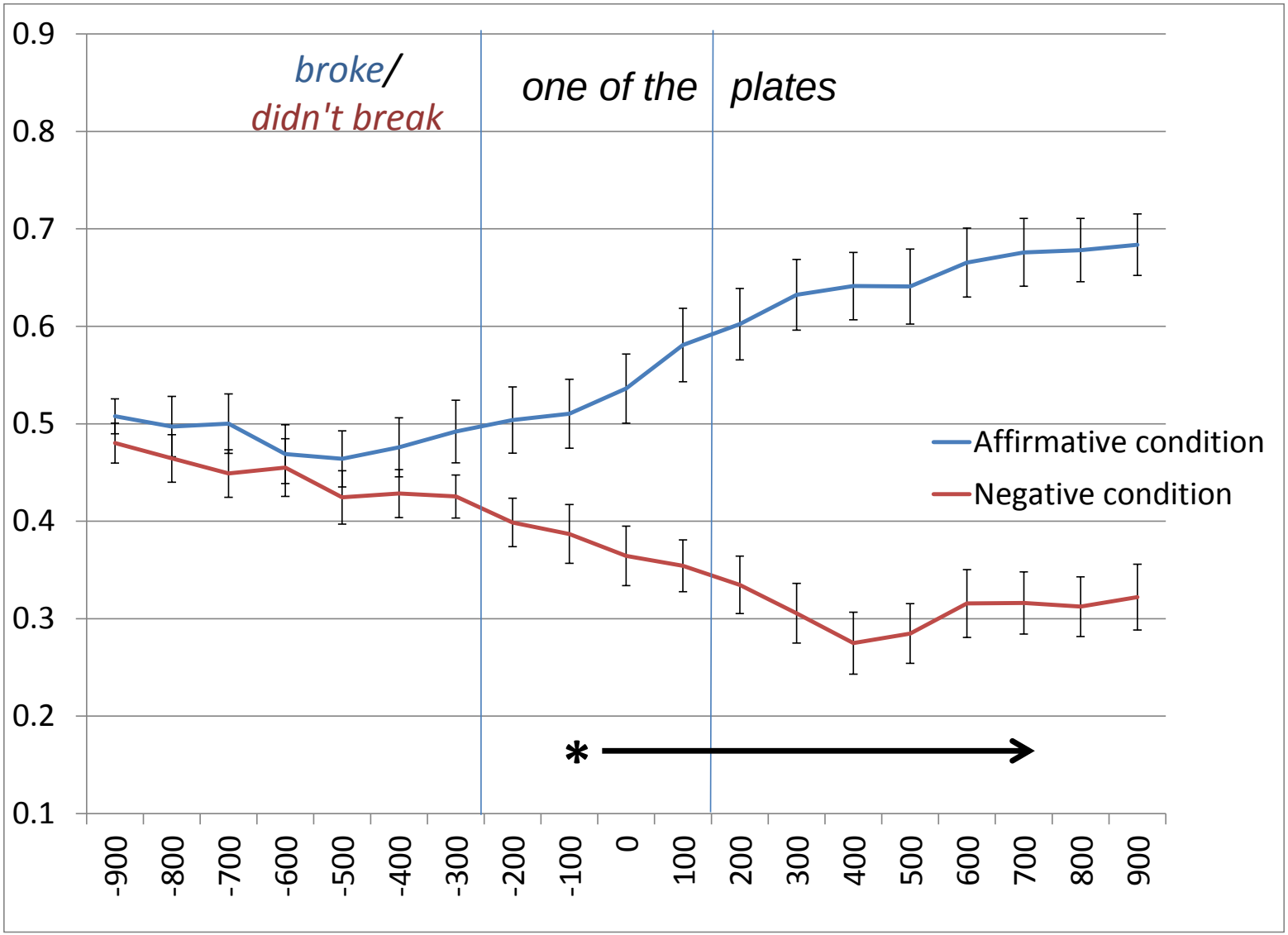




4 year olds are incremental but slower and noisier

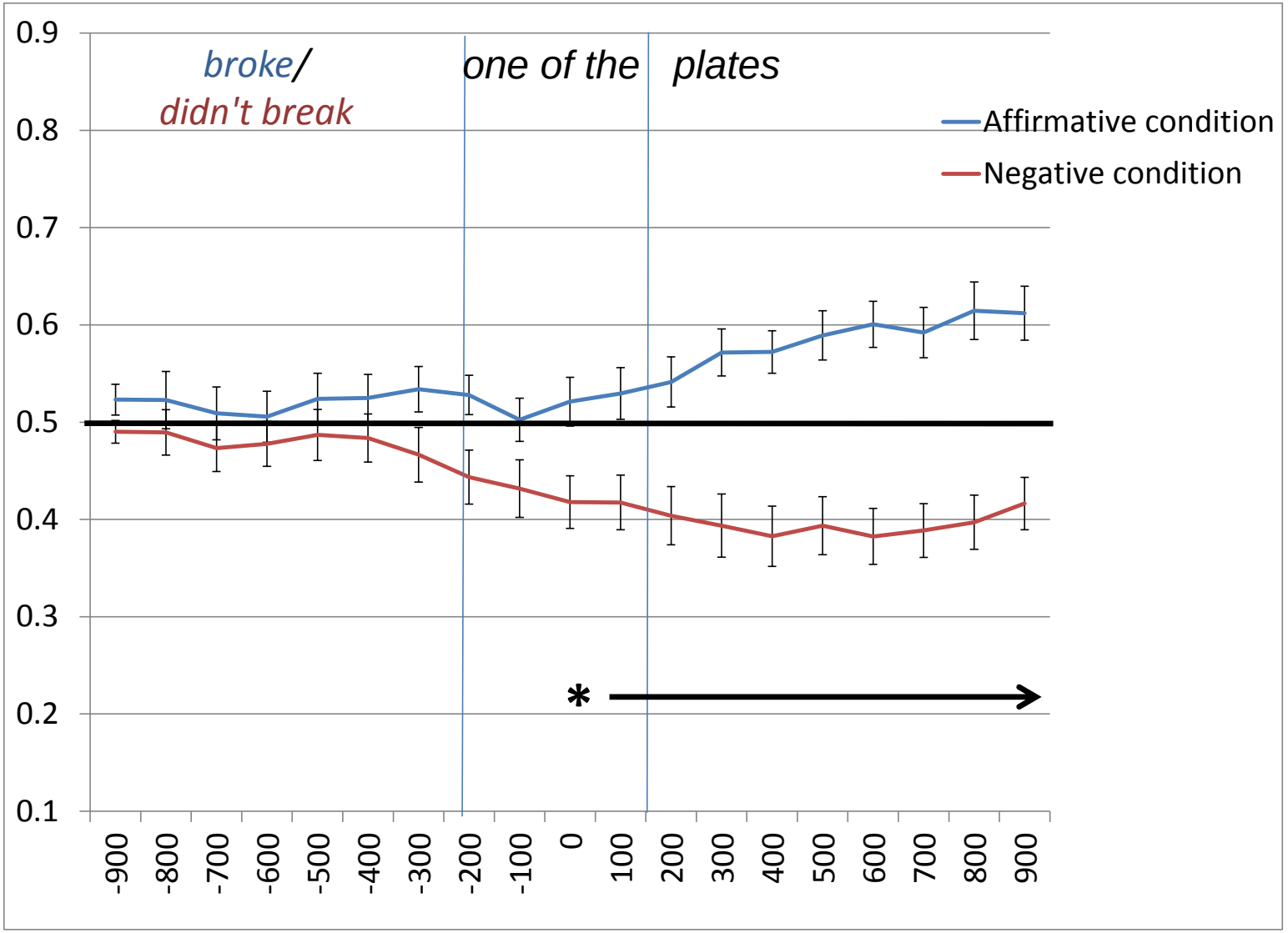
M=4;7





3 year olds are incremental but even noisier

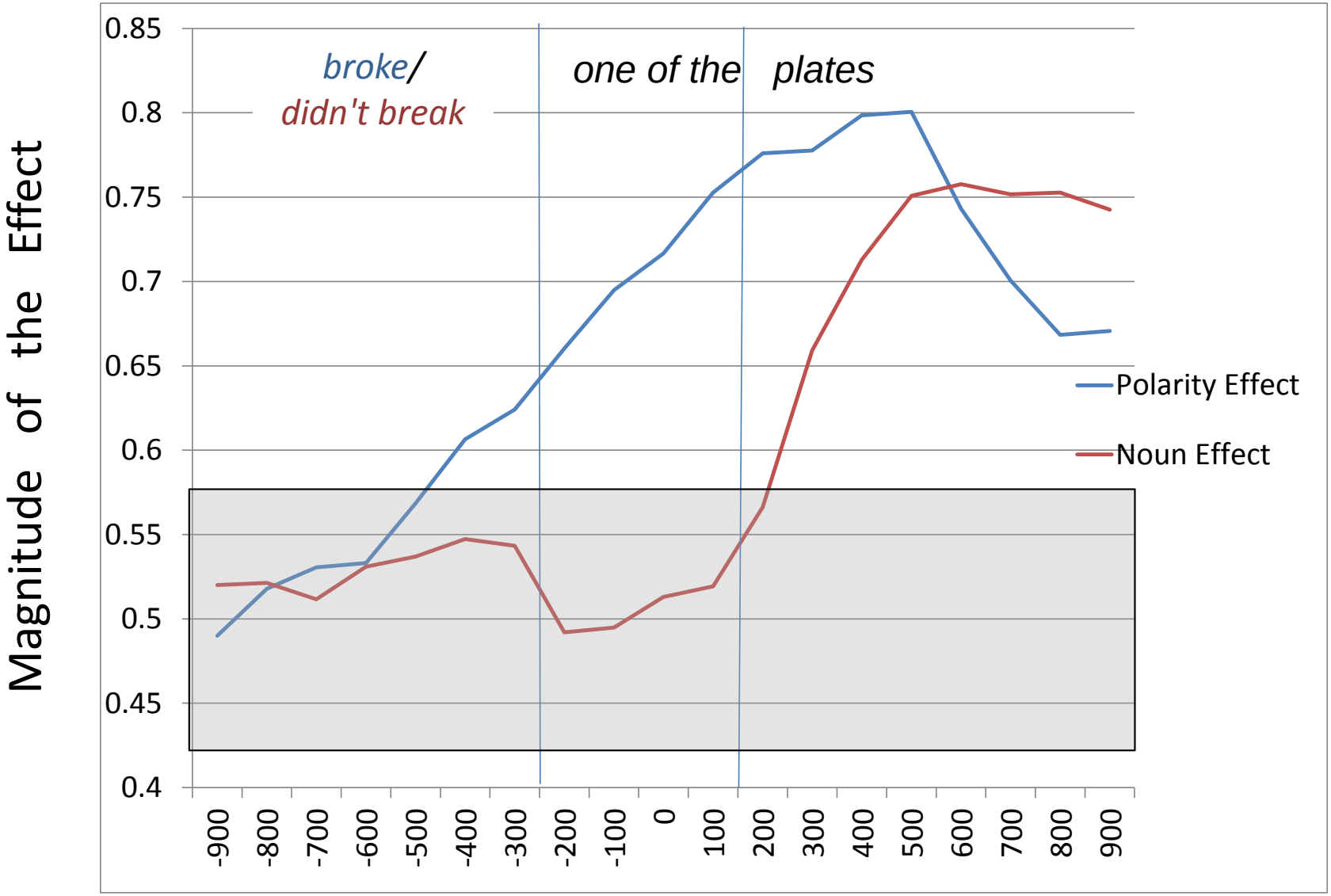
M=3;5



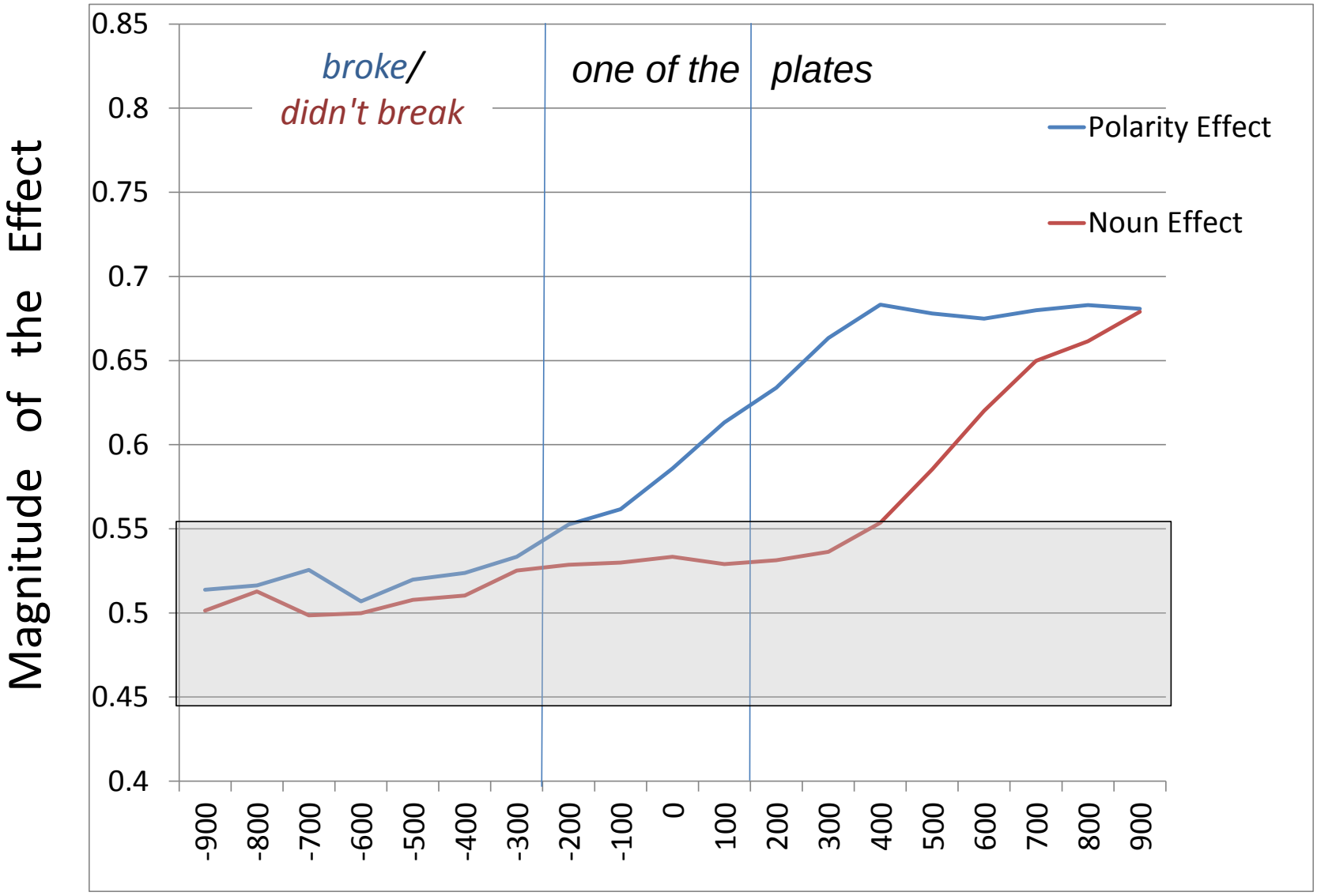
What accounts for developmental change?

- Hypothesis 1: semantic processing is less incremental in children (mixture model)
- Hypothesis 2: all processes are noisier and slower but children are equally incremental
- Test: compare effects of negation and the sentence final noun (plate identification)

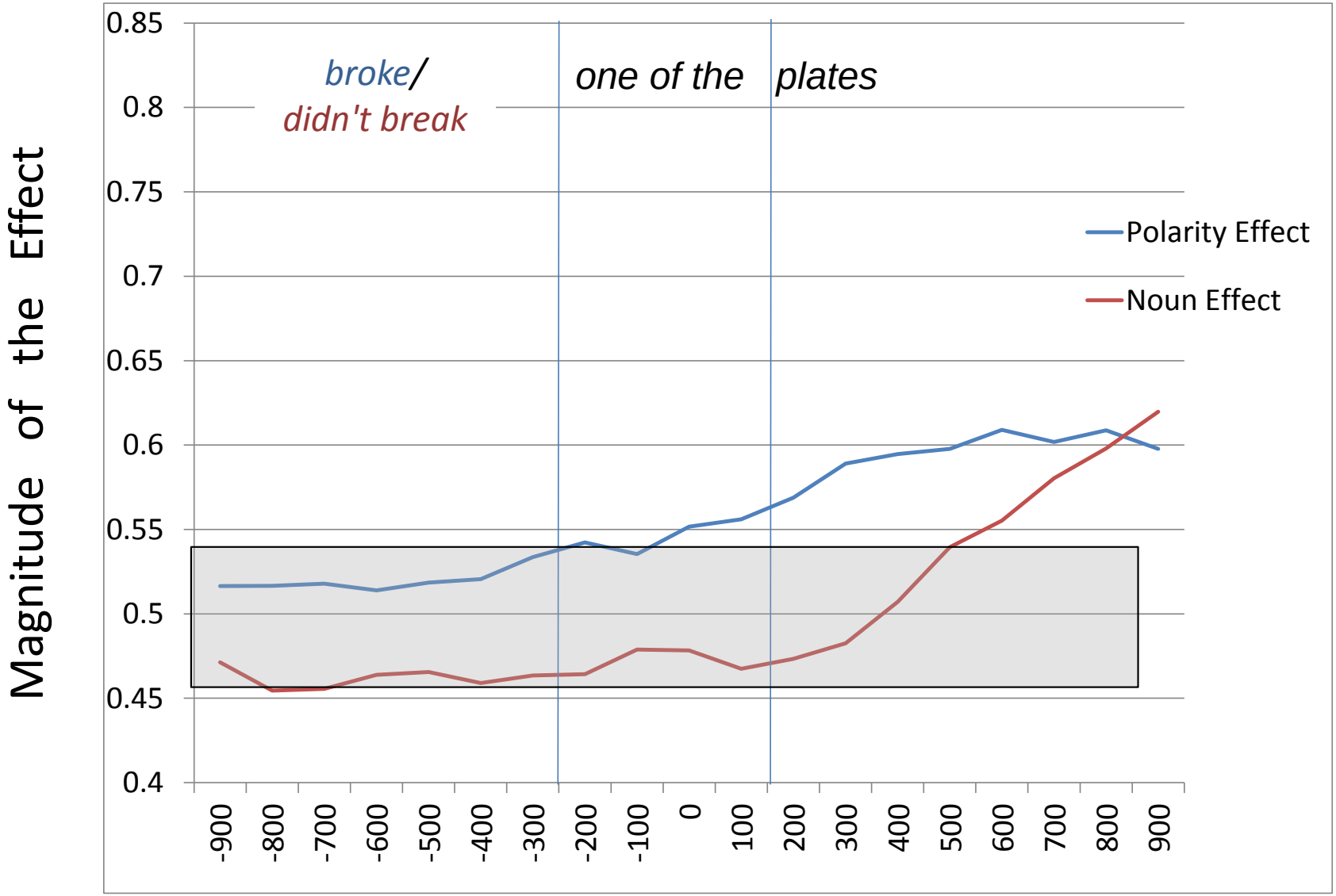
Adults: ~600ms lag similar sized effects



4 year olds: ~500ms lag similar sized effects



3 year olds: ~600ms lag, polarity more gradual



Morals from Negation

- Children are constructing incremental semantic interpretations
- Discourse context matters for kids too
- Don’t assume your task measures only the construct you are interested in
  - Developmental changes in many abilities
- Children’s processing is slower and noisier

B. Children often perseverate

Test Case: Prosody in Parsing

Sylvia Yuan

1998-2002 studies in several labs suggests that 4-6 years olds do use prosody as constraint on syntax

- Within subjects designs
  - Ex: children hear both VP and NP attachments (mixed)
- Globally ambiguous utterances

Perseveration: continuing to perform the same response when the context has changed

Priming: activation of a representation that has recently been useful

How can you tell? Blocked design

Prosody in parsing

(Snedeker & Yuan, 2008)

- 4-6 year olds
- Instrument Prosody

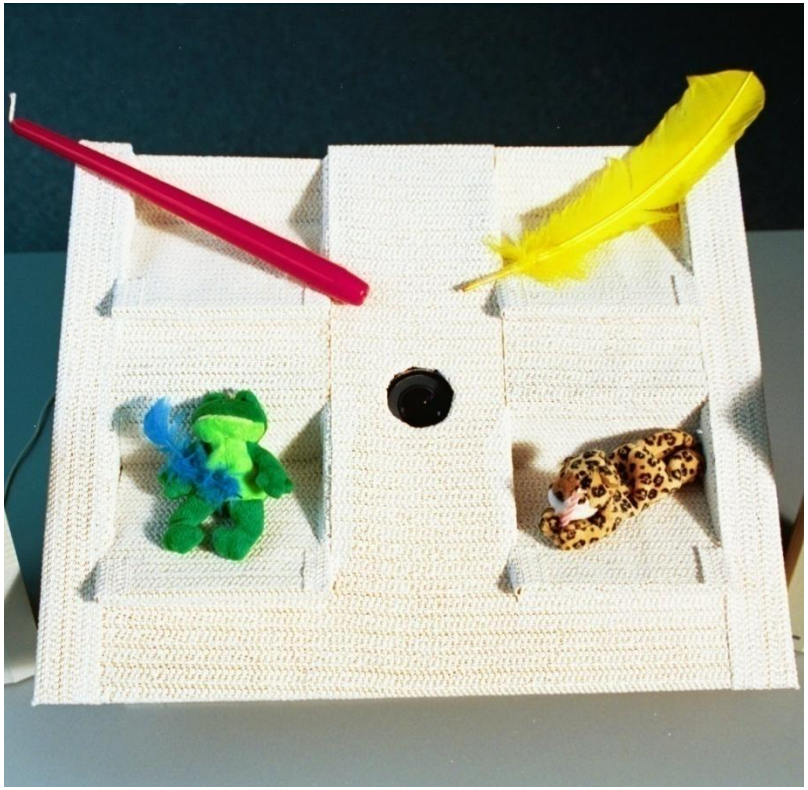
  You can feel the frawwg….
  ….with the feather

- Modifier Prosody

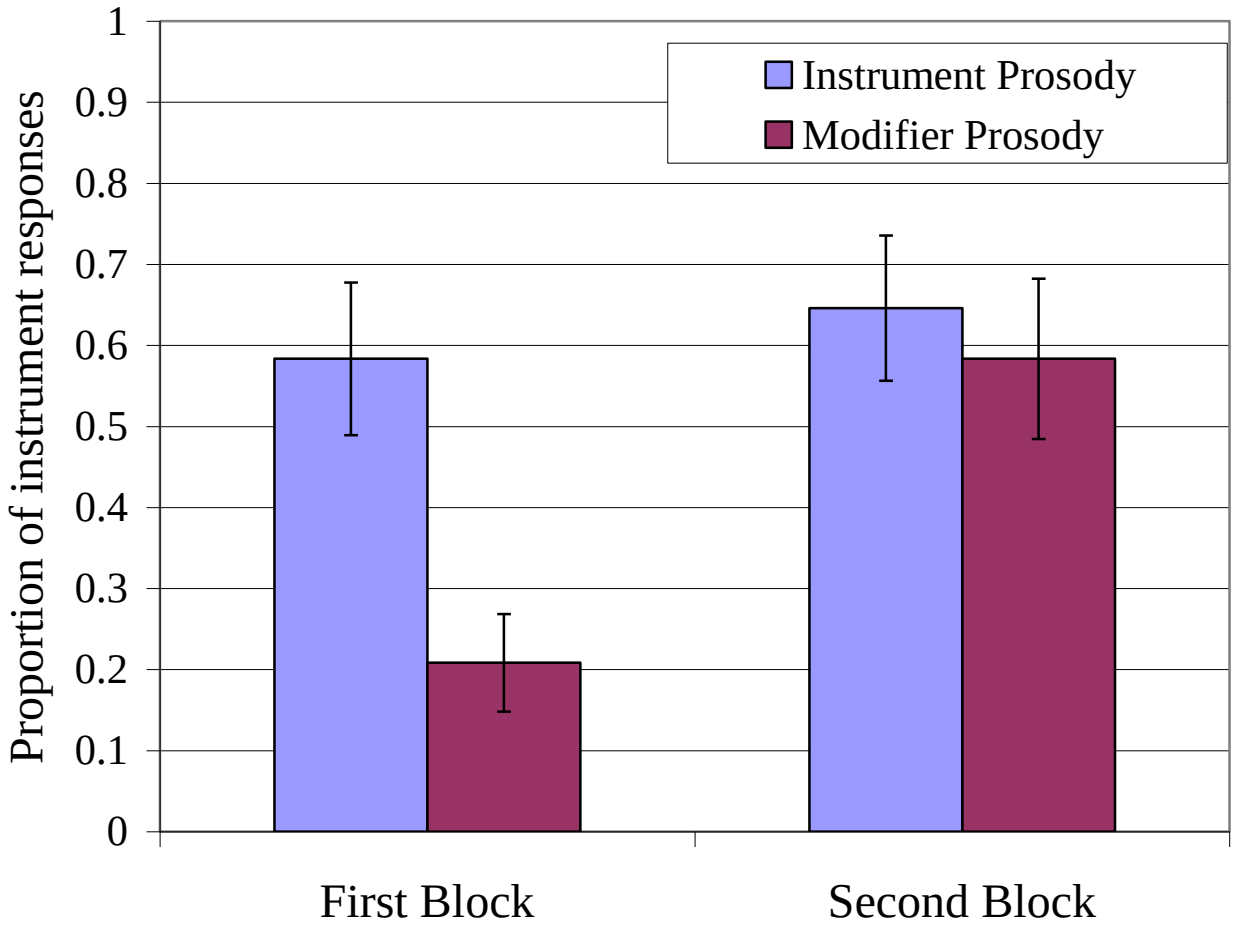
  You can feeeel….

  ,….the frog-with-the-feather

- Blocked Design



Yes…but only for the first block of trials



Snedeker & Yuan, 2008

Perseveration in prosodic parsing

- Perseveration is present in the online measures as well
- Disappears by age 8
- Reflects changing expectations about analysis
    - Participants begin predicting the interpretation they’ve been hearing
    - Adults and older children rapidly change their prediction in response to prosody
    - Younger children do not

Morals

- Children adjust to experiments
- But have difficulty updating their expectation (perseveration)
- Constrains the design and interpretation of developmental studies

C. Children often fail to revise misanalyses

John Trueswell

University of Pennsylvania

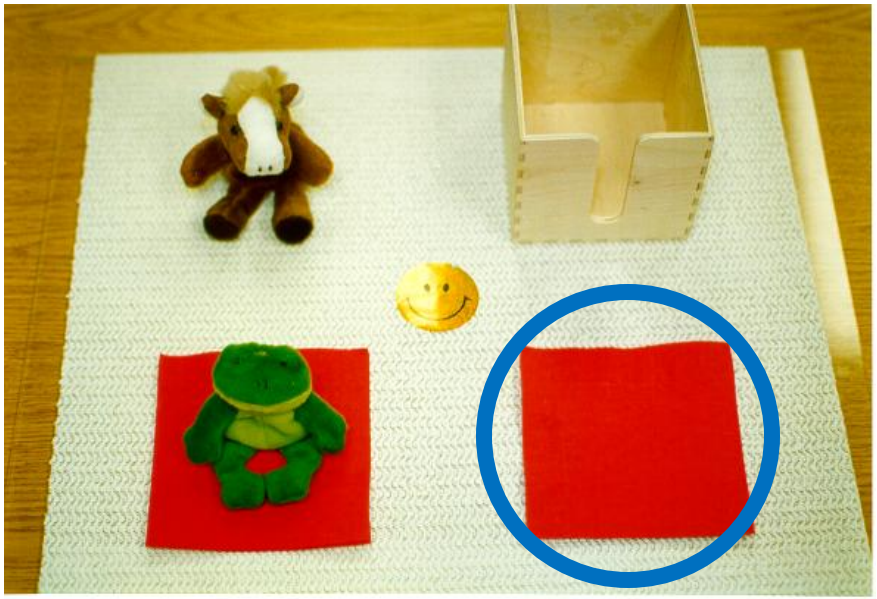
Yi Ting Huang

University of Maryland

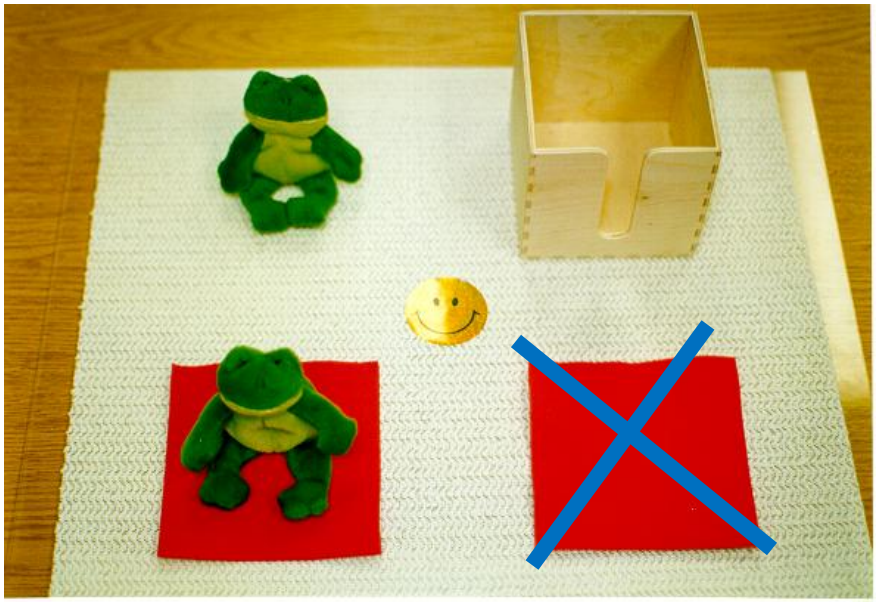
Adults use referential context

Tanenhaus, Spivey-Knowlton, Eberhard & Sedivy (1995)

1-Referent Context



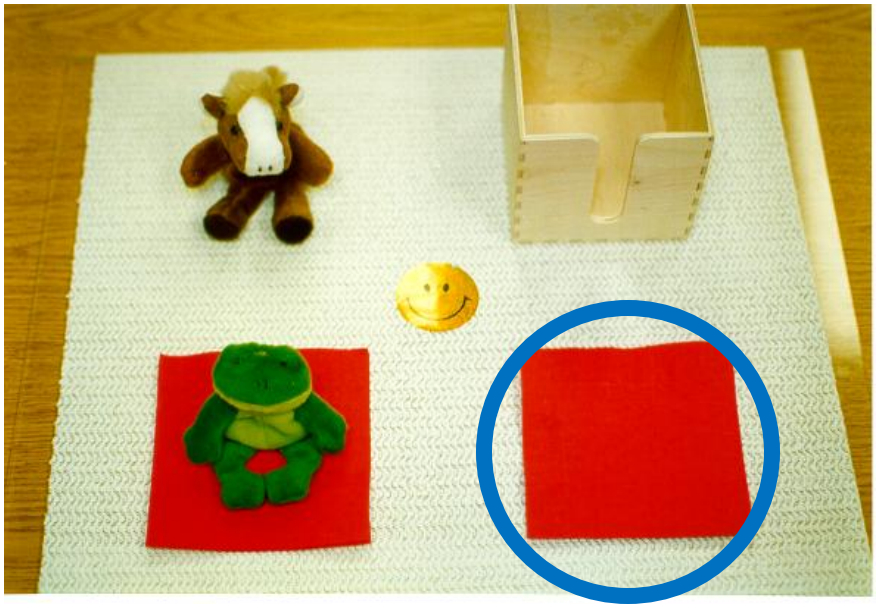
2-Referent Context



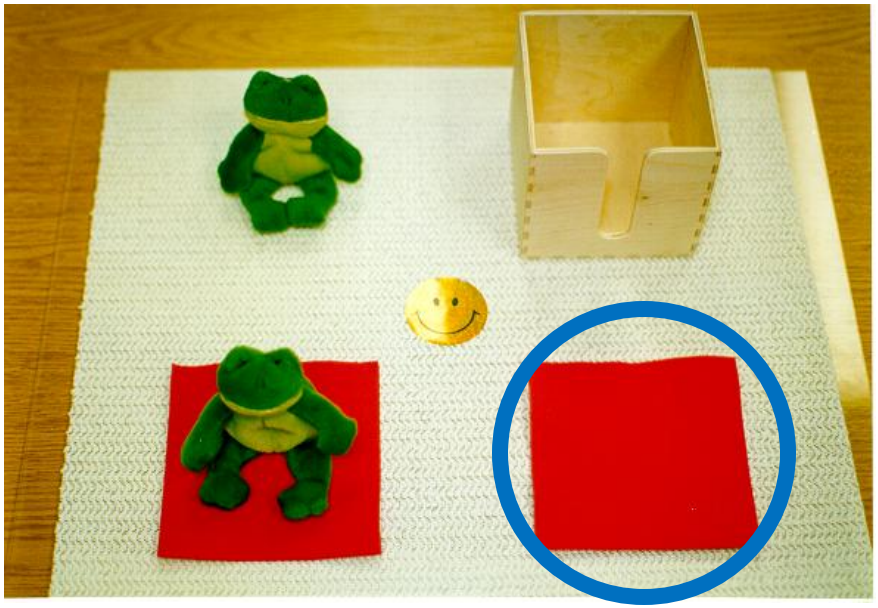
"Put the frog on the napkin in the box."

5 year olds consider incorrect destination regardless of context

1-Referent Context



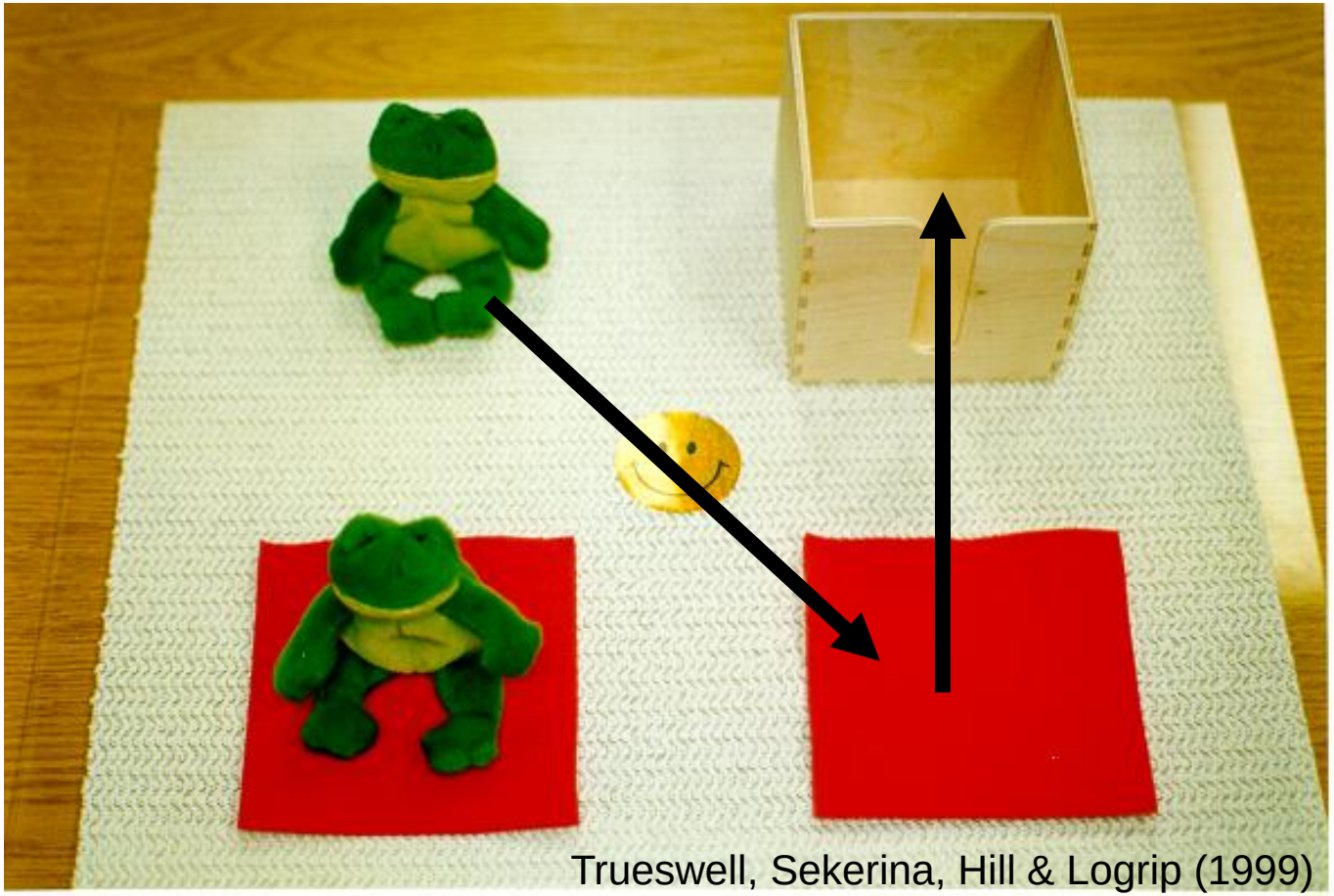
2-Referent Context



"Put the frog on the napkin in the box."

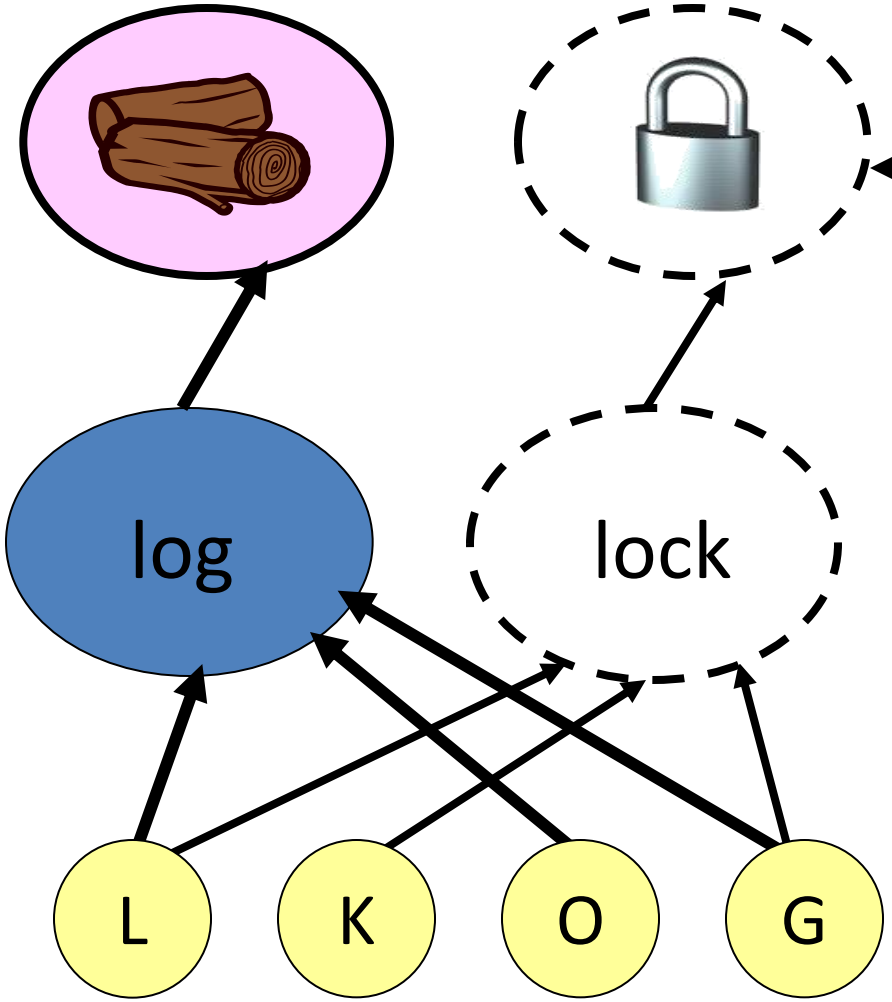
Trueswell, Sekerina, Hill & Logrip (1999)

…..and often fail to revise



"Put the frog on the napkin in the box."

Example: Phonosemantic priming



"Pick up the **log**…g"

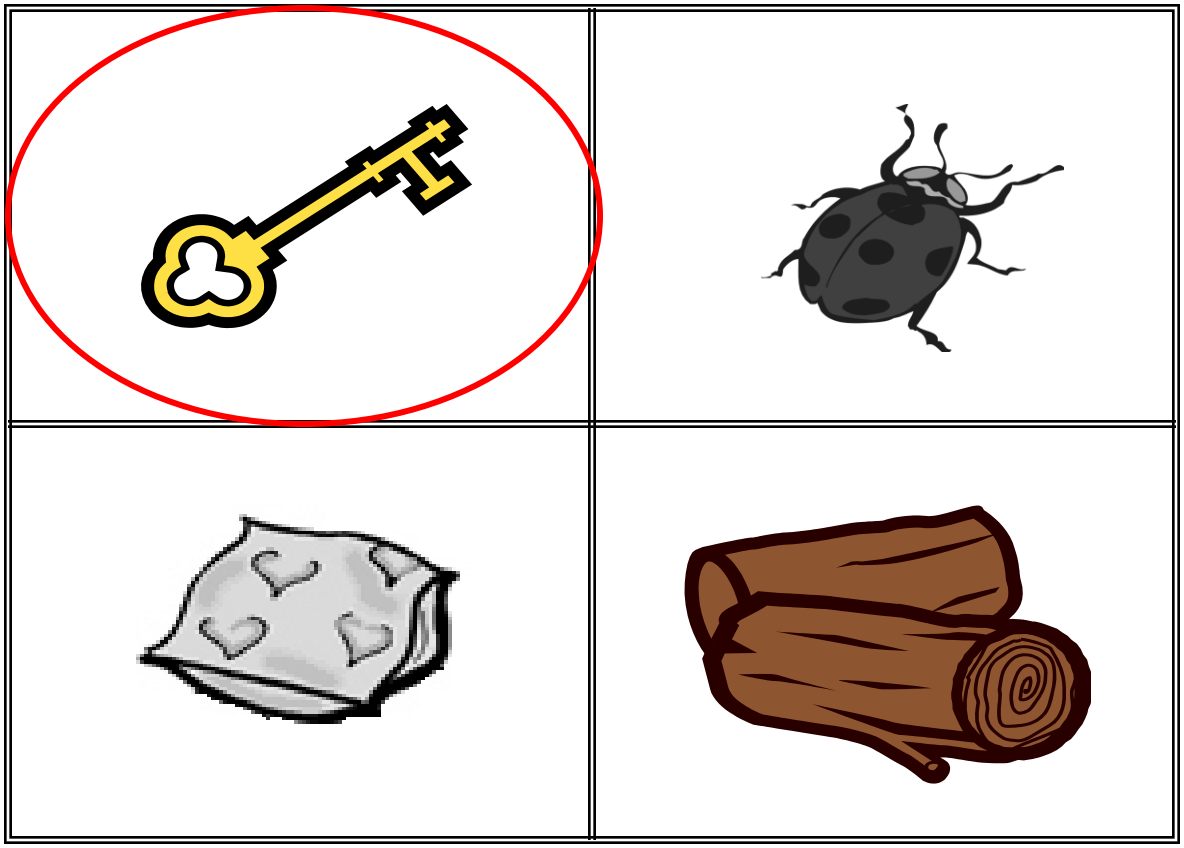
Conceptual priming via phonological associate

Marslen-Wilson & Zwitserlood (1989)
Yee & Sedivy (2006)

Phonosemantic priming in 5 year olds

“ Pick up the logs ”

Looks to phono-semantic prime

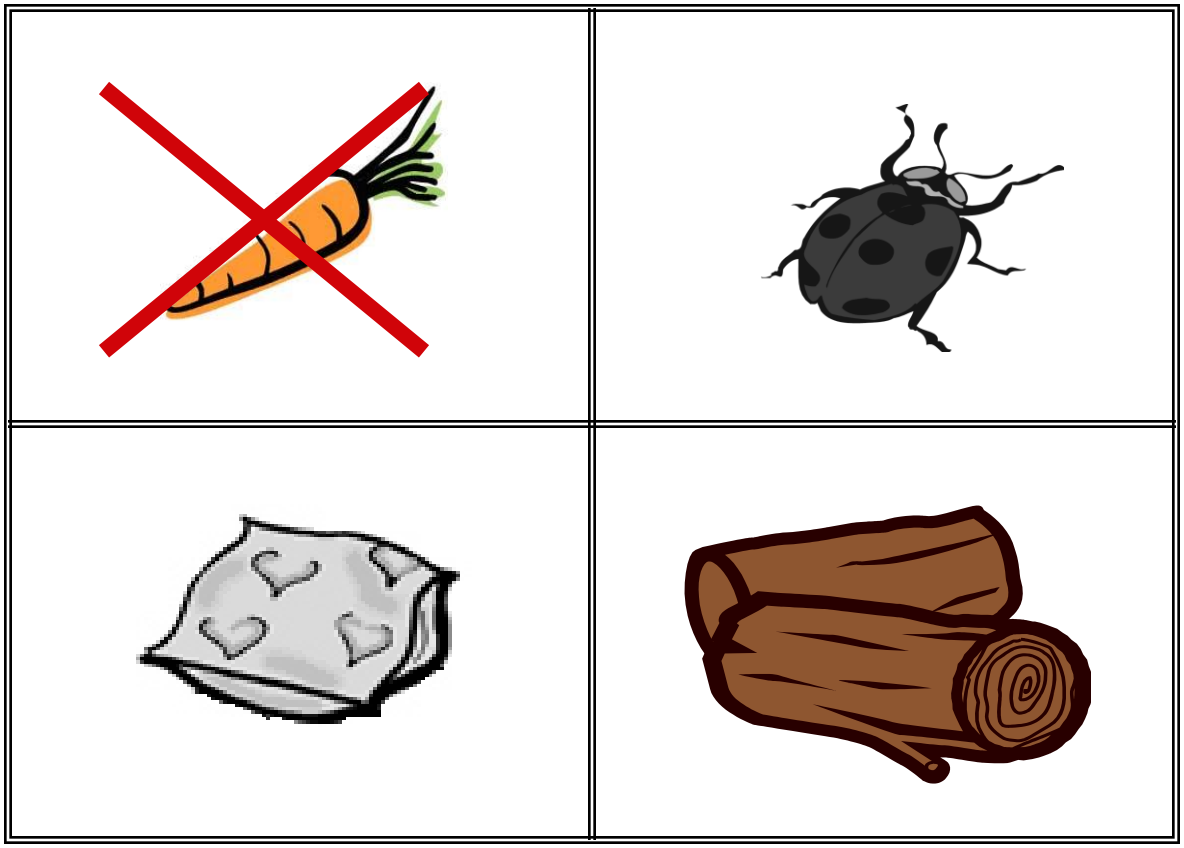


Phonosemantic priming in 5 year olds

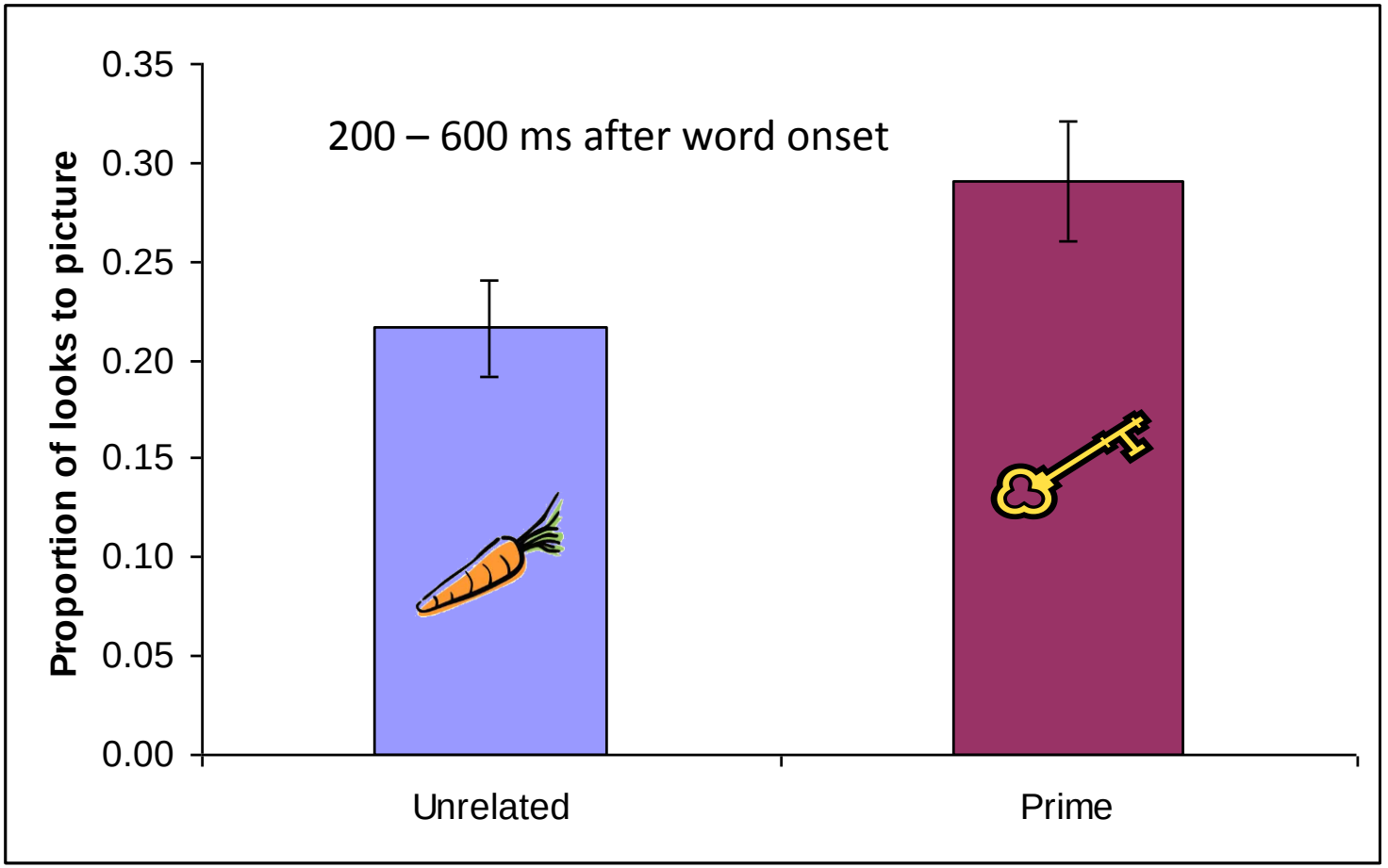
“ **Pick up the lo**gs ”

Control: Shuffle primes and targets

Fewer Looks

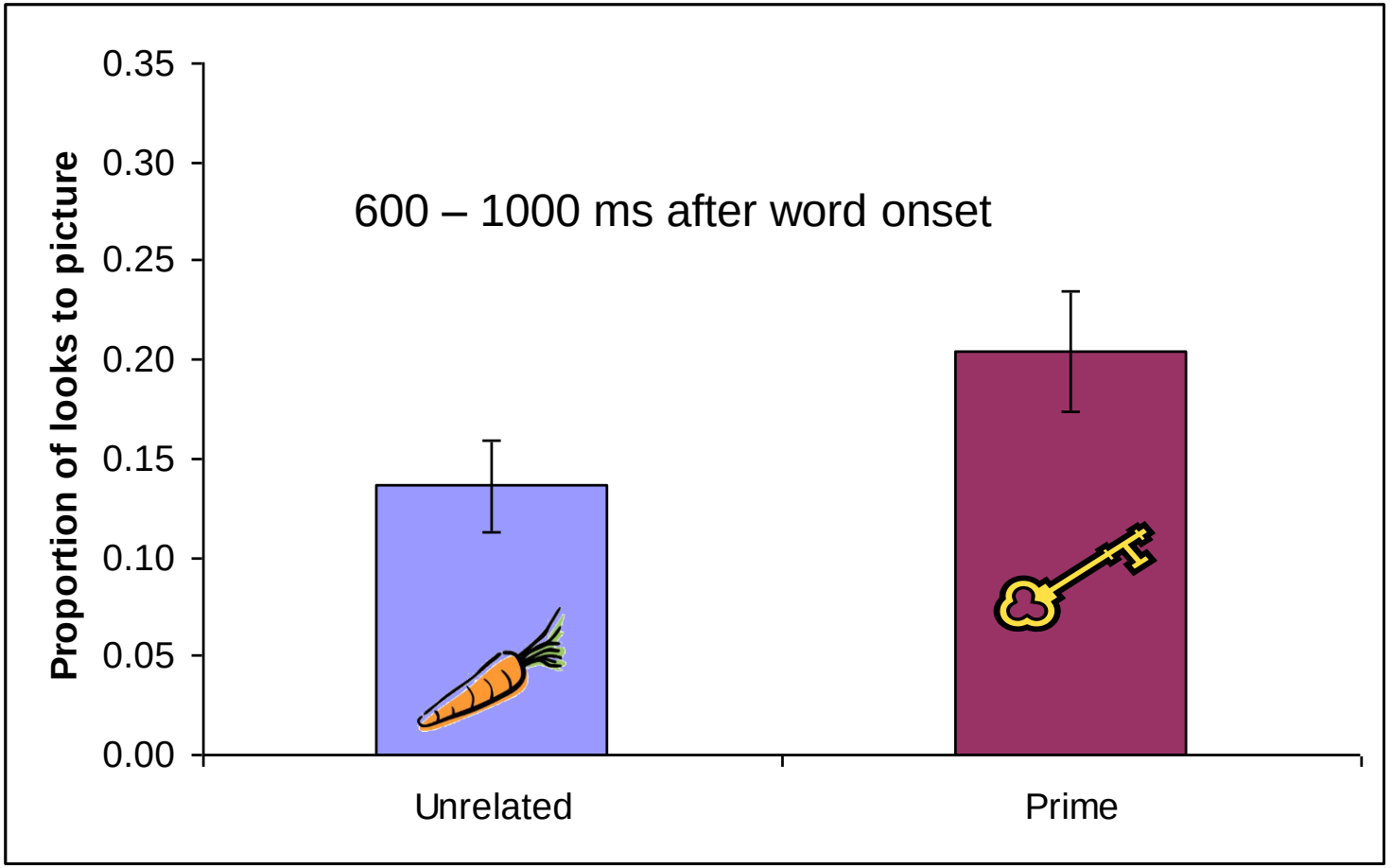


5 yr old children show phonosemantic priming



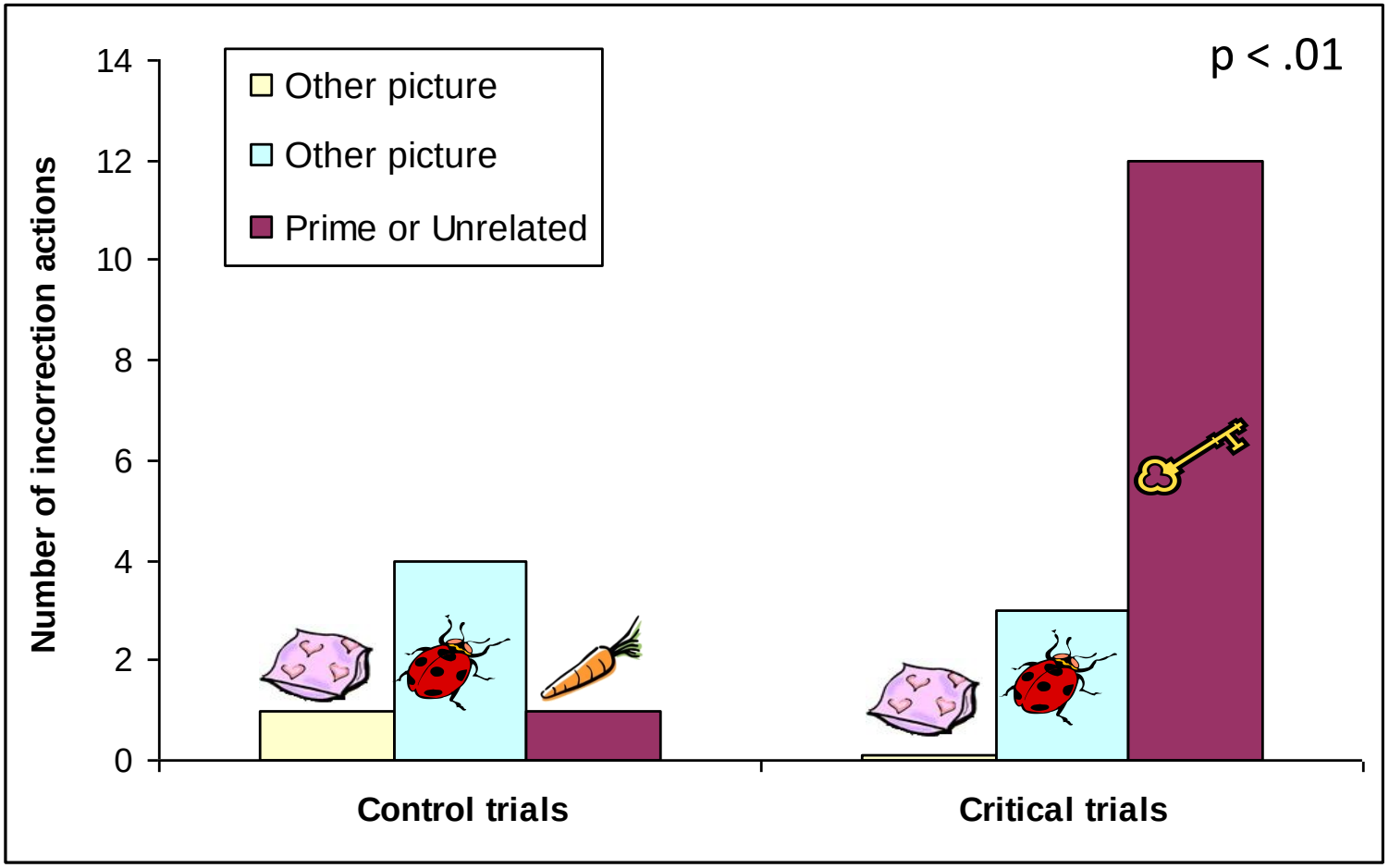
Huang & Snedeker (2011)

….but it lingers well after phonological disambiguation of the critical word



Huang & Snedeker, in press

If fact they make “phonosemantic errors”



Huang & Snedeker, 2011

Morals

- Children use cues early in the utterance to generate interpretations
- Have difficulty using information that arrives later, to revise or select an interpretation

D. In comprehension, children make less use of top-down cues

Test Case: Attachment ambiguity

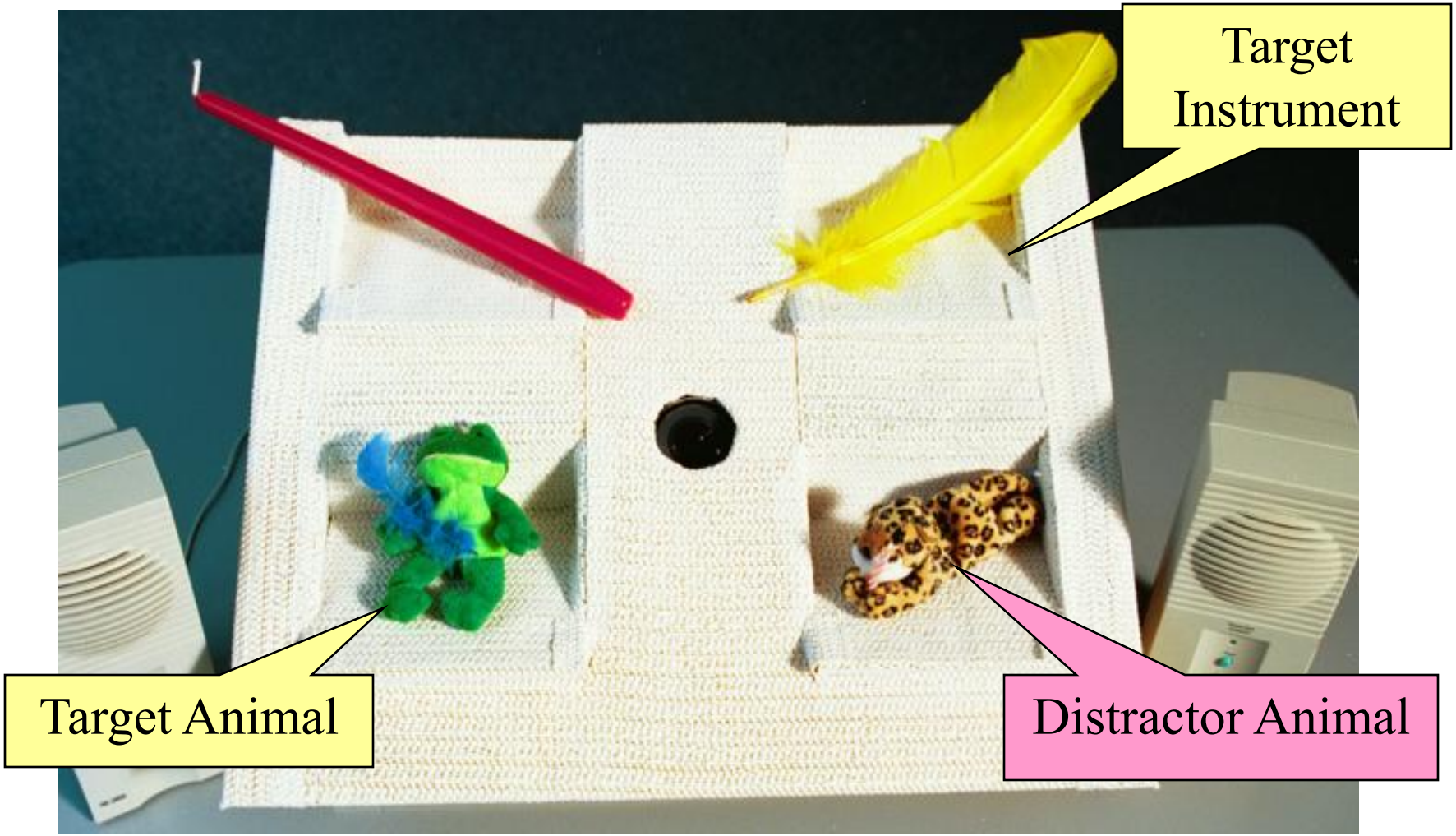
John Trueswell

Carissa Shafto

Amanda Worek

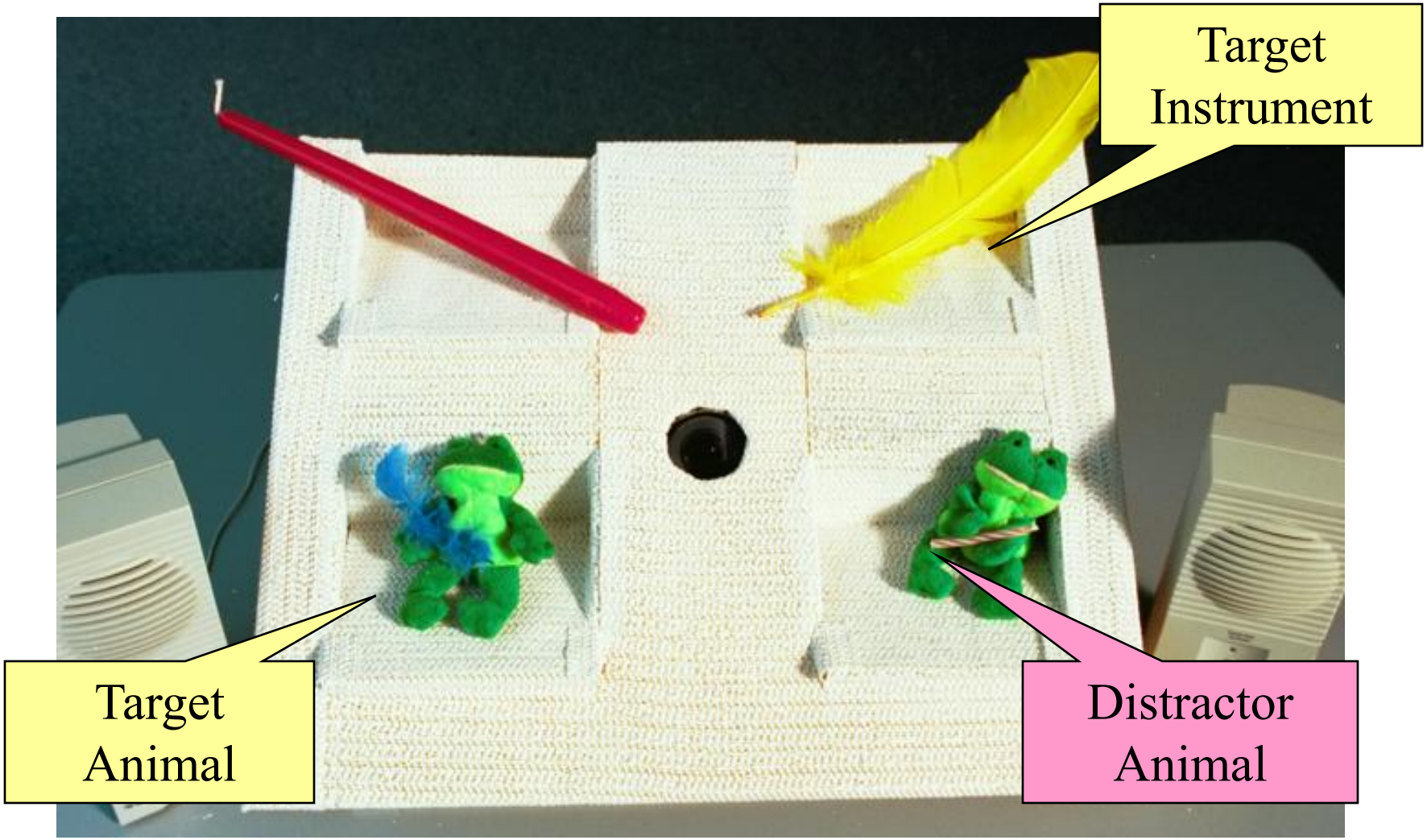
1 Referent Context

"Feel the frog with the feather"



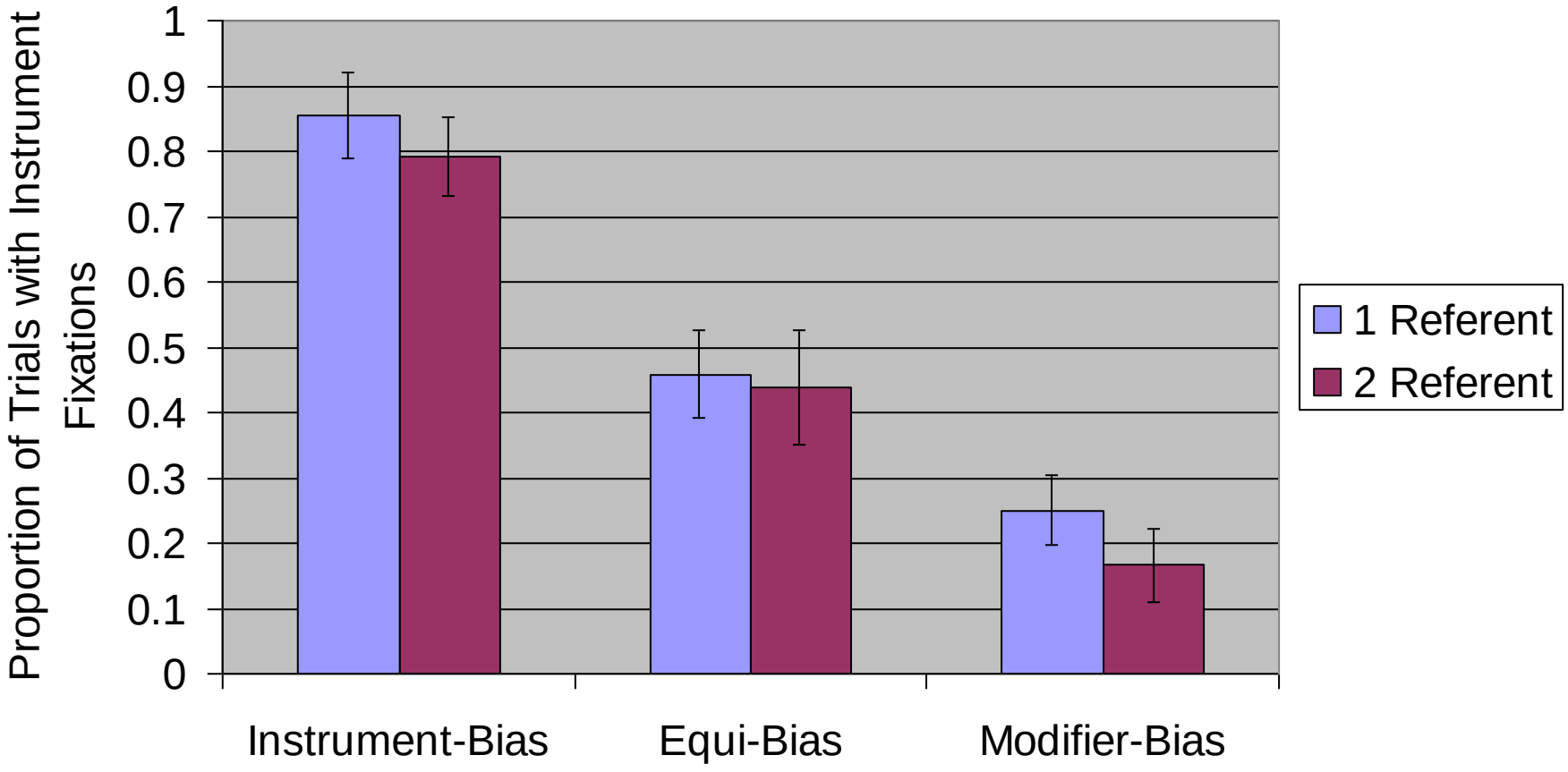
2 Referent Context

"Feel the frog with the feather"



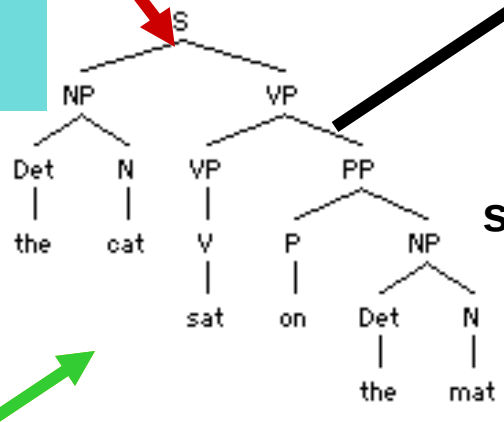
Children rapidly use lexical information

But do not use referential context….



Top-down vs. bottom-up constraints

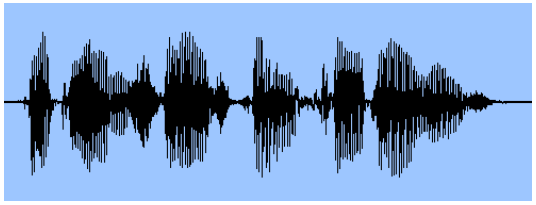
reference model



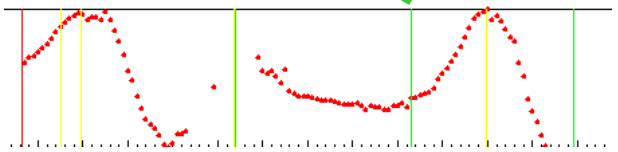
syntax

/kæt/: noun, singular, animate
/sæt/: verb, past, intransitive
/mæt/: noun, singular, inanimate

lexical



acoustic



prosodic

Plausibility, another top-down constraint

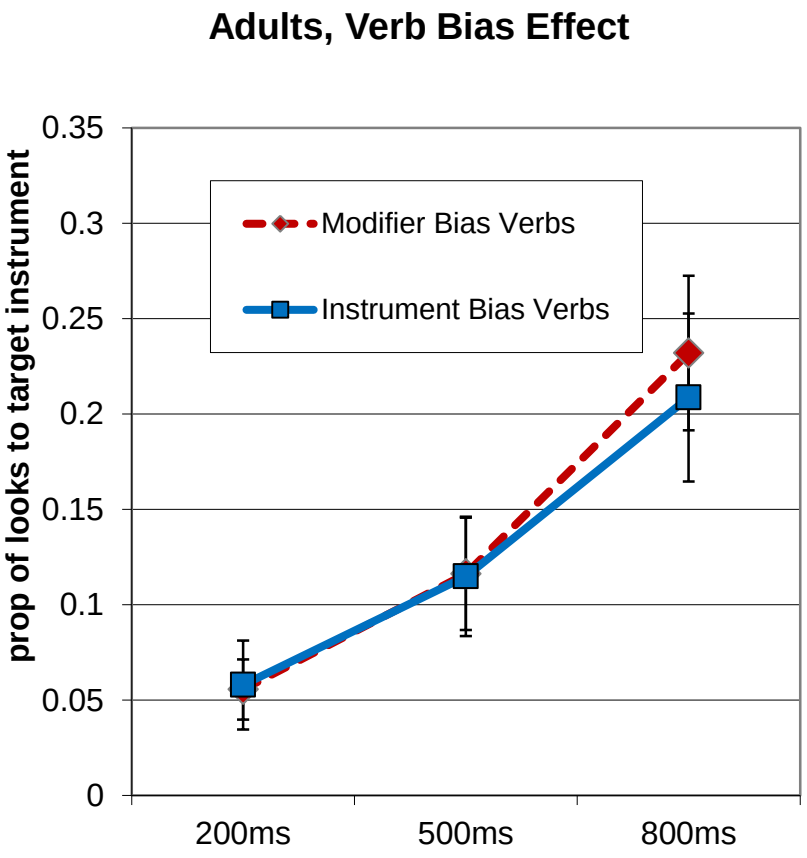
- Global plausibility (top down)
  - How likely is a given interpretation given the affordances of the objects?
  - Requires that the interpretation be under consideration (role assignment)

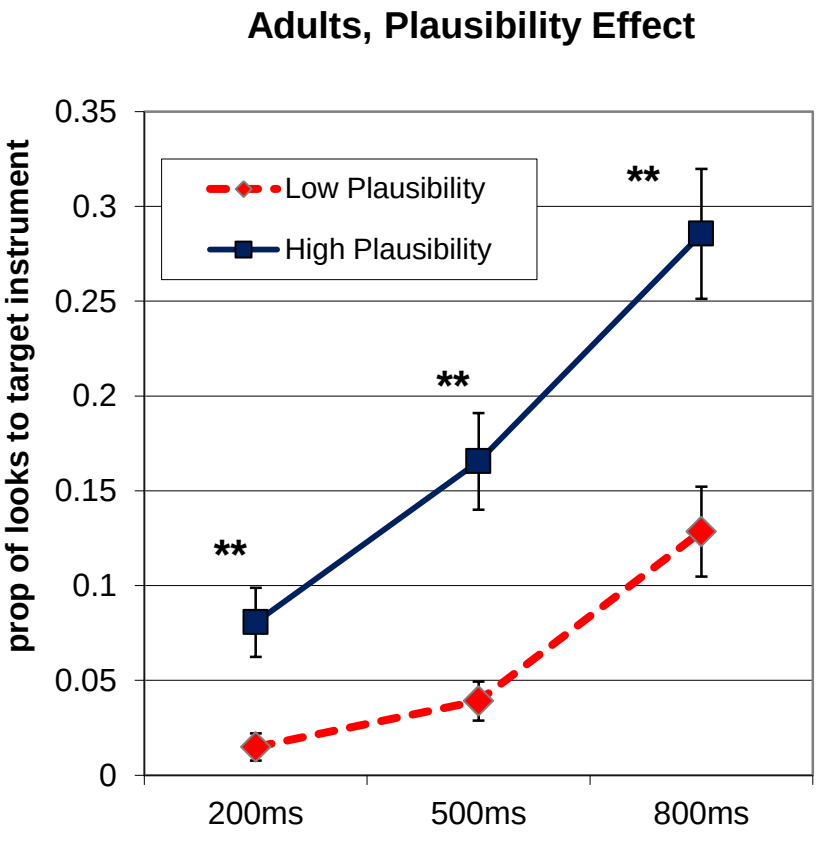
Do children use plausibility to resolve ambiguity?

- Factor 1: Lexical Bias (vary verb).
- Factor 2: Plausibility (vary prepositional object)
- Modifier-Biased
  - You can find the zebra with the sponge (Low)
  - You can find the zebra with the magnifying glass (High)
- Instrument-Biased
  - You can tickle the bear with the mirror (Low)
  - You can tickle the bear with the paintbrush (High)

Snedeker, Shafto & Worek, in prep

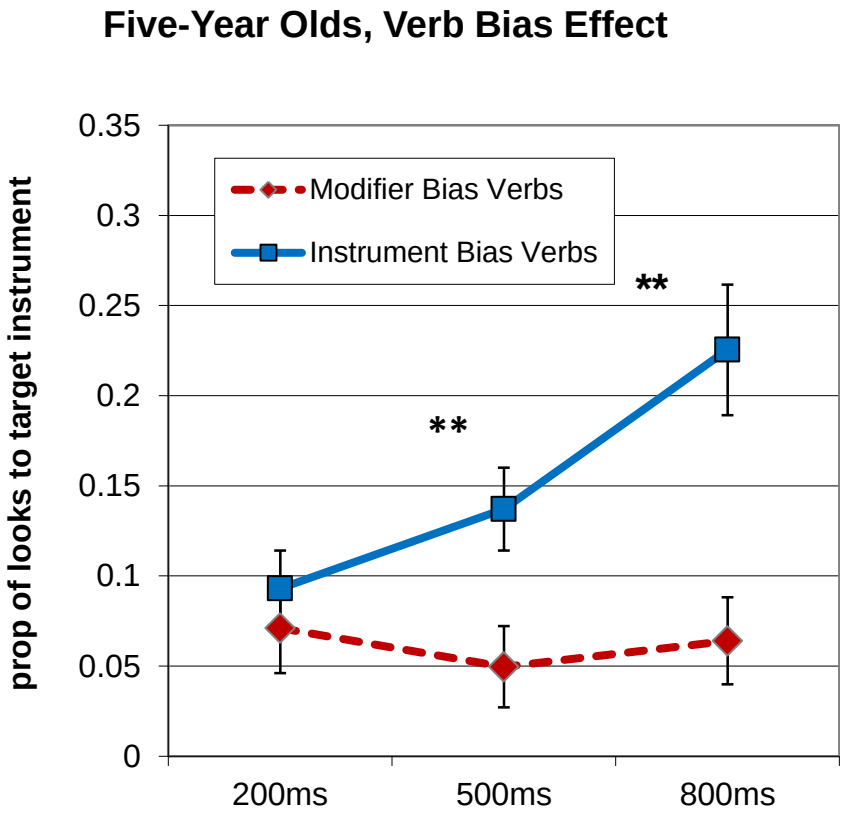
Adult eye movement data

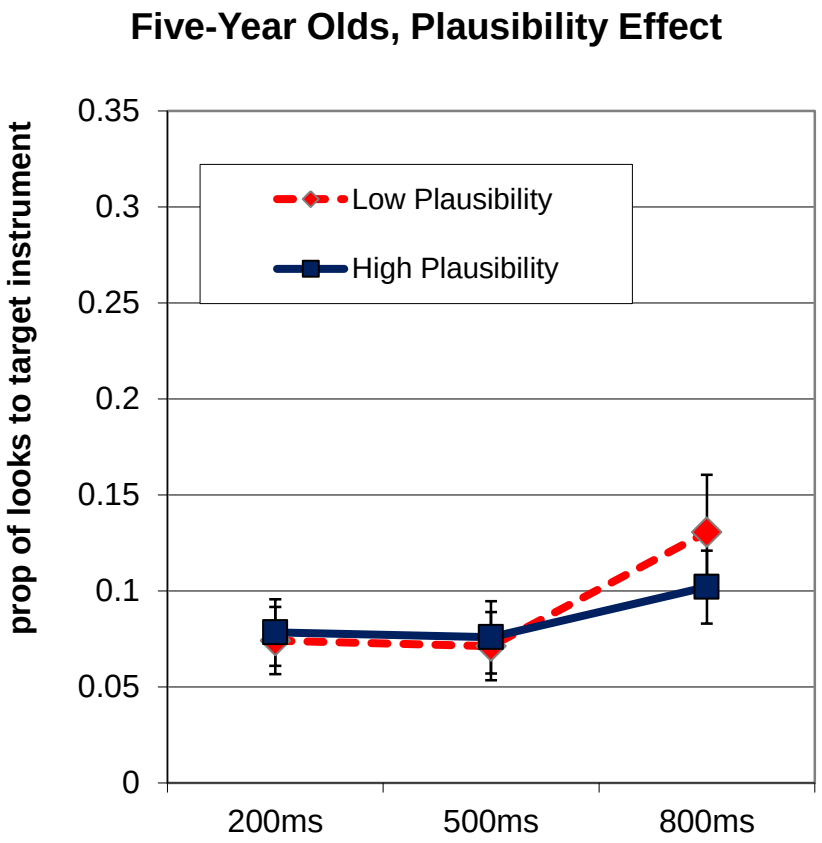




In adults, plausibility effects emerge early and dominate parsing

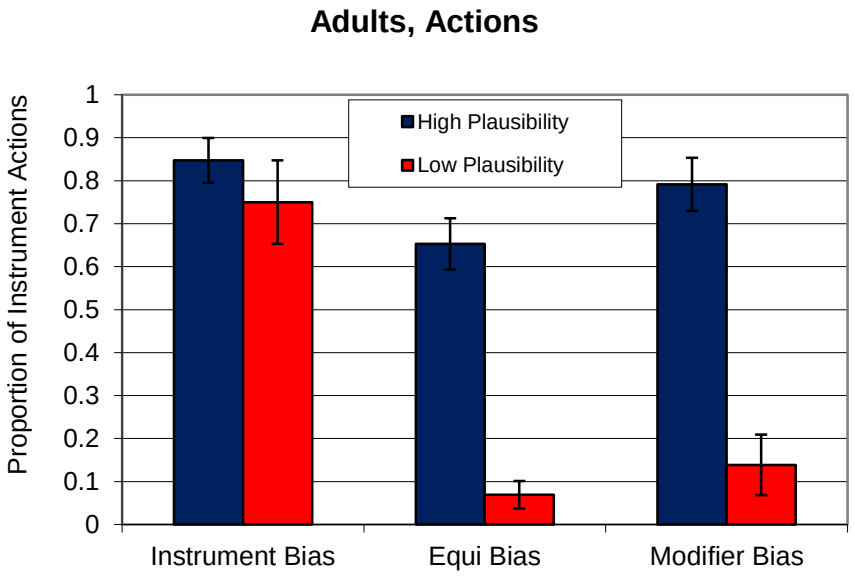
Children's eye movement data





In children, lexical effects emerge early and dominate parsing

Action data: adults and children are each sensitive to both cues but in very different ways

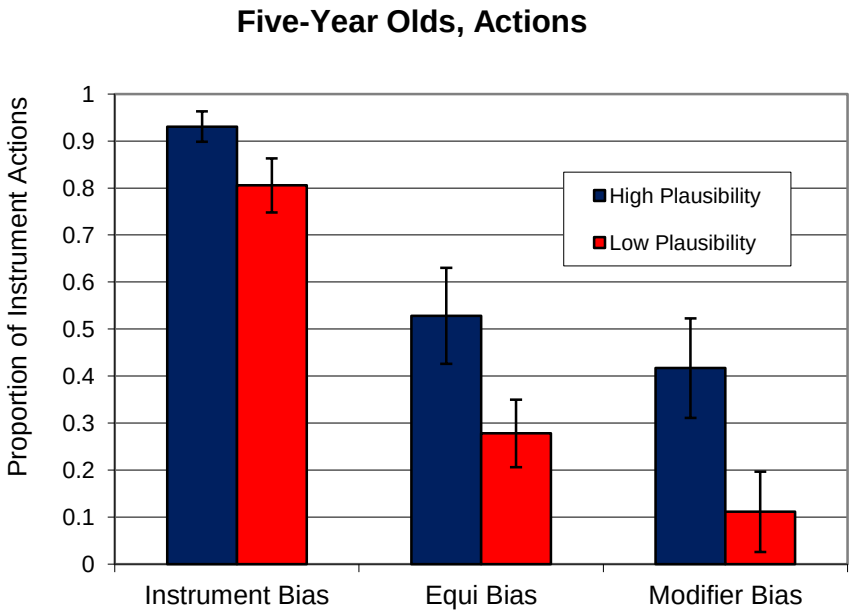


Adults

- Large Plausibility Effect
- Smaller Lexical Effect
- Interaction

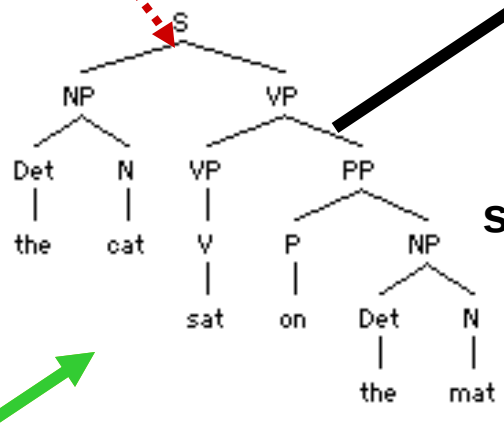
Children

- Large Lexical Effect
- Smaller Plausibility Effect
- No Interaction



Early on bottom-up constraints dominate

reference model



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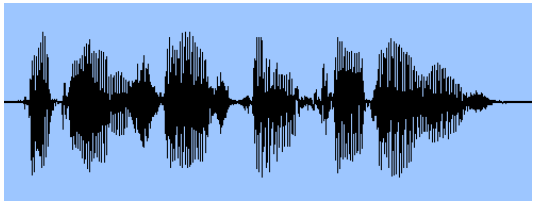
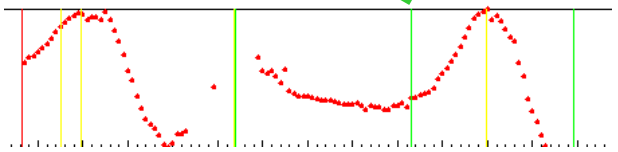


acoustic



prosodic

Why are children different from adults?

- Possible explanations for poor top-down processing
  - Slower processing?
  - Predictive vs. reactive processing?
  - Are top down connections slower to develop?

Why are children different from adults?

Possible explanations for perseveration & poor revision

- Executive Function account
  - Cognitive control required to revise misanalyses (Novick, Kan, Trueswell, Thompson-Schill, 2009)
  - Immature prefrontal systems result in failure to revise
  - Domain-general maturation
- Input driven accounts
  - Representations gradually refined via experience
  - Domain-specific learning
- My crazy thought: literacy plays a role…

III. Understanding children's pragmatic limitations

The primary observation

Children often accept under informative scalar terms in judgment tasks

- Accept “might be” in context of MUST BE (Noveck, 2001)
- Accept “started” for FINISHED (Papafragou & Musolino, 2003)

Possibility 1: Children are poor at social cognition and treat language as a module isolated from communication

Non-starter: Social cognitive abilities emerge early, children’s show many pragmatic skills in linguistic contexts

Possibility 2: Children must acquire a single discrete skill (implicature)

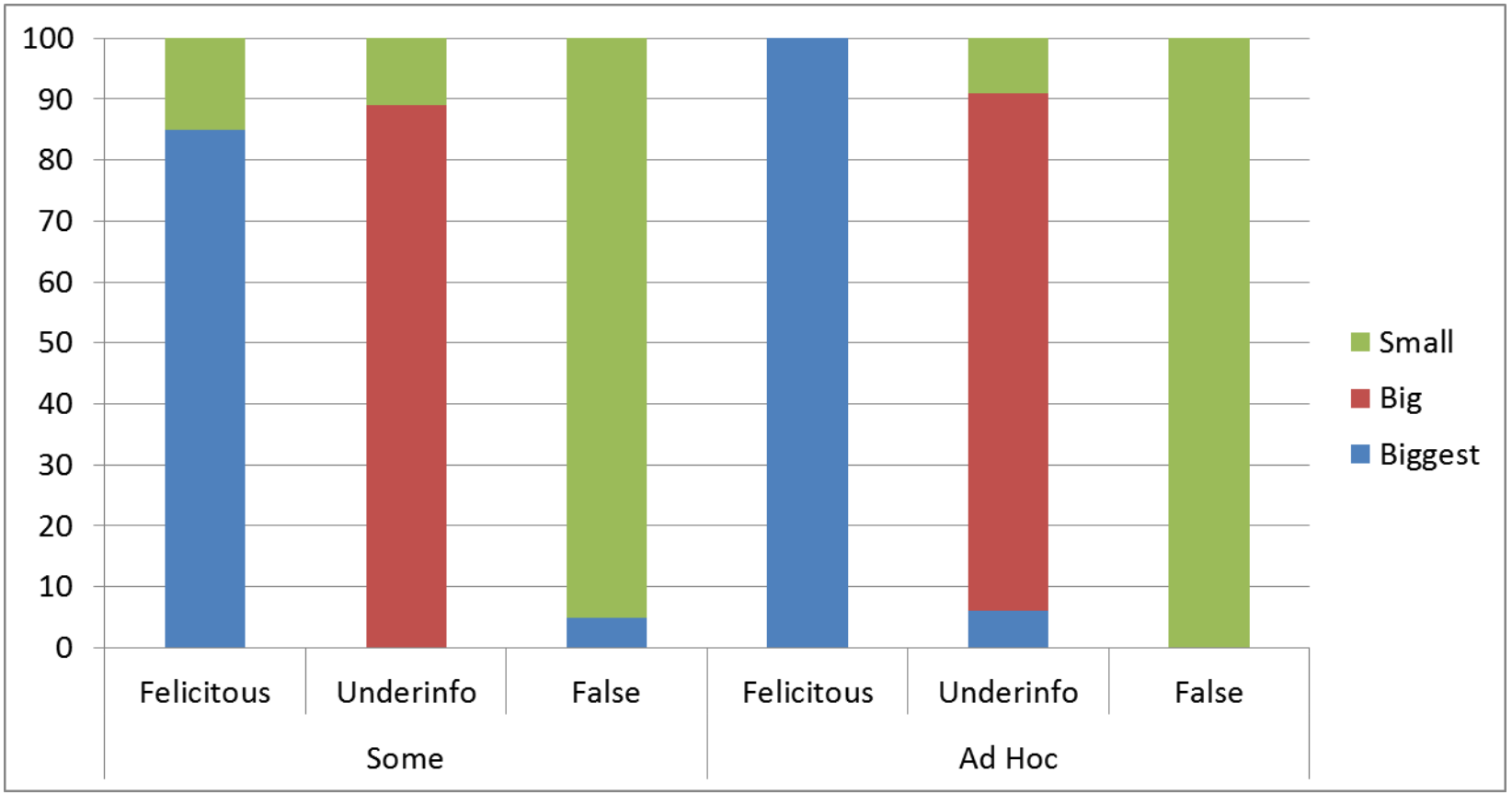
- Some piece of pragmatic knowledge must be acquired and is learned late

Non-starter: there is too much variation

- Performance heavily task dependent (Papafragou & Tantalou, 2004; Pouscoulous, Noveck, Politzer, Bastide, 2007)
- Instructions matter (Papafragou & Musolino, 2003 i.a.)
- Variation across scalar terms
- Age range success ~3-10

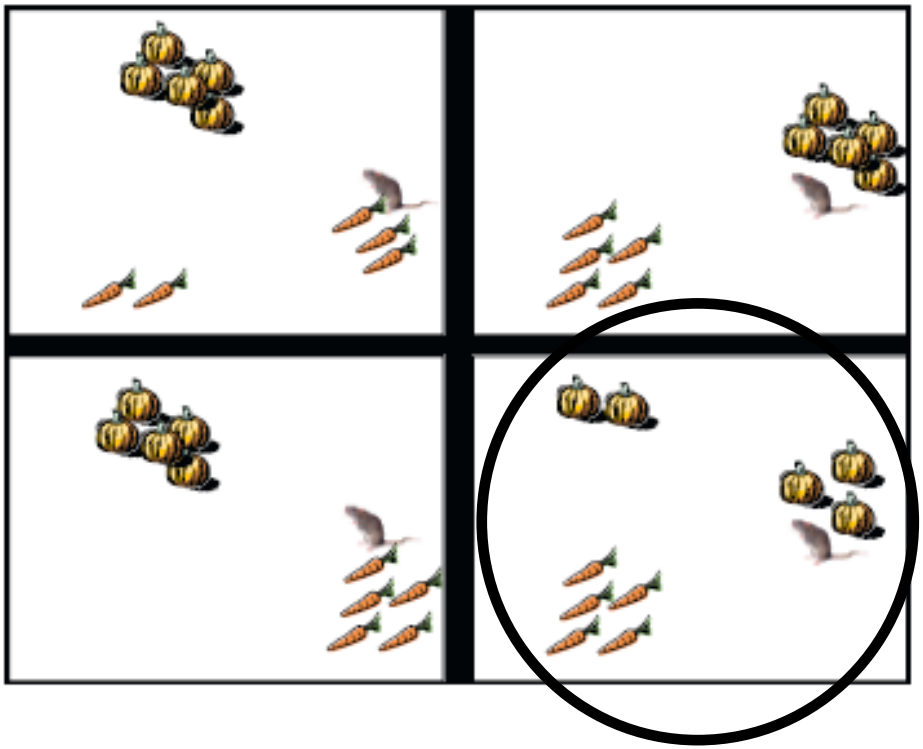
Possibility 23: Children are simply tolerant
(Katsos & Bishop, 2011)

- 5 year olds succeed with 3 point scale



Theory 1: Children are tolerant of pragmatic violations (Katsos & Bishop, 2011)

- 5 year olds succeed with forced choice task

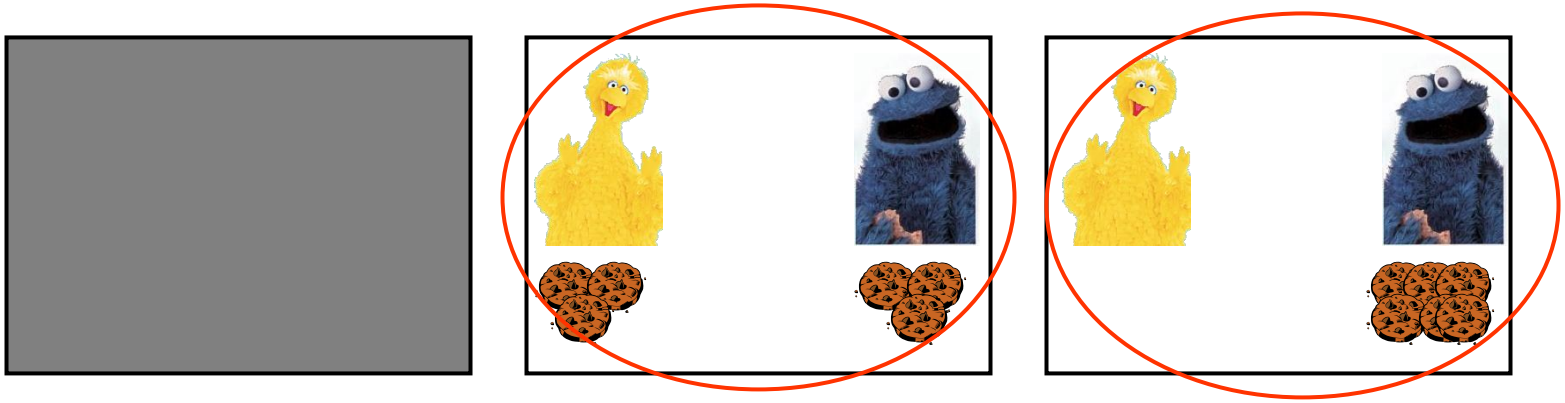


"In my story the mouse had some of the pumpkins"

Tolerance can’t explain it all

- Younger children fail at selection tasks
  - Huang, Spelke, & Snedeker 2013 (2;6-4:0)
  - *“Can you give me the box where Cookie Monster has some of the cookies?”*

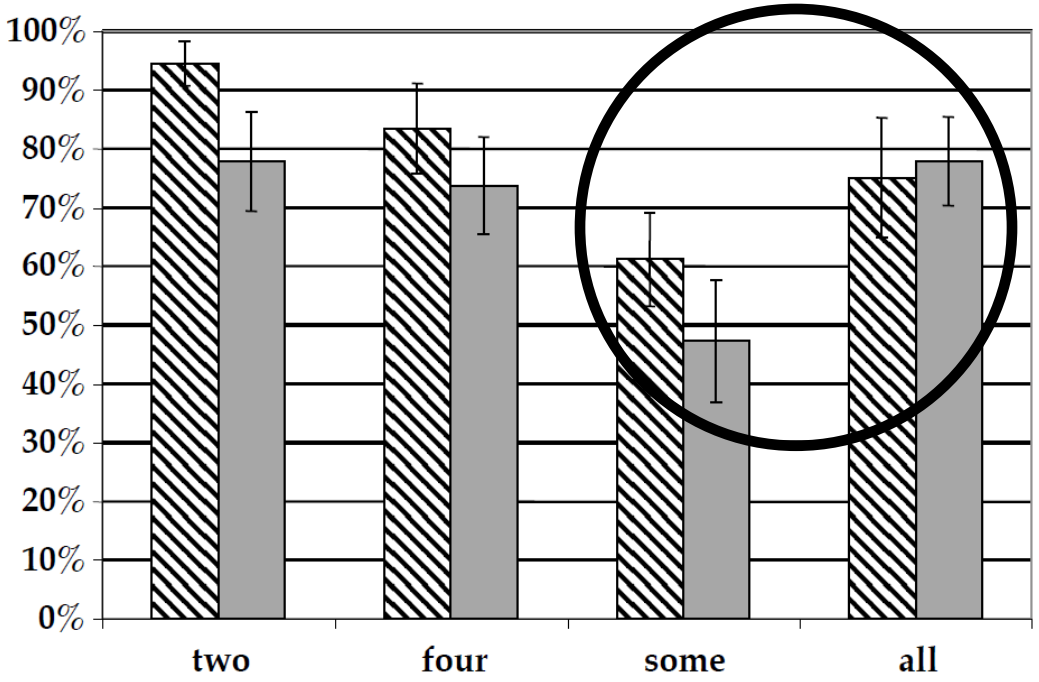
kids pick either one



See also Hurewitz et al., 2006

Tolerance can’t explain it all

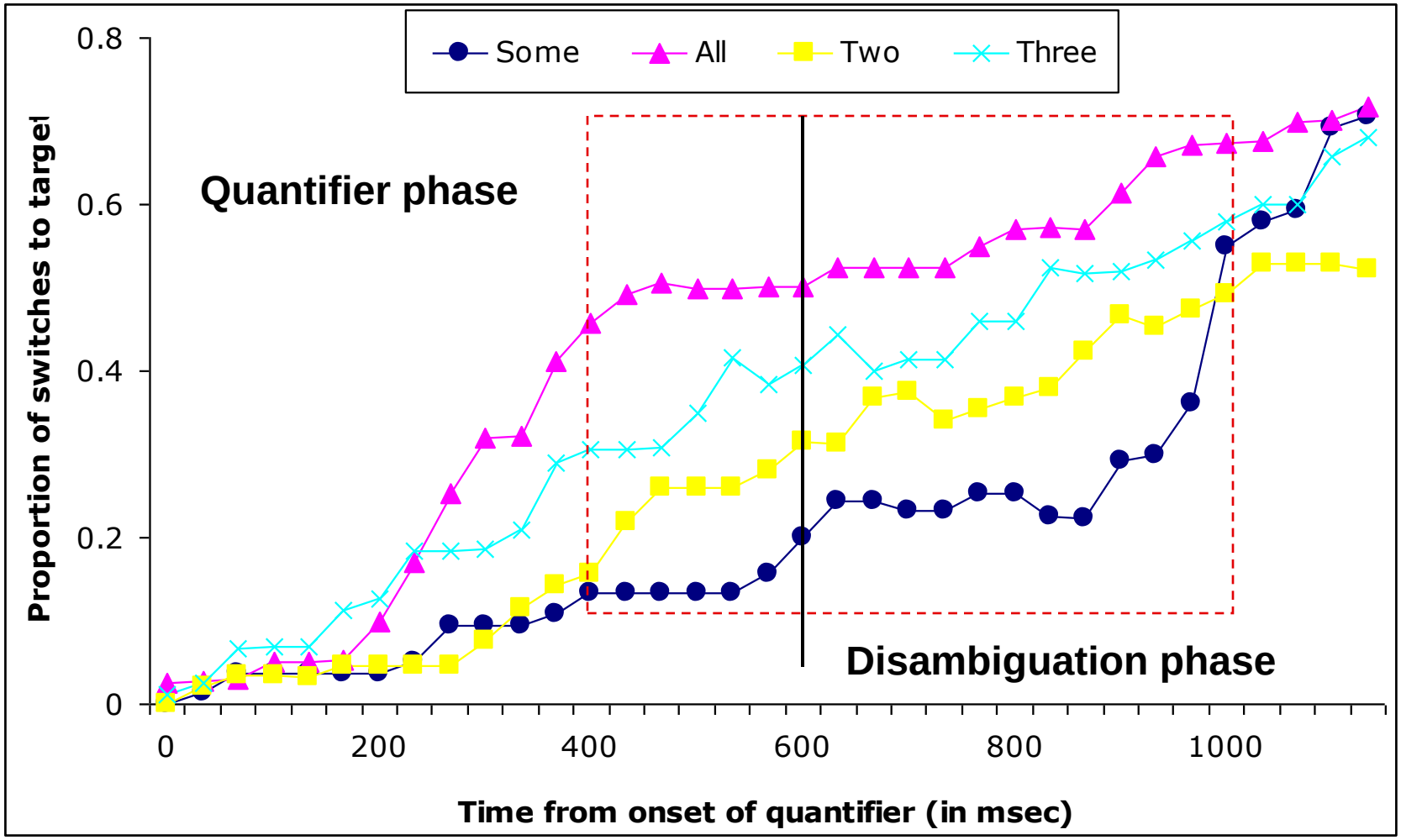
- Younger children fail at the selection tasks
  - Hurewitz et al. 2006 (three year olds)



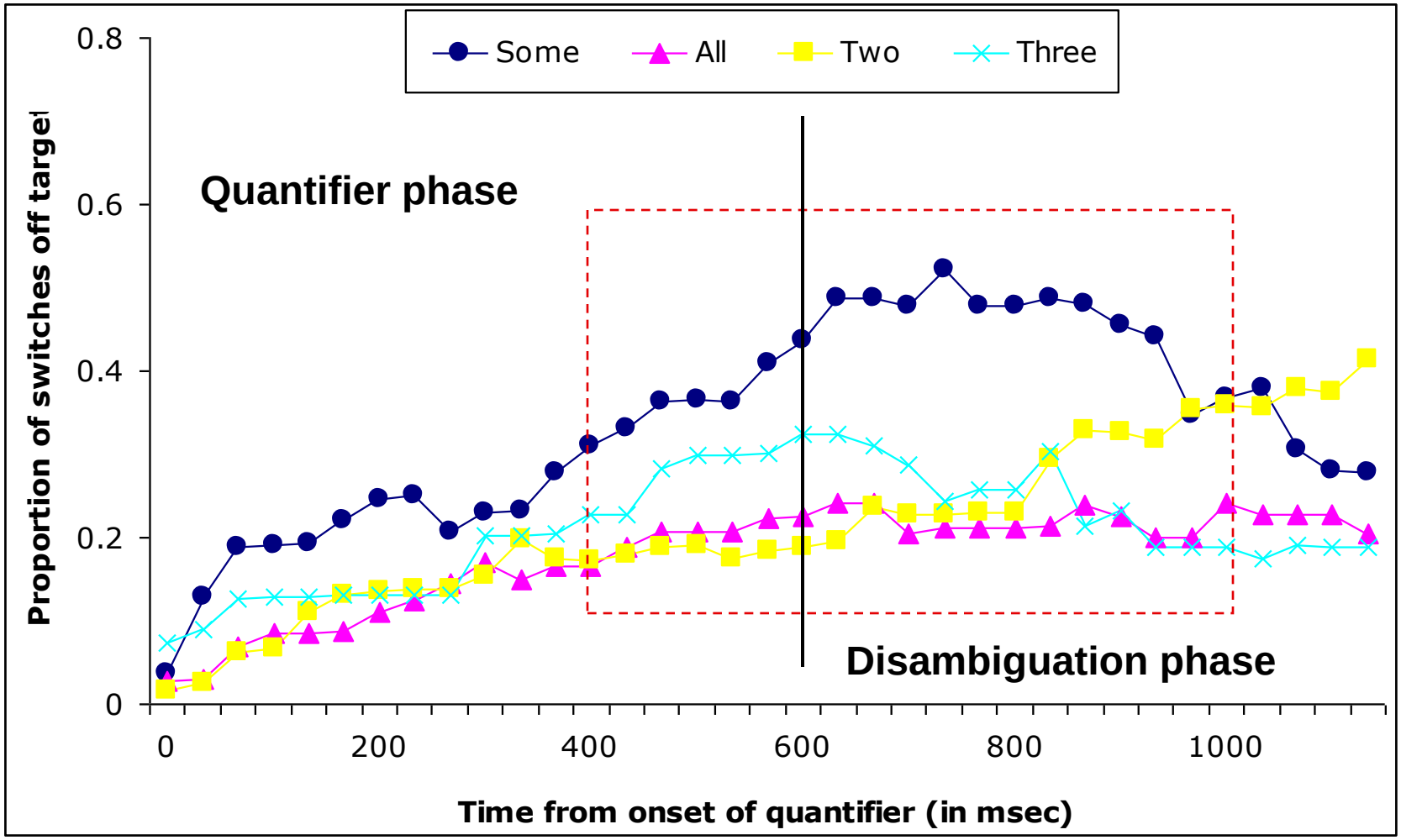
Tolerance can't explain it all

- Generic bias (Leslie & Gelman, 2012)
  - Adults and children misremember universal statements as generics (all dogs → dogs)
  - 3 yr olds *also* misremember "some" statements as generics (some dogs → dogs). But not "no dogs"
  - Suggests they aren't generating implicature
- Ira's adjective studies yesterday
- No evidence that children generate upper-bound during processing

Children: switches off distractor



Children: switches off target



So what?

- Implicature is sluggish in adults
- Children's processing is generally slower

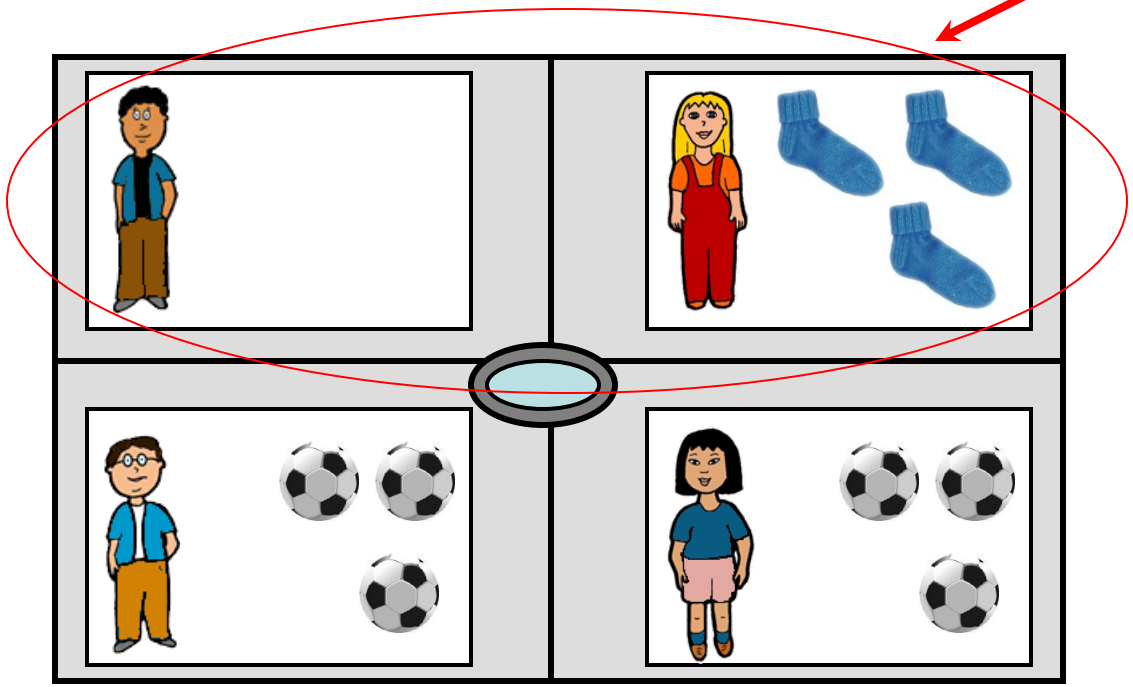
Is there **any** evidence of scalar implicature in children's on-line processing?

Test: SI-consistent vs. SI-violating utterances

Implicature violating utterances

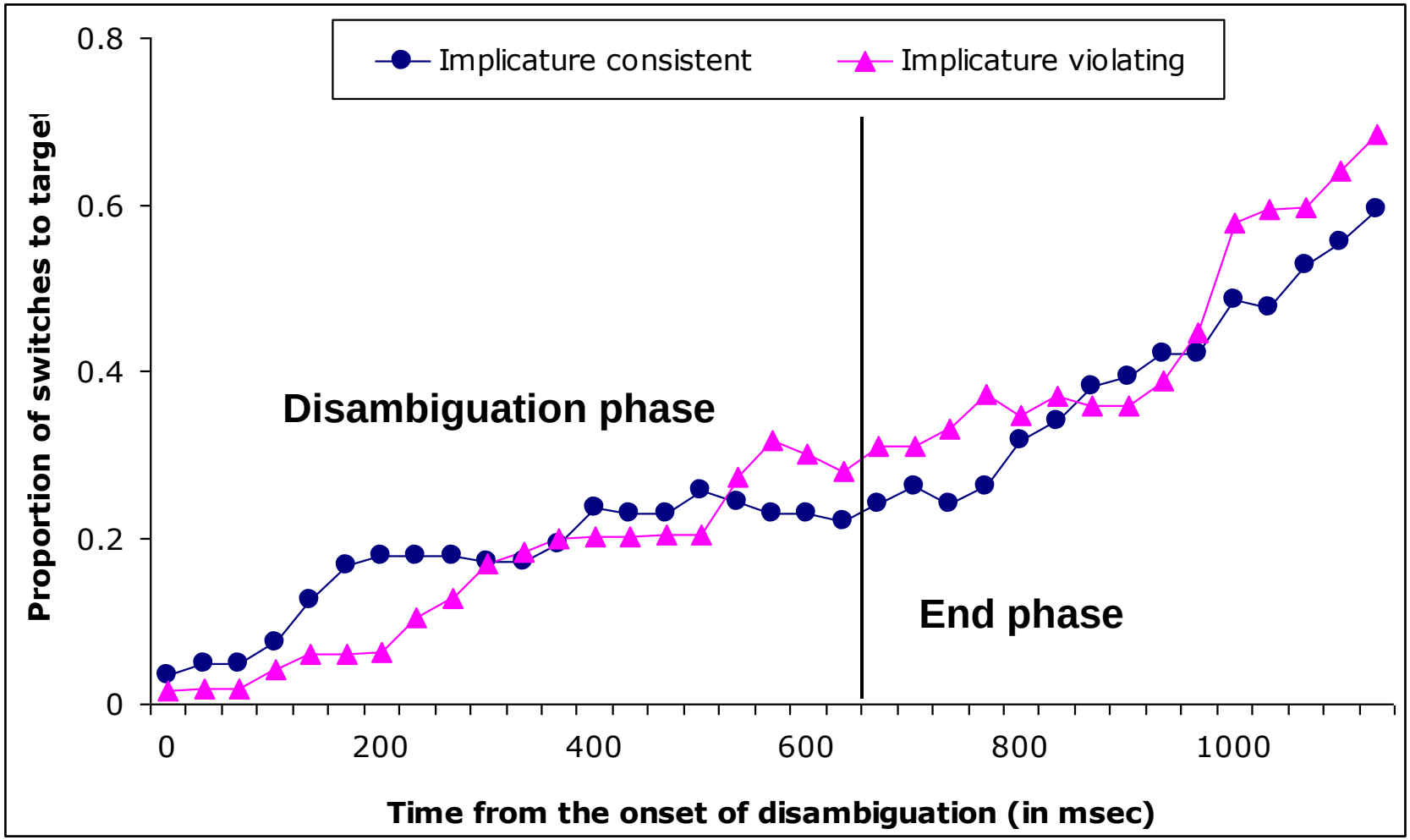
"Point to the girl that has some of the socks."

Delays corresponding to violation of SI

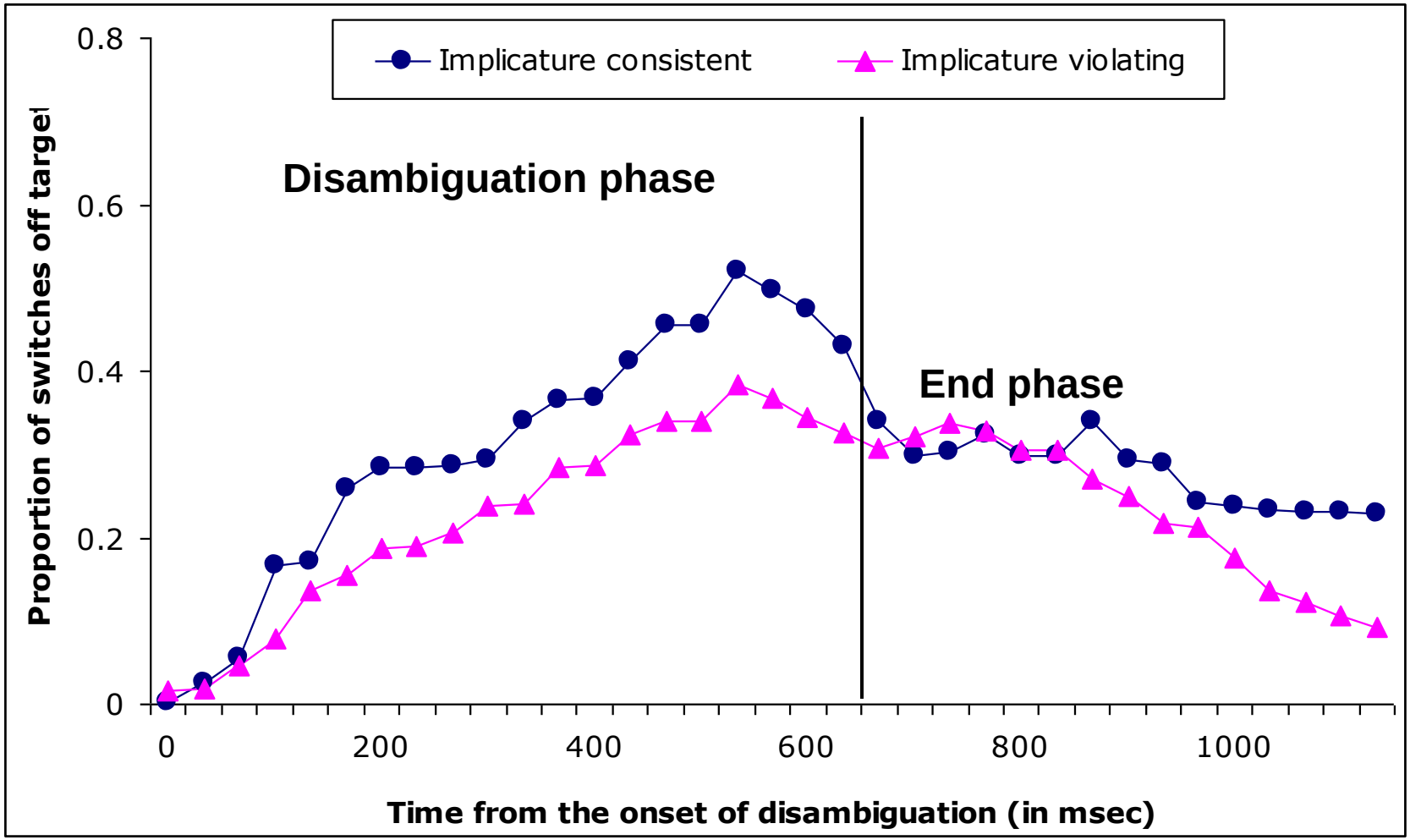


Target = total set

Children, switches off of distractor



Children, switches off target



Possibility 4: processing account

- Computing SI without pre-encoding is effortful
  - Children fail to pre-encode in contexts where adults do (Huang, data)
- Children have difficulty retrieving scales (Barner, Brooks & Bale, 2012)
- Children have difficulty using top-down cues (Snedeker, 2013)
  - SI may involve generating higher-level information to enrich interpretation
  - Such loops unfold over time (see Dell, 1986)
  - Slower processing = fewer time steps….
- As they become faster more efficient processors, they may be able to calculate SI's more often

A brief digression about scalar implicature in adults

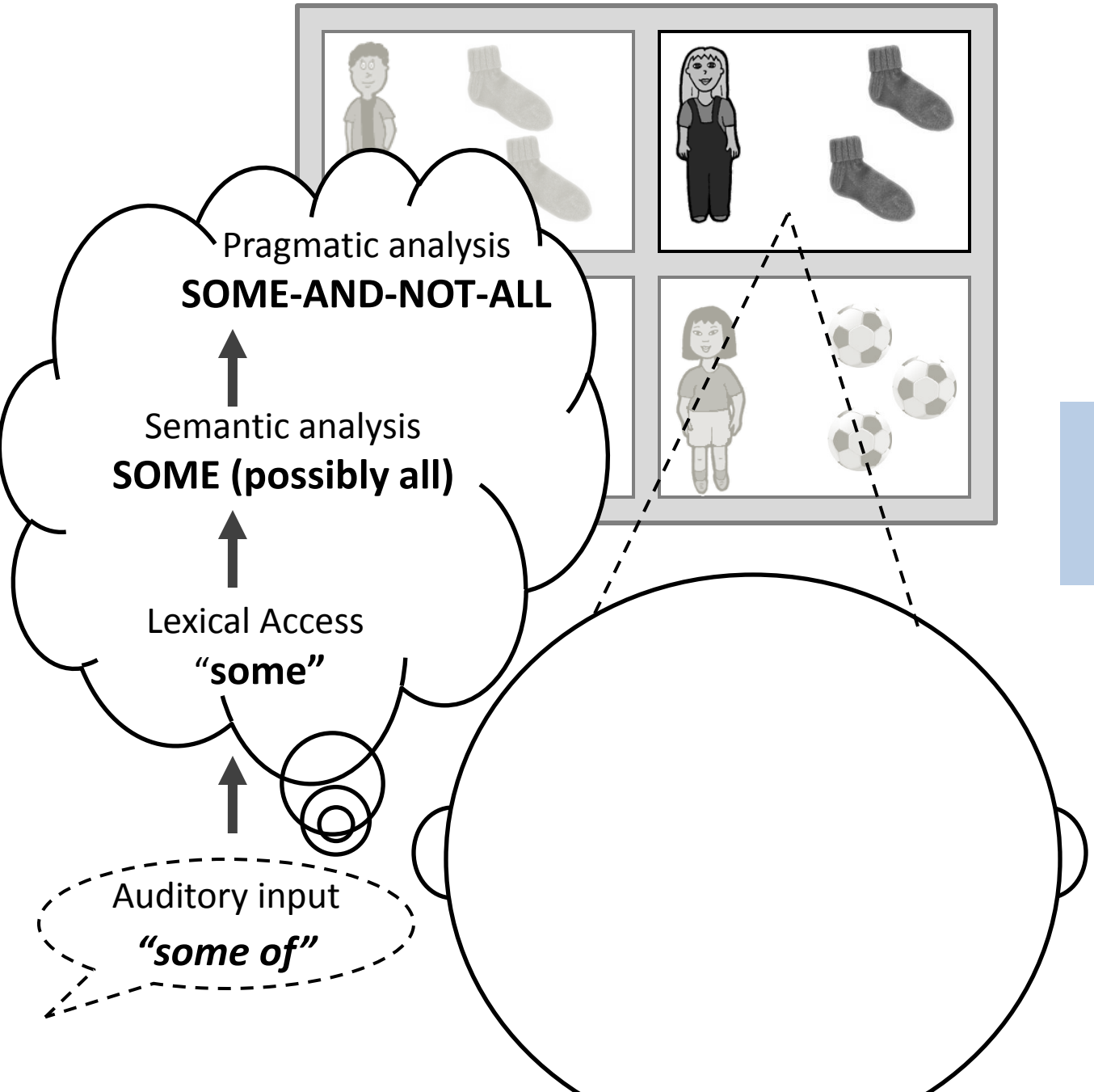
Two ways to calculate scalar implicatures

Bottom-up

- Hear “some”
- Retrieve its meaning
- Activate stronger alternative (*all*)
- Construct enriched meaning
- Evaluate / link to context

Dependent on context!

Remember, this is incremental and interactive
(not “2-stage”)

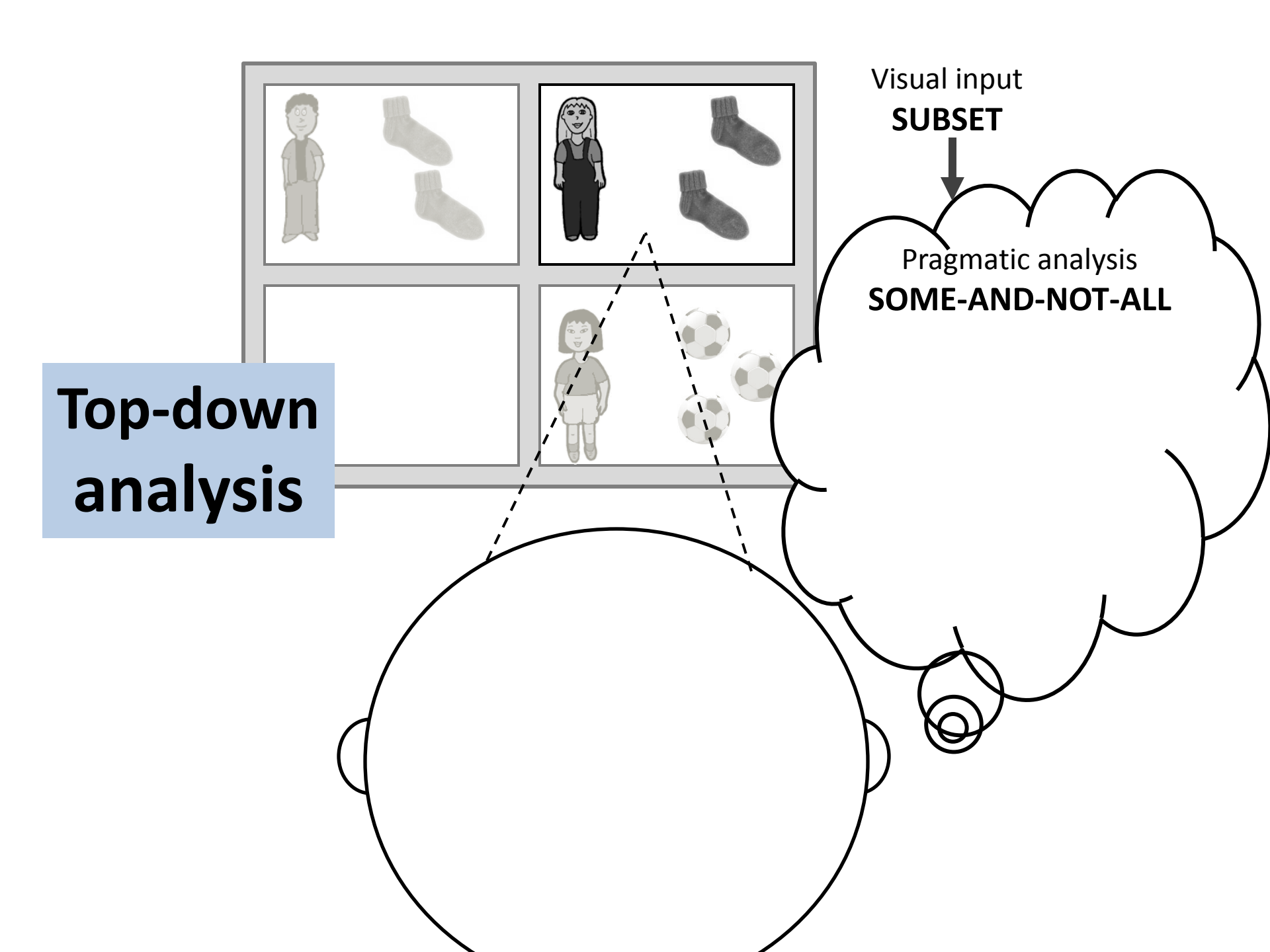


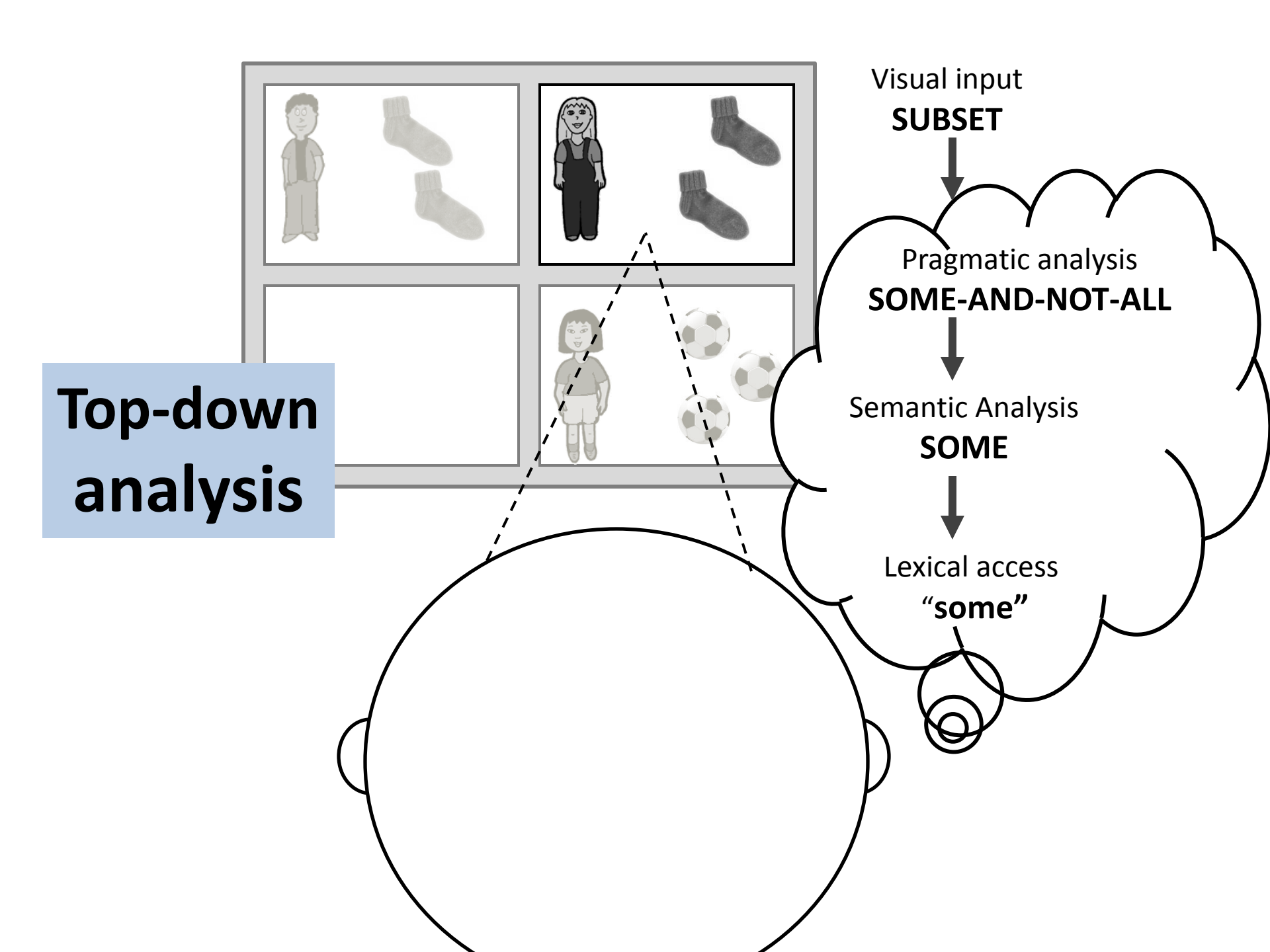
Bottom-up analysis

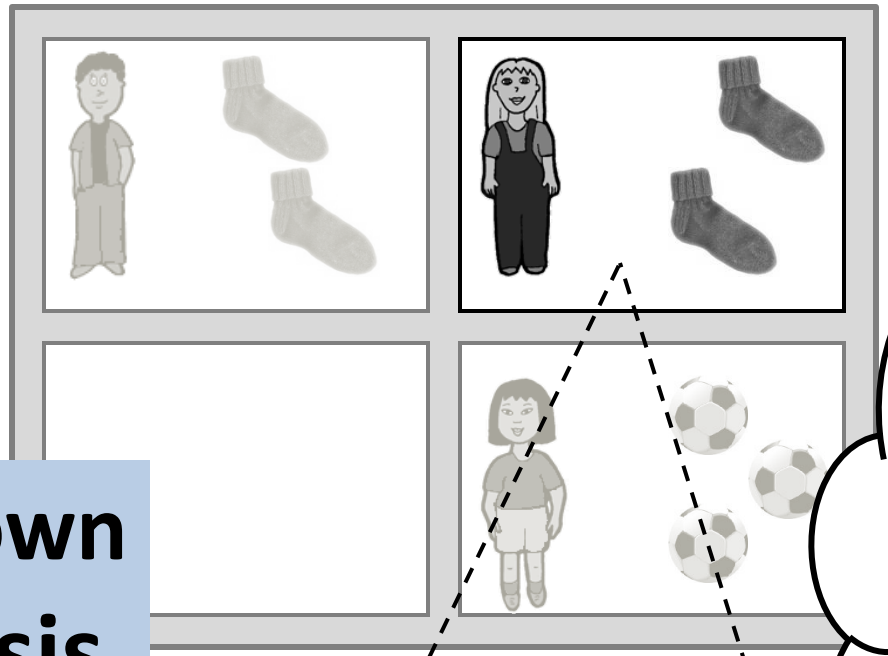
Two ways to calculate scalar implicatures

Top-down

- Listener sees display (knows the situation)
- Encodes a “message level” representation of possible referents (GIRL + SUBSET OF X’S)
- Begins to link to lower levels of representation (semantic, maybe even lexical)


Visual input
SUBSET
Pragmatic analysis
SOME-AND-NOT-ALL
Top-down analysis


Top-down analysis
Visual input
SUBSET
Pragmatic analysis
SOME-AND-NOT-ALL
Semantic Analysis
SOME
Lexical access
“some”



Visual input
SUBSET

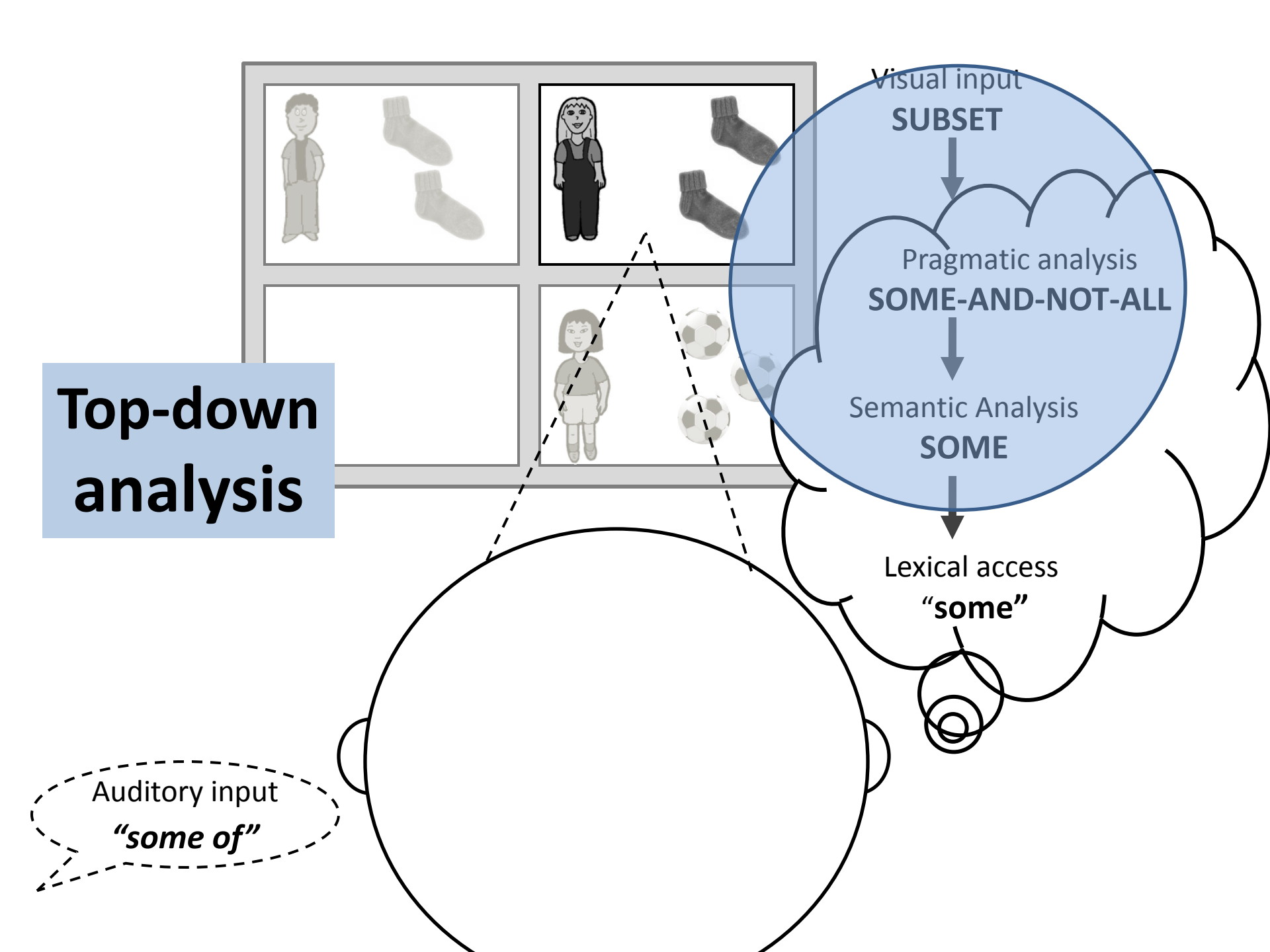
Pragmatic analysis
SOME-AND-NOT-ALL

Semantic Analysis
SOME

Lexical access
“some”

Top-down analysis

Auditory input
“some of”

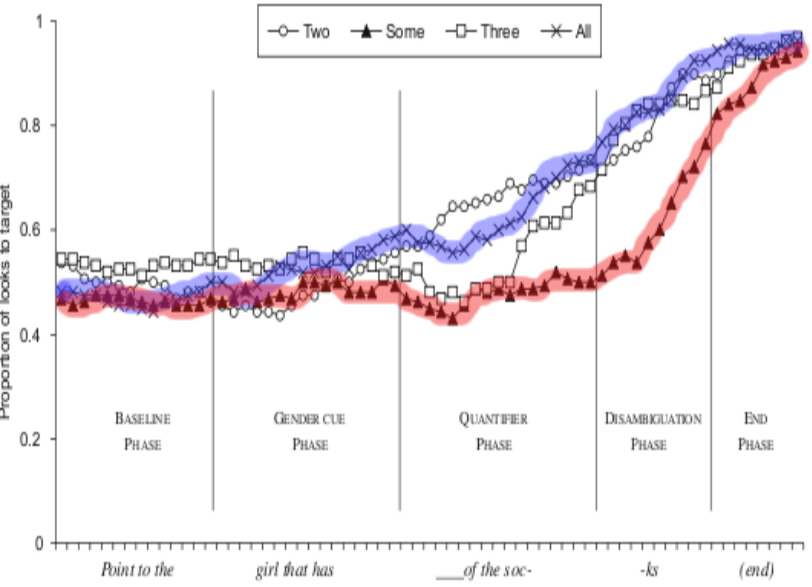

Top-down analysis
Visual input
SUBSET
Pragmatic analysis
SOME-AND-NOT-ALL
Semantic Analysis
SOME
Lexical access
"some"
Auditory input
"some of"

Predictions

- Bottom-up
  - Scalar upper bound delayed relative to lexically encoded upper and lower bounds
  - Occurs when verbal encoding is difficult
    - Messages more unpredictable to comprehender
    - Multiple construals of given referent
- Top-down
  - Scalar upper bound guide reference resolution as rapidly as lexical bounds
  - Occurs when a verbal encoding is easy
    - Facts already known to listener (visual world)
    - Single salient construal of each referent in task

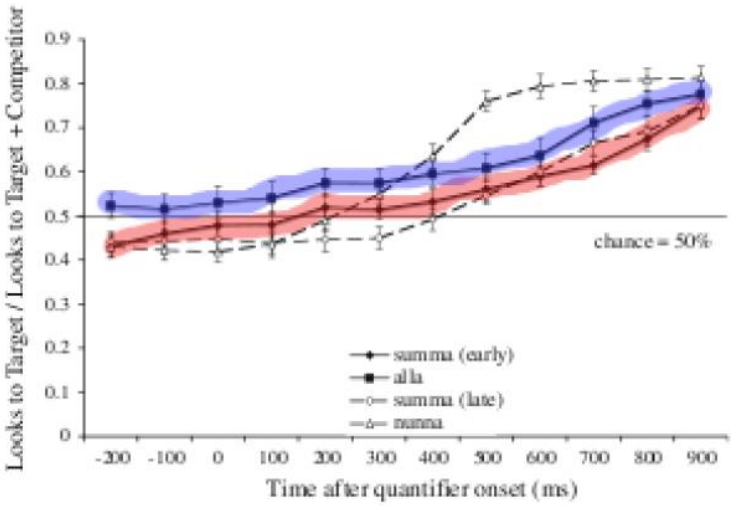
Divergent Findings in Visual World Paradigm

Delayed Upper Bound for “Some”



Huang & Snedeker (2009)

Instant Upper Bound for “Some”

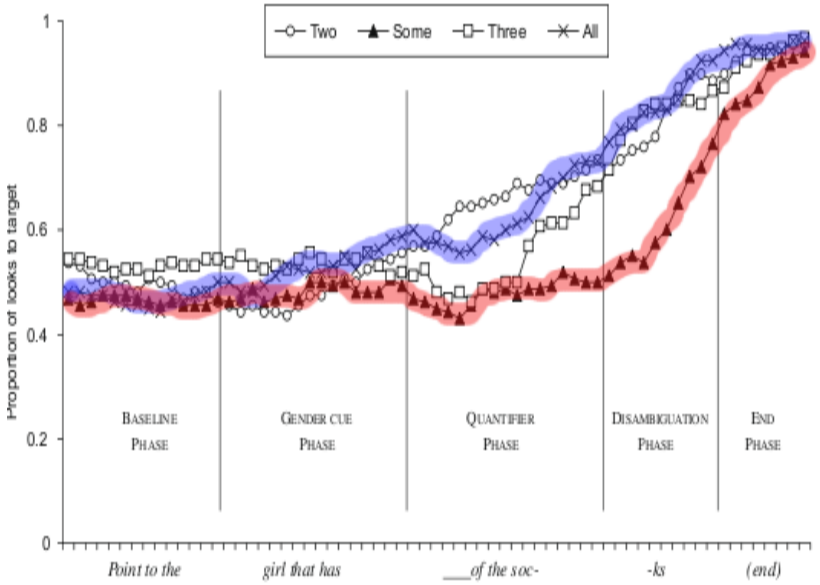


Grodner et al. (2010)

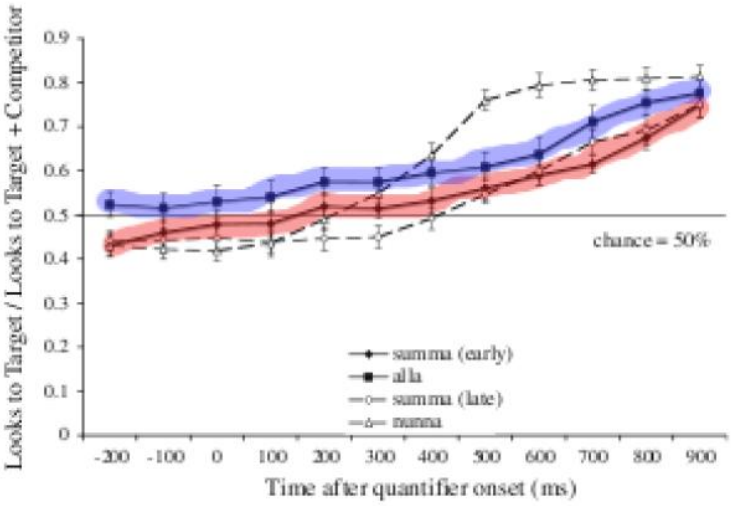
Methodological differences

- Pronunciation “summa” vs. some of
- Embedded in stories vs. not
- Length of experiment
- Number trials (Huang, Hahn & Snedeker; Degen & Tanenhaus)

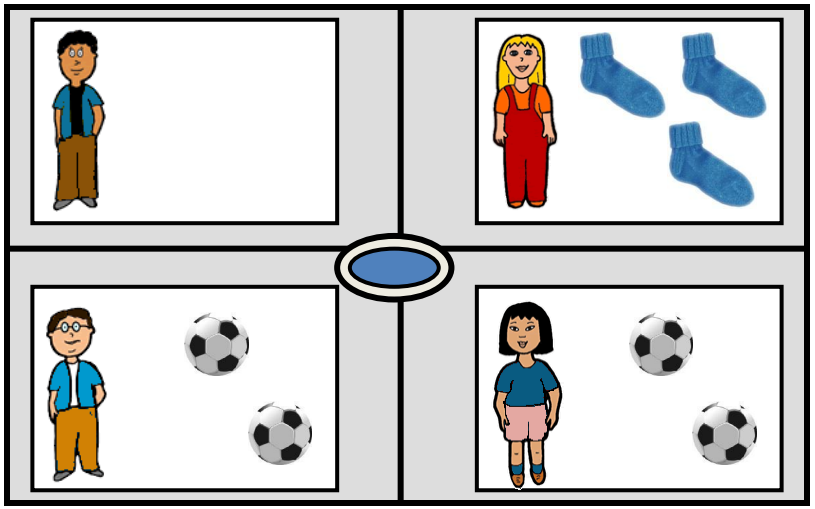
Huang & Snedeker (2009)



Grodner et al. (2010)



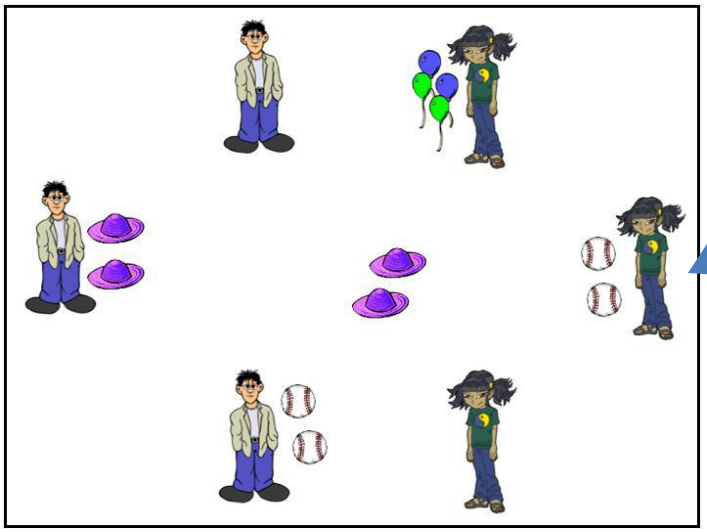
Comparison of studies



Dual Encoding:

The girl with some of the soccer balls
The girl with two of the soccer balls.

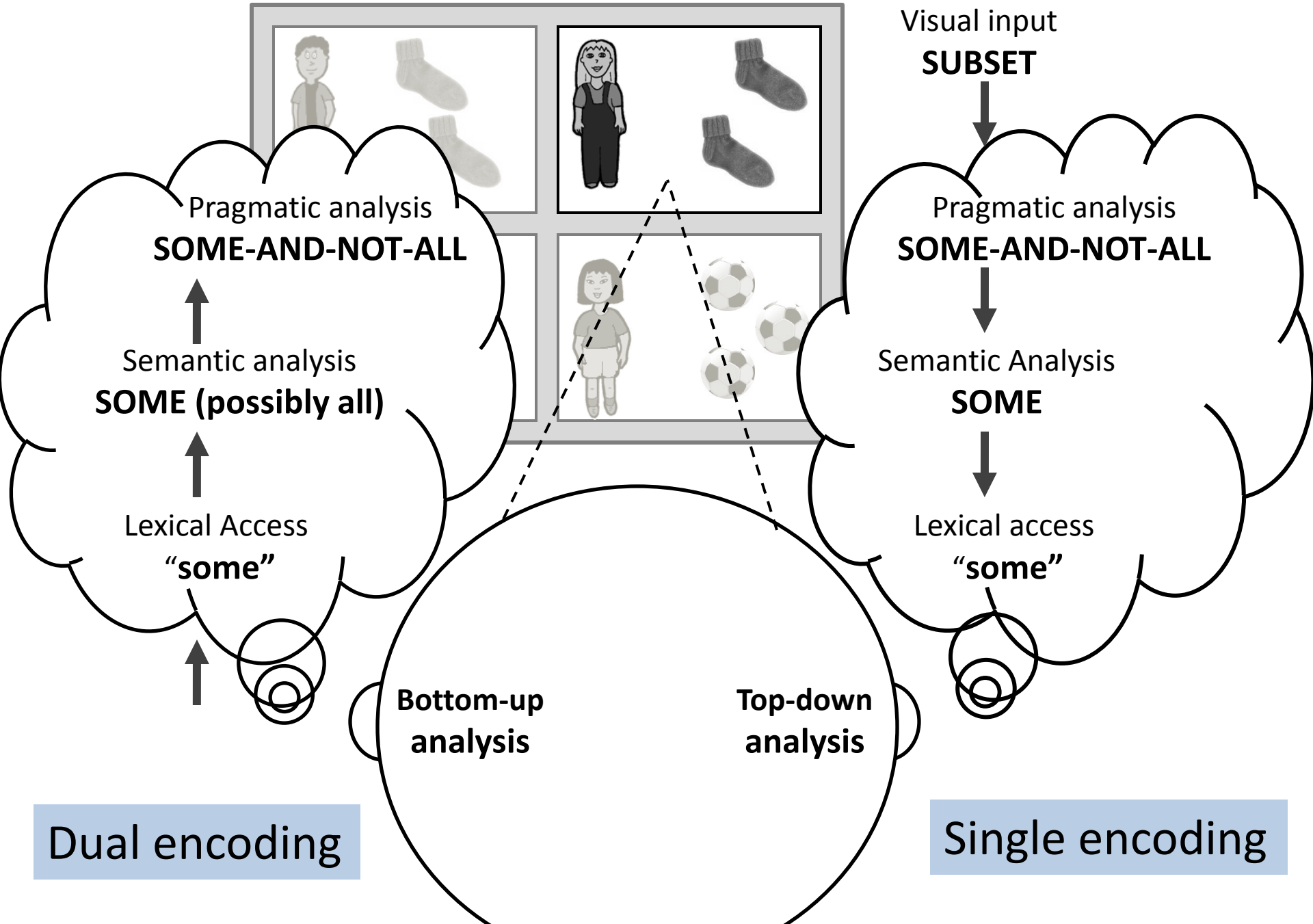
SI delayed



Single Encoding:

The girl with some of the balls

Immediate SI


Visual input
SUBSET
Pragmatic analysis
SOME-AND-NOT-ALL
Semantic analysis
SOME (possibly all)
Lexical Access
"some"
Pragmatic analysis
SOME-AND-NOT-ALL
Semantic Analysis
SOME
Lexical access
"some"
Bottom-up analysis
Top-down analysis
Dual encoding
Single encoding

Robust generalization across experiments

Red: slow SI, fast semantic; Green: both fast

Dual Encoding

- H&S, 2009
- H&S, 2011
- Panizza, Huang, Chierchia & Snedeker (2009)
- Huang, Hahn & Snedeker
- Degen & Tanenhaus
- Hartshorne et al

Single Encoding

- Grodner et al., 2010
- Breheny, Ferguson & Katsos, (2012)
- Breheny, Ferguson & Katsos (2013)
- Huang,Hahn & Snedeker
- Degen & Tanenhaus
- Hartshorne et al.
- Huang (*most*, *start*, pc)

Underlined studies manipulated encoding

Now back to children

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How this plays out in TVJ

- Child hears utterance
  - Some of the horses jumped over the fence
- Semantic content is constructed incrementally and passed on for syntactic analysis
- Salient referent (for “some horses who jumped”) is available in the context
- Child commits to this interpretation before pragmatic processing is complete

In sum

1. Implicature takes some work (bottom up)
2. But the work can be done ahead of time
   - When the conceptual encoding for each message is unambiguous
   - Listener as speaker
3. Thus SI proficiency develops gradually as children become more effective processors
4. Thus SI breaks down with language skills
   - Consistent with a distinction btw grammatical/social inferences or explicatures/implicatures?

Thank you!

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