

The on-line computation of pragmatic information

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9.59J / 24.905J

Constraint interaction: Time course of information use

The immediate effects of:

- Plausibility: Ferreira & Clifton (1986) vs. Trueswell, Tanenhaus & Garnsey (1994)
- Context: Tanenhaus et al. (1995); Trueswell et al. (1999)
- Pragmatics: The computation of non-literal language: implicatures (Huang & Snedeker & 2008; Grodner et al. 2008; Sedivy et al. 1999; Keysar et al. 2000; Heller et al. 2008)

Time course of information use: syntactic rules vs. plausibility

Old research question: Does syntactic structure processing take place before other levels of sentence processing? (perhaps: priority of bottom-up information source use: lexical and syntactic information first? Frazier, 1978)

Framed in terms of modularity: is syntactic processing modular, so that it is insulated from other levels of analysis, such as real-world plausibility?

Ferreira & Clifton (1986)

Eye-tracking investigation of the main-verb (MV) / reduced-relative (RR) ambiguity, manipulating the plausibility of the initial NP as agent of the MV.

MV rule: S → NP VP (High frequency rule)

RR rule: NP → NP Rel-clause-VP (Low frequency rule)

The (evidence / defendant) examined by the lawyer turned out to be unreliable.

Unambiguous controls:

The (evidence / defendant) that was examined by the lawyer turned out to be unreliable

Ferreira & Clifton (1986)

The evidence (that was) examined by the lawyer turned out to be unreliable.

Syntax-first ("modularity") predictions:

1. slow at "by the lawyer": syntactic reanalysis.

Non-modularity predictions: no difference between ambiguous and unambiguous controls in any region.

Animate initial noun control:

The defendant (that was) examined by the lawyer turned out to be unreliable.

Ferreira & Clifton (1986)

Results: First pass times (msec/character)

| | examined | by the lawyer |
|-------------------|----------|---------------|
| Animate ambig. | 33.3 | 40.4 |
| Animate unambig | 31.9 | 30.7 |
| Inanimate ambig | 37.7 | 38.4 |
| Inanimate unambig | 30.1 | 30.3 |

These results support the modularity theory.

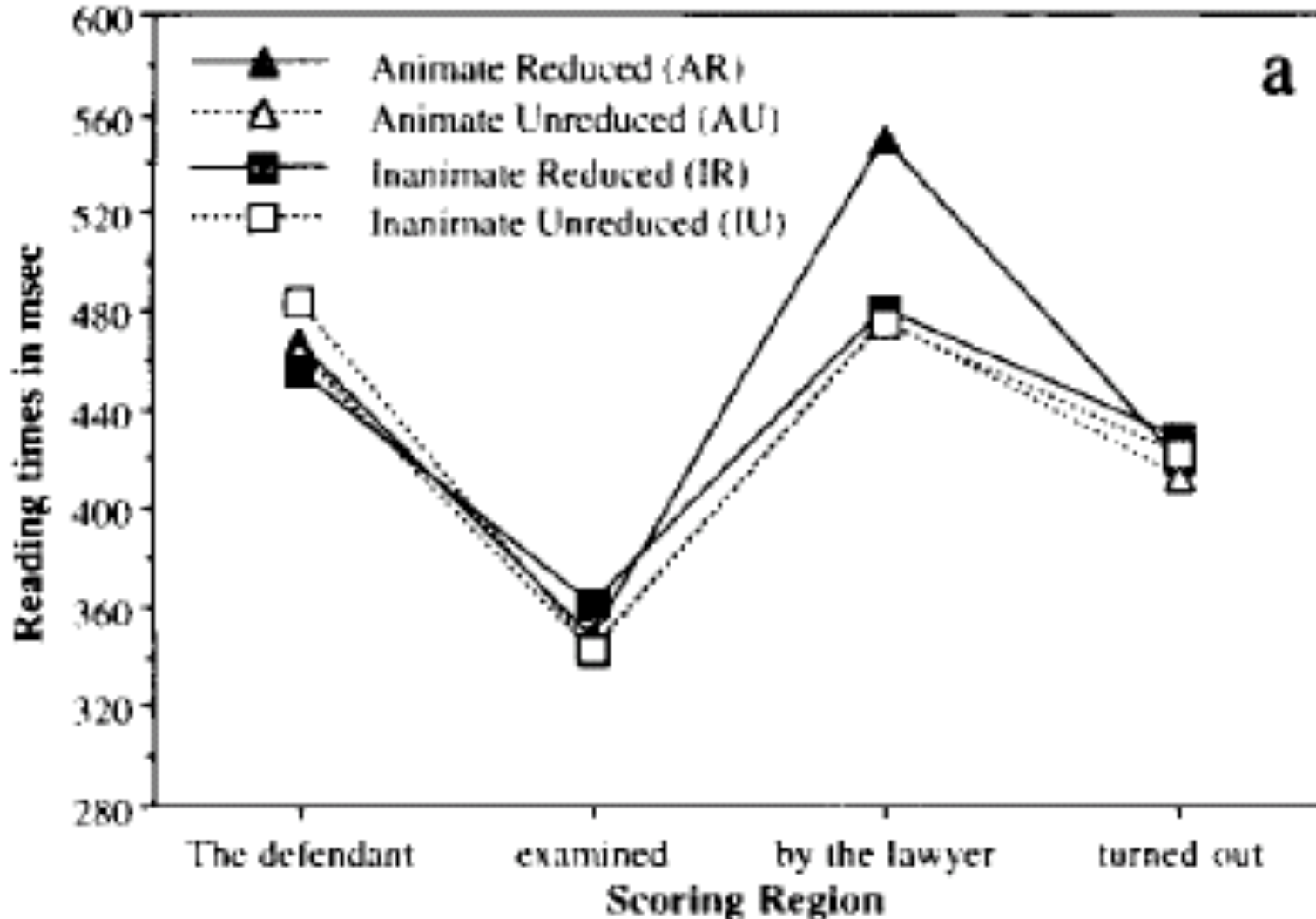
Trueswell, Tanenhaus & Garnsey, 1994

Problems in Ferreira & Clifton's items:

Half (8/16) of the inanimate items weren't implausible agents:

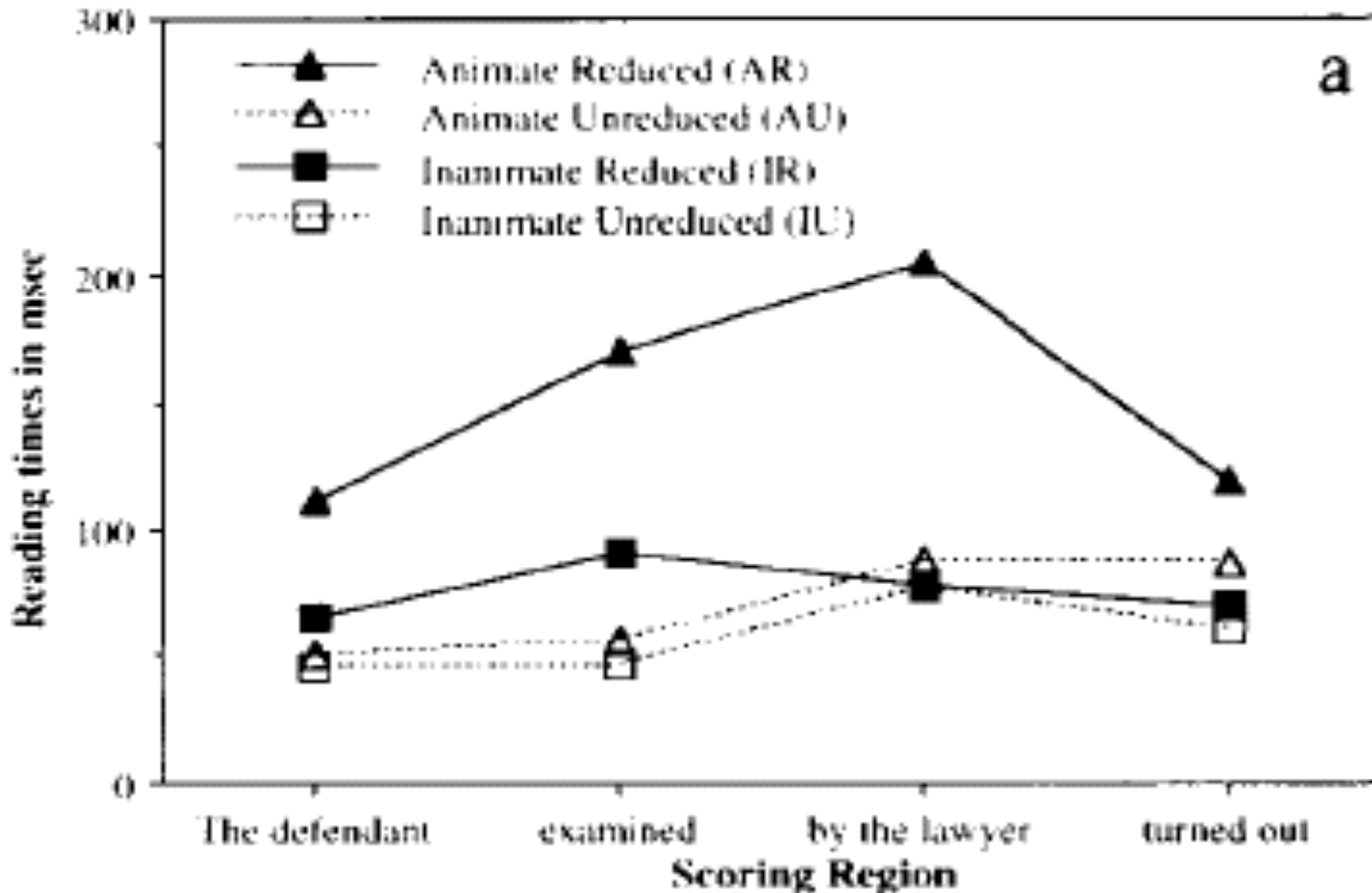
The car towed by the truck ...
(cf. The car towed the trailer.)

Trueswell, Tanenhaus, and Garnsey (1994): Experiment with better items.
Mean first pass times



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Trueswell, Tanenhaus, and Garnsey (1994): mean second-pass times



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Trueswell, Tanenhaus & Garnsey, 1994

Conclusion: Plausibility and lexical frequency are used as soon as can be measured in resolving ambiguity in on-line sentence processing.

This is evidence against the syntax-first modularity hypothesis:

Plausibility information may be available immediately

Language:

Information sources and constraints

Current Context (Crain & Steedman, 1985; Altmann & Steedman, 1988; Tanenhaus et al., 1995): visual or linguistic

Ambiguity:

There were two defendants, one of whom the lawyer ignored entirely, and the other of whom the lawyer interrogated for two hours.

The defendant examined by the lawyer turned out to be unreliable.

Monitoring visual eye-movements while listening to spoken instructions
(Tanenhaus et al., 1995; Trueswell et al., 1999)

1-referent context: “Put the hippo on the blanket into the basket.”

Many looks to the incorrect target %



Monitoring visual eye-movements while listening to spoken instructions (Tanenhaus et al., 1995; Trueswell et al., 1999)

2-referent context: “Put the bear on the plate into the box.”

No looks to the incorrect target %



Pragmatics: non-literal language

- Gricean Maxims: Cooperative conversation.
 - Violating a maxim leads to an **implicature**
 - *Implicature*: an inference whose source is a linguistic expression
- Implicatures and on-line sentence processing
 - When do people compute contrast sets? Test cases:
 - Contrast sets associated with scalar adjectives like “tall” and non-scalar adjectives like materials (e.g., “plastic”) and color (e.g., “red”)
 - Scalar implicatures associated with determiners like “some” vs. “all”

Grice's Maxims

Four conversational maxims for a cooperative speaker:

(1) Maxim of Quantity:

- Make your contribution as informative as is required
- Do not make your contribution more informative than is required

In a context where all of the students passed the test.

?? Some of the students passed the test.

In a context with only one cup:

Pass me the cup.

?? Pass me the tall blue cup that's made out of plastic.

(2) Maxim of Quality: e.g., when your friend Paul has betrayed you in some way: “Paul is a fine friend”

- Do not say that which you believe to be false
- Do not say that for which you lack evidence

(3) Maxim of Relation:

- Say only what is relevant for the current purposes of the conversation.

(4) Maxim of Manner:

- Be brief but avoid ambiguity or obscurity of expression.

Grice's Maxims

- As long as the speaker adheres to the cooperative principle, he/she can disobey the maxims intentionally.
 - Deliberate violation of a maxim can give rise to an **implicature**.
 - **Implicature**: exploiting the cooperative principle to convey more information than is actually contained in an utterance.
 - Hyperbole, sarcasm, understatement are all violations of Quality maxim.

Huang & Snedeker (2008); Grodner et al. (2008): When do people compute non-literal meaning in scalars?

The girl has some of the balloons

Speaker:

some but not all

PRAGMATIC, NON-LITERAL

Sentence:

some and possibly all

LITERAL

... in fact she has all of them. ✓

... in fact she has none of them. ✖

Test for literal vs. non-literal interpretation: a non-literal interpretation can be contradicted (“cancelled”), and still result in a plausible meaning in the context. A literal interpretation cannot be contradicted.

Literal meaning of “some”

Some of the students passed the test.

Meaning1: some and possibly all

Meaning2: some and not all

Why not meaning2? Many contexts when it must be meaning1:

e.g., Interrogatives:

Did some of the students pass the test?

I wonder if some of the students passed the test.

Possible worlds:

The test is really hard.

If some of the students pass the test, then the teacher will get a bonus.

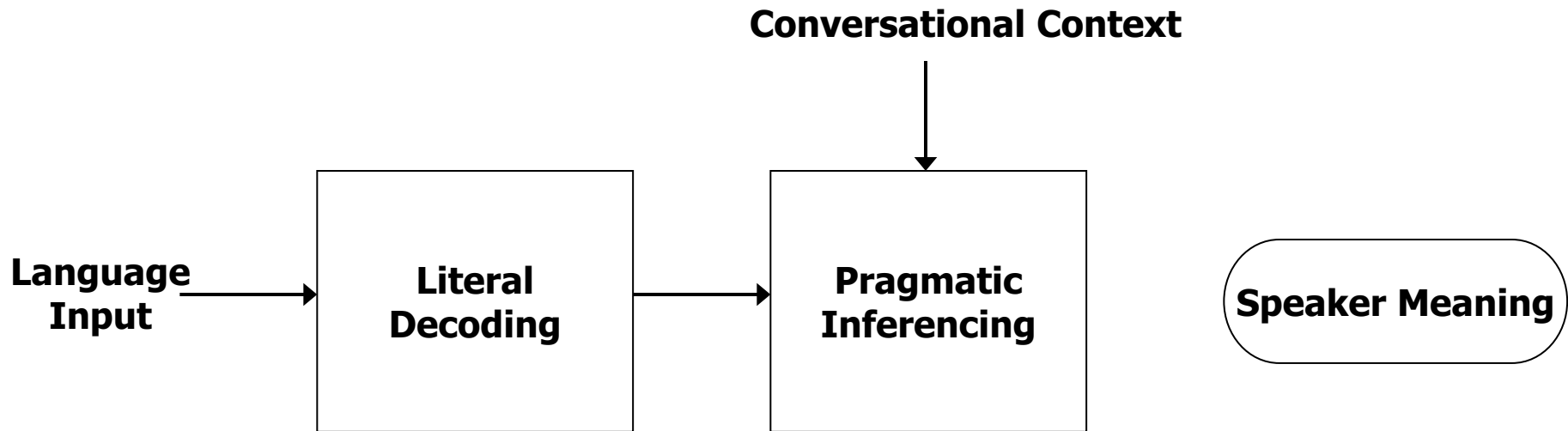
We need meaning1 for these situations. Simplest theory: one meaning for “some”, meaning1. Other meanings come from inference in particular situations.

Scalar Inference

- Grice's quantity-1:
 - Make your contribution as informative as is required for the current purposes of the exchange.
- Implicational scale
 - ~~<all, most, many~~ *some*>
- Potentially difficult
 - Reasoning counterfactually
 - Imputing intention, perspective to speaker

How do perceivers compute scalar inferences in real time?

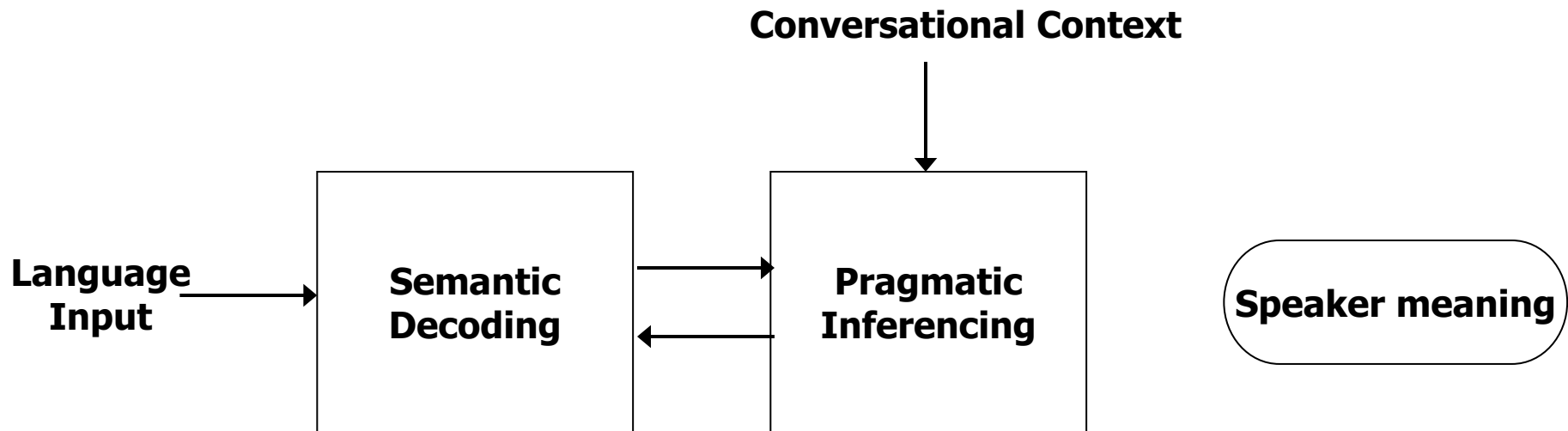
- **2-stage models** (Sperber & Wilson 1995, Bott & Noveck 2004; Breheny et al. 2006, Huang & Snedeker 2006, 2008)



- Literal meaning computed before pragmatic

How do perceivers compute scalar inferences in real time?

- **Direct Access Models** (Gibbs 1984, Gildea & Glucksberg 1983)



- Pragmatic meaning computed earlier / immediately

Scalar Implicature (SI): (

“The girl has some of the balloons.”

semantic
interpretation:

The girl has some, and
possibly all, of the balloons.

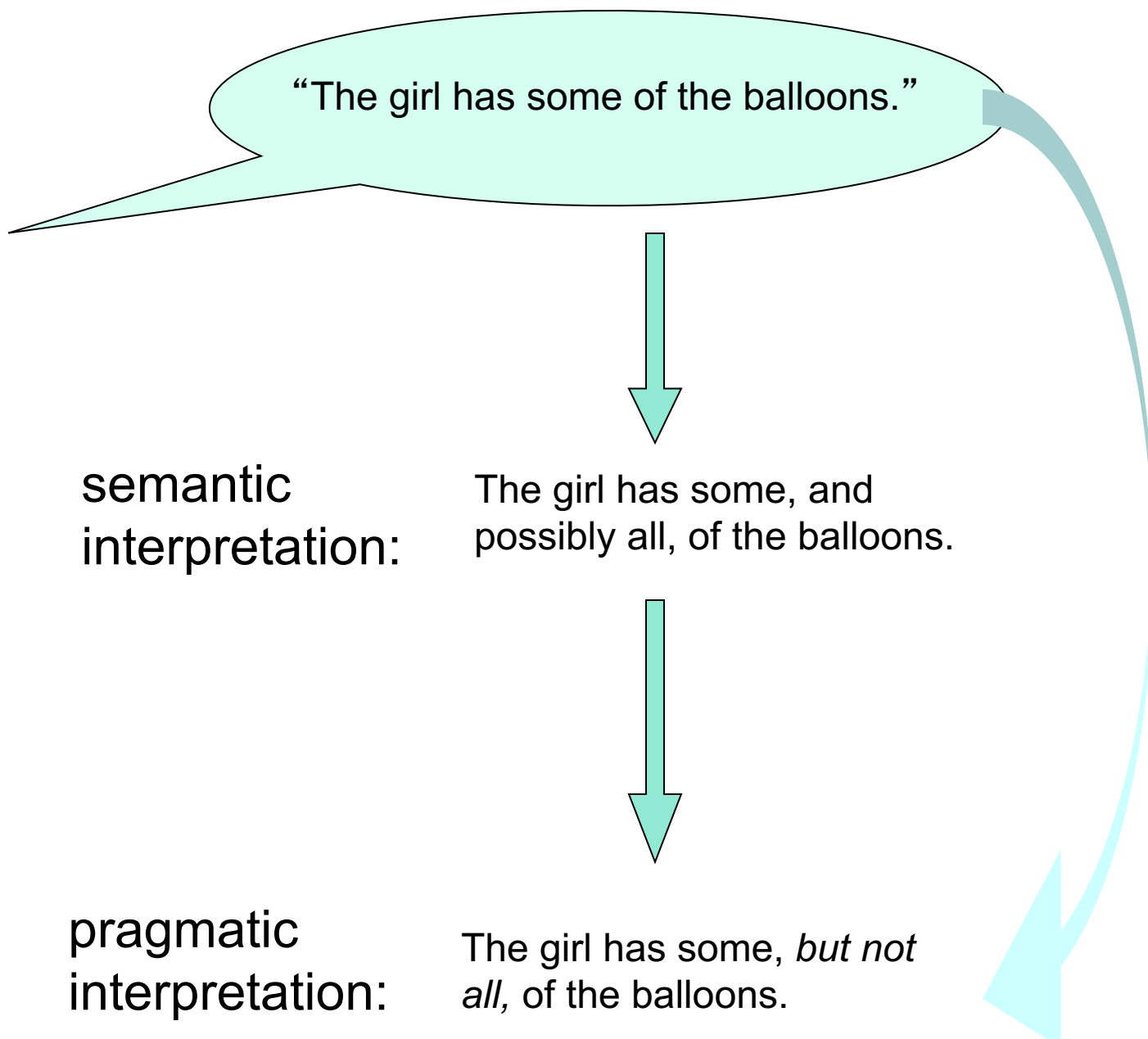
pragmatic
interpretation:

The girl has some, *but not
all*, of the balloons.

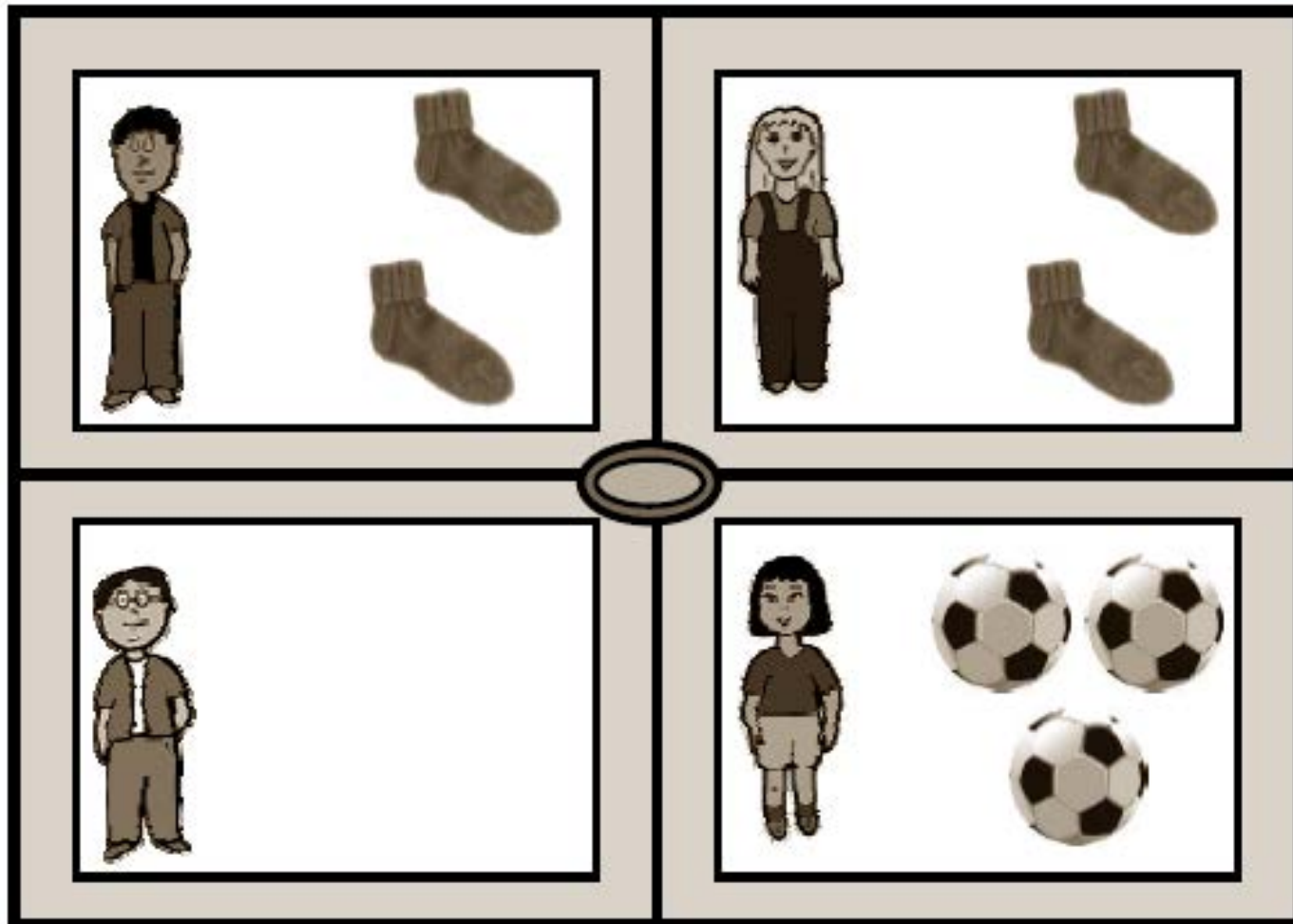
Questions:

How rapidly is the
pragmatic
interpretation
generated?

Is there evidence
that literal is
computed first?



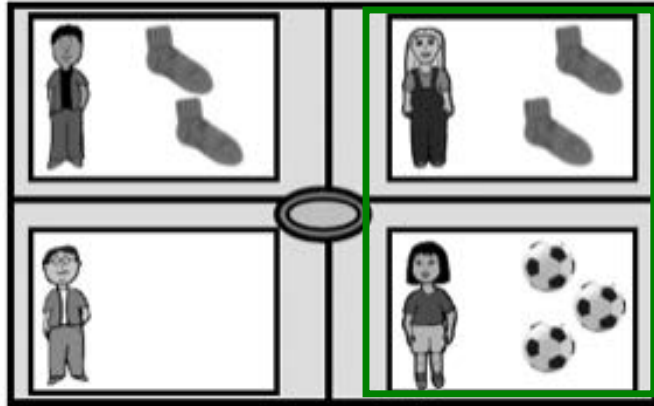
“Point to the girl that has some of the socks.”
Huang & Snedeker (



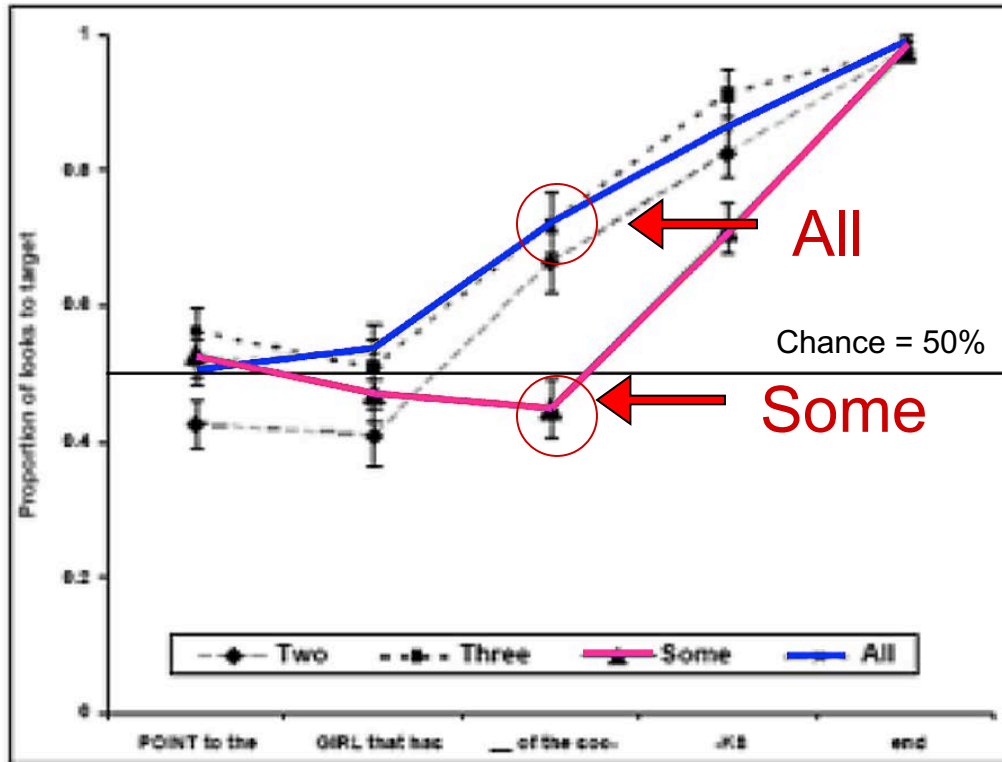
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- One girl has some of something (socks); the other girl has all of the soccer balls. (
- “Socks” and “soccer balls” share the same onset. (

“Point to the girl that has some of the socks/all of the soccer balls.”



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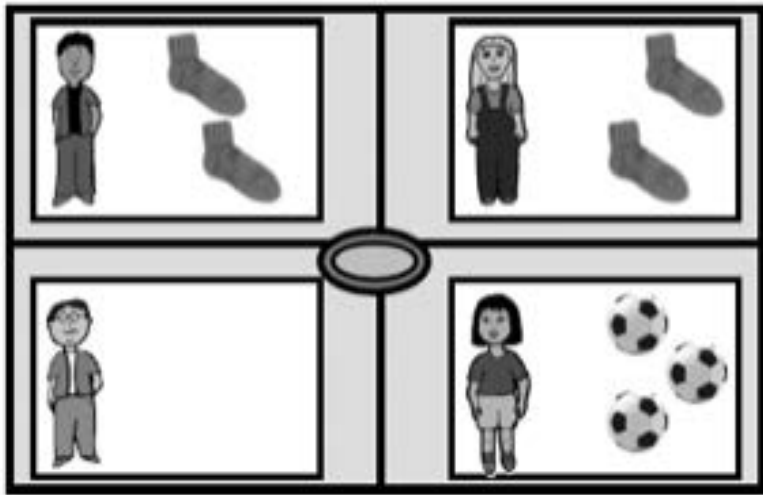


- Looks to pragmatic target for “some” delayed
- Looks to literal target for “all” immediate

Potential Challenges to H&S Conclusion that Literal Precedes Pragmatic

“Point to the girl that has some of the socks.”

“Point to the girl that has all of the soccer balls”



1. The “all” target is more visually salient
2. Cue to SI doesn't arrive until the partitive
“Point the girl that has some socks”
3. “Some” may require a more complex comparison

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Grodner et al. (2010): Experiment 1

1. Included *none* as an additional literal control
2. *some of --> summa*
all of --> alla
none of --> nunna
3. Included a baseline summa-late condition to establish whether SI is computed prior to noun point-of-disambiguation



“There are 4 balls, 4 planets and 4 balloons.”



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Conditions:

- summa-early
- alla
- nunna



Click on the girl
who has...
summa the balls
alla the balloons
nunna the items



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*Click on the girl
who has summa
the balls*



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Condition

- summa-late \$

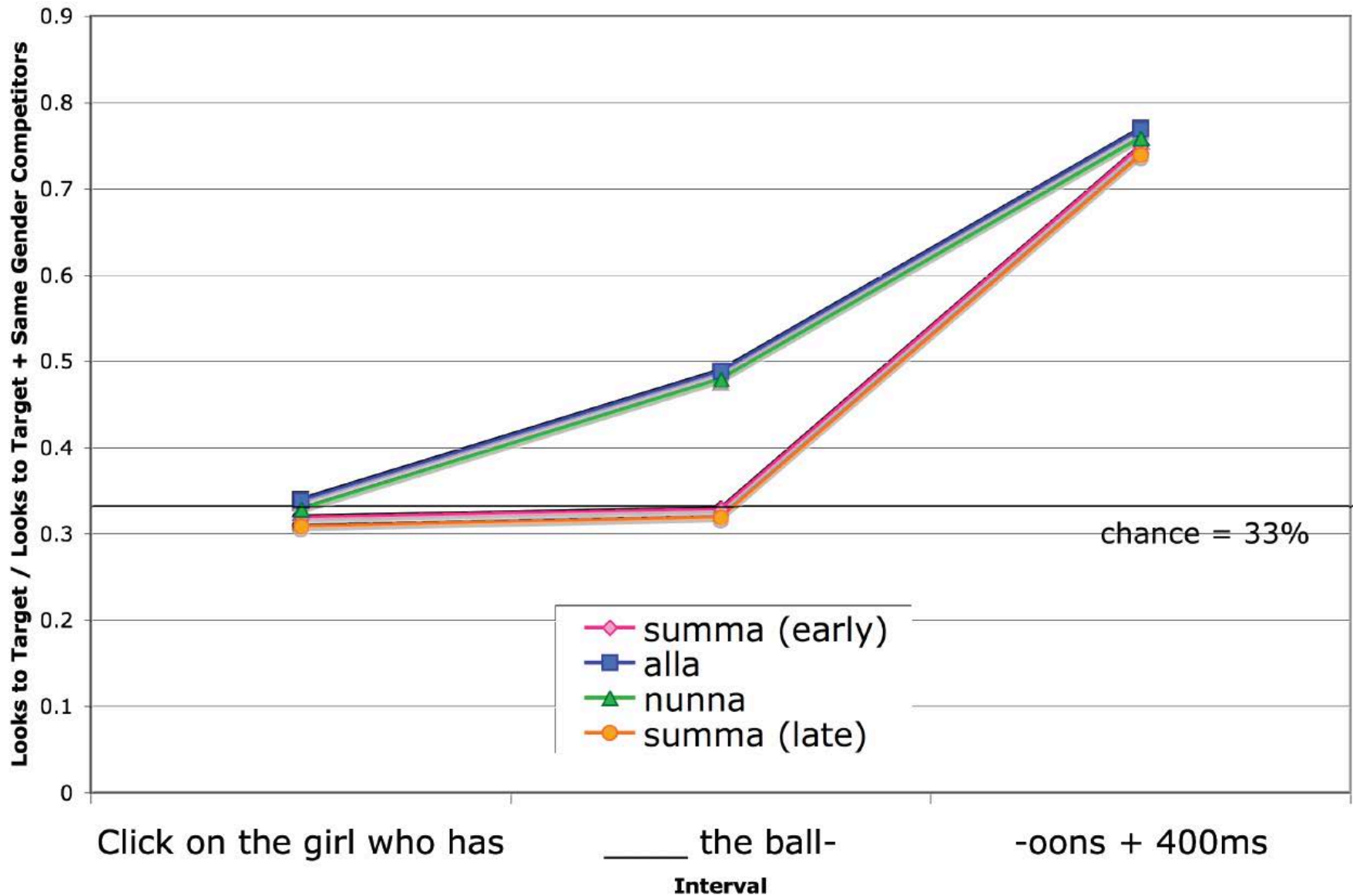


*Click on the girl who has **summa** the balls*

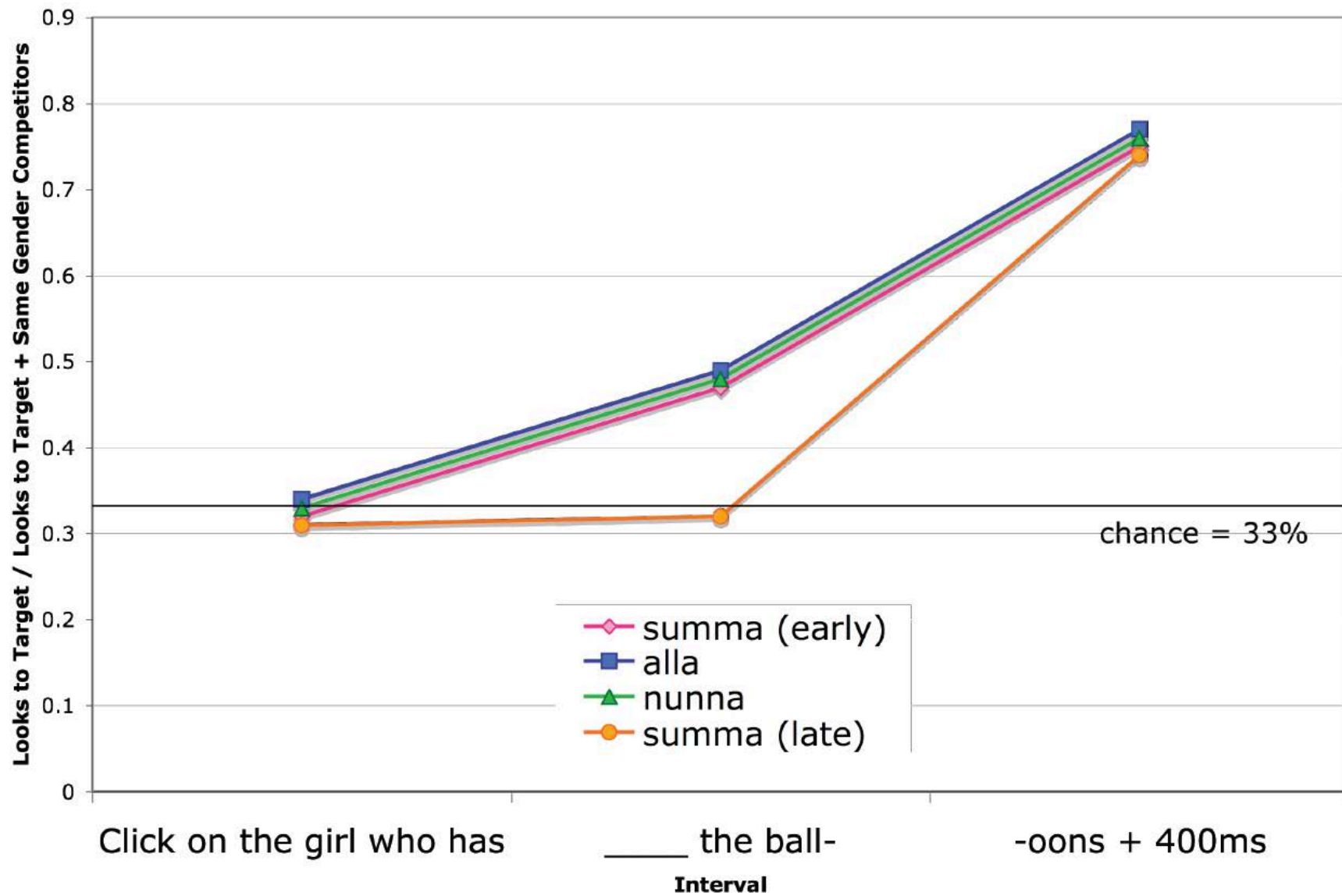


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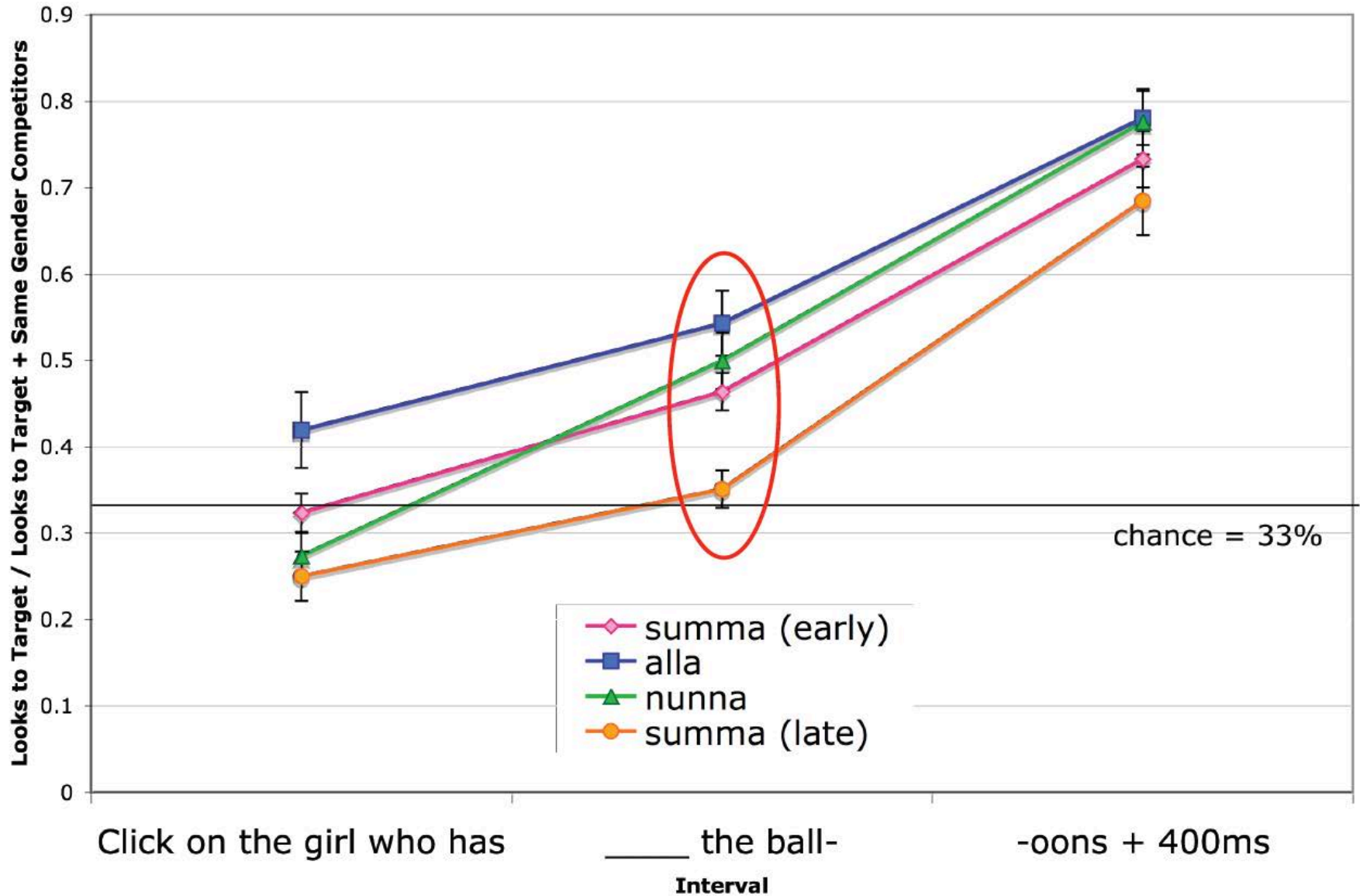
Exp 1 Predictions: Two Stage Model



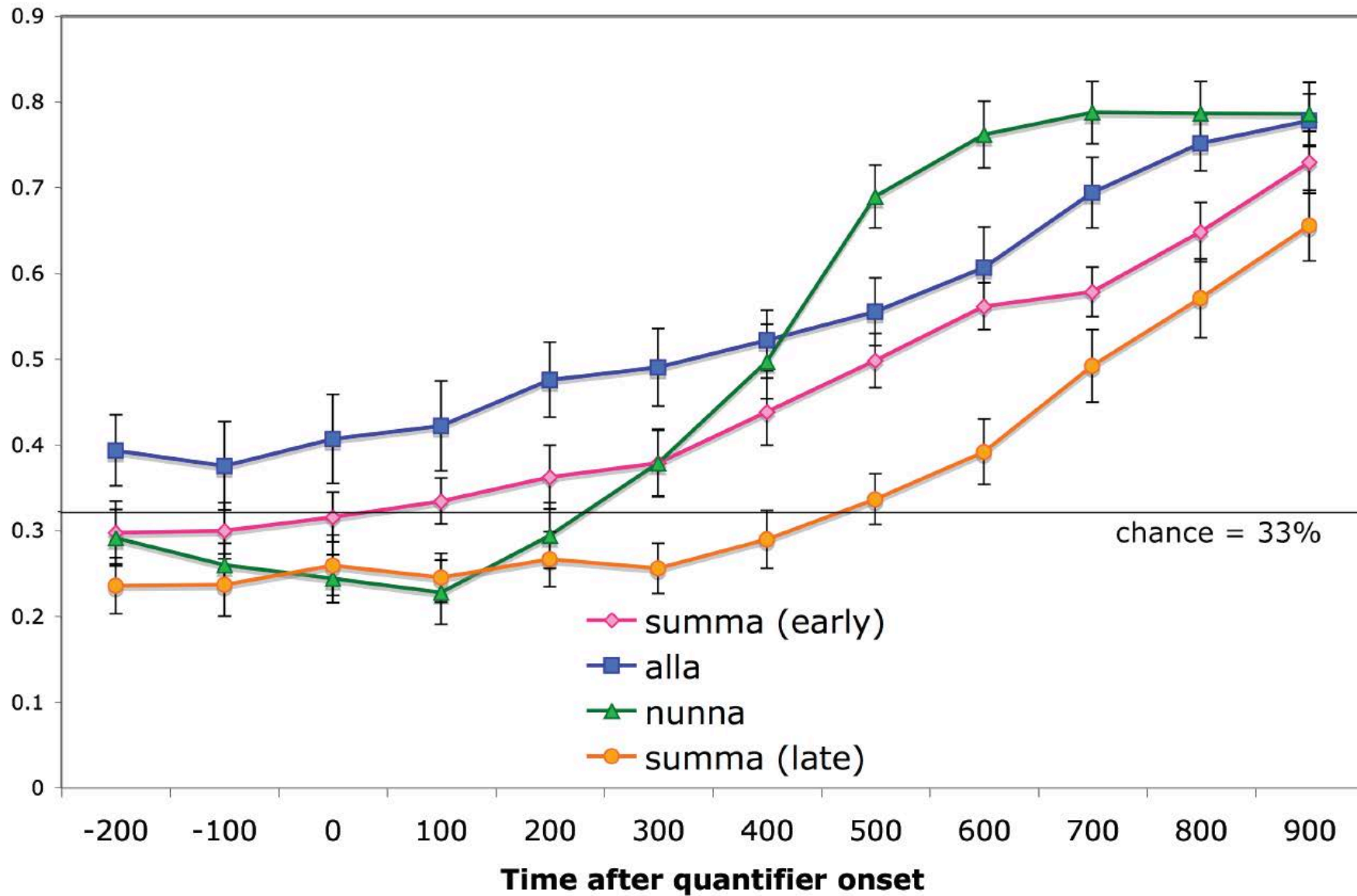
Exp 1 Predictions: 1.5 Stage/Direct Access Model



Exp 1 Results



Exp 1 Results



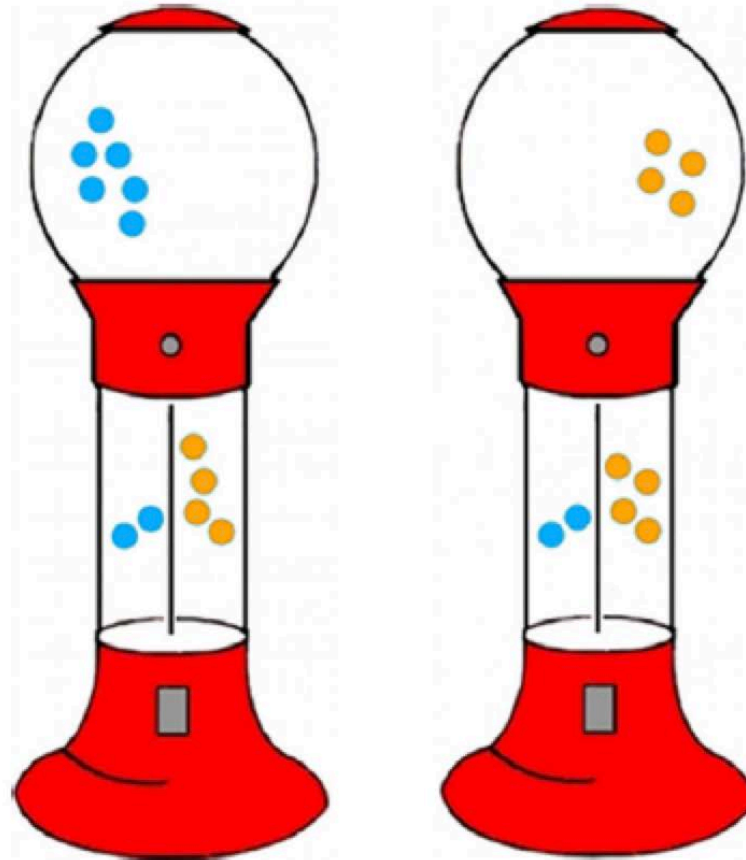
Grodner et al. (2010): Exp 1 Conclusions

- No evidence for delay of pragmatic relative to literal controls
 - Scalar implicature is generated prior to point of disambiguation of the Noun
 - Target ID for *summa* was no slower than *nunna, alla*
- Pragmatic meaning accessed immediately

Where does this leave us?

- Grodner et al. (2010): No evidence for delay of pragmatic relative to literal controls
- Huang & Snedeker (2009): “Some” is slower than “all” by 600-800 msec (!!)
- How do we reconcile these?
- Degen & Tanenhaus (2015): It may have to do with the expected alternative quantifiers

Degen & Tanenhaus (2015)



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Fig. 1. Example displays that contain the same contrast between set sizes in the lower chamber but differ in whether the big or small set is partitioned. Display on the left could occur with sentences *You got some/two of the blue gumballs* or *You got all/four of the orange gumballs*, while the display on the right could occur with *You got all/two of the blue gumballs* or *You got some/four of the orange gumballs* in the early condition.

Degen & Tanenhaus (2015)

- Experiment 1: replicate Grodner et al. (2010) using just quantifiers “some” and “all” and “none” (no numerals): early looks to “some” because no other terms are expected there
- Experiment 2: replicate Huang & Snedeker (2009) using “some”, “all”, “two”, “three”: slow looks to “some” because numbers are expected

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