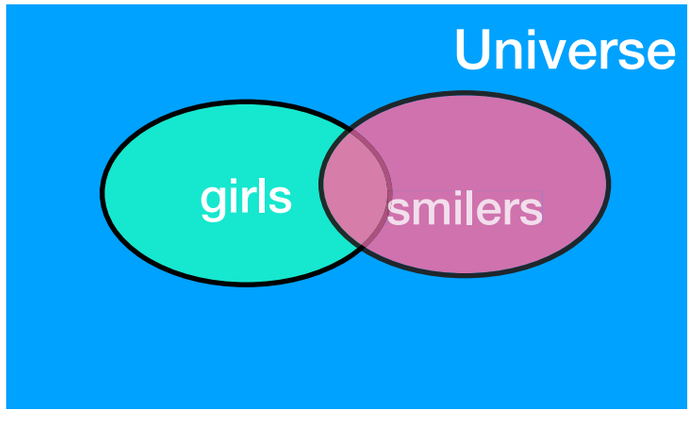
24.904
Language Acquisition

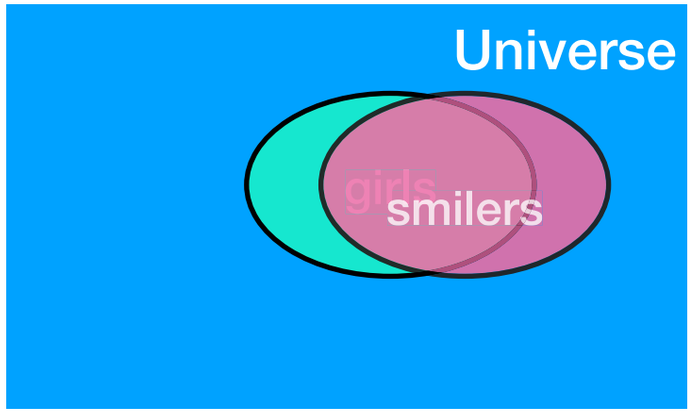
Class 21: Exhaustivity Inferences

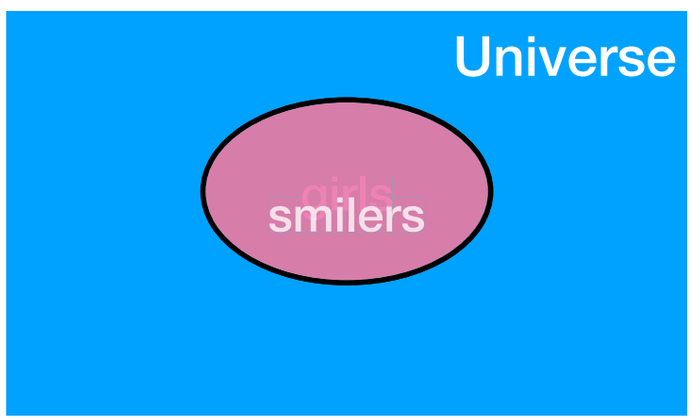
Does *some* mean *some but not all?*

- Recall the meaning we gave for *some*:



  - [[some girl smiled]] = T iff
  - [[**some**]] ([[girl]])([[smiled]]) = T iff
  - {x: x is a girl} ∩ {y: y smiled} ≠ 0





Does *or* mean *XOR*?

- What the logicians tell us vs. what natural language utterances convey:

(1) This summer, I will visit Budapest or Vienna.

A	B	A ∨ B
T	T	T
T	F	T
F	T	T
F	F	F

Conveying more than what is literally said

- We often find mismatches between the “literal meaning” of a sentence (its truth- conditions arrived at through compositional semantics) and what it ends up actually conveying:

  a. *It’s cold in here* can end up conveying “please close the window!”

  b. If I turn to you at dinner and utter *Can you pass the salt?*, unless you’re six years old, you don’t say “yes, I can” and continue your meal. Rather, it’s clear that I’m actually saying, “please pass me the salt.”

  c. *I’m out of gas* can come to mean “please tell me where I can get gas.”

  d. *Some of the boys were at the party* can end up conveying that some, but not all, of the boys were at the party.

Conveying more than what is literally said

- Are these data facts about the literal meaning of sentences, or about something else?

- Surely *it's cold in here* does not mean, literally, "please close the window!" (for instance, I can say it in a windowless room)

- **Explanandum:** what is this "something else"?

The Gricean program

- **The Main Idea Behind the "Something Else:"**
  - Language use is governed by formal maxims, derived from general principles of rational action.
  - <u>The guiding theme:</u> you try to make sense of the speech act under the assumption that your interlocutor is rational…
    - such that it makes sense to ask, "why did S say X and not Y?"
  - This, plus a component of cooperativity, will be argued to be the key to such kinds of wacky inferences.

Paul Grice

Implicature

- Particularized implicatures (situation-specific):

  (1) Imagine that Maya, a Harvard undergrad, applies to M.I.T. for the graduate program in linguistics. Prof. Liz Spelke writes her the following letter, which reads: *Maya is very punctual. She is always on time, she is very friendly, and she has very neat handwriting.*

  What do you infer from this scenario?

Implicature

- Particularized implicatures (situation-specific):

  (2) You live on the west coast, say, in Palo Alto. Your friend visits the linguistics department at M.I.T. You have lunch upon her return, and you ask: *Who did you meet while you were there?* Your friend replies: Athulya Aravind. You conclude, of course, that your friend didn't meet Noam Chomsky (along with many others).

  What do you infer from this scenario?

Implicatures

- Generalized implicatures (not situation-specific):

(1) Some of the boys were at the party
  ¬ *All of the boys were at the party*

(2) Sue ate at Area 4 or at Catalyst
  ¬ *Sue ate at Area 4 and at Catalyst*

(3) A: Who among John, Mary and Sue came to the party?
  B: John and Sue did.
  ¬ *Mary came to the party.*

Some properties of implicatures

- **Cancellable:** Some boys were at the party. In fact, all of them were.

- This makes them rather different from entailments. For example, I can't say: *I'm standing in the living room of my house. In fact, I'm not in my living room.*

a. **Context:** Anyone with three children is entitled to some pension plan or other.
Pension Agent: Who else in this room has three children?
Bob: Sally does. In fact, she has four.

b. **Pension Agent:** How many children does Sally have?
Bob: #Three. In fact, she has four.

Some properties of implicatures

- **Reinforceable:** Some boys, but not all, were at the party.
- This again makes them different from entailments, which give rise to oddity if “reinforced”. For example, it’s odd to say: *I’m standing in the living room of my house and in my house.*

Gricean maxims of language use

- **Cooperative Principle:** Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged.

- **Maxims:**
  Quality: Speak the truth.
  Quantity: Give as much information as required, no more, no less.
  Relation: Be relevant.
  Manner: Don’t be ambiguous. Don’t go on and on, don’t be briefer than necessary, etc.

- **General Logic of Gricean Reasoning:** Speaker said X, but she could have said X’. Why did she not say X’? Assume that these reasons are calculable, and that these reasons, in the spirit of the cooperative principle and the fact that she said X, license the inference that ¬X’.

Explicit reformulation

- **Definition 1:** α entails β if whenever α is true, β is true.
  - Example: α = *I'm standing in this room*, β = *I'm in this room*
- **Definition 2:** α asymmetrically entails β if α entails β but β does not entail α.
- **Definition 3:** A speaker S appropriately asserts β just in case:

  (i) S believes that β is true

  (ii) S believes that β is relevant to the subject of the conversation

  (iii) For all α such that α asymmetrically entails β, (i) and (ii) do not both hold with respect to α.

Scalar implicatures

- **Definition 4:** A sentence β is a scalar implicature of a sentence α if β is a logical consequence of the conditions under which α can be correctly used.

(1) α: **Some** of the boys were at the party.
β: **All** of the boys were at the party.

Scalar implicatures

- **Definition 4:** A sentence β is a scalar implicature of a sentence α if β is a logical consequence of the conditions under which α can be correctly used.

(1) α: **Some** of the boys were at the party.
β: **All** of the boys were at the party.

Premise 1: S asserts α correctly. So, either:

¬ S believes β is true or

¬ S believes β is relevant

Premise 2: S believes that β is relevant

Premise 3: S is opinionated about β, i.e. S believes β or S believes ¬ β

- Given the three premises, we infer: ***S believes ¬β***

A non-trivial issue

- Everything is driven by having some set of alternative things the speaker could have said.

- But we haven't said anything about where these alternatives come from. How are they derived? Why this set of alternatives and not some other?

- Currently, our definition says all stronger alternatives should be plugged into the algorithm, but that's a bad prediction. Consider:

  (1) α: Some of the boys were at the party.
      β: Some but not all of the boys were at the party.

Horn Scales

- Horn Scales: <*some, all*>, <*or, and*>, <*warm, hot*>, <*can, must*>, <1, 2, 3, ... , n, ...>

- Where do these scales come from?
  Gazdar (1979): “they’re just given to us.”

The learner

- How do they figure out the underlying truth-conditional meaning from potentially discrepant meaning conveyed in a situation?

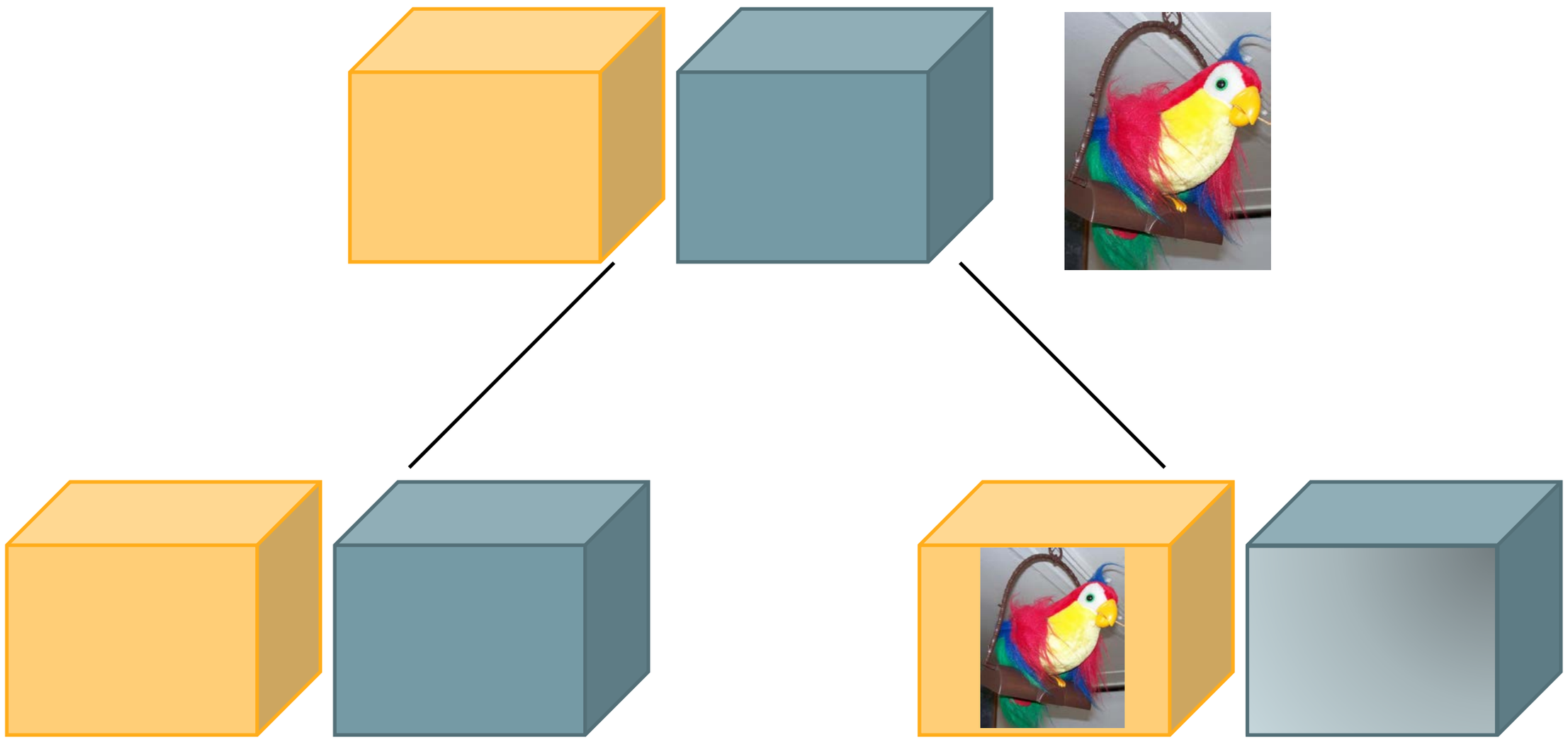
- E.g. 90% of sentences with *or* that children hear are in exclusive contexts

Observation

- A long line of acquisition work has demonstrated that, descriptively, children (roughly between the ages of three and seven) behave as if they do not derive standard scalar implicatures

Smith 1980; Noveck 2001; Papafragou and Musolino 2003; Reinhart 2006; Crain 2008; Barner and Bachrach 2010; Crain and Khlentzos 2010)

Noveck 2001



“The parrot might be in the yellow box.”

Adults: ?? eh…

Children: yes!!!

Papafragou & Musolino 2003

Fig. 1. The horses are about to jump over the fence.

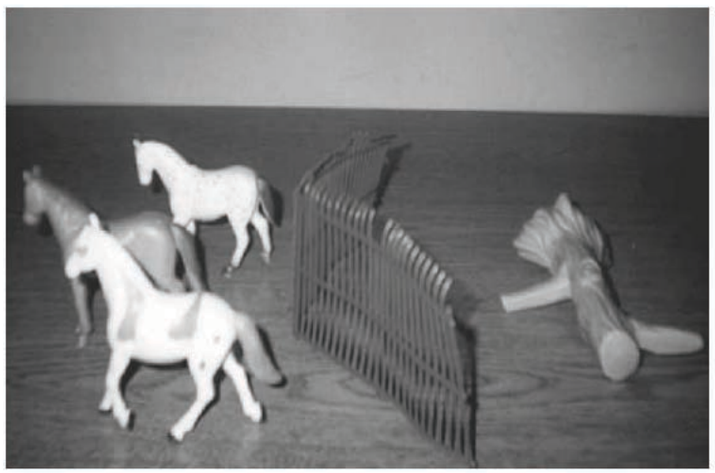
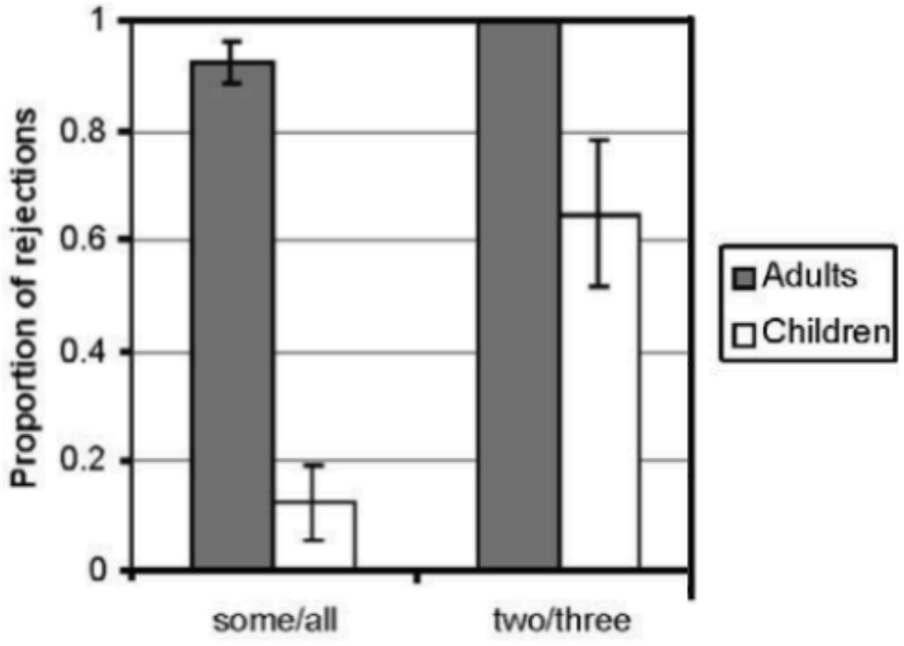


Fig. 2. All of the horses jumped over the fence.

(1) Some of the horses jumped over the fence

(2) Two of the horses jumped over the fence



Implications

- Adults' rejections/hesitations are based on scalar implicatures they compute (e.g. some but not all horses)

- Children's failure to reject suggests that they are not computing them

- On the other hand, these failures also provide indirect evidence that the kids have the "logical" underlying meanings of the relevant expressions, though they are obscured in their input

Where are they going awry?

S = *Some of the horses jumped over the fence.*

Step 0: Gricean norms of conversation

Step 1: Generate alternatives to S

ALT = *{All of the horses jumped over the fence}*

Step 2: Reason about speaker's epistemic state

Does speaker consider the *all* variant relevant? Is speaker likely to be opinionated about *all*?

Step 3: Negate stronger alternatives, yielding the strengthened meaning:

Some of the horses jumped over the fence
AND
Not all of the horses jumped over the fence

Where are they going awry?

- Foppolo, Guasti and Chierchia (2012)

- Two experiments: TVJT (conceptual replication) vs. Felicity Judgment

Where are they going awry?

- Foppolo, Guasti and Chierchia (2012)
- TVJT: 63 4-to-7-yos
- Critical trials = underinformative *some*-statements (5x):

  "This is a story about a group of Smurfs that are on holiday. Look how many of them we have! They can do a lot of interesting things here. See ... they have a boat, so they can go for a trip on the river by boat. They also have a car and they can drive their car in the forest. Let's see how many will opt for the boat trip and how many would opt for the car trip. Let's see what happens."

  [in the end all Smurfs opt for the boat trip.]

  Puppet: *Some Smurfs are going on a boat*

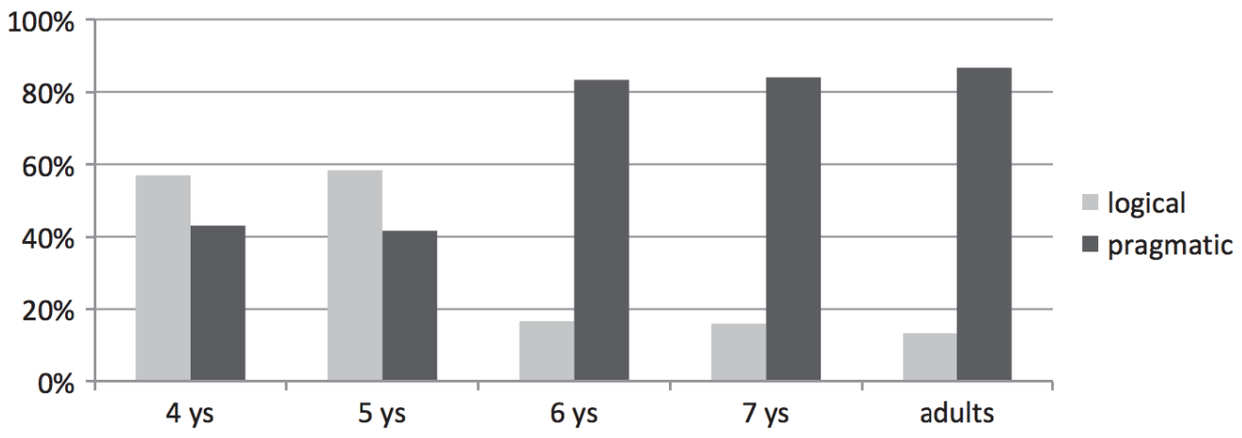


FIGURE 1 Incidence of logical (=acceptance of underinformative-*some*) and pragmatic (=rejection of underinformative-*some*) responses in the developmental study (children from 4 to 7 years of age and adults).

Where are they going awry?

- Felicity Judgment Task
  - a subset of 17 5-yo participants from Exp 1 who failed to derive SIs
    - same stories, but two puppets present alternative descriptions of the scenes
    - 95% adult-like in these cases
- **Upshot:** not Step 0

Where are they going awry?

- Barner et al. (2010)

- Goal: test the possibility that the issue lies with Step 1, the generation of scalar alternatives

- Test case: *only*

Only

- [[only S]] = S is true and for all S’ s.t. S ⇏ S’, S’ is not true

Only

- [[only S]] = S is true and for all S’ s.t. S ⇏ S’, S’ is not true

(1) Only course 24 students are happy.

- What’s the problem here?

Only

- [[only S]] = S is true and for all S’ s.t. S ⇏ S’, S’ is not true

- **Solution:** Domain restriction

  - Like all natural language quantifiers, the domain of *only* is restricted

  - Unlike quantifiers ranging over individuals, the restriction of *only* is a set of sentence meanings, ALT

Only

- [[only ALT S]] = S is true and for all <u>S' ∈ ALT</u> s.t. S ⇏ S', S' is not true

(1) Only course 24 students are happy.

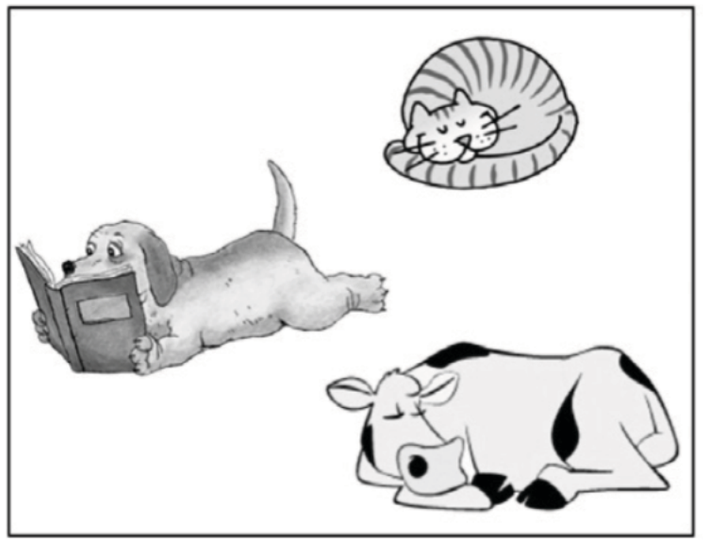
ALT = {*Course 2 students are happy,*
Course 6 students are happy,
Course 8 students are happy,
Course 9 students are happy…}

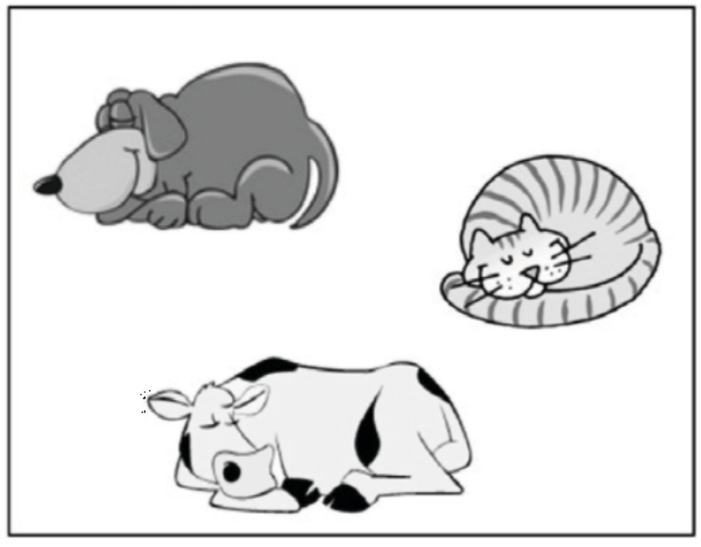
= Course 24 students are happy and it's not the case that course 2 students are happy, not the case that course 6 students are happy…

Barner et al. 2010

- 60 4-year-olds tested on 4 types of critical sentences

a. Are some of the animals sleeping?
b. Are only some of the animals sleeping?
c. Are the dog and the cat sleeping?
d. Are only the dog and the cat sleeping?

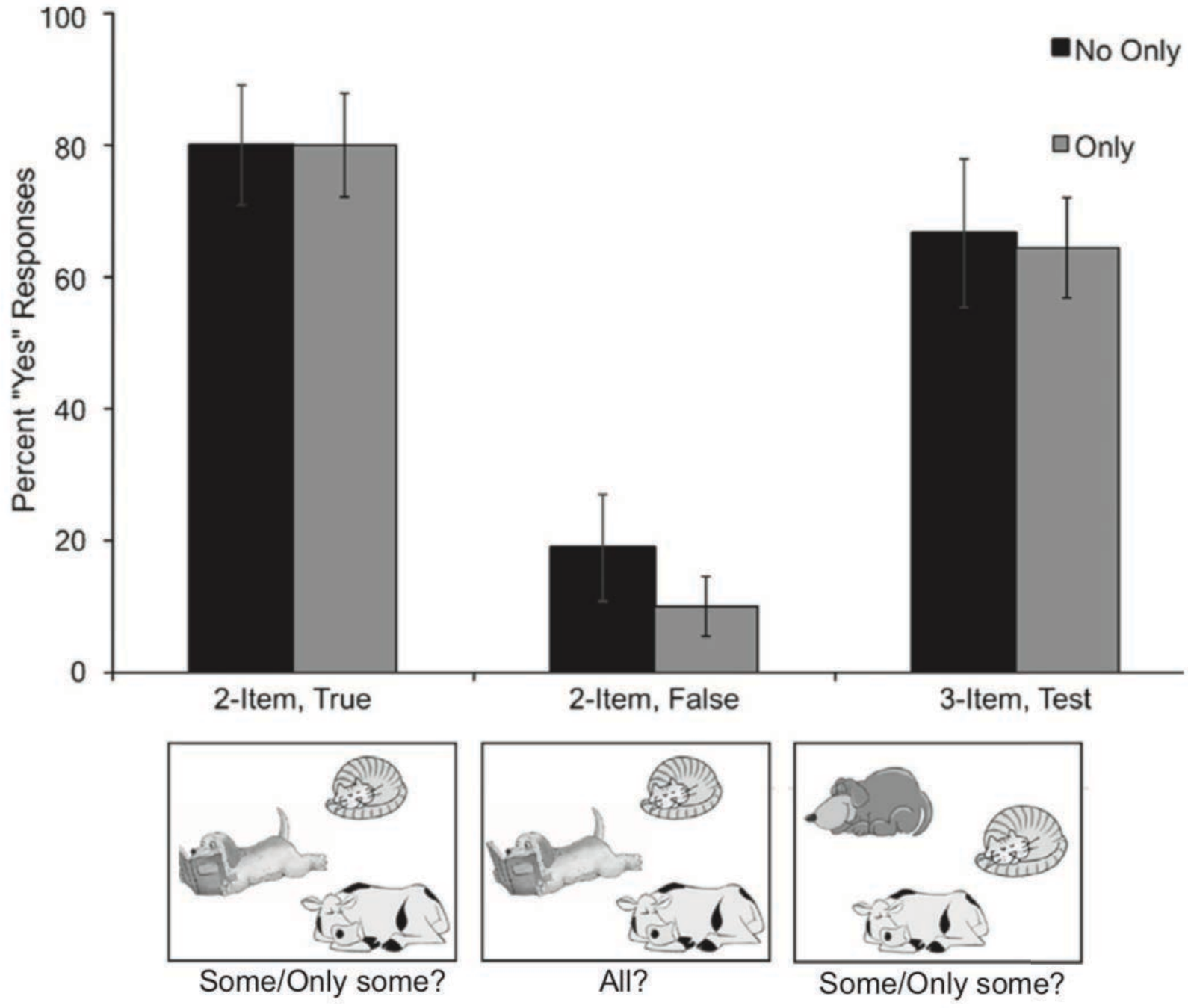




Barner et al. 2010

Adult expecations

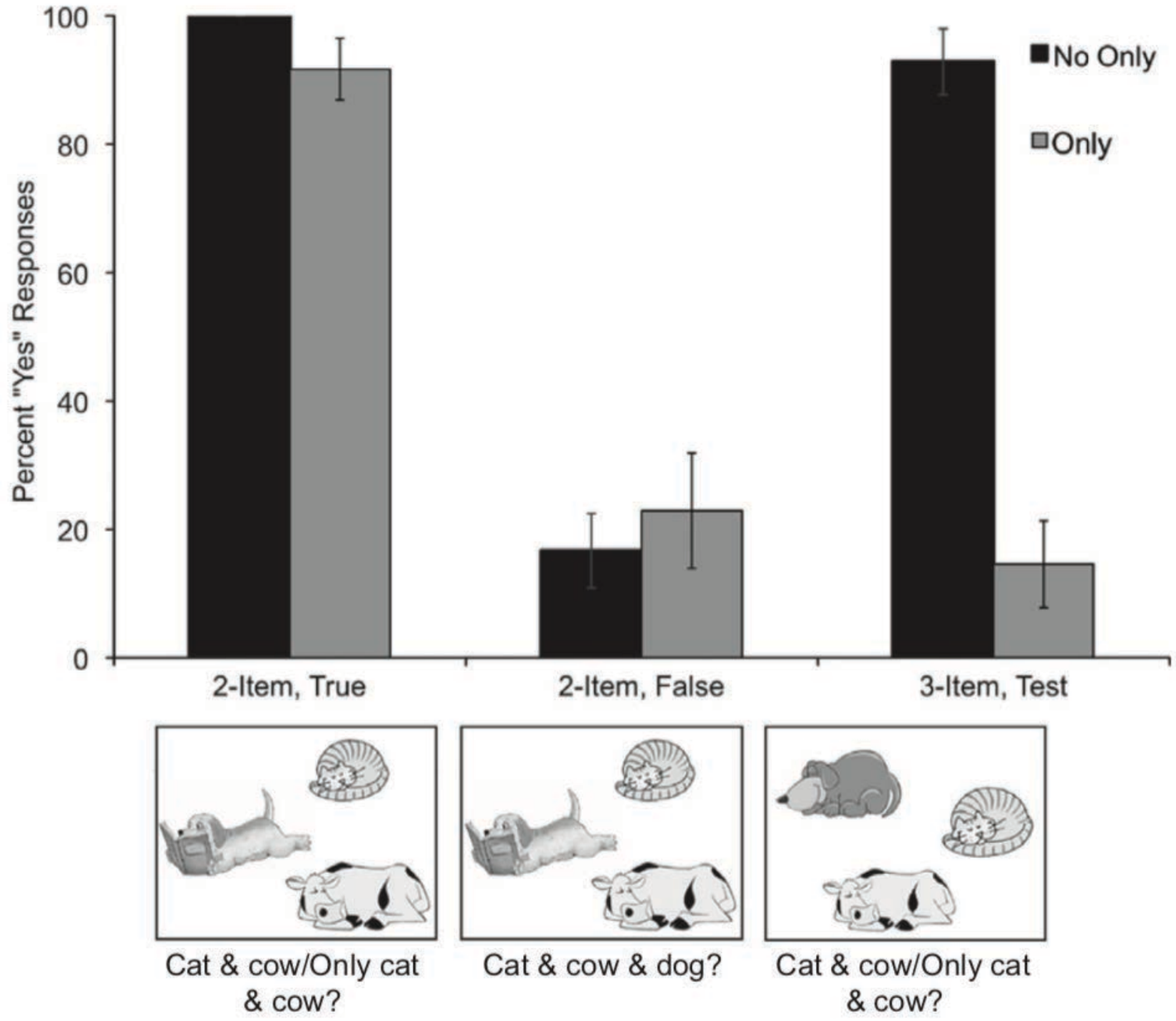
- **2/3 sleepers**
  - *some*: literally true
  - *only some*: literally true
- **3/3 sleepers**
  - *some*: literally true, pragmatically underinformative
  - *only some*: literally false



Barner et al. 2010

Adult expectations

- **2/3 sleepers**
  - *cat & cow*: literally true
  - *only cat & cow*: literally true
- **3/3 sleepers**
  - *cat & cow*: literally true, pragmatically underinformative
  - *only cat & cow*: literally false



Barner et al. 2010

- Two-way interaction:
  - An effect of grammar (vs. pragmatics), but only with contextually-generated (vs. logical) alternatives

Next time

- We’ll continue discussing implicatures