What children reveal about the enrichment of sentence meaning

Ira Noveck
L2C2 (Laboratoire sur le Langage, le Cerveau et la Cognition)

noveck@isc.cnrs.fr

"From breadth through depth to perspective"

Binghamton University motto

Plan:

I. **Breadth**
   Present a panorama of pragmatic-developmental effects

II. Review in **depth** one of them
   - Scalar items

III. **Perspective** …Consider why underdetermined meanings might be is necessary for communication

Breadth…

1. Metaphor

Probe: boxer

From Gibbs, 1990

Stu went to see the Saturday night fights.
There was one boxer that Stu hated.
This guy always lost.
Just as the match was supposed to start,
Stu went to get some snacks.
He stood in line for ten minutes.
When he returned, the bout had been cancelled.
“What happened?” Stu asked a friend.
The friend replied,

“The creampuff didn’t even show up.”

“The fighter didn’t even show up.”

“The referee didn’t even show up.”

Mean reading times and probe recognition times (from Gibbs, 1990)

Final sentence	Reading	Probe
Metaphoric	**2177**	**1118**
Literal	**1735**	**1229**
Control	**1867**	**1331**

"The longer reading times for metaphor sentences is an unusual finding"(Gibbs, 1990, page 60).

Assessments from Relevance

(a) Effect: The greater the effects,
the greater the relevance.

(b) Effort: The smaller the effort,
the greater the relevance.

Example:

(a) Catherine went off to her music lesson.
(b) She was worried that the lesson would not go well.
(c) During the week, her flute fell and is now a bit cracked.
(d) Yet, the lesson did go well.
(e) At the end, Catherine asked if she played all right.
(f) "You were very good," replied her professor,
(g) "but your nightingale needs to be repaired."
(h) She promised to go by the instrument maker.

(g') "but your instrument needs to be repaired."

Three kinds of follow-up questions

a) general (comprehension)

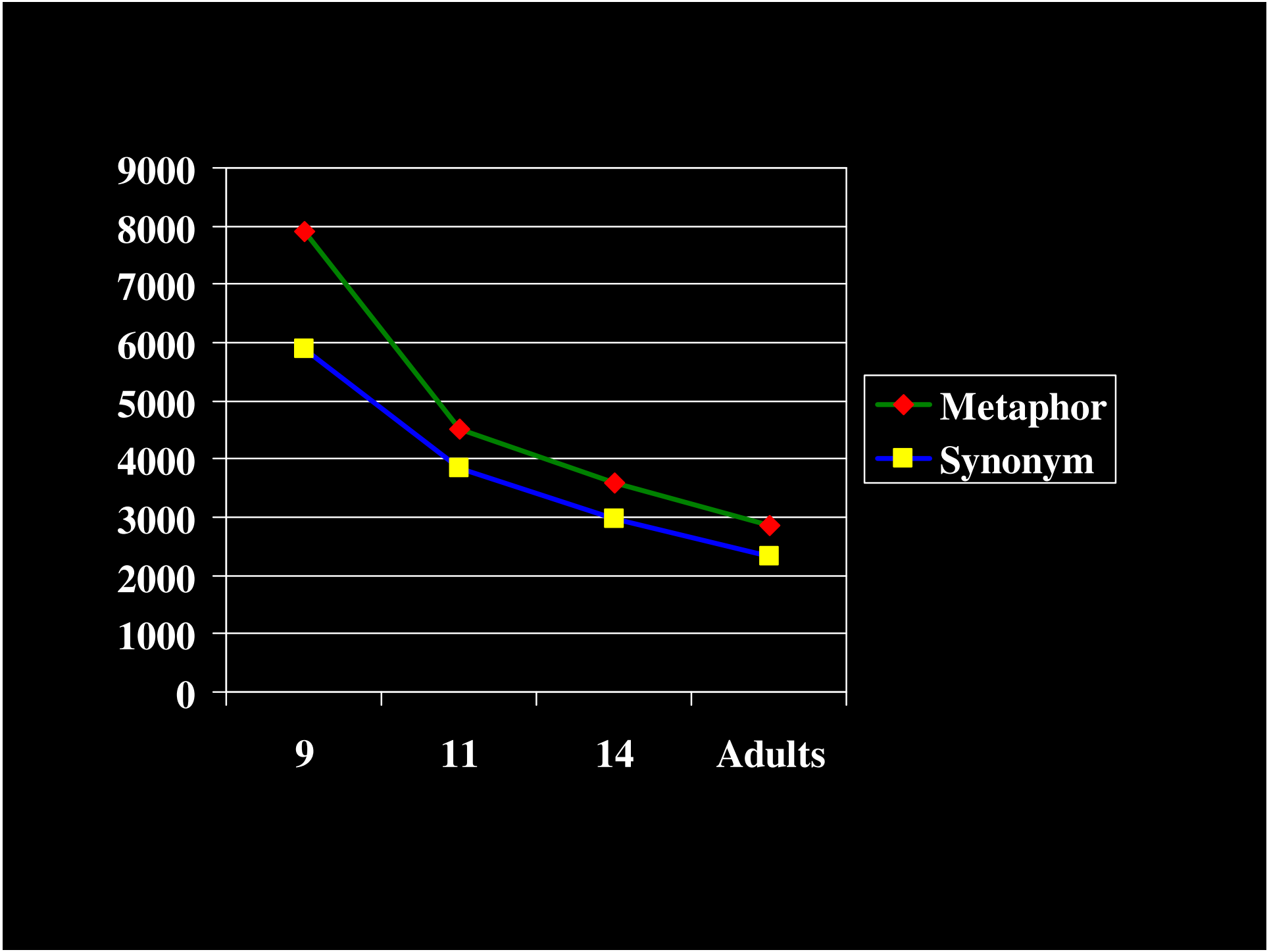
b) on a detail of the story (memory)

c) on the reference

a) Is Catherine angry about her flute being slightly damaged?

b) Is the flute slightly cracked?

c) Is it the flute that needs to be repaired?


9000
8000
7000
6000
5000
4000
3000
2000
1000
0
9
11
14
Adults
Metaphor
Synonym

Results of Experiment 2

	Reference	
Age	Metaphoric	Synonymous
9	7908 msec (74%)	5586 msec (82%)
11	4510 msec (73%)	3842 msec (77%)
14	3609 msec (86%)	2967 msec (87%)
Adult*	2851 msec (90%)	2321 msec (83%)

In parentheses, rates of correct responses to follow-up questions.

Noveck, Bianco & Castry, 2001

What you find is that there are longer reading times (extra costs), but they come with extra effects (deeper comprehension) with age.

2. Scalars

Consider these "scalar" inferences:

(1a) ***Some children have teddy bears***
(1b) ***Inference : Not all children have teddy bears***

(2a) ***The meal was decent***
(2b) ***Inference : the meal wasn't excellent***

(3a) ***Either you work one hour less per week or you take an extra week of holidays.***
(3b) ***Inference : You can't have both one hour less work per week and an extra week of holidays.***

(Slide borrowed from Nausicaa)

Implicature becomes more prominent with age

Or → not-both

Paris (1973, *JECP* p. 284): The tendency to treat disjunction exclusively was more pronounced among the older Ss…

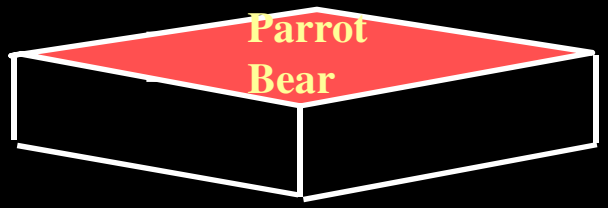
See also Sternberg (1979, *JECP* p. 492) and Braine and Rumain (1981, JECP, p.62).

Implicatures add processsing time: Some → Not All

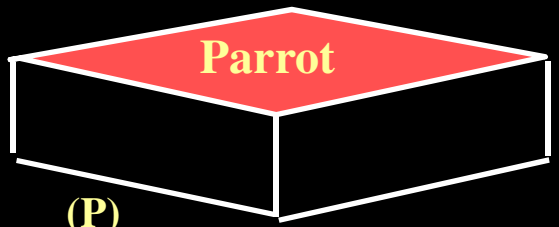
Rips (1975): pragmatic interpretations appear to take longer than "logical" ones (for sentences such as *Some pennies are coins*:)

When children are more logical than adults (Noveck, Cognition 2001)

Modal Reasoning

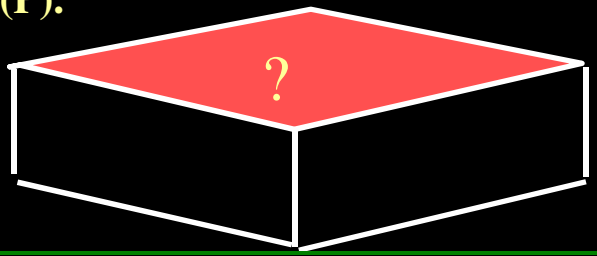


(P+B)

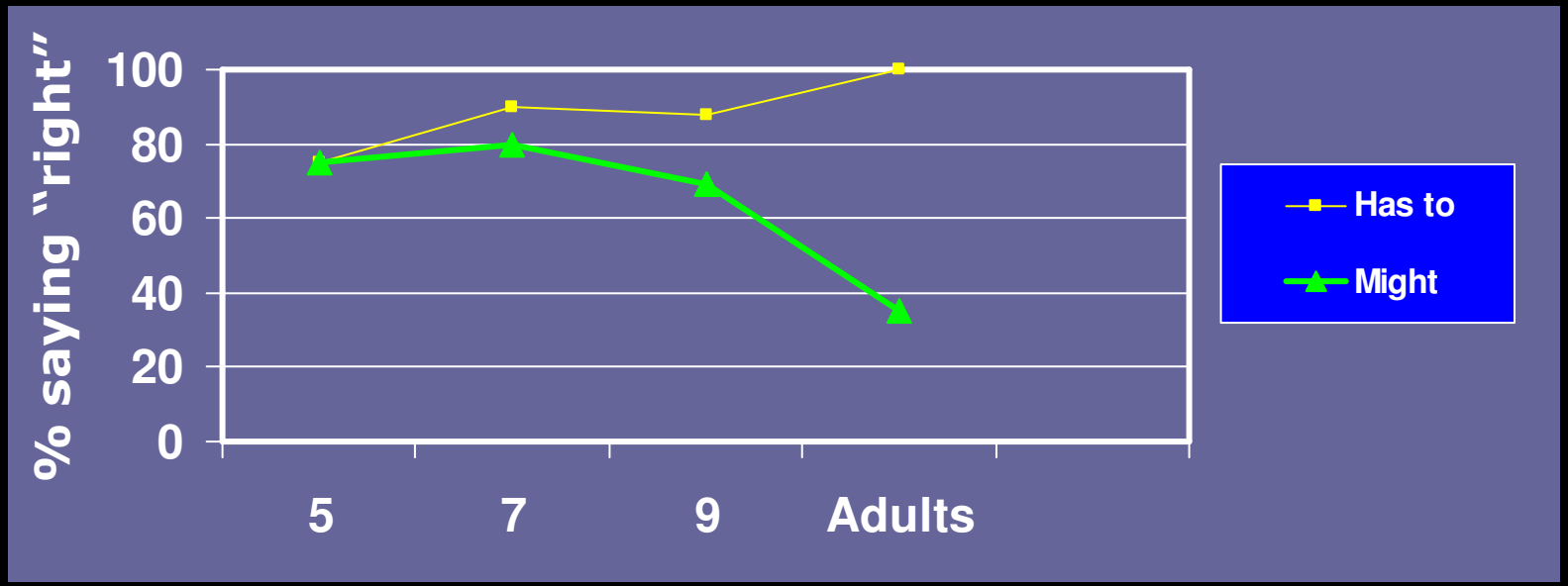


(P)

All I know is that whatever is inside this box (below) looks like what's inside this box (P+B) or this box (P).



How participants respond to the utterance "There has to be a parrot in the box" vs. "There might be a parrot in the box"



See Noveck, 2001; Noveck & Reboul, 2008

A paradigm based on Smith (1981): *Certains (Some)*

For example,
Certains éléphants ont des trompes.
Some elephants have trunks.

Certains livres ont des pages.
Some books have pages.

Certains chats ont des oreilles.
Some cats have ears.

% giving logical response (*oui, d'accord*):

8-year-olds:	89%
10-year-olds:	85%
Adults:	41%

3. “All are not” sentences…

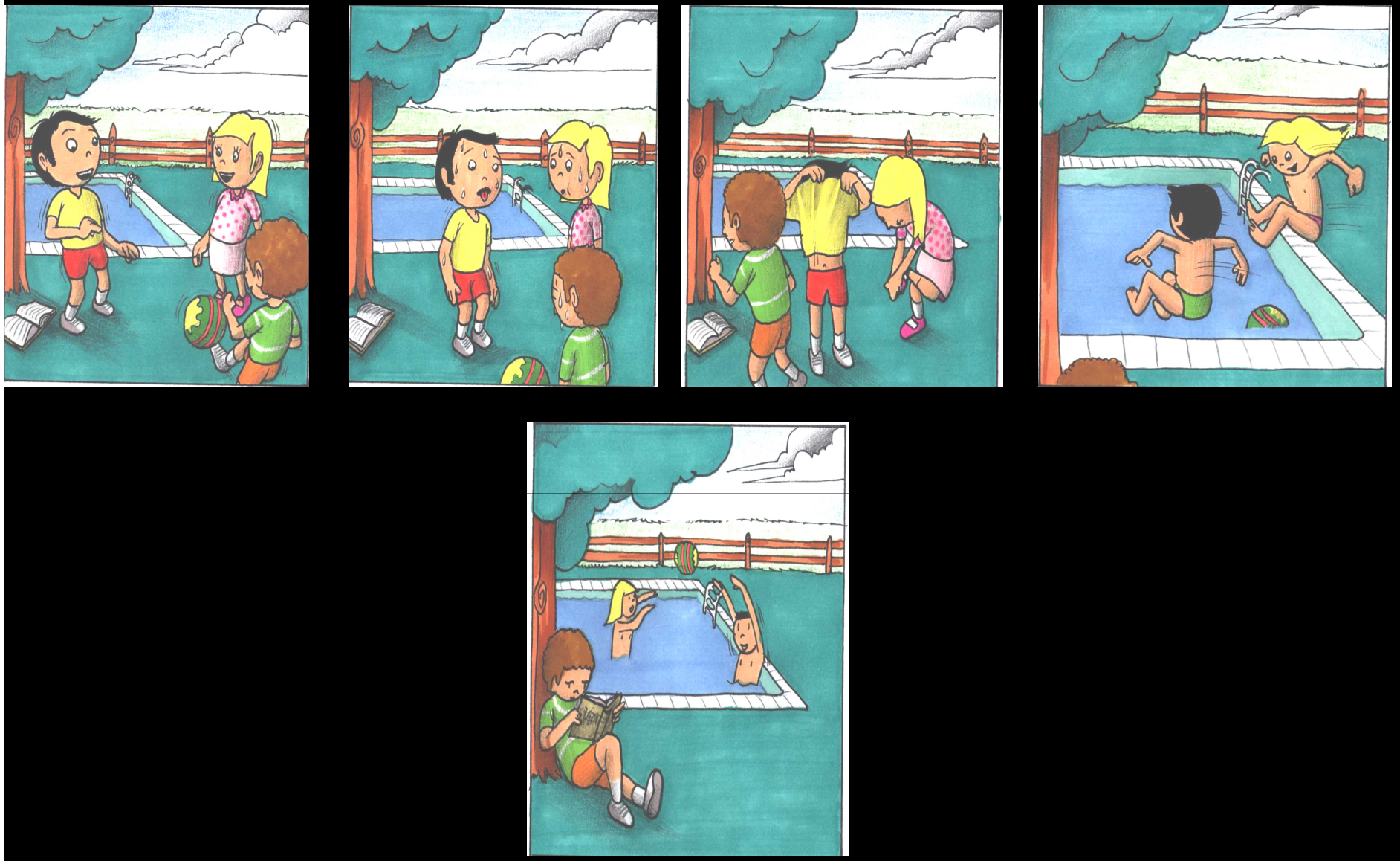
Every horse did not jump over the fence

Two readings:

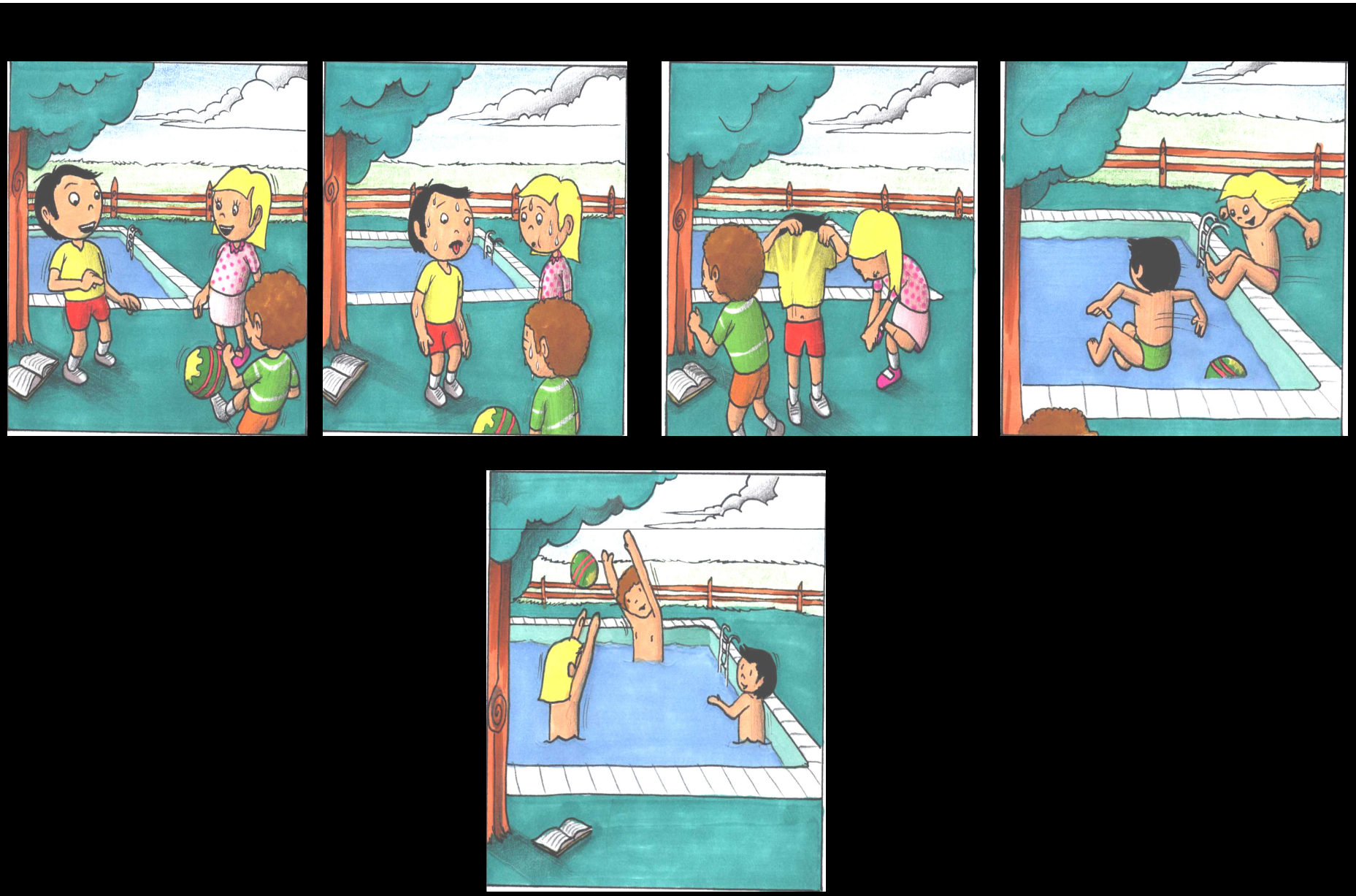
- **"None" (isomorphic) reading - "All are not"**
- **"Not all' reading**

Investigations from Musolino, Lidz and company (Musolino, Crain and Thornton (2000); Lidz and Musolino (2002), Musolino & Lidz (2003)) concerning the interaction of negations and quantifiers indicate that:

Children prefer the literal (ïsomorphic¨) "None" reading and adults the"Not all" reading in sentences such as:



Tous les enfants ne sont pas dans la piscine.
All the children are not in the pool.



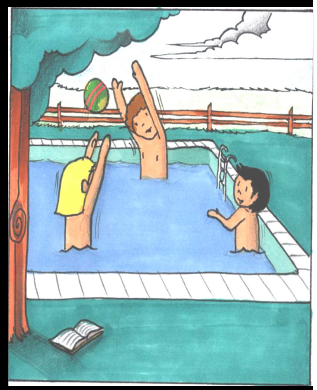
Tous les enfants ne sont pas dans la piscine.
All the children are not in the pool.

Structure of experiment

19 Children (Age: 4:6)
15 Autistic Participants (CA:16:3; MA 8:6)
20 Adults

10 Stories
5 with *2 out of 3* context
5 with *3 out of 3* context

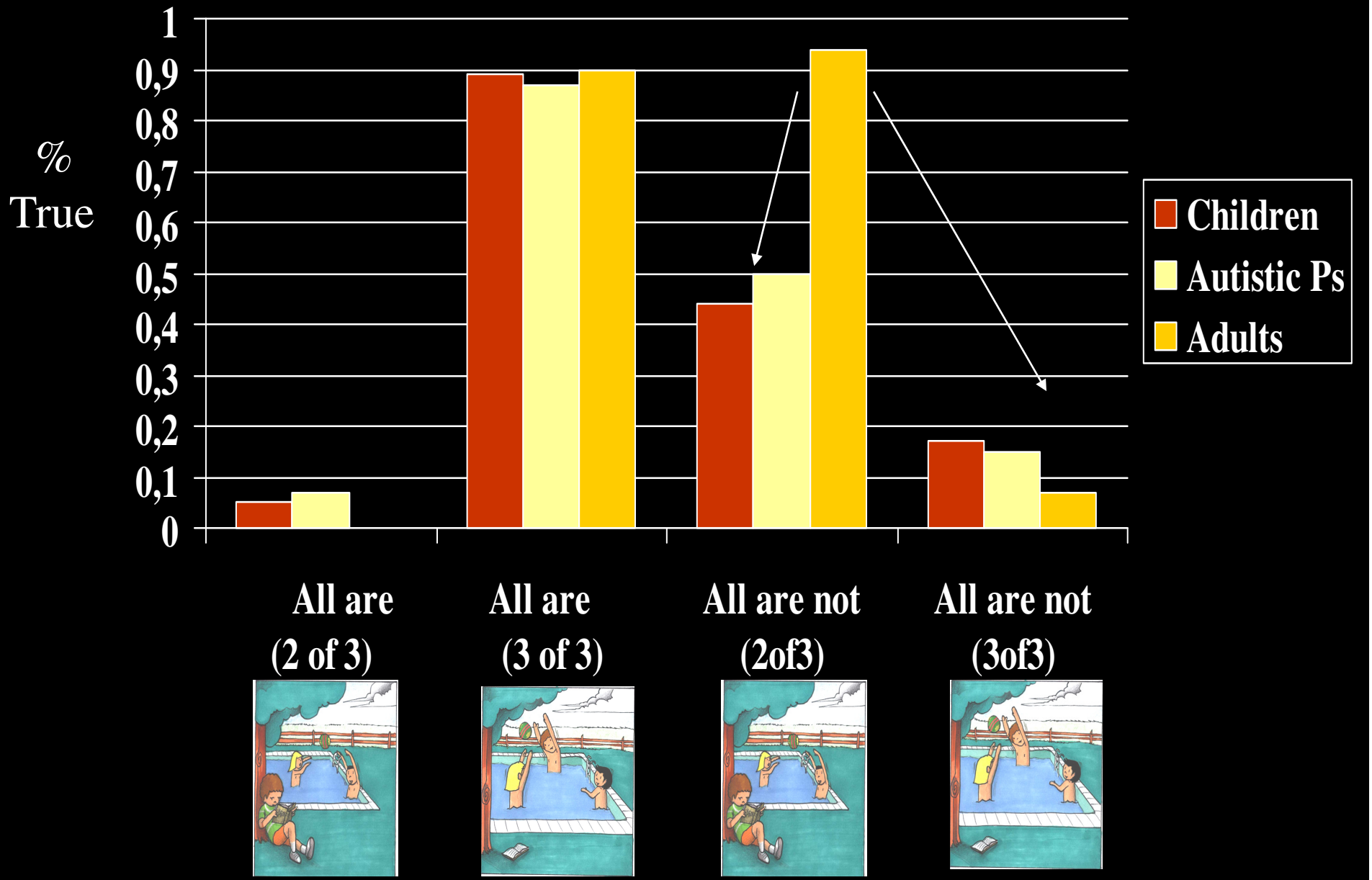
4 main questions that were rotated among the 10 stories



All the children are in the pool.	**F**	**T**
All the children are not in the pool.	**F/T**	**F**

Results

Noveck et al., 2007

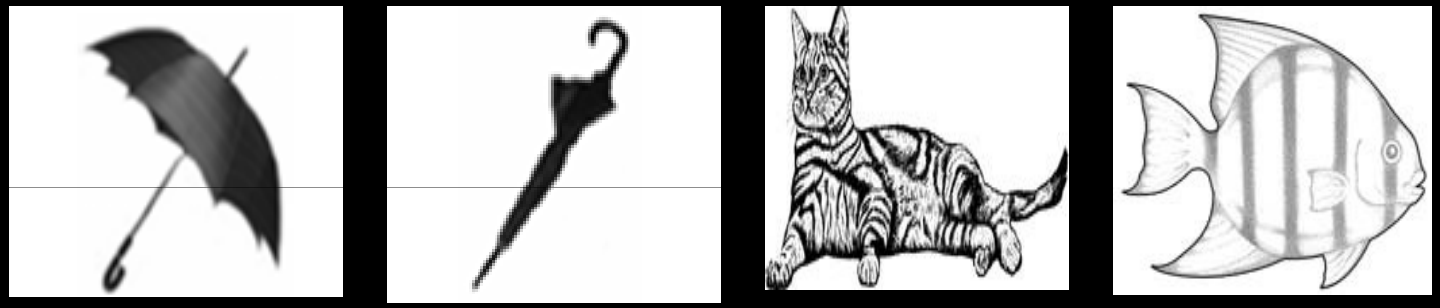


This is a case where there is a structural ambiguity and children, before adopting the language's standard, are either equivocal between the two readings or do prefer the isomorphic reading.

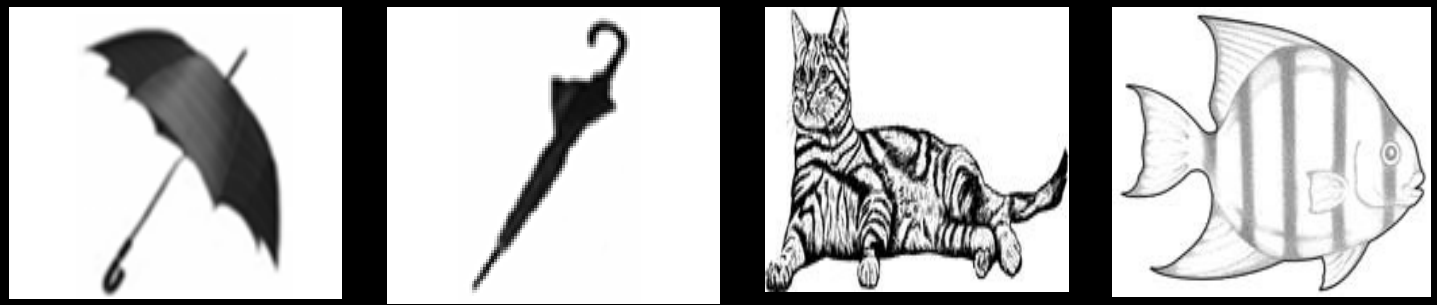
4. Contrastive inference

Kronmuller, Morriseau & Noveck (in prep)

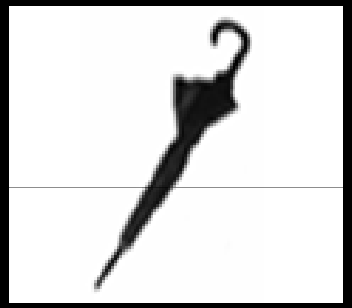
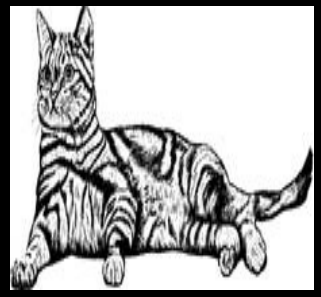
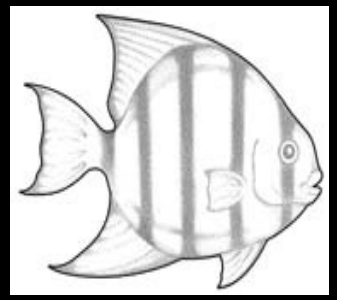
Imagine I show you (the participant) a set of four cards :



that I have as well

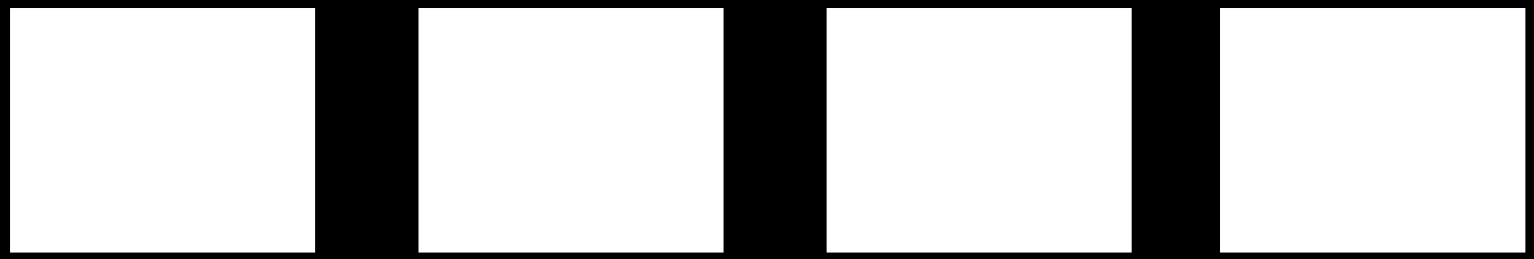


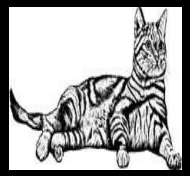
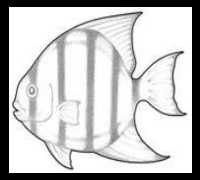
Kronmuller, Morriseau & Noveck

I take my set and turn the cards over…

I mix them up ...



(   )

Now I take two:

I look at the two, show them to a friend and say:

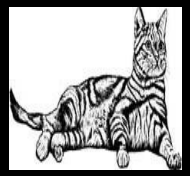
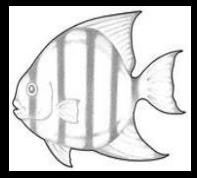
“Show me the closed umbrella”

Question for the participant (who is watching this) is:

What is on the other card I'm holding?

Should be the other (open) umbrella

The adjective is additional information that can enrich sentence meaning and provide the speaker's intended meaning.

(   )

Now, imagine that again I take two:

I look at them, show them to a friend and say:

“Show me the umbrella”

Question for the participant (who is watching this) is:

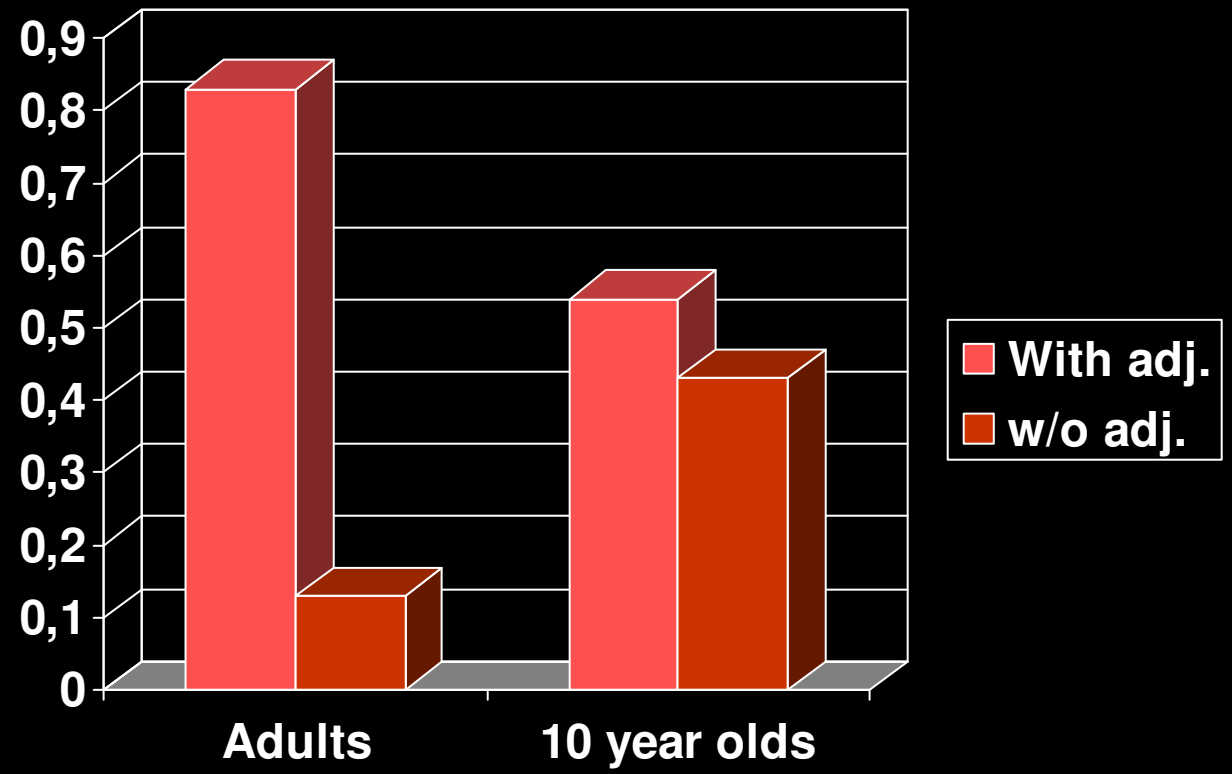
What is on the other card ?

Should be some other non-umbrella card

With no adjective, the best one can infer is that the two cards being talked about is the umbrella and something else (cat or fish).

Percentage pointing to the "other" comparable item
(e.g. the open umbrella after hearing "Show me the closed umbrella")

N=32; 16 Adults and 16 ten-year-olds



Depth…

Two foundational ideas of Gricean pragmatics:

1) <u>There is a distinction to be made between sentence meaning and speaker meaning.</u>

"Generalized conversational implicatures."

Bill is meeting a woman tonight.
***Implicature*: Not his wife, sister, mother etc.**

I broke a finger yesterday.
***Implicature*: It was my own finger that I broke.**

2) <u>There is some sort of standard in conversation.</u>

Maxims of Quantity:
Maxims of Quality:
Maxim of Relation:
Maxims of Manner:

Two features of Grice's explanation that are hard to square.

1. **There is a convergence between the meaning of a logical term and what it "says" :**

   "and" = &
   "or" = v

   However, implicatures are thought to be pieces of information that go beyond the semantics of logical terms. What they ultimately "mean" is what is "said" plus inference.

2. **Generalized Conversational Implicatures are thought to go through automatically (unlike Particularized implicatures) but to be cancelable ("defeasible").**

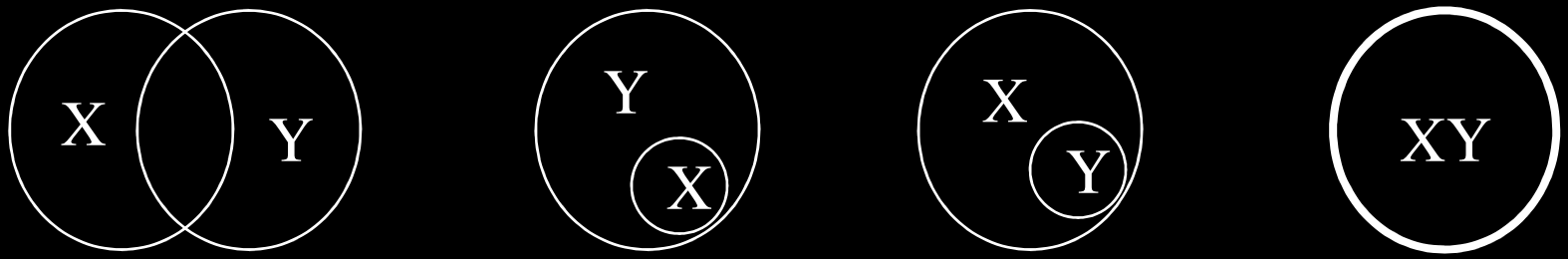
This has led to a divergence in the literature:

Those who argue for default readings that include enrichments

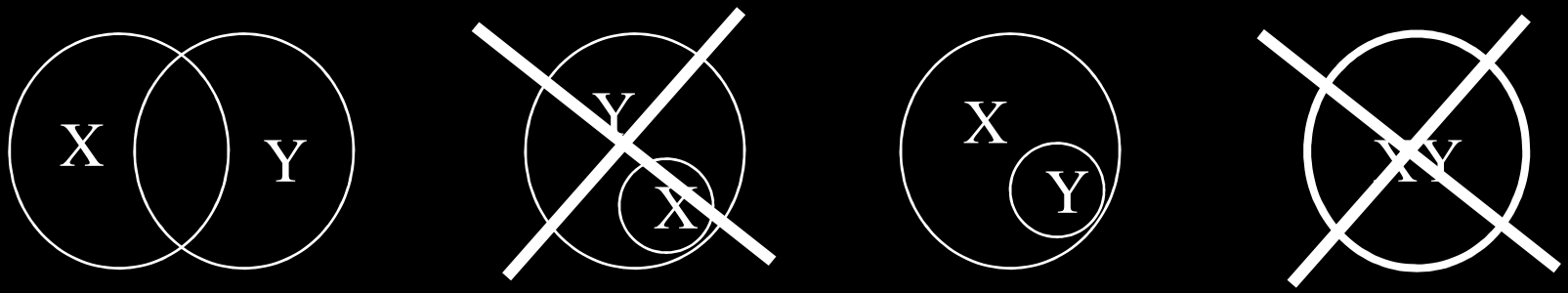
vs.

Those who argue that enrichments come at a (perhaps small) cost

To compare the two approaches: Consider *Some X are Y*.
One can imagine 4 representations based on a minimal interpretation:



With *Some but not all X are Y*, only two representations remain:



Levinson One treats *Some* with the enrichment as a default, by way of a heuristic. However, this step could be cancelled by virtue of context.

RT By reducing the number of true instances, the enrichment renders the utterance more informative. Thus, there is a gain in effects. However, there is an extra step. Thus, there is a cost in effort.

Will processing data show that initial treatments of *Some* are compatible with the logical or a "default" pragmatic interpretation?

Consider a categorization task where the quantifier is weaker than it ought to be:

For example,
Some cows are mammals (Certaines vaches sont des mammifères).
Some trout are fish (Certaines truites sont des poissons).
Some parakeets are birds (Certains perroquets sont des oiseaux).

Biensur...
All cows are mammals.
All trout are fish.
All parakeets are birds.

Thus, an interlocutor has a reason to be tempted to say that "Some cows are mammals" is ***false*** because it implicates that *Not All cows are mammals.*

Lewis Bott and I (Bott & Noveck, 2004, *JML*)
have run 4 experiments based on the following paradigm:

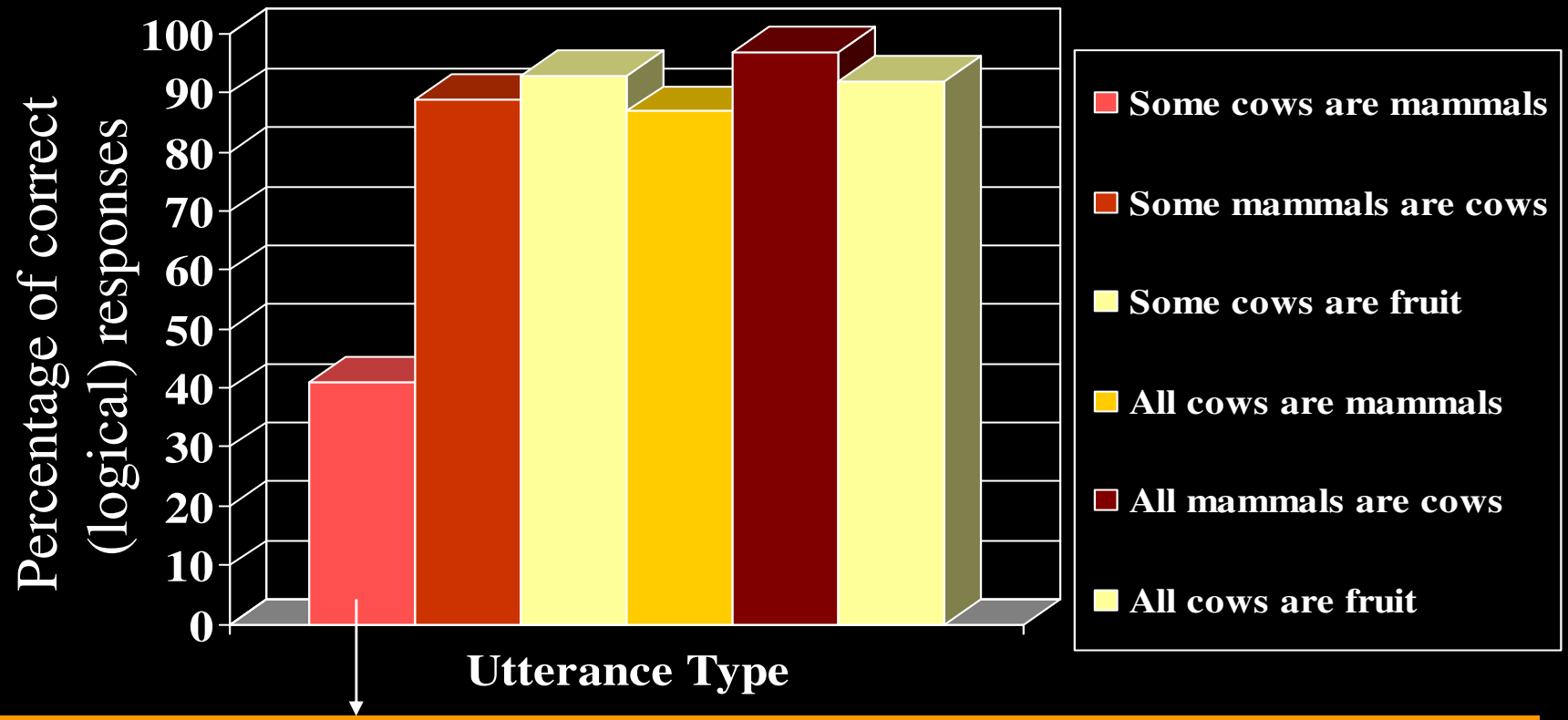
54 items randomly presented by computer.

6 Categories -- mammals, fish, reptiles, shellfish,
birds, fruit

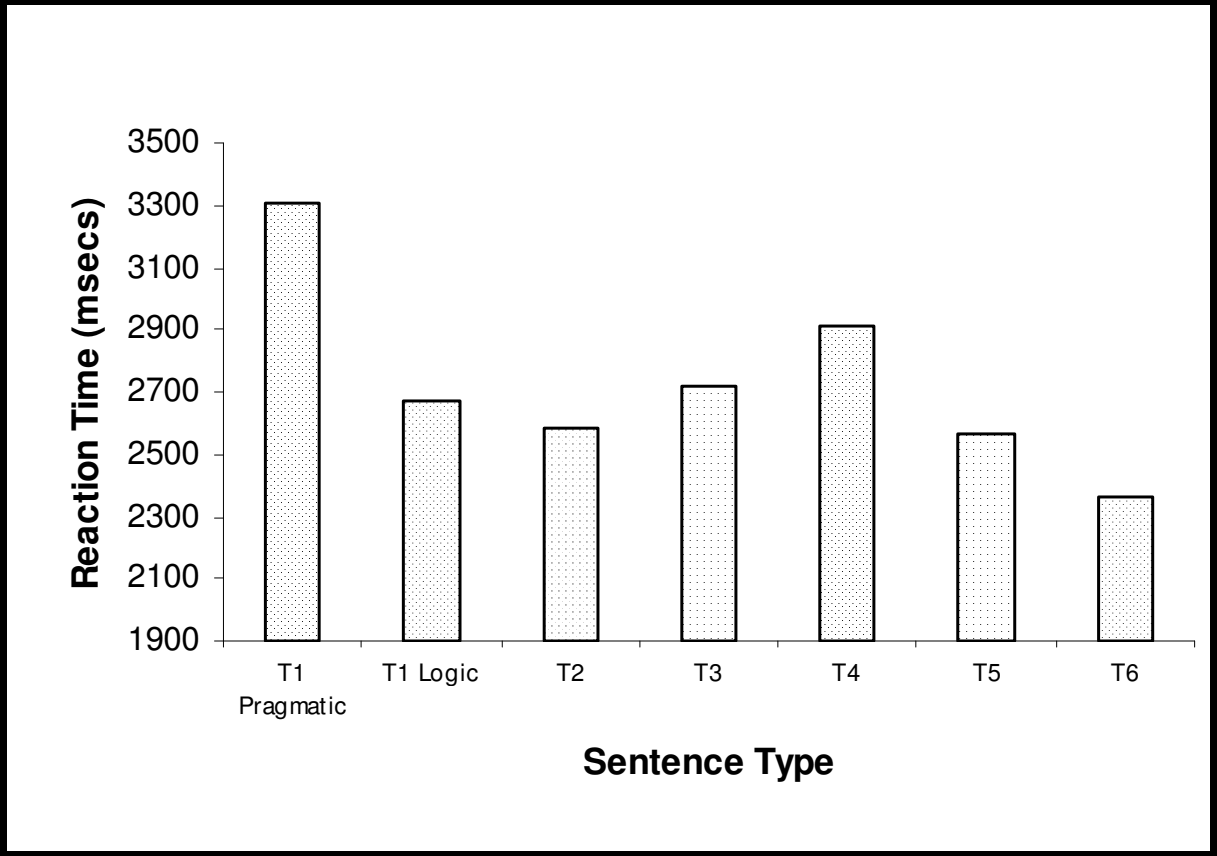
1) Some cows are mammals. * (True logically/False with enrichment)
2) Some mammals are cows. (True)
3) Some cows are insects. (False)
4) All cows are mammals. (True)
5) All mammals are cows. (False)
6) All cows are insects. (False)

Experiment 3 : **Whole sentences, no specific instruction**
e.g. Some cows are mammals (Certaines vaches sont des mammifères)

Presented 54 items (6 categories; 9 per condition) and asked 32 participants to respond "True" or "False".



41% True and 59% False (in line with other data; Noveck, 2001)



T1) Some cows are mammals.	**(Logic - true / Pragmatic - false)**
T2) Some mammals are cows.	(True)
T3) Some cows are insects.	(False)
T4) All cows are mammals.	(True)
T5) All mammals are cows.	(False)
T6) All cows are insects.	(False)

Perspective…

To sum up:

Sentences are the starting point of any interpretational process.

They can be readily enriched at a cost (there is an effort involved) that is not always salient to us.

This enrichment can be a …

Loosening of word meaning (metaphor)
Scalar inference
Structural disambiguation
Contrastive inference

-- There are many other experimental demonstrations of developmental enrichments such as conjunction enrichment (Noveck et al. in press), the understanding of *Si* (doch) etc.

Some basics to pragmatics and its development

Linguistically encoded meanings are systematically underdetermined with respect to speaker meaning.

All things being equal, pragmatic enrichments require some effort.

A central feature of linguistic maturity is gaining access to implicit meanings.

Enrichment is concomitant with a gain in informational value.

Questions:

Why is language built this way (leaving so much room for inference)?

Why is it not the case that communication comes with completely encoded messages?

Evolutionary accounts view language as the result of

Sexual selection (increase mating success)

or

Kin-selected communication system

See Fitch, 2003, for some arguments against the former and in favor of the latter

Proposal:

- Language co-evolved with Theory of Mind

- Code allows one to provide a minimal honest communication

- Inference allows one
  - -- to build coalitions
  - -- avoid cheaters
  - -- test ingroup/outgroup status
  - -- to have access to membership in a community (whether it shares your mother tongue or not)

Danke schön…

Two cases of enrichment:
scalars & direct reference

	Scalars		Direct Reference	
	Simple scenarios	**Relatively difficult scenarios**	**Simple scenarios (few objects in a small grid)**	**Relatively difficult scenarios (7 objects, 4X4 grid)**
Children (5-year-olds)	**32% Logical**	**90% Logical**	**Get it relatively early * (Nadig & Sedivy)**	**We don't know**
Adults	**14% Logical**	**50% Logical**	**Get it relatively early * (Hanna et al.)**	**Get it late Keysar et al.**

* Still in need of interpretation

Both cases capture distinctions between sentence meaning and speaker meaning.

Both require enrichments of one sort or another.

Enrichment of an utterance in the case of scalars and
a modification of the speaker's belief in the case of reference.

Need to work out the ultimate interpretation.

Claims of early, default roles for pragmatic factors in utterance interpretation, such as theory of mind constraints, enrichments and the like are, generally speaking, yet to be demonstrated.

From Breheny, Katsos & Williams (2006)

(a) Upper-Bound

While Mary and John were out shopping,/ it started raining./ John would get wet./ Even though she did not have a lot of money,/ Mary offered to buy him/ an umbrella or a coat.

(b) Lower-Bound

It was highly probable that it would rain./ Mary advised John/ to dress accordingly. To avoid getting wet,/ she suggested to him/ to take with him/ an umbrella or a coat.

To read sections like *an umbrella or a coat*

Upper Bound 1291 msec

Lower Bound 1204 msec

Conjunction

If it works as an enrichment in the way scalars do, it ought to be interpreted initially in a minimal way and eventually in an enriched way so that….

P & Q = Q & P

P	&	Q
T_1		T_2
~~T_2~~		~~T_1~~ *

*with the enrichment -- that implies, e.g., *and then* -- Q & P is no longer compatible with P & Q.

When provided a series of events where Mary got married and had a baby:

Mary had a baby (T_2) and got married (T_1).

It could be considered *true* with a minimal reading of *and*
and *false* with an enriched meaning.

Conjunction

If it works as an enrichment in the way scalars do, it ought to be interpreted initially in a minimal way and eventually in an enriched way so that….

P & Q = Q & P

P	&	Q
T_1		T_2
~~T_2~~		~~T_1~~ *

*with the enrichment -- that implies, e.g., *and then* -- Q & P is no longer compatible with P & Q.

When provided a series of events where Mary got married and had a baby:

Mary had a baby (T_2) and got married (T_1).

It could be considered *true* with a minimal reading of *and*
and *false* with an enriched meaning.

From Noveck, Chevallier, Musolino, Bott & Chevaux, in press:

Guillaume just finished eating dinner at his friend's home.
Since it was not late, he decided to walk home.
On the way, he hears a noise in a bush.
He heads to the bush and, in the branches, discovers a cat.
Guillaume takes the cat into his arms and caresses its head.

Guillaume took a cat into his arms and ate dinner at a friend's?

10 year olds	**Adults**
46%	**18%**

Percentage who agree

Take home message about logical terms:

Whether one is talking about *Some, (not), or, and, if*

•Their literal meaning in an utterance is initially weak, making them compatible with definitions found in logic textbooks.

•Pragmatic enrichments come at a (perhaps slight) cost

•Though we can thank Grice for the initial insight, more work remains to be done.

From Noveck, Chevallier, Musolino, Bott & Chevaux, in press:

Guillaume just finished eating dinner at his friend's home.
Since it was not late, he decided to walk home.
On the way, he hears a noise in a bush.
He heads to the bush and, in the branches, discovers a cat.
Guillaume takes the cat into his arms and caresses its head.

Guillaume took a cat into his arms and ate dinner at a friend's?

10 year olds	**Adults**
46%	**18%**

Percentage who agree

CONDITIONALS

Two of the better known fallacies in the reasoning literature -- what Geis & Zwicky coined *invited inferences* -- stem from the conditional.

If John leans out the window any further, then he'll fall.

$L \subset F$

$\sim L \subset \sim F$

If you mow the lawn, I'll give you five dollars.

$M \subset \$5$

$\sim M \subset \sim \$5$

Geis & Zwicky, 1971

This "regular association….asserts a connection between linguistic form and a tendency of the human mind 'to perfect conditionals to biconditionals' in words suggested to us by Lauri Kartunnen…

Thank you

Pouscoulous, Noveck, Politzer & Bastide, 2007

Aim of the present experiments

It has been demonstrated that the semantic meaning is accessed among younger children before the pragmatic one:

→ Does that mean that younger children are incapable of drawing the implicature?

→ Is there an age at which implicatures become accessible?

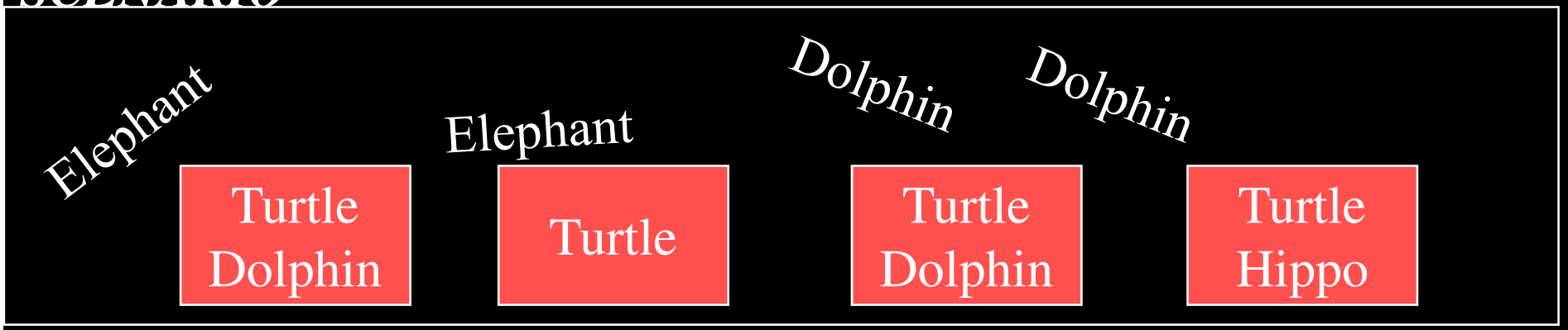
Our experiments aim to establish that implicature production is not linked to specific ages, but rather to task complexity.

A simpler task which is more readily understandable ought to make implicature production more likely.

Experiment 1

Participants :
23 9-10 years-old children
19 Adults

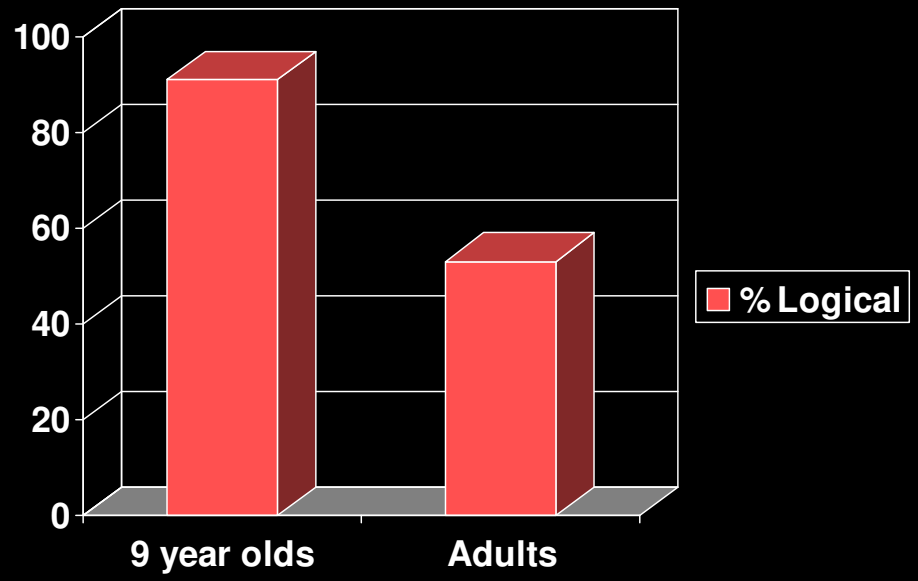
SCENARIO



Questions :
Key question **: Some turtles are in the boxes**
(*certaines tortues sont dans les boîtes*)

Other questions **:**
All the turtles are in the boxes
Some turtles aren't in the boxes
All the dolphins are in the boxes
Some dolphins are in the boxes
No dolphin is the boxes
Some dolphins aren't in the boxes
Some elephants are in the boxes
No elephant is in the boxes
Some elephants aren't in the boxes

Experiment 1 – Results



-Higher proportion of children respond « logically », i.e. lower proportion of children responded pragmatically to the test question compared to the adults : 92 % versus 53% respectively; $\chi^2 = 8.05$, $p < 0.005$.

The effect found earlier is robust, i.e. it persists even with materials that do not rely on encyclopedic knowledge.

Experiment 2

If we make the task less complex, do we find that younger children are able to make the implicature ?

Is there an age at which young children make implicatures ?

The task was made simpler by making the following changes :

-- we used the French word *quelques* instead of *certains*

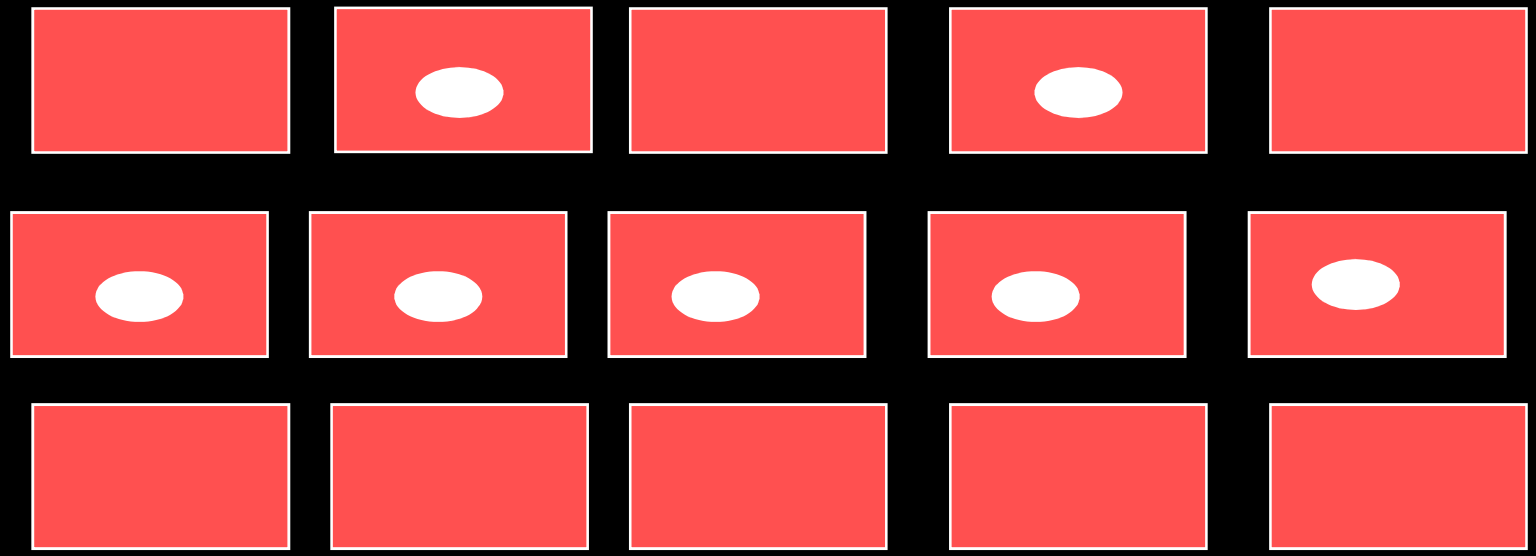
-- we asked participants to perform an action on the basis of the puppet's instructions, rather than making a judgement on the validity of the puppet's statements

-- the presentation concerned only tokens; there were no animals and these tokens were not left strewn around. All the statements concerned the contents of the box.

Experiment 2

Participants
147 children, 4 to 9 years old
21 adults

3 SCENARIOS



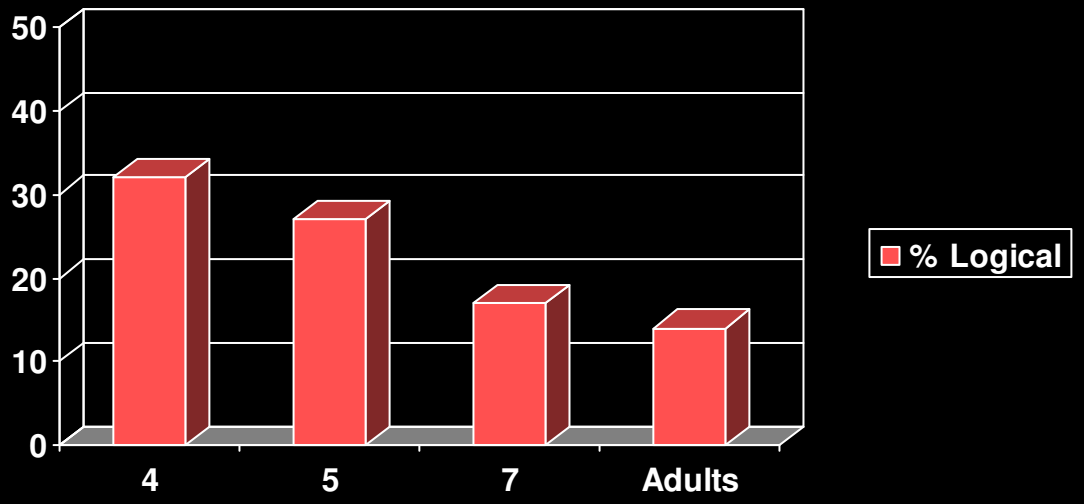
Questions :

D1 : I would like all of the boxes to have a token

D2 : I would like some of the boxes to have a token *je voudrais que quelques boîtes contiennent des jetons*

D3 : I would like none of the boxes to have a token

Experiment 2 – Results



- A high rate of pragmatic responses for all the participants

- **Even the four years olds responded with the implicature** (25 out of 34) which is significantly more than would be expected if they were responding on the basis of chance, $p < 0.005$

-There is a trend showing that pragmatic responses increase with age

Conclusions

Experiment 1

Children are more logical than adults : they are much less likely to make the implicature on the word *some* than adults, confirming Noveck's (2001) original findings

Experiment 2

We demonstrated that a reduction in the cognitive load resulted in more implicature responses and that young children's rate of pragmatic responses was surprisingly high.

Two main effects

	Scalars	
	Simple scenarios	**Relatively difficult scenarios**
Children (5-year-olds)	**32% Logical**	**90% Logical**
Adults	**14% Logical**	**50% Logical**

We took these findings to mean that

-there is no age threshold for implicature (explicature) - production
-effort plays an important role in implicature production

Relevance Theory explains this well :
-The fewer cognitive demands placed on the child, the more likely the child is to make the implicature.

Levinson's GCI Theory doesn't :
- If scalar implicatures were automatic, task complexity ought not to matter.

Levinson's account of underinformative statements:

Time

Some but not all elephants are mammals.

"Some elephants are mammals."

True.

Why? Undo implicature.

False.

Why? Disconfirmed inferred meaning.

Some but not all

Some

Some but not all.

According to Levinson, the implicature intrudes on semantic processing

Relevance account of underinformative statements:

Enrichments are part of an effort to render the utterance more relevant.

Time (effort)

False.
Why? Higher expectations of relevance bring about the implicature.

Some but not all elephants are mammals.

True.
Why? Lower expectations of relevance are satisfied without implicature.

"Some elephants are mammals."