Language and Cognition Lab

Penn UNIVERSITY of PENNSYLVANIA

The development of scalar implicatures: New questions and methods

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Pragmatic principles of communication

Grice (1975): Maxim of Quantity

Make your contribution as informative as required by the purposes of the exchange.

Scalar implicatures

Scalar implicature: the inference that a speaker chose a less informative statement because the more informative statement is not true (e.g., *'some'* implies *'some **and not all'***)

Some sea otters sleep on their backs.

→ *Not all sea otters sleep on their backs.*

The development of scalar implicatures

Early studies found that children struggle with SIs until late in development.

- *10-year-olds: "Some giraffes have long necks"* (Noveck, 2001)

- *5-year-olds: "Some of the horses jumped over the fence"* (Papafragou & Musolino, 2003)

However… in simple paradigms that make alternatives more salient, children compute SIs between 3 ½ - 5 (Papafragou & Tantalou, 2004; Katsos & Bishop, 2011; Stiller et al., 2014; Skordos & Papafragou, 2016).

Do children compute SI in accordance with speaker knowledge?

Adults derive scalar implicatures in accordance with the speaker's knowledge state.

- Hearers are sensitive to speakers' epistemic state in online comprehension (Breheny, Ferguson, & Katsos, 2013)

- Difference in reading times for "some" in contexts where speaker knows that "all" is true vs. contexts where the speaker *might* know that "all" is true (Bergen & Grodner, 2012)

- For children, evidence is pessimistic (Papafragou, Friedberg, Cohen &, 2018; Hochstein et al., 2016).

Do children compute SIs from non-linguistic stimuli?

Grice and others (e.g., Sperber & Wilson, 1986) proposed that pragmatic principles apply to both linguistic and non-linguistic exchanges, but this idea hasn't been systematically tested

Maxim of quantity in non-linguistic domain - If someone is assisting with the repair of a car and the mechanic needs four screws, they are expected to hand him four, not two or six (Grice, 1989)

Informativeness in non-linguistic communication: pictures
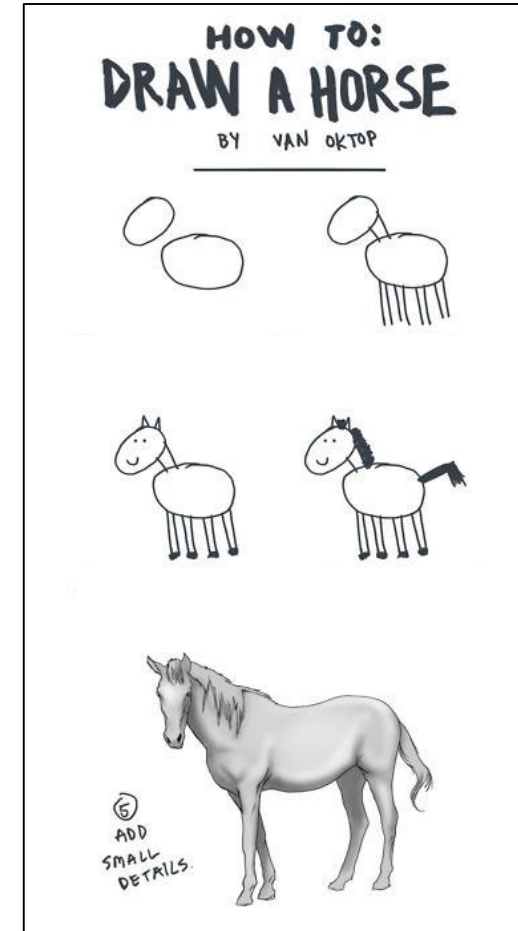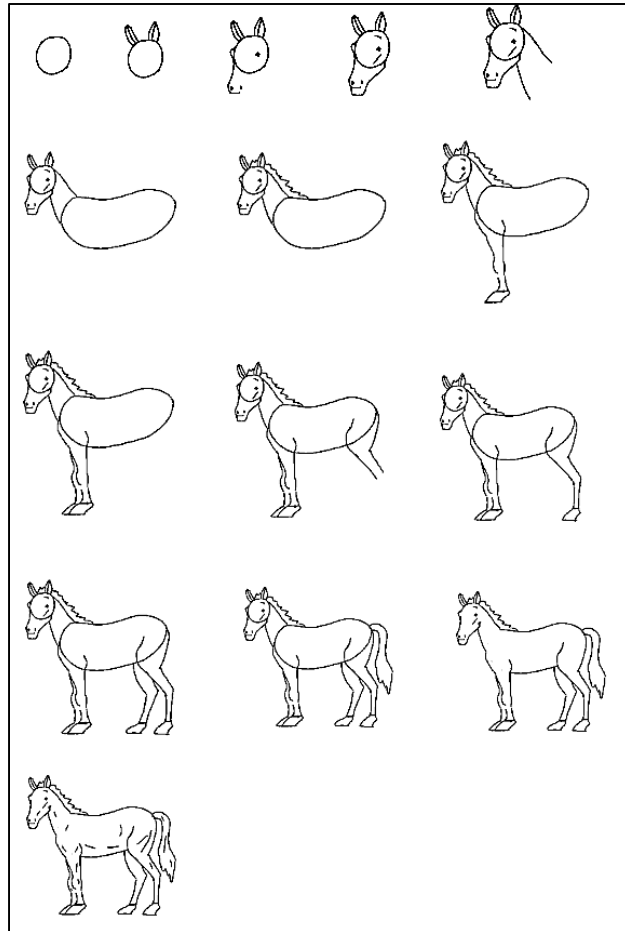
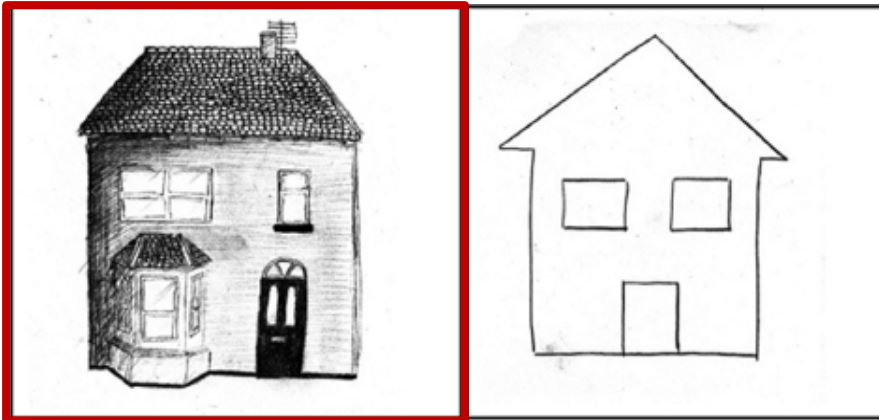# Can children use pictures communicatively?

By age 3, children are reliably able to use pictures abstractly to find a hidden toy in a retrieval task (DeLoache, 1991)
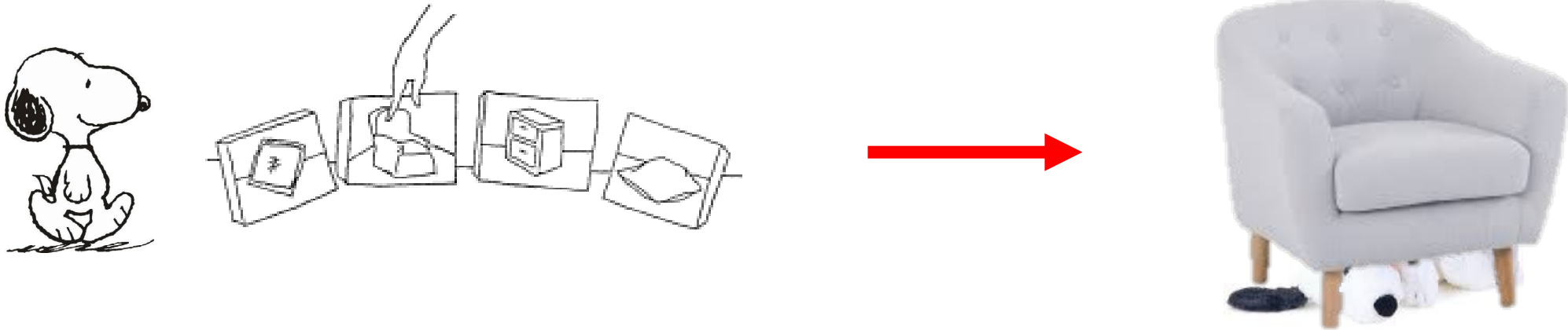
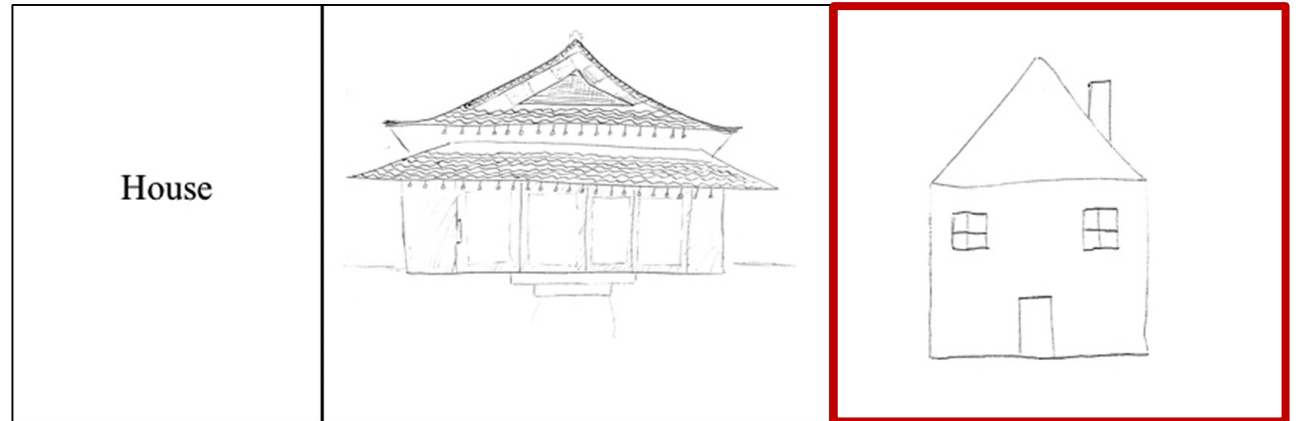# Are children sensitive to informativeness in pictures?

3-year-olds can select which drawing will be most useful to another person (Allen et al, 2010; see also Gweon et al., 2014)

Exp. 1

More detailed

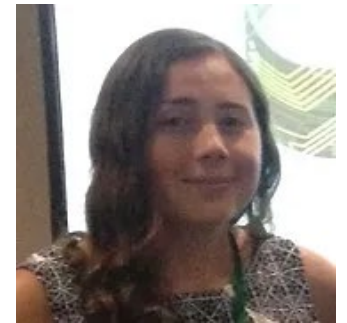Exp. 2

House

Prototypical

Our plan: Revisiting SI development

Do children compute SIs in accordance with speaker knowledge?

Do children apply the Quantity principle to non-linguistic communication?

Experiment 1: Language

Experiment 2: Pictures

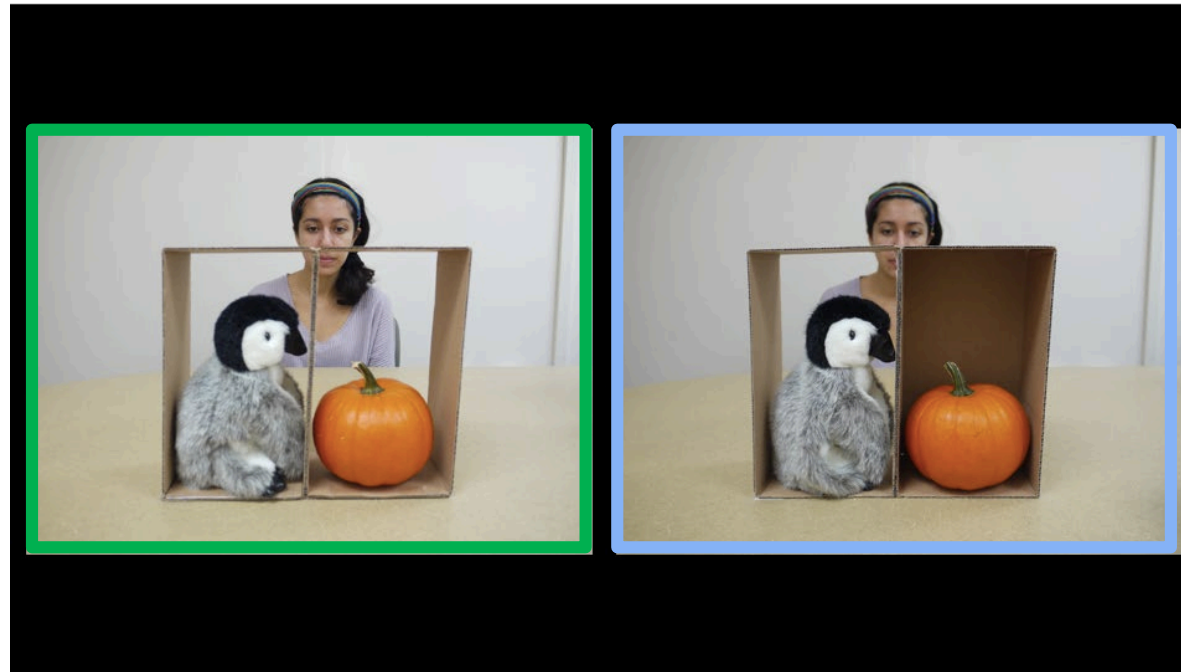Experiment 3: Abstract pictures

Alyssa Kampa

Experiment 1: Language (Kampa & Papafragou, *DevSci*, 2020)

Can children incorporate sensitivity to speaker epistemic state into scalar inferences?

Full knowledge speaker — More informative statement

Limited knowledge speaker — Less informative statement

Paradigm

E: First, she's going to look at this box… then she's going to look at the other box… and then she's going to tell us what she sees in just one of the boxes. You have to decide which box she's talking about.
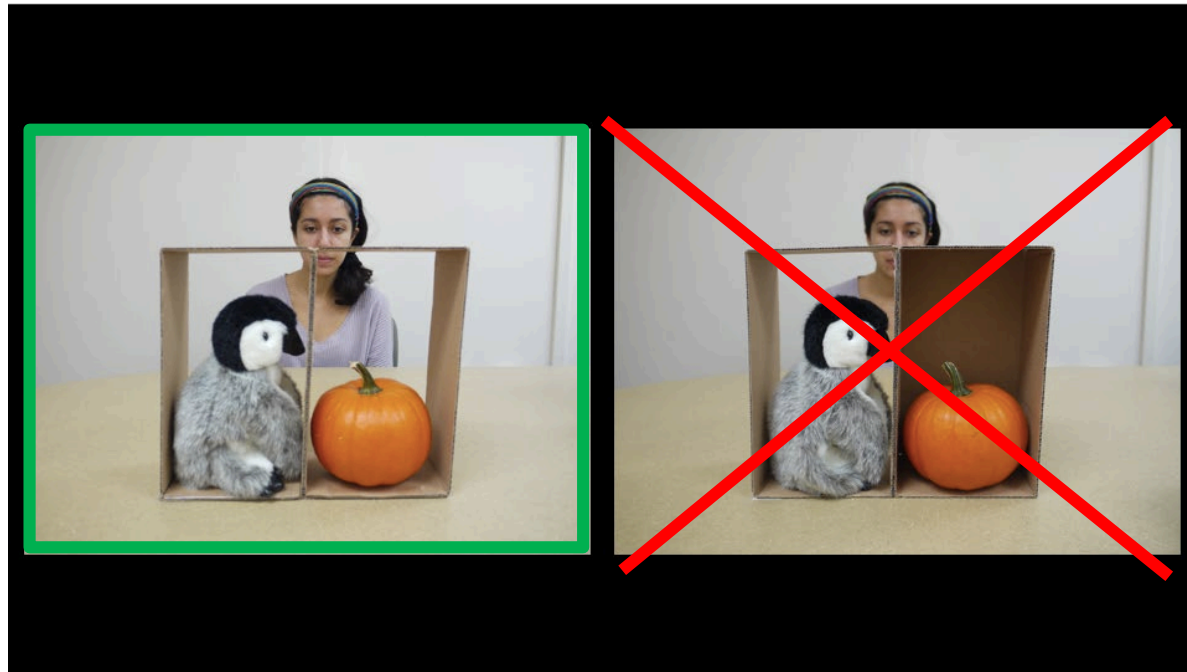
More informative: "I see a penguin and a pumpkin."

OR   *Less informative*: "I see a penguin."
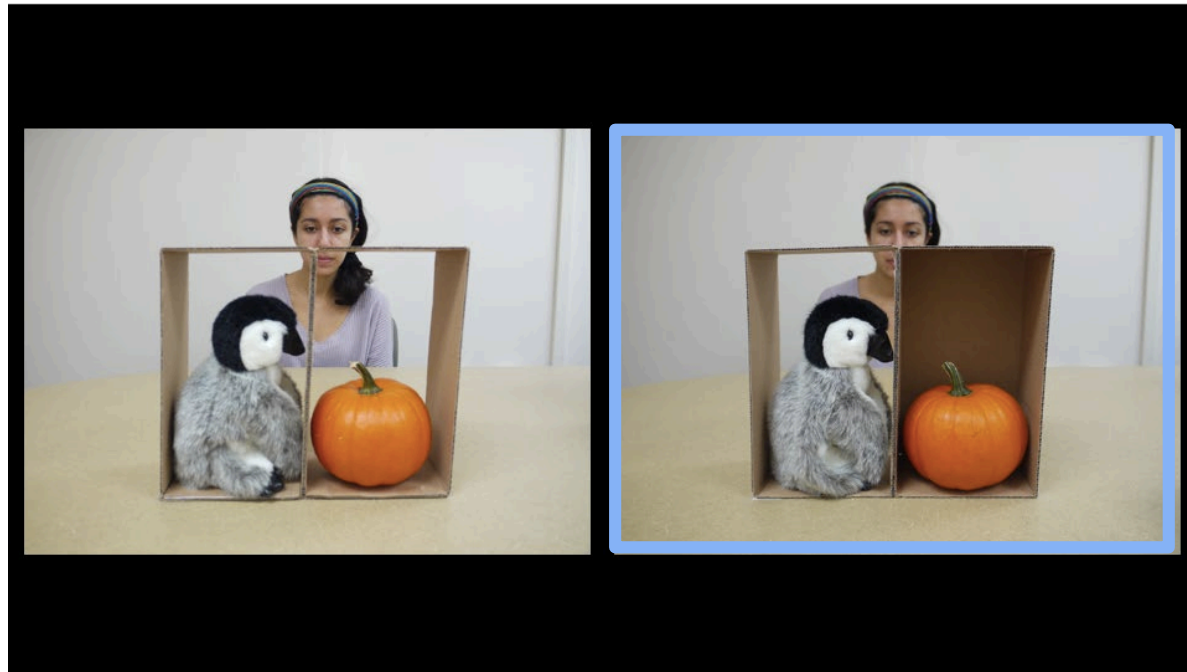
Which box is she talking about?

Predictions

A pragmatic listener will match the more informative statement to the full-knowledge speaker.

Requirements: perspective taking

More informative: "I see a penguin and a pumpkin."

Predictions

A pragmatic listener will match the less informative statement to the limited knowledge speaker.

Requirements: perspective taking + sensitivity to informativeness (scalar inference)

Less informative: "I see a penguin."

Procedure

1. Limited-access box explanation

2. 2 pre-test trials

3. 8 test trials
   - Mixed order of trials, always beginning with a more informative trial
   - Box reminder midway through (same as explanation)
   - Counterbalanced box side

Results - Exp. 1 (Language)
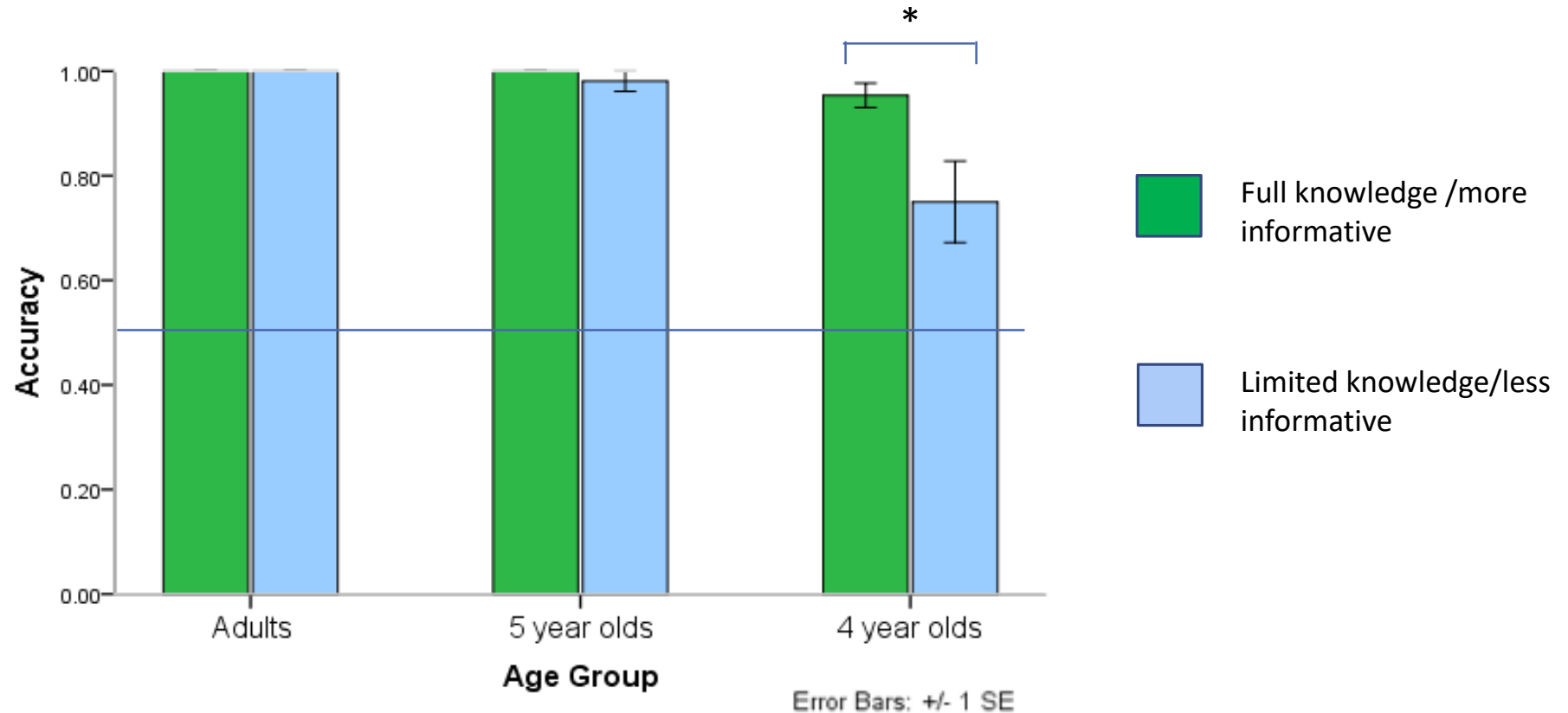
Comparison to .50 chance (4yos) - full/more: p=.001, limited/less: p=.021

Full/more (M = 96%), Limited/less (M = 69%); t (30) = 2.35, p = .001

Discusssion

In linguistic communication, children are able to incorporate epistemic state into the derivation of scalar inferences earlier than previously thought (age 4)!

5-year-olds do so in an adult-like manner (in this task)

- Improvement in performance from previous studies

Non-linguistic communication (Kampa & Papafragou, *JML*, 2023)

Do children and adults apply the same principles of informativeness to non-linguistic scalar inferences, as predicted by Grice?

Linguistic paradigm to non-linguistic
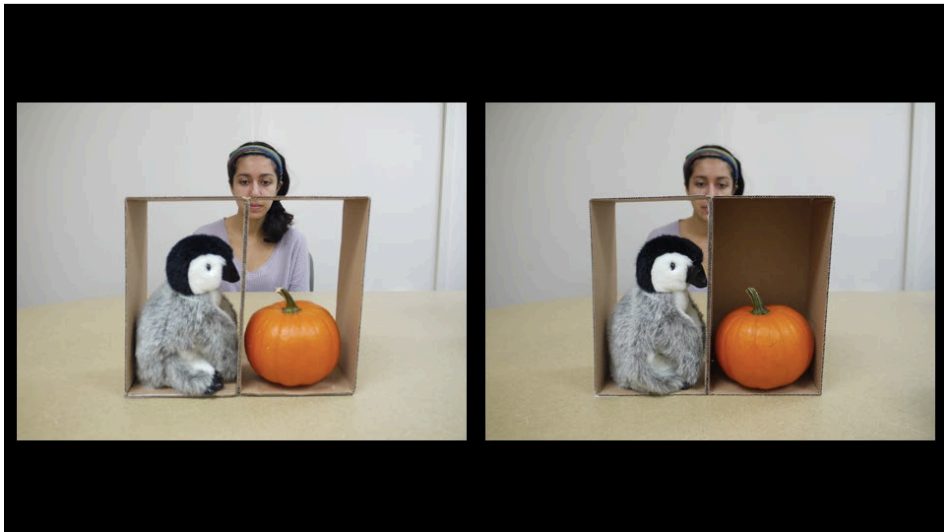
More informative: "I see a penguin and a pumpkin."
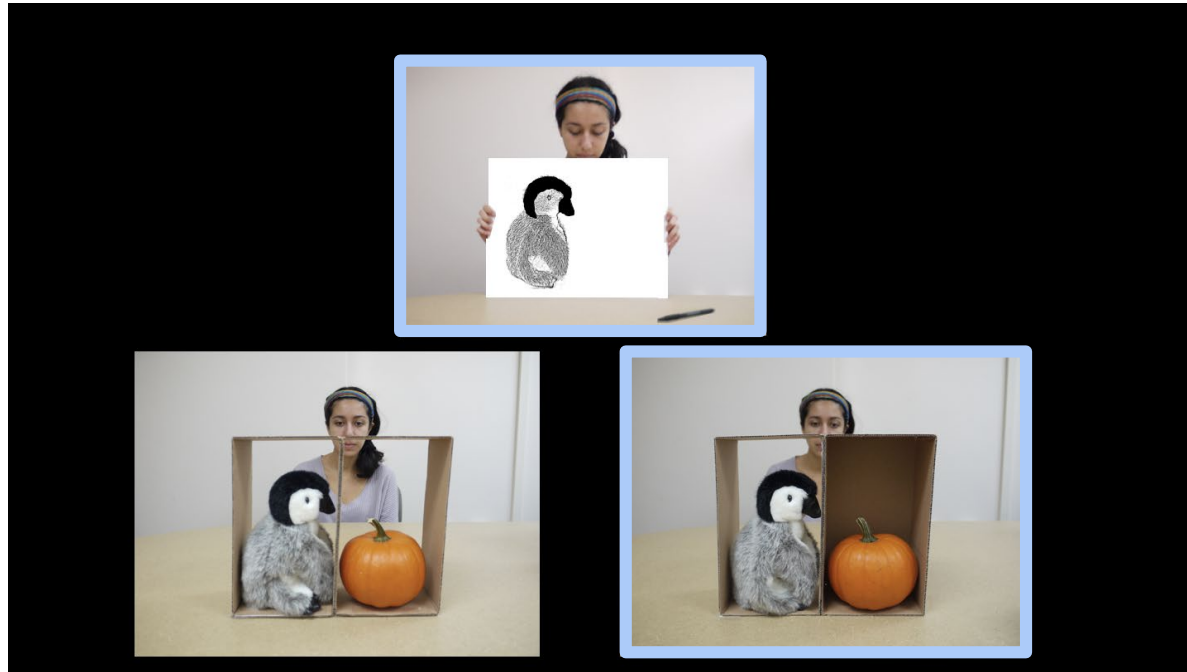
Less informative: "I see a penguin."
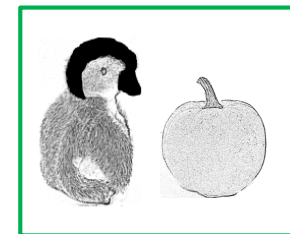
Predictions

A pragmatic reasoner will match the more informative drawing to the full-knowledge creator.

Requirements: perspective taking

Which box did she draw?

Predictions

A pragmatic reasoner will match the less informative drawing to the limited knowledge creator

Requirements: perspective taking + sensitivity to informativeness

(scalar inference)

Which box did she draw?

Methods (same as Exp.1)

Participants: 25 4-year-olds, 25 5-year-olds, 25 adults

1) Box explanation   2) 2 pre-test trials   3) 8 test trials

- Mixed order of trials, always beginning with a more informative trial

- Box reminder midway through (same as initial explanation)

- Counterbalanced box side

Results – Exp.2 (Pictures)
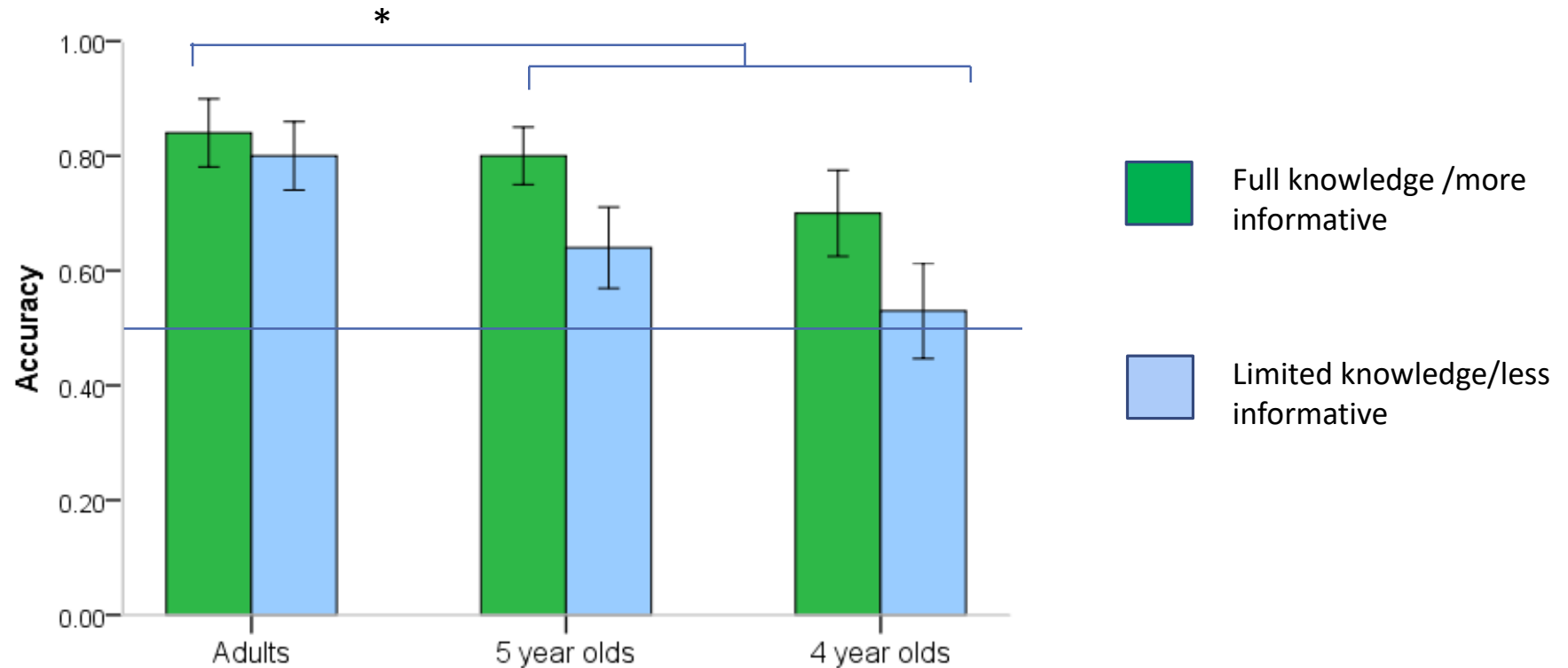
Effect of age - Adults vs. children (β=-1.6094, z=.6, p=.008)

5-year-olds vs. 4-year-olds (β=.776, z=.6, p=.21)

Discussion

Adults and children reliably associate a more informative drawing with a full-knowledge speaker

Only adults associate a less informative drawing with a limited knowledge speaker

Discussion

Adults do extend pragmatic principles (informativeness) to non-linguistic communication in accordance with the speaker's epistemic state.

Children appear to be unable to do so despite success in an equivalent linguistic task.

Why do children fail?

- Could be the characteristics of the drawings….

Dual nature of symbolic artifacts

Children have to understand that symbolic artifacts (such as pictures, maps, scale models etc.) have a dual nature

- Dual representation theory (DeLoache, 2000; Uttal et al., 2009)
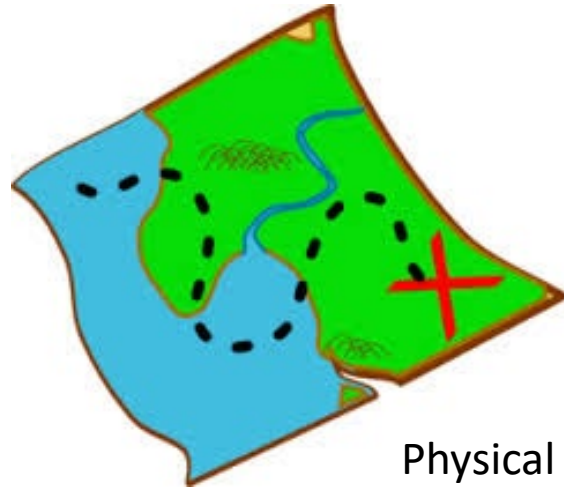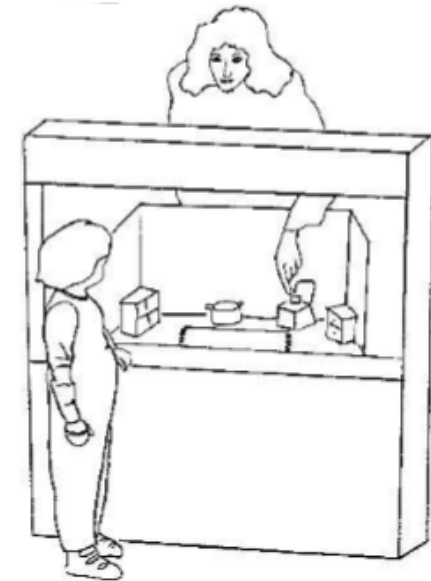

Physical

Abstract

Accessing dual representations

Children sometimes struggle to overcome the physical nature of symbolic artifacts to access the abstract (DeLoache, 2000)

- 2½ to 3-year-old children are shown in a 3-D model of a room where Snoopy is hiding, have to find in real room

Age 2½: ❌

+ put the 3-D model behind a screen
(emphasize abstract nature of symbol) ✔
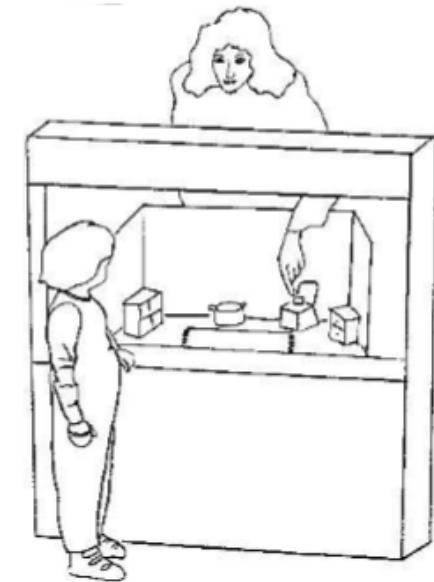
Accessing dual representations

Children sometimes struggle to overcome the physical nature of symbolic artifacts to access the abstract (DeLoache, 2000)

- 2½ to 3-year-old children are shown in a 3-D model of a room where Snoopy is hiding, have to find in real room

Age 3: ✔

+ children play with the model first (emphasize physical nature of symbol) ✘
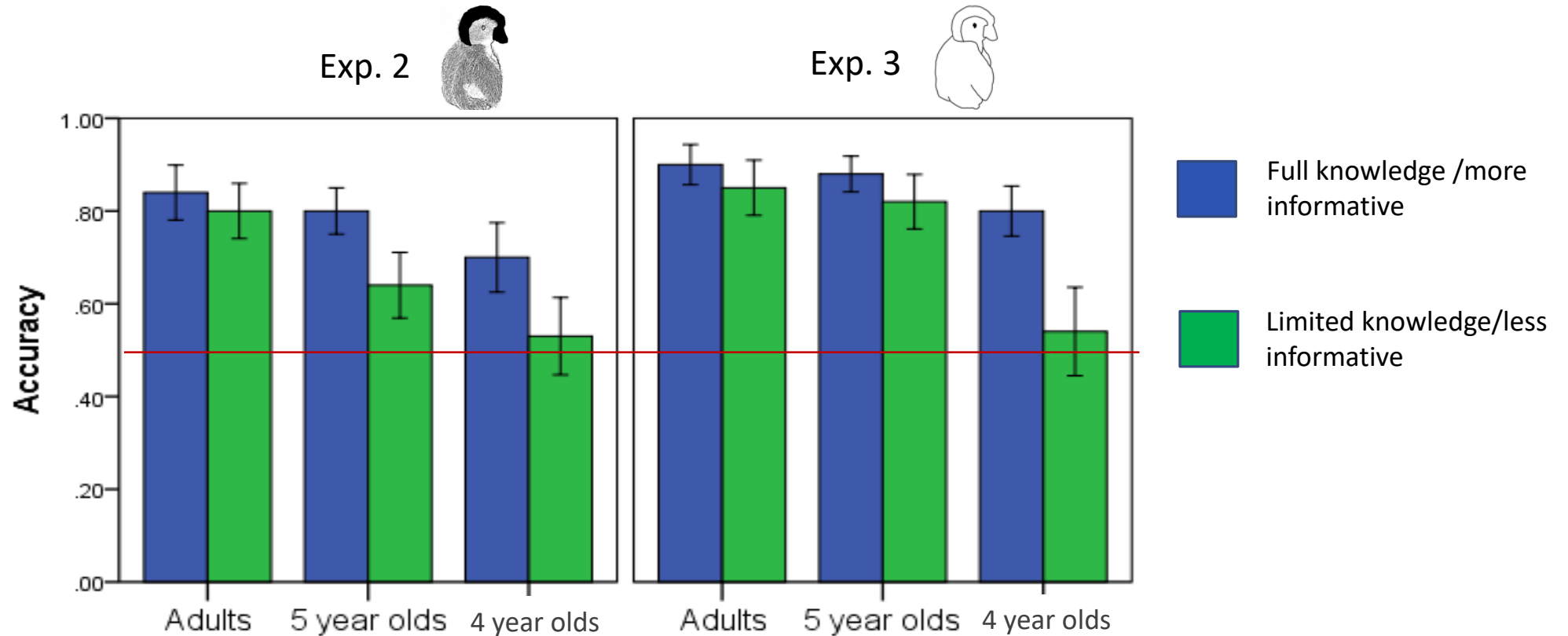
Experiment 3 – More abstract pictures

Children sometimes struggle to overcome the physical nature of symbolic artifacts to access the abstract (DeLoache, 2000)
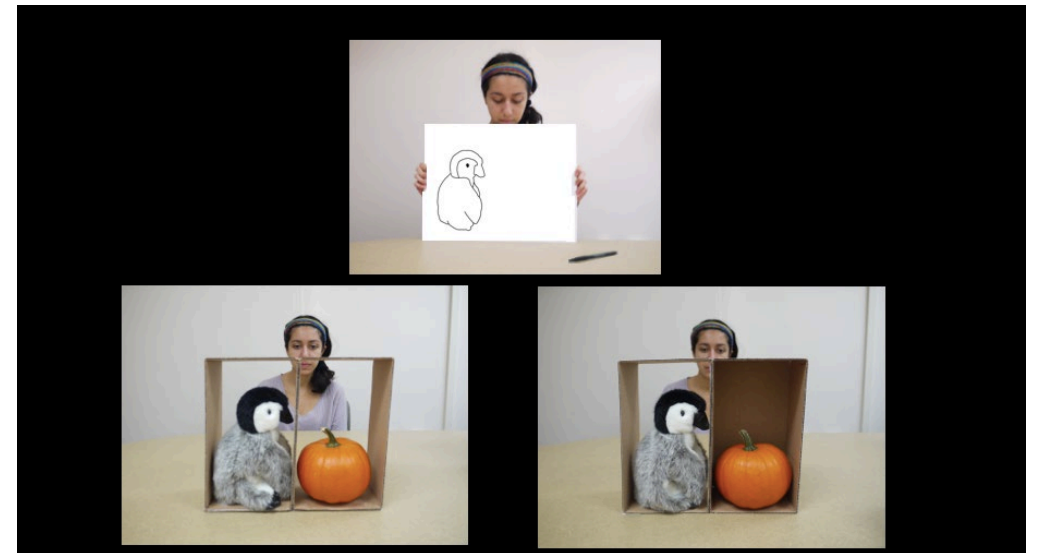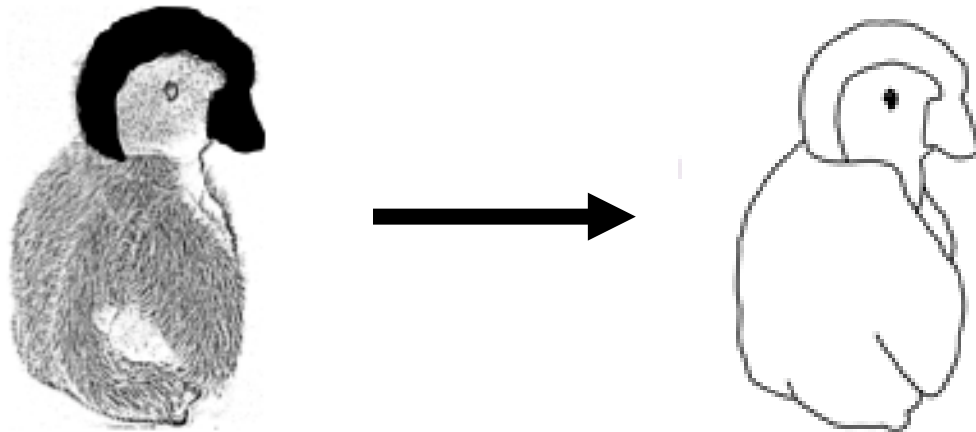
Results – Exp.3

Effect of experiment – Exp. 2 vs. Exp. 3 (β=-1.6022, z=-2.284, p=.022)

Effect of age - 5-year-olds vs. 4-year-olds (β=1.2361, z=2.773, p=.006)

Discussion

Overall, performance improves significantly when it's easier to access the abstract representation of drawing.

5-year-old children successfully apply pragmatic principles when the drawings are simple, but not when they are detailed
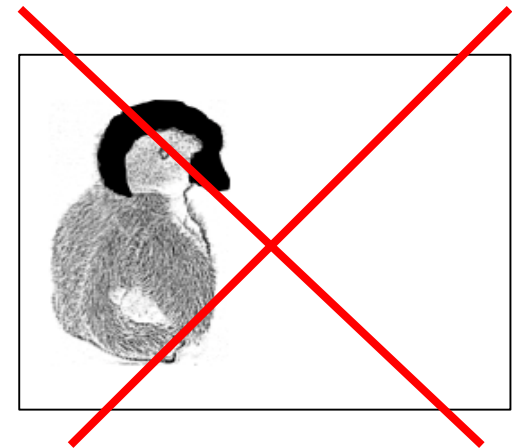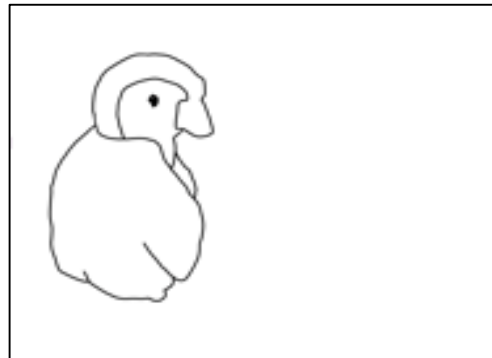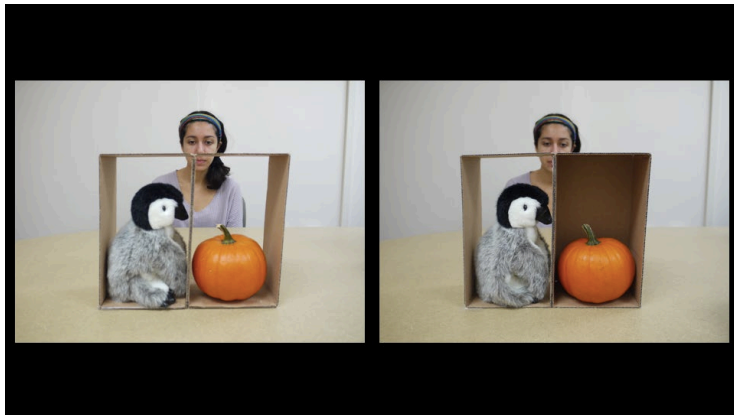
Discussion

However, 4-year-olds do not successfully link less informative drawings to a limited knowledge speaker.

4-year-olds appear to still be developing an understanding of the selective and representational function of drawings as symbols and struggle to use them abstractly in this task

Summary

Linguistic communication

Adults	✔
5-year-olds	✔
4-year-olds	✔

Non-linguistic communication
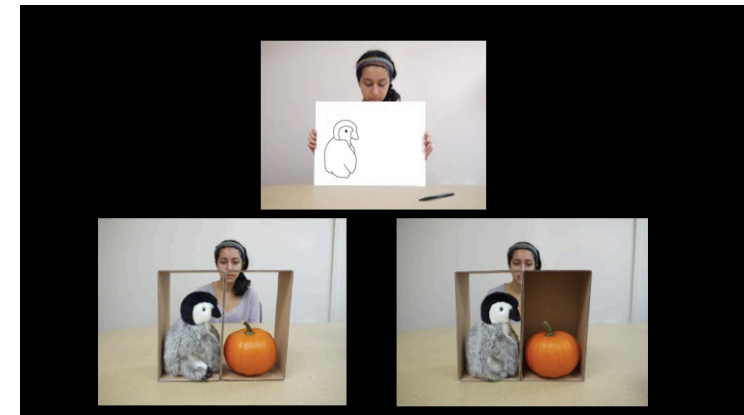
Adults	✔		✔
5-year-olds	⎯		
4-year-olds	✘		✘

Conclusion: The principle of informativeness **does** extend to non-linguistic symbols

5-year-olds and adults expect drawings, like utterances, to be informative in accordance with the creator's knowledge.

- However, the drawings' visual detail affects 5-year-old's success.

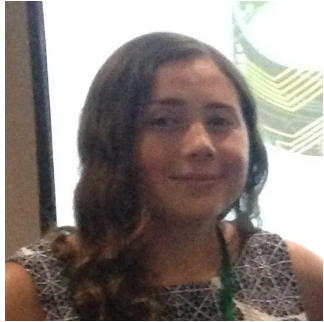4-year-olds appear to be still developing this ability.

- Seems to be specific to using drawings as symbols since 4-year-olds succeed in a matched linguistic task.
- Can succeed in tasks with reduced processing demands (Kampa, Richards & Papafragou, JECP, 2023).

Progress in the field…

◦ New questions

◦ New methods

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Thank you!

Kampa et al., JECP, 2023