Neg-raising in child language

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Neg-raising

- Neg-raising predicates (e.g., *think*, *want*, *believe*) allow a reading in which a matrix negation is interpreted as though it were in the embedded clause

(1) a. Tiger **doesn't think** that his box is empty
b. ⇒ Tiger **thinks** that his box is **not** empty

(2) a. Tiger **didn't say** that his box is empty
b. ⇏ Tiger **said** that his box is **not** empty

(3) a. Tiger **didn't want** Pig to dance
b. ⇒ Tiger **wanted** Pig **not** to dance

(4) a. Tiger **didn't tell** Pig to dance
b. ⇏ Tiger **told** Pig **not** to dance

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"neg-raising inferences"

Analyses of neg-raising

- **Syntactic analyses** (e.g., Fillmore 1963; Collins & Postal 2013)
  - Negation is base-generated and interpreted in the embedded clause, but raises above the predicate and linearly precedes it

- **Presuppositional analyses** (e.g., Bartsch 1973; Gajewski 2007)
  - Neg-raising sentences in combination with their excluded middle presupposition entail the neg-raising inference

  Assertion: John doesn't believe it's raining
  Presupposition: John believes it's raining or John believes it's not raining
  ⇒John believes it's not raining

- **Scalar implicature analysis** (e.g., Romoli 2012, 2013)

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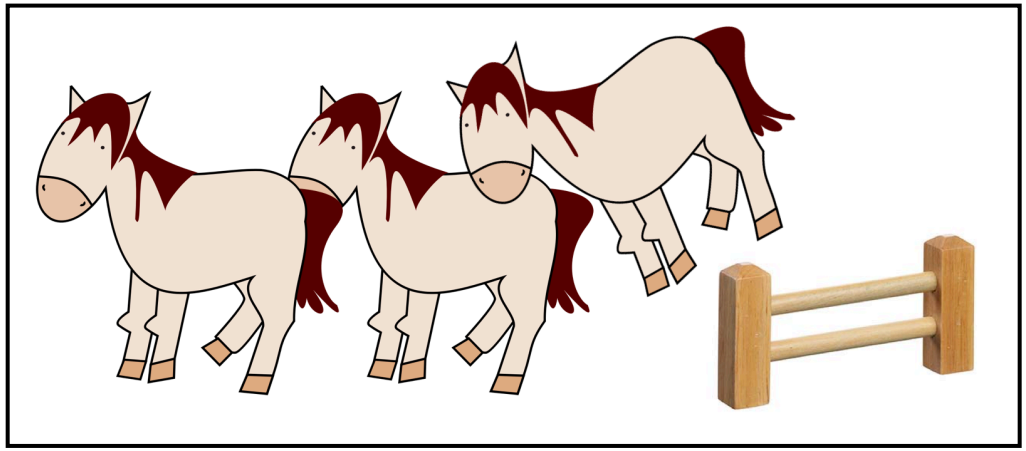
- **Scalar implicature analysis** (e.g., Romoli 2012, 2013)

Scalar implicatures

- Scalar implicatures involve ‘strengthening’ of literal meanings
- Arise from competition between alternative forms

(1) a. **Some** of the horses jumped over the fence
b. ⇝ not (**All** of the horses jumped over the fence)



Literal meaning: YES Scalar implicature: NO	Children: YES Adults: NO

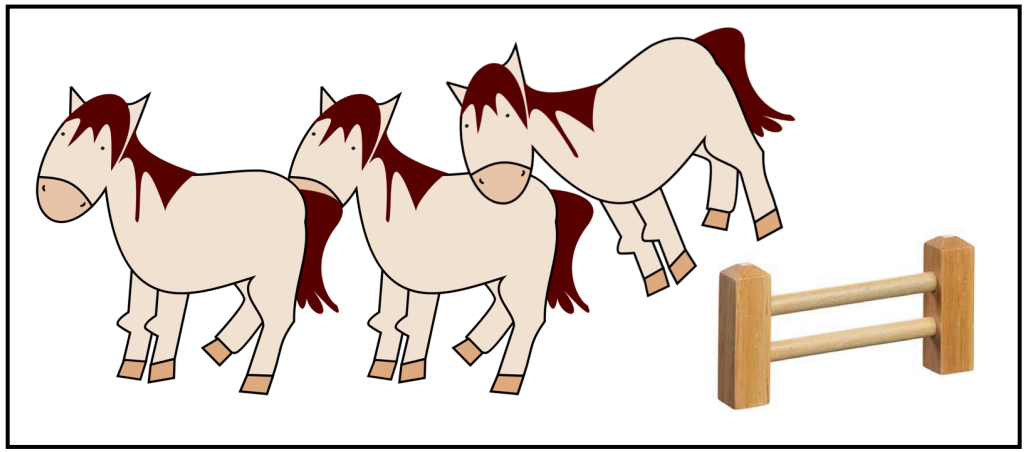
Deriving scalar implicatures

- Hear an assertion:
  Some of the horses jumped over the fence
- Compare it to the stronger alternative:
  All of the horses jumped over the fence
- Negate the stronger alternative:
  NOT (All of the horses jumped over the fence)
- Result: assertion + negation of stronger alternative
  Some but not all of the horses jumped over the fence

Deriving scalar implicatures

- **Exh**(austivity operator) takes a proposition and its alternatives and affirms the proposition while negating certain alternatives
  (Groenendijk & Stokhof 1984; van Rooij & Schulz 2004; Sauerland 2004; Spector 2007; Fox 2007; Chierchia et al. 2012, a.o.)

  EXH (Some of the horses jumped over the fence)
  = Some of the horses jumped over the fence
  and NOT (All of the horses jumped over the fence)



Literal meaning: YES Scalar implicature: NO	Children: YES Adults: NO

NRIs as scalar implicatures

(Romoli 2012, 2013)

- The alternatives of a positive sentence containing **believe** include the assertion itself and an *excluded middle* proposition:

entails

1. Tiger believes that his box is empty
2. Tiger believes that his box is empty or Tiger believes that his box is not empty
   (Tiger has an opinion as to whether his box is empty)

- The excluded middle is entailed by the assertion
- Exhaustification is semantically vacuous

NRIs as scalar implicatures

(Romoli 2012, 2013)

- The alternatives of a negative sentence containing **believe** include the assertion itself and the negation of the EM

1. NOT(Tiger believes that his box is empty)

2. NOT(Tiger believes that his box is empty
   or Tiger believes that his box is not empty)
   (Tiger doesn't have an opinion as to whether his box is empty)

- The negation of the excluded middle is not entailed by the assertion
- Exhaustification yields the negation of the negation of the excluded middle

NRIs as scalar implicatures

(Romoli 2012, 2013)

- The alternatives of a negative sentence containing **believe** include the assertion itself and the negation of the EM

1. NOT(Tiger believes that his box is empty)

2. **NOT** (NOT(Tiger believes that his box is empty
   or Tiger believes that his box is not empty))
   = Tiger believes that his box is empty
   or Tiger believes that his box is not empty

3. ⇝Tiger believes that his box is not empty

Predictions for acquisition

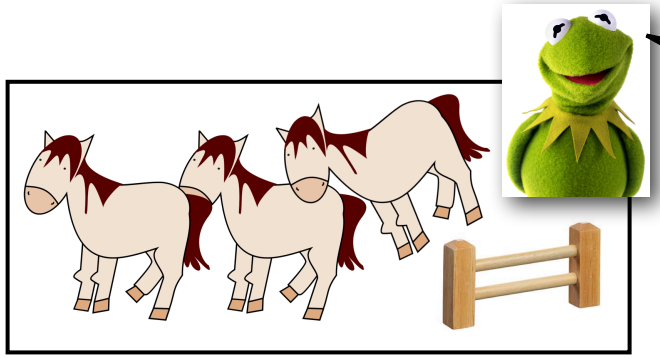
- The same mechanism underlies classical scalar implicatures and neg-raising inferences

- All else being equal, we should see parallel behavioural profiles across the two phenomena

- Follows in a line of research comparing children's performance on classical scalar implicatures with their performance on other 'enrichment' phenomena:
  - free choice inferences (Zhou, Romoli, & Crain 2013; Tieu, Romoli, Zhou, & Crain 2015)
  - plurality inferences (Tieu, Bill, Romoli, & Crain 2014; in prep)
  - embedded questions (Cremers, Tieu, & Chemla, under review)
  - homogeneity inferences (Tieu, Križ, & Chemla, under review)

Scalar implicatures

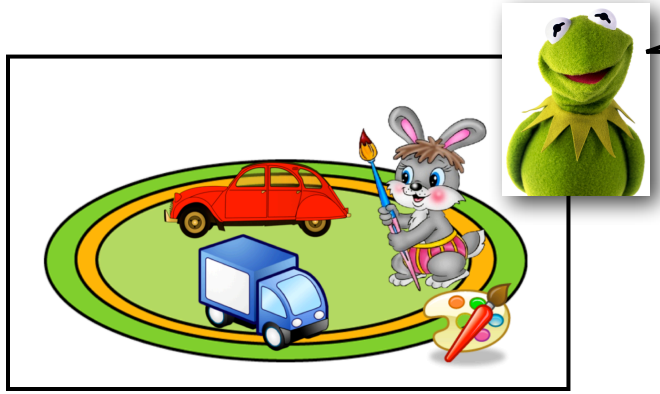
- Children typically compute fewer implicatures than adults
  (Paris 1973; Braine & Rumain 1981; Noveck 2001; Chierchia et al. 2001; Gualmini et al. 2001; Papafragou & Musolino 2003; Barner et al. 2011)



Some of the horses jumped over the fence

↝ **not** (**All** of horses jumped over the fence)

Literal meaning: YES Scalar implicature: NO	Children: YES Adults: NO



Bunny painted the car **or** the truck

↝ **not** (Bunny painted the car **and** the truck)

Literal meaning: YES Scalar implicature: NO	Children: YES Adults: NO

Predictions for acquisition

- If neg-raising inferences are a kind of scalar implicature, we expect children and adults to differ from each other in similar ways across the two phenomena
- Children access the literal meaning of scalar terms like *some* and *or* more often than adults
- Expect to see more literal meanings of neg-raising sentences from children than adults

Experiment

- Tested 4-year-olds' and adults' interpretation of sentences containing neg-raising predicates and sentences containing scalar terms
- Target sentences were true on their literal meaning, but inferences were made false

Procedure

- Truth value judgment task: stories told through series of cartoon images on laptop computer
- Puppet appeared on screen to utter test sentences
- Children judged puppet's descriptions as 'right' or 'wrong' and justified their responses
- Single 25-minute session

Design

- 2x2 design
  - Group : adults vs. children
  - Inference type : Neg-raising vs. Scalar implicature, within subjects
- Each participant received 2 training items, 7 test items, and 10 control items (presented in pseudo-randomized order)

Neg-raising targets (x4)

- Targets were true on the literal interpretation but false on the neg-raising interpretation

  Tiger didn't want Rabbit to feed the pigs

- *Literal interpretation:* (TRUE)
  It's not the case that Tiger wanted Rabbit to feed the pigs
- *Neg-raising interpretation:* (FALSE)
  Tiger wanted Rabbit not to feed the pigs

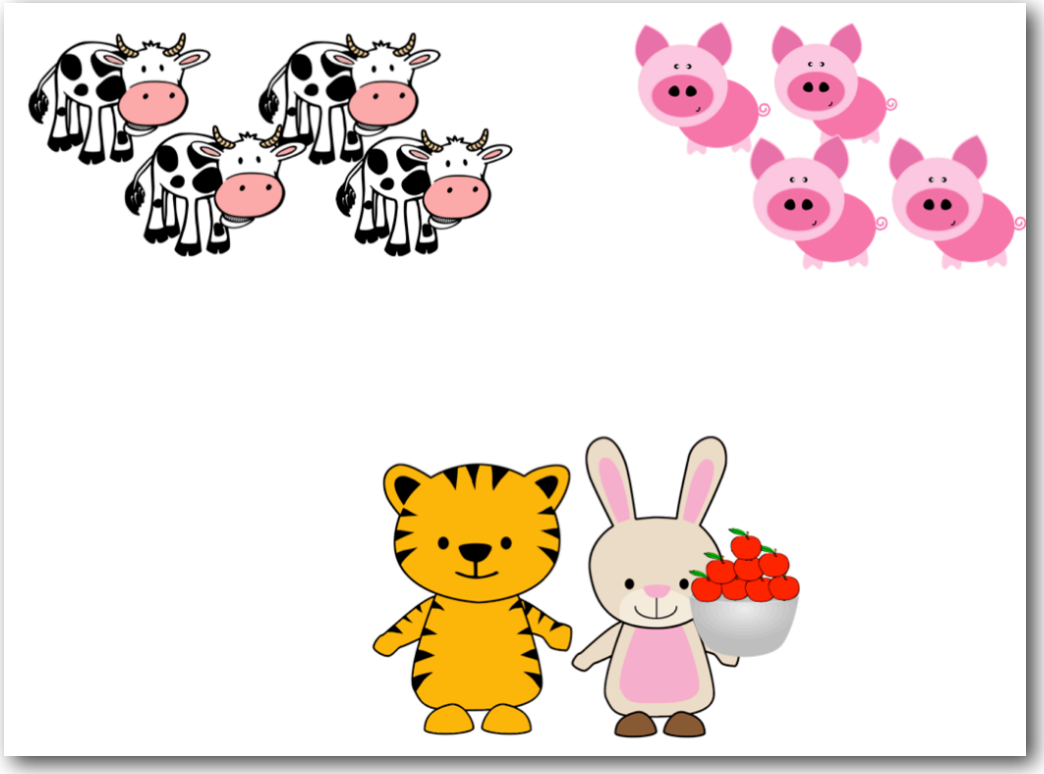
Scalar implicature targets (x4)

- Targets were true on the literal interpretation but false on the reading with the scalar implicature

  Lion carried some of the apples

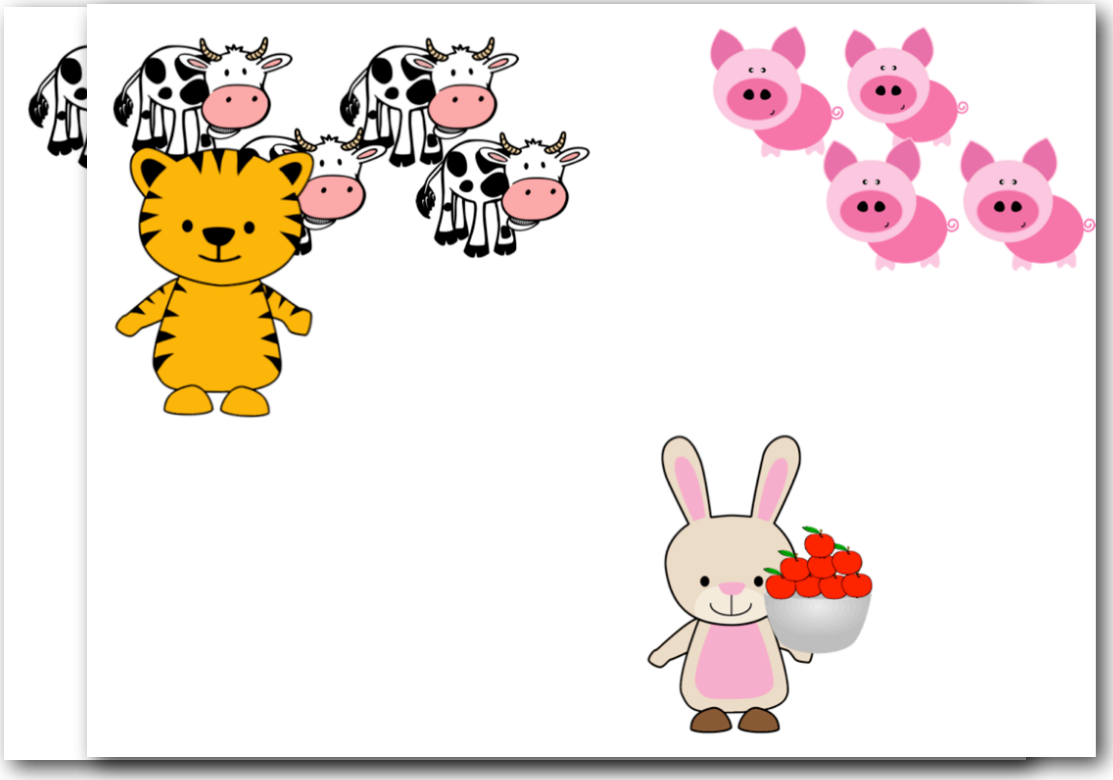
- *Literal interpretation:* (TRUE)
  Lion carried one or more apples
- *Interpretation with scalar implicature:* (FALSE)
  Lion carried some but not all of the apples

Neg-raising example



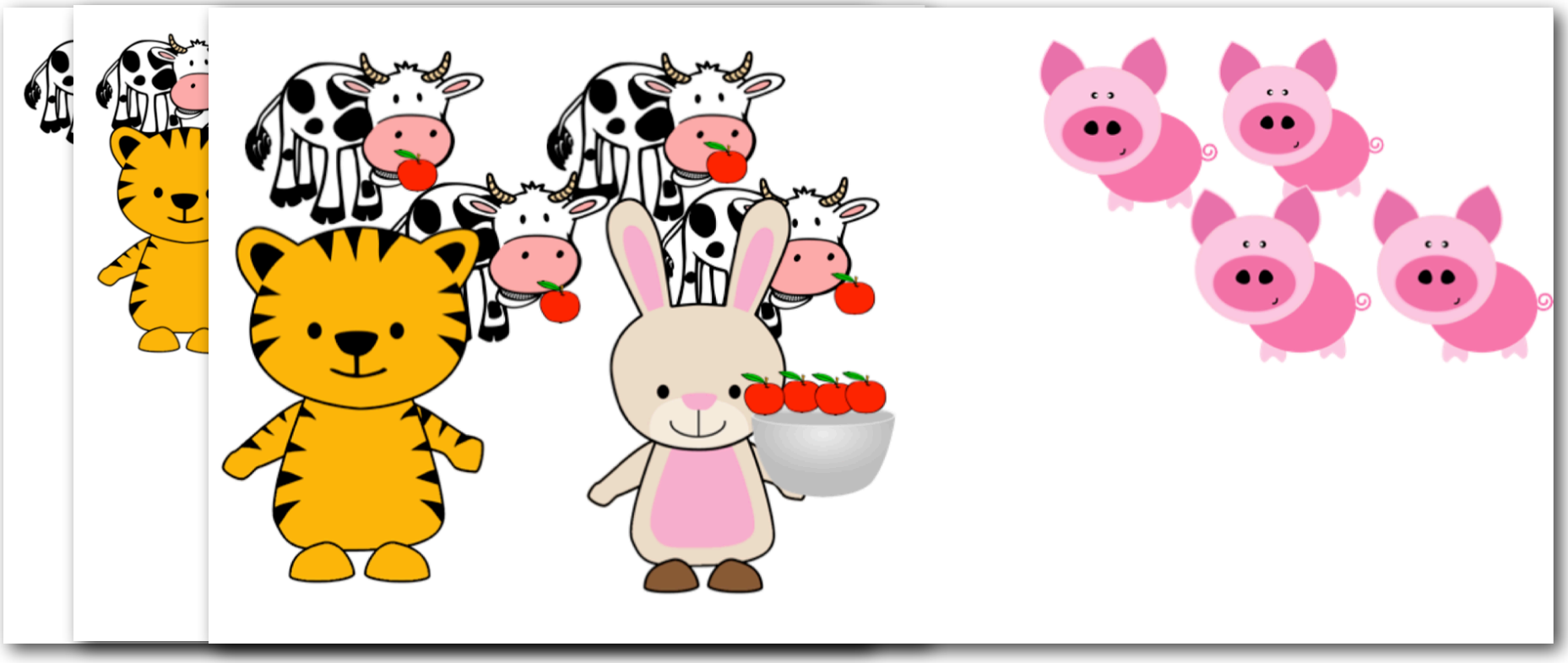
Tiger and Rabbit are visiting a farm today. Look at the cows and the pigs! Rabbit brought a bowl of apples to the farm.

Neg-raising example



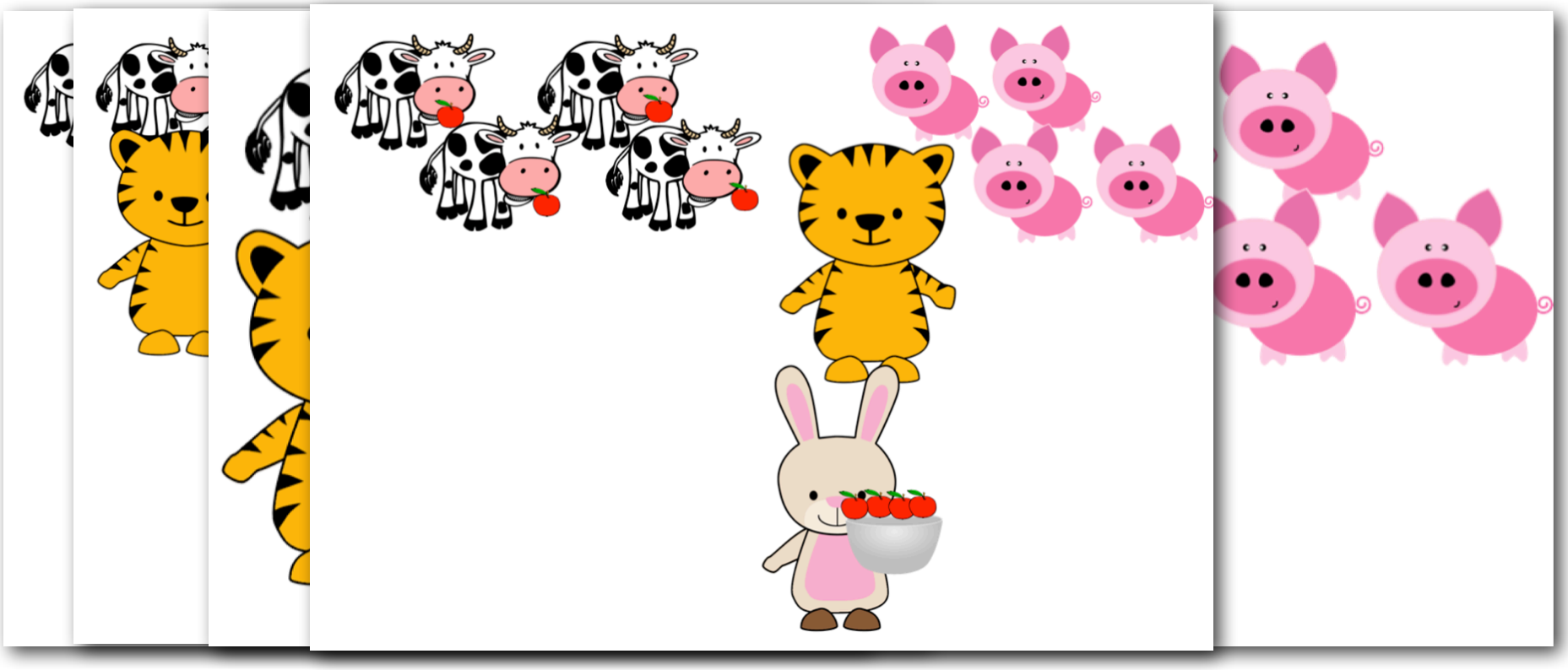
Tiger says to Rabbit, “Hey, look at the cows, I love cows! Will you please feed them?”

Neg-raising example



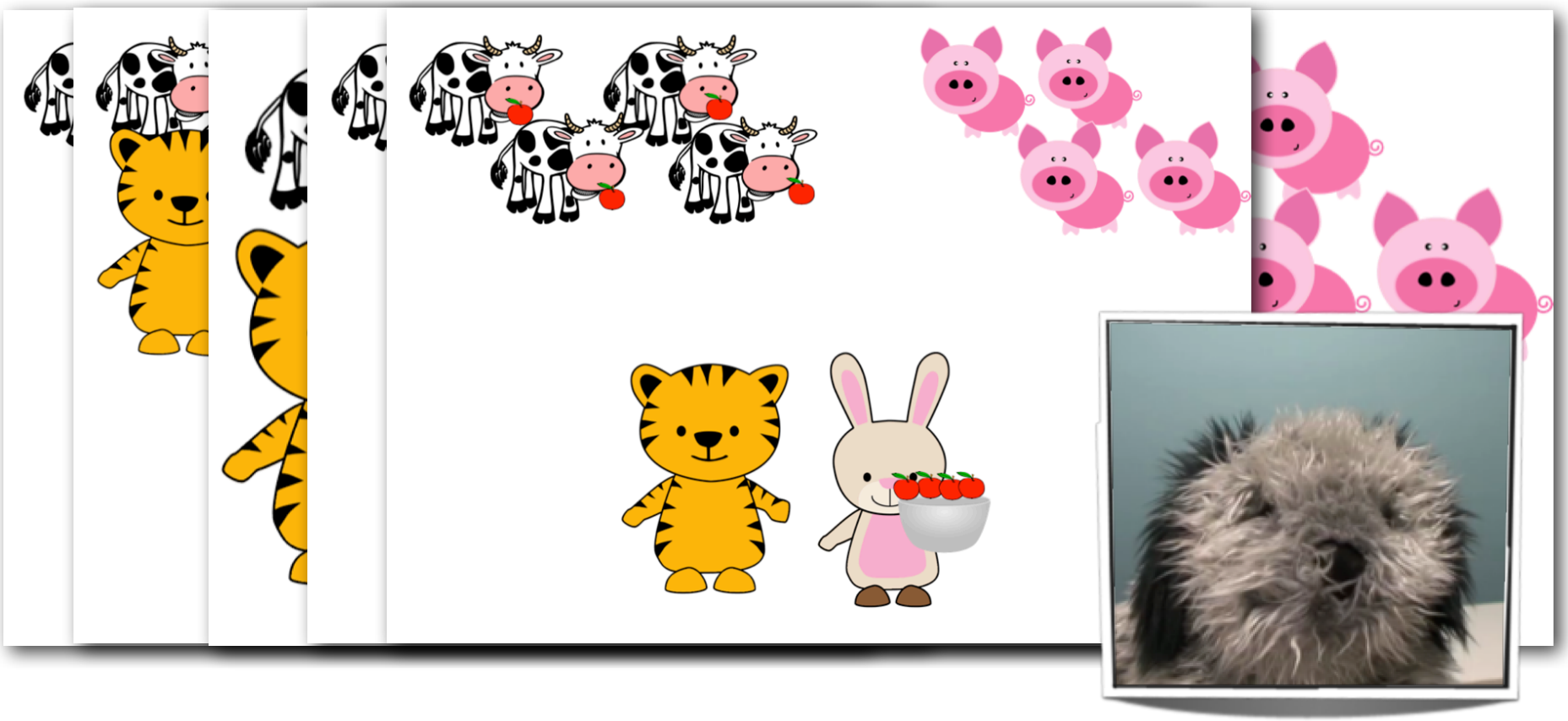
Rabbit says, “Good idea, I will feed the cows.”
“But, what about the pigs?”

Neg-raising example



Tiger says, “I don’t mind whether you feed the pigs or not, it is up to you, it is fine with me either way.”

Neg-raising example

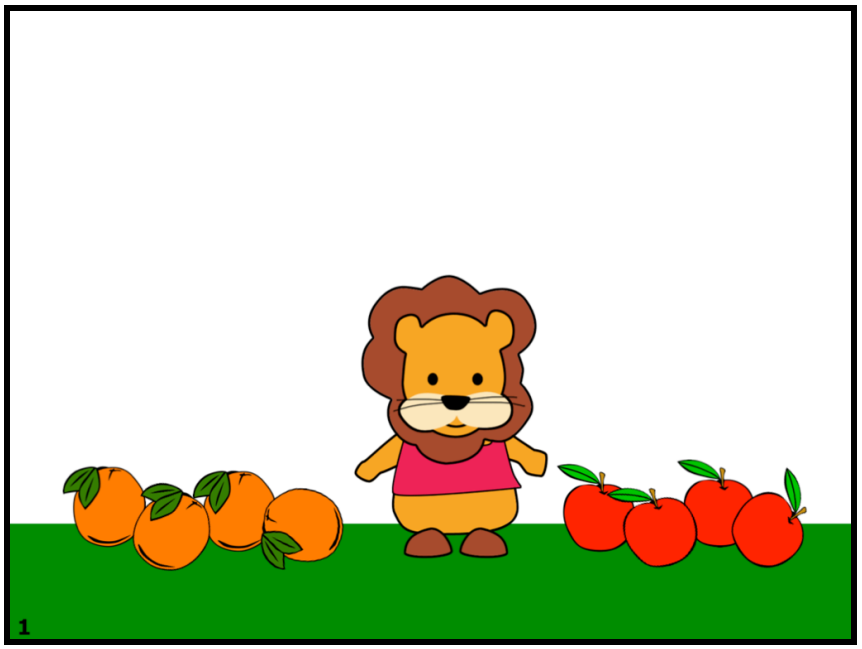


Experimenter: So Tiger wanted Rabbit to feed the cows. What about the pigs?

Puppet: Tiger didn't want Rabbit to feed the pigs!

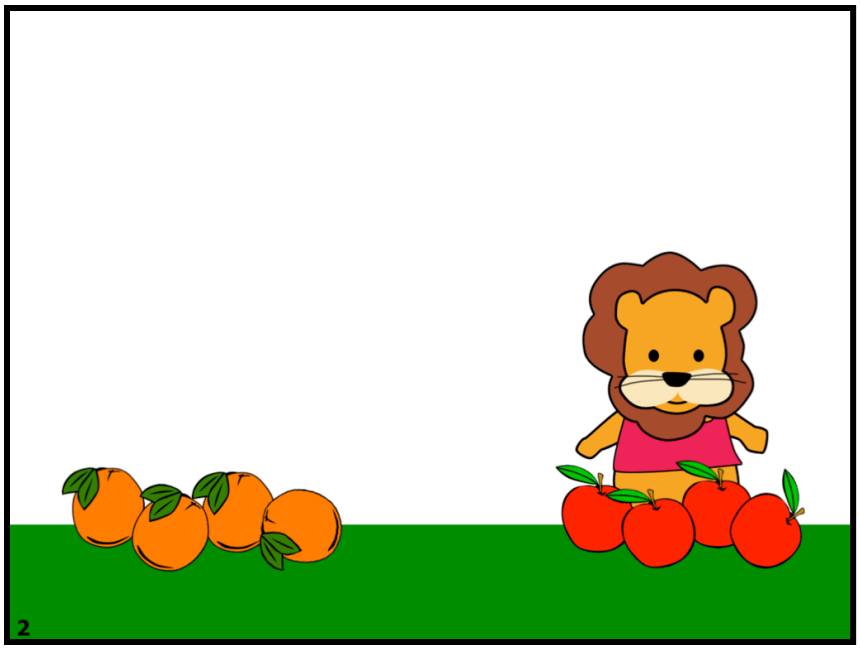
(Literal: TRUE | Neg-raising inference: FALSE)

Scalar implicature example



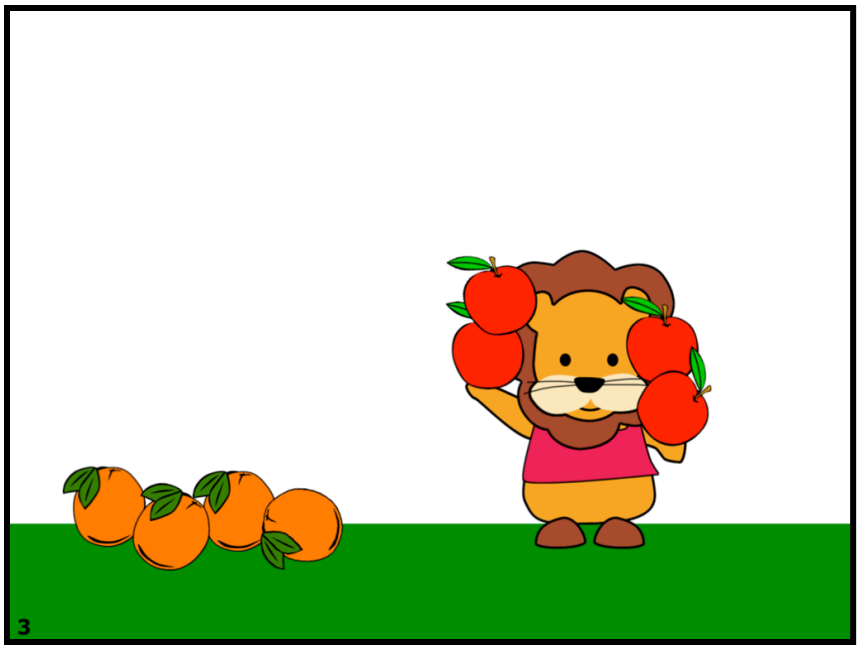
Lion loves to help his mom with the groceries. Look at these apples and oranges! Lion wants to carry the fruit, but they’re very heavy!

Scalar implicature example



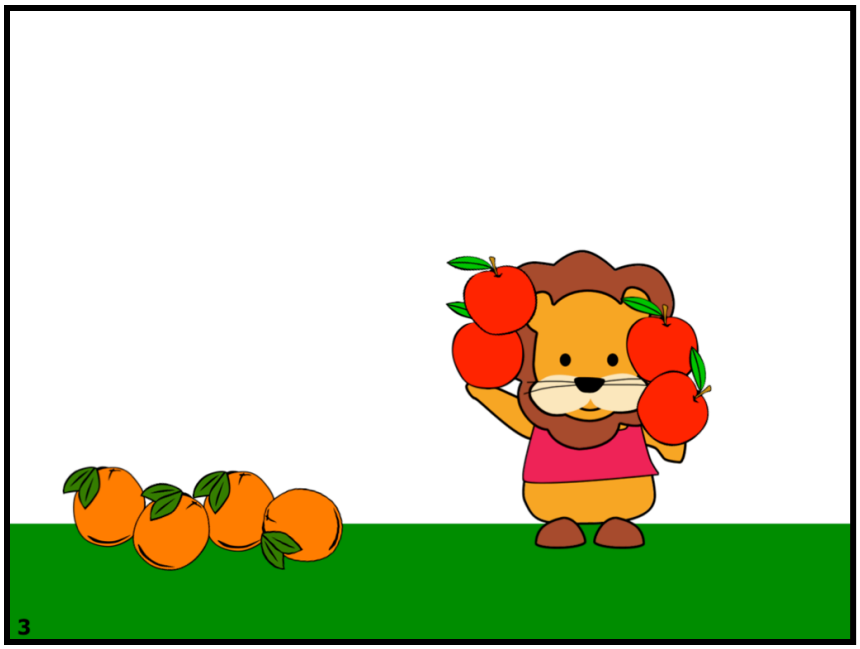
Lion carries these four apples over here.

Scalar implicature example



Then his arms are full, so he leaves the oranges on the ground. So remember, Lion only carried these four apples here!
Now let’s see if Ellie’s paying attention.

Scalar implicature example



Experimenter: Okay, Ellie, so Lion didn't carry any oranges. What about the apples?
Puppet: Lion carried some of the apples!

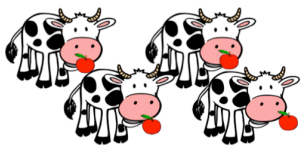
(Literal: TRUE | Scalar implicature: FALSE)

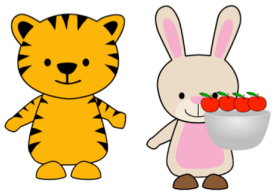
Non-neg-raising *tell* (x3)

- Non-neg-raising predicate *tell*
- Parallel with neg-raising condition: true on literal interpretation, false on neg-raising interpretation

Tiger didn't tell Pig to feed the pigs

- *Literal interpretation:* (TRUE)
  It's not the case that Tiger told Pig to feed the pigs
- *(Unavailable) neg-raising interpretation:* (FALSE)
  Tiger told Pig not to feed the pigs





Unambiguous *want/tell* controls

- (2) negative *want* controls (*yes*-targets)
- (2) negative *tell* controls (*no*-targets)

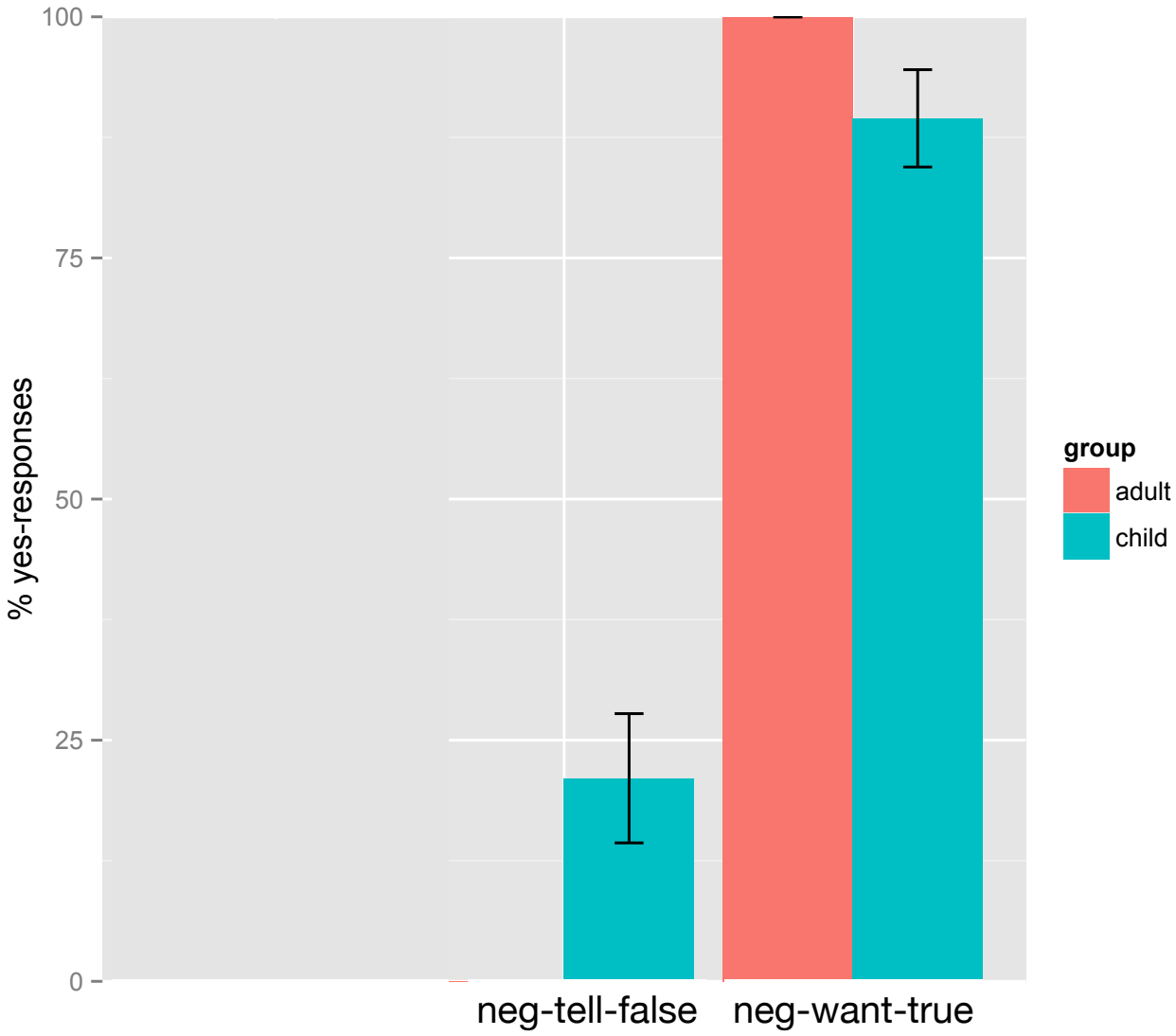
- (2) positive *want* controls (*yes*- or *no*-targets)
- (2) positive *tell* controls (*yes*- or *no*-targets)

- (2) negation controls (*yes*- or *no*-targets)

Participants

- 19 English-speaking children (4;00-5;10, M=4;06) tested at Macquarie University, Australia
- 20 English-speaking adults tested at Macquarie University, Australia
- All participants passed the controls

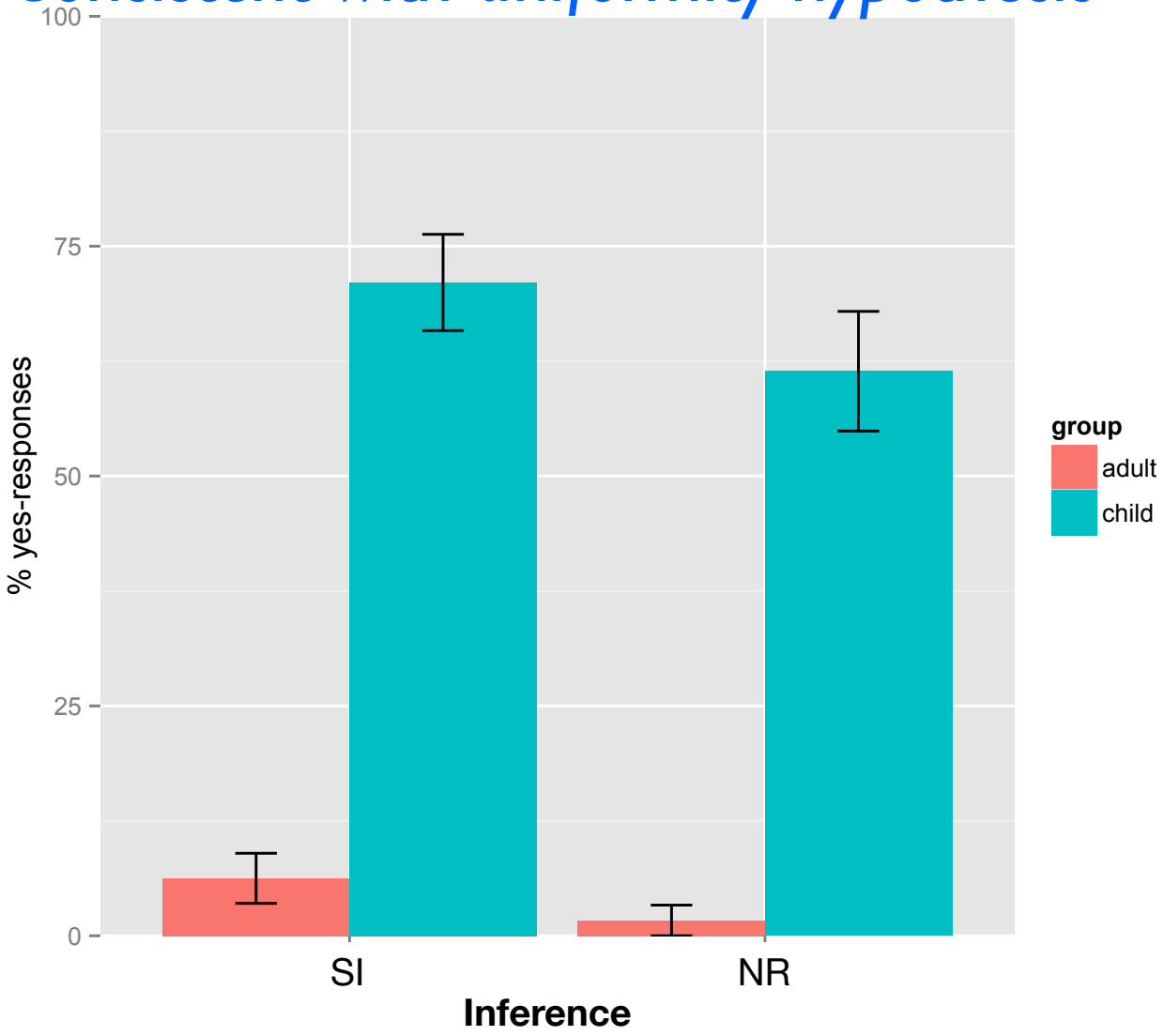
Results: Controls



- Children and adults displayed ≥80% accuracy on unambiguous TELL and WANT controls

Results: SI and NR targets

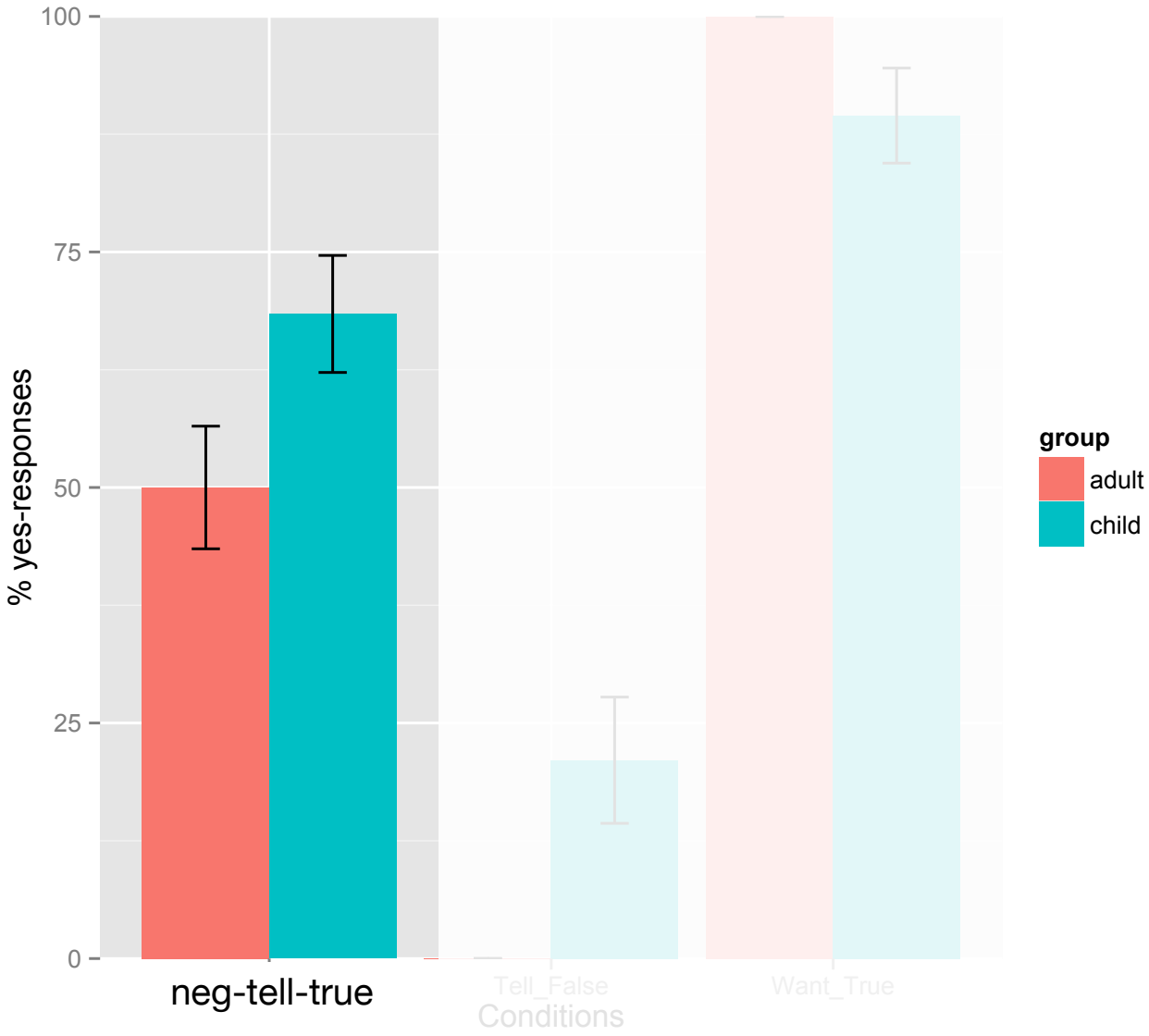
Consistent with uniformity hypothesis



- Mixed models logistic regression (with Group and Condition as fixed effects and Item and Participant as random effects) revealed:

  - Main effect of Group ($p<.05$)
  - No interaction
  - No effect of Inference Type

Discussion: Non-NR verbs



- Adults and children gave fewer *yes*-responses on the NEG.TELL condition than expected

Discussion: Non-NR verbs

- Half of the adults are rejecting when they should be accepting

  Tiger didn't tell Rabbit to feed the pigs
  ⇝Tiger told Rabbit not to feed the pigs
  (Literal: TRUE | Neg-raising inference: FALSE)

- Possibly due to expressed ambivalence: lack of enthusiasm about p, in contrast to enthusiasm about q, may communicate an indirect desire for not-p
- Planned follow-up: eliminate ambivalence
  e.g., instead of having Tiger tell Rabbit that he doesn't care about the pigs, something happens to prevent Rabbit from feeding the pigs (for example, they run out of food)

Discussion: Alternatives

- Children's difficulty with scalar implicatures may have to do with accessing lexical alternatives (Chierchia et al. 2001; Reinhart 2004, 2006; Barner & Bachrach 2010; Barner et al. 2011; Zhou et al. 2013; Singh et al. 2013; Chemla & Bott 2014; Tieu et al. 2015)

- Children compute implicatures involving alternatives that are contextually or explicitly made available
- e.g., children compute more implicatures from *or* when *and* is made salient/available (Chierchia et al. 2001; Gualmini et al. 2001)

- For neg-raising inferences, we may expect to be able to improve performance by making the excluded middle alternative more salient

Discussion: Learning

- Child participants who successfully compute implicatures need access to:
  - Co-scalar status of the relevant alternatives (e.g., *some* vs. *all*; negated NR predicate vs. its excluded middle proposition)
  - Exhaustification procedure
  - Retrieval of alternatives when presented with weak scalar term (e.g., retrieval of *all* when presented with *some;* EM when presented with target sentence)

- How does the child learn to associate neg-raising predicates with an excluded middle alternative?

Conclusion

- Theorists have proposed that neg-raising interpretations can be derived as a scalar implicature
- Our results provide support for this perspective
- We find parallel differences between adults and children, for neg-raising and scalar implicatures

Acknowledgements

- We are grateful to our participants at Macquarie University.
- The research leading to these results has received funding from:
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