Polarity Sensitivity of *Even* in Early Child Grammar

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What’s the status of scalar inferences in child grammar?

English *even* provides us with a useful domain in which to investigate this question.

Even:

- Has scalar inferences derived through a presupposition
- Triggers different presuppositions depending on the environment
- Triggers presuppositions associated with a scale of likelihood.

Even

English *even* is a scalar particle, which triggers a least-likely presupposition in positive sentences, and a most-likely presupposition in negative sentences, in addition to a negative/positive existential presupposition. (K&P 1979)

1. Even JOHN came to the party.
    - John was the least-likely to come to the party.
    - There were other people that came to the party.
2. Even JOHN didn’t come to the party.
    - John was the most-likely to come to the party.
    - No one else (out of some salient context set) came to the party.

Previous Work

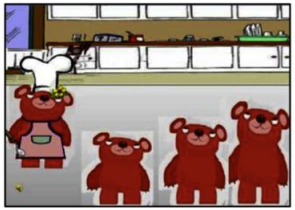
Kim 2011 tested acquisition of *even* and *only* in children following Filik et al. (2009), who found that adults process *even* more slowly than *only*

Kim's hypothesis: given that children already have a hard time with *only*, they should learn *even* even later.

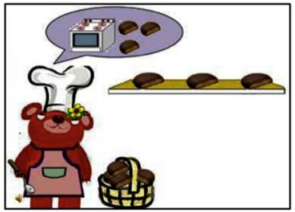
She argues her hypothesis is borne out: children don't know *even*.

Kim’s Setup

30 children, ages 4-5

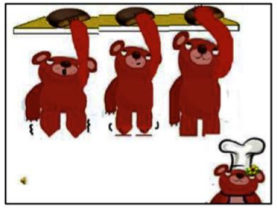


This story is about Mama Bear and her three sons. Look at the three sons. Each one has a different height. Who is the shortest one? Can you point to him? Who is the tallest one? Can you point to him?



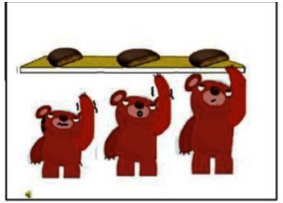
Since Mama Bear wanted to know how high her sons could reach, she put three cookies on a shelf and then asked each of them to try to reach the cookies. Mama Bear said, “I made cookies for you guys. After all of you try to reach the cookies, let’s have them together.”

Affirmative



The three bears were very excited about eating the cookies. Each bear tried to reach the cookies on the shelf and managed to do so. Mama Bear said, “**Even Larry was able to reach the cookie**.”

Negative



Each bear tried to reach the cookies on the shelf, however, none of them could reach the cookies. Mama Bear said, “**Even Larry was not able to reach the cookie.**”

Kim's Results

	affirmative pre-subject *even*				negative pre-subject *even*			
	item1	item2	item3	**total**	item1	item2	item3	**total**
Adults (n=30)	30/30	30/30	30/30	90/90 **100%**	30/30	30/30	29/30	89/90 **98.6%**
Children (n=30)	13/30	12/30	16/30	41/90 **45.6%**	17/30	14/30	11/30	42/90 **46.7%**

<Table 4.3. Mean percentage of correct responses to test sentences in both groups>

Kim's Results

Selection pattern	target characters for both sentence types	opposite characters for both sentence types	always rightmost or leftmost character
rate of responses	33.3% (30/90)	38.9% (35/90)	27.8% (25/90) (22.2% for rightmost, 5.6% for leftmost)

<Table 4.7. Rate of responses out of different types of pragmatics for test sentences in children's group>

No middle characters were chosen! This means that the rate of adult-like responses is roughly chance.

Kim concludes...

… that children basically don't know *even* at ages 4-5 (slight age effect)

Our questions:

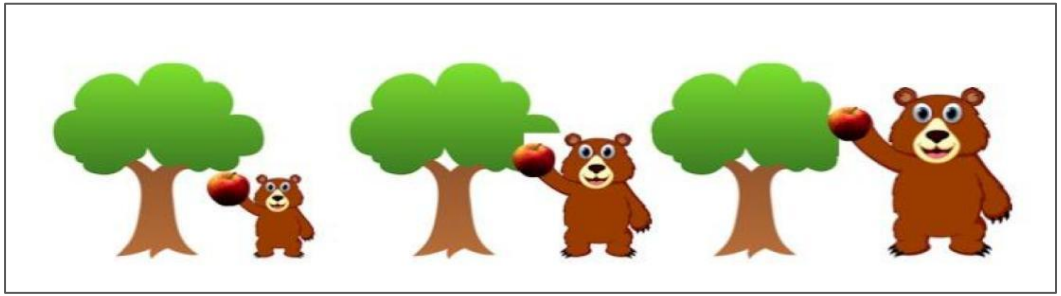
- What is the developmental trajectory for *even*?
  - Kim only looked at 4-5 year-olds.
- What reasoning do children use when evaluating *even*?
  - Kim did not systematically record children's justifications
- Why don't any children choose the middle character?
  - None of Kim's control or target items targetted the middle character.
- What if we change the scale types to pick out different characters?
  - In Kim's study, the least-likely character was always leftmost and most-likely rightmost.

Methods

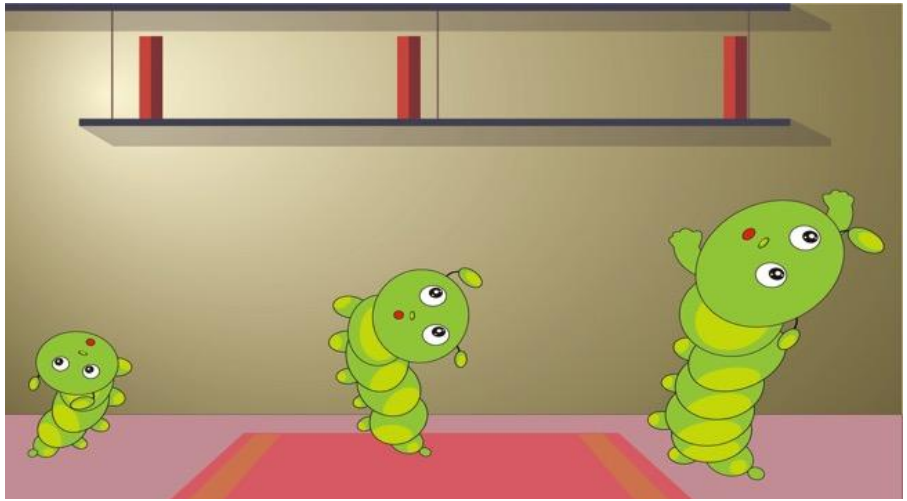
- 75 children, ages 3-6
- 4 different scales (8 total target stories with positive/negative distinction)
- 4 filler stories that target middle character
- Blocked design in two orders, negative-first or positive-first.
- Children are asked to justify their answers
- Data collected at Boston-area daycares, preschools, and at the Museum of Science

Methods

Reaching stories:



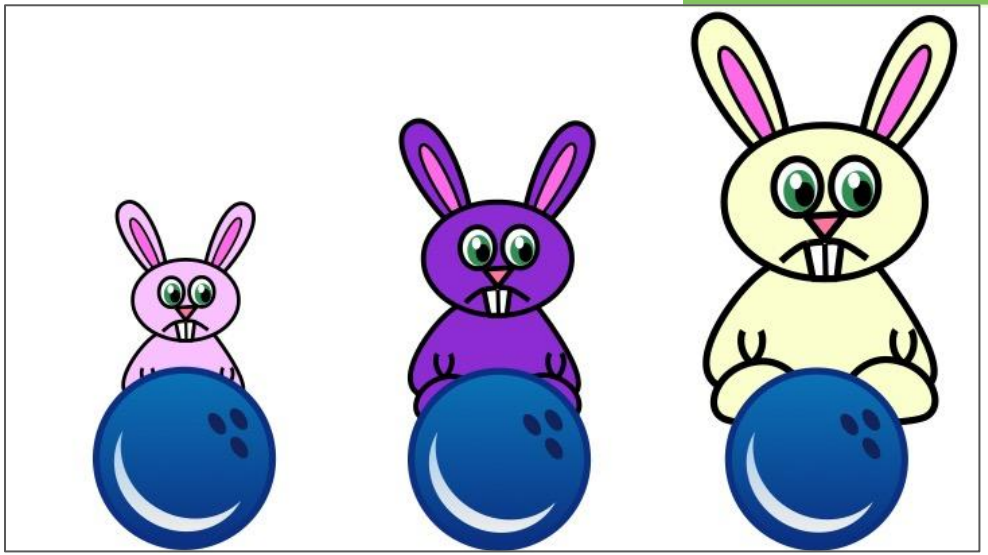
Positive: “Even Benny was able to reach an apple!”



Negative: “Even Jessiepillar wasn’t able to reach a book!”

Methods

Lifting/Weight stories:

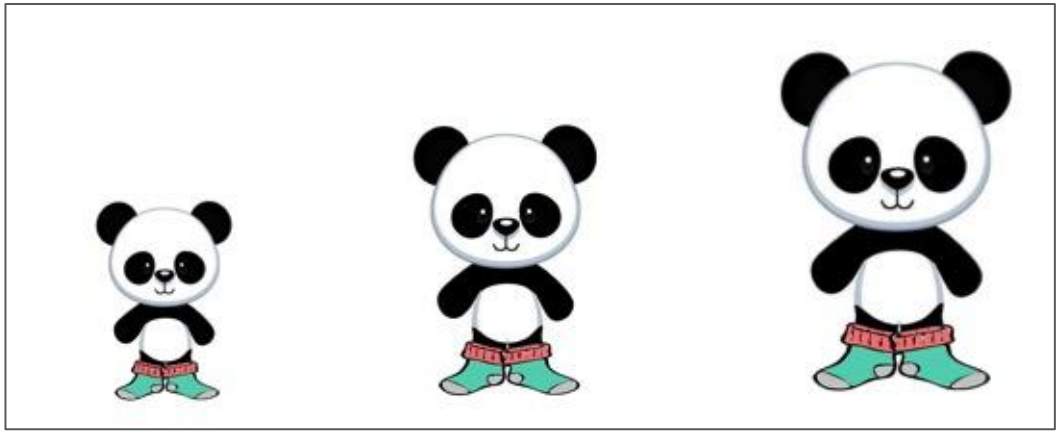


Positive: “Even Rufus was able to lift a pumpkin!”

Negative: “Even Henrietta wasn’t able to lift a bowling ball!”

Methods

Fitting stories:



Positive: “Even Frankie was able to fit into the socks!”

Negative: “Even Mary wasn’t able to fit in the hole!”

Methods

Filling/Capacity stories:

Positive: “Even Sammy was able to fill up his basket!”

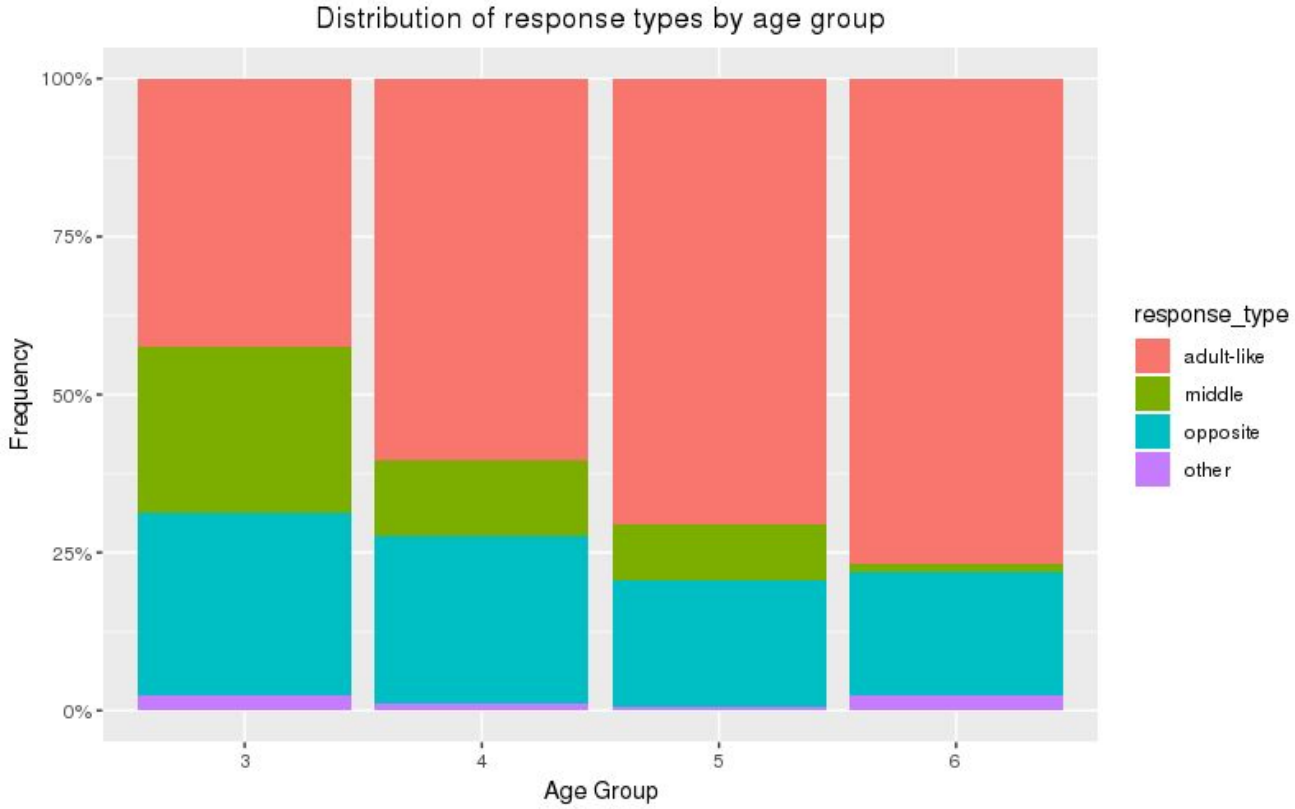
Negative: “Even Frida wasn’t able to fill her cup!”

Methods

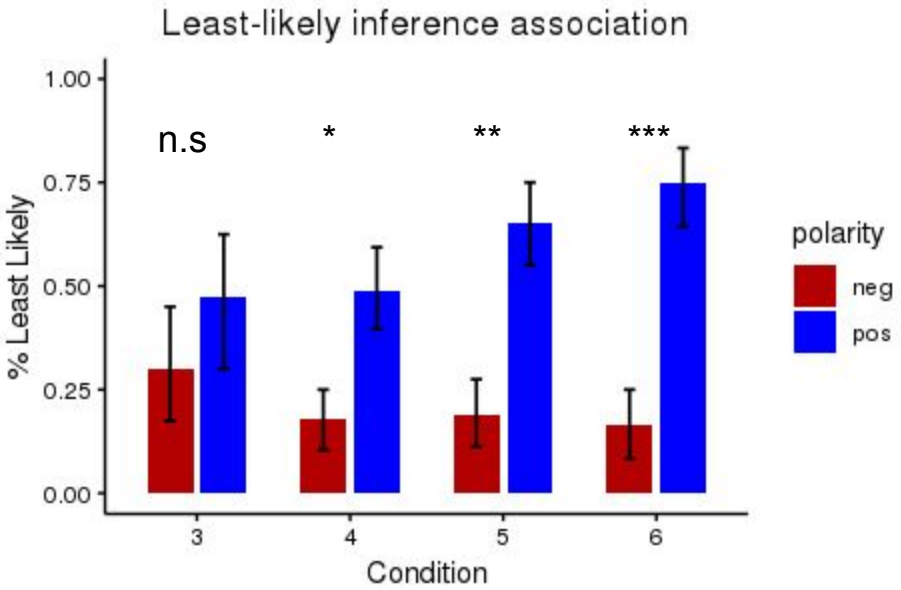
Sample filler story:

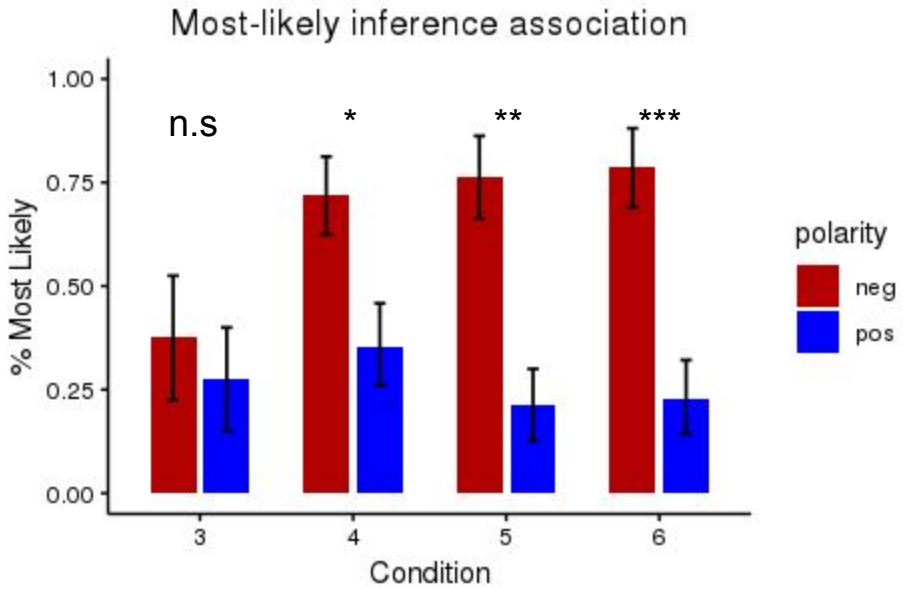
“Marcus picked the yellow chair that matched his party hat!”

Preliminary results



Preliminary results





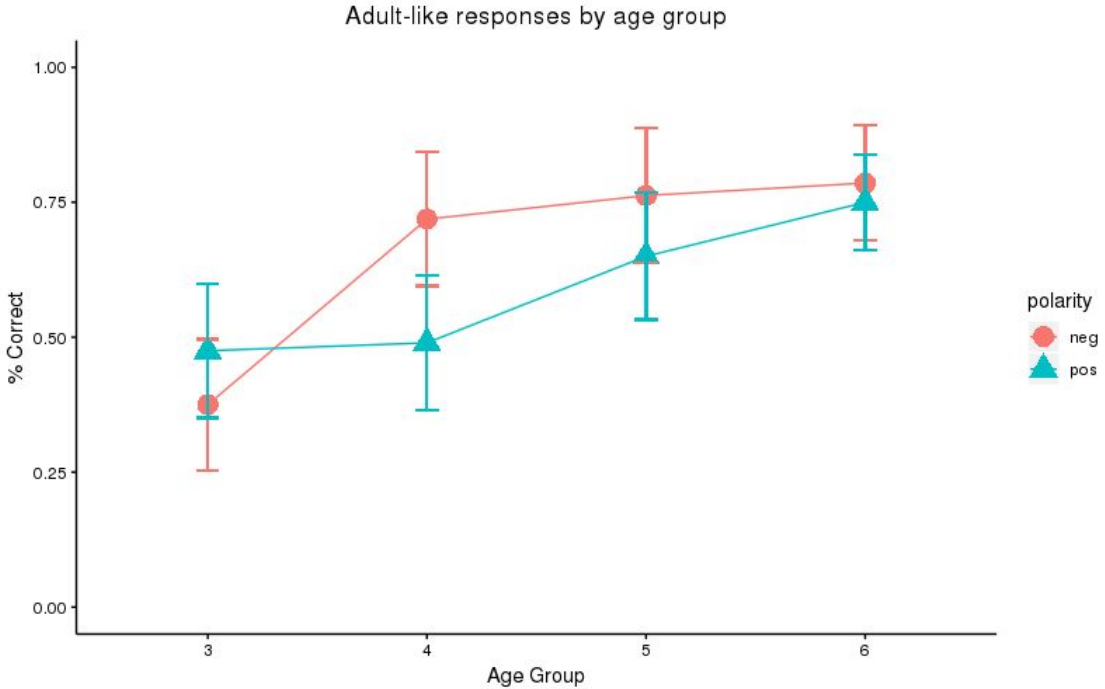
While 3 year-olds are not significantly more likely to associate a least-likely inference with a positive environment, 4-6 year olds are!

Preliminary results

Children do know something about even!

- They’re significantly more likely to give extrema responses than middle responses, suggesting that they know that even is scalar.
- 4-6 year olds are starting to associate polarity with the correct likelihood inference.

Preliminary results



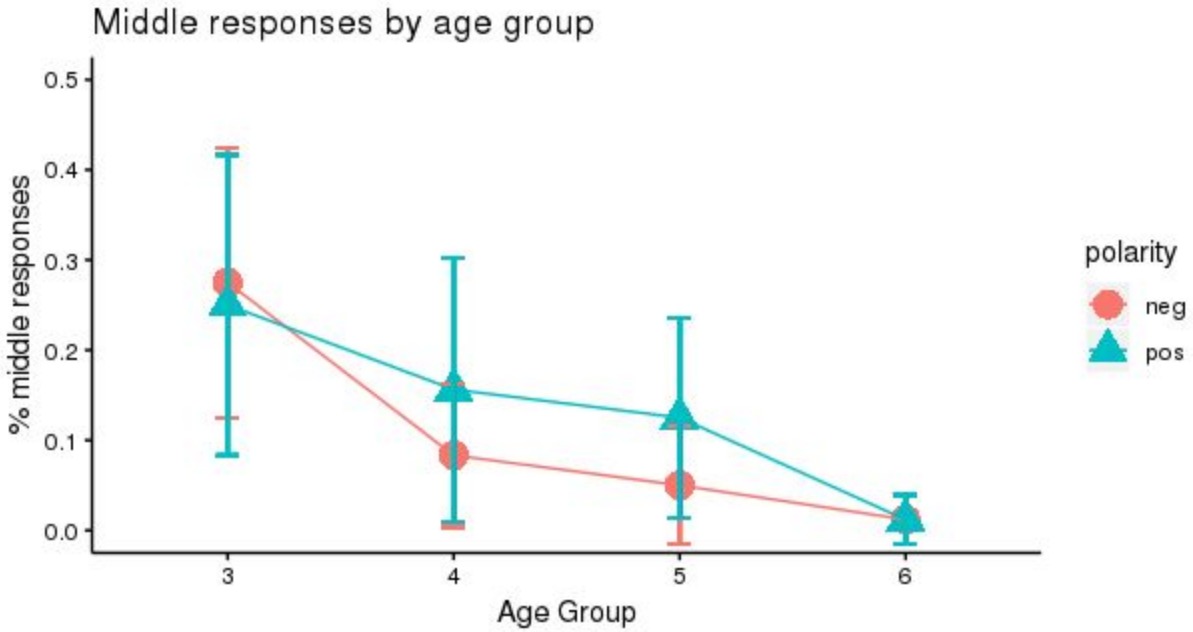
There seems to be a polarity effect in 4-year-olds - better performance on negative items than positive

Preliminary Results

- Analyzed data using a linear mixed-effects logistic regression
- Stacked binomial analysis: first middle against extrema, then extrema against one another
- Fully specified model does not converge
- A simplified analysis not taking order into account as a main effect shows a significant effect of polarity on accuracy only in 4-year-olds (p=0.008)

Fully specified model: correct ~ 1 + polarity*order + (1|item) + (1 + polarity|subject)

Results



Same polarity effect: Negative > Positive

Results

Justifications suggest that children are using scalar reasoning to understand *even!*

Justifications	*Justification Type*			
Response	none	random	scale	Grand Total
smallest 1	69	14	195	278
middle 2	45	17	15	77
largest 3	68	13	175	256
Grand Total	**182**	**44**	**385**	**611**

Results

We got middle responses! Middle responses are a measure of confusion -- the middle character is never the least-likely nor most-likely.

Justifications	*Justification Type*			
Response	none	random	scale	Grand Total
smallest 1	69	14	195	278
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Grand Total	**182**	**44**	**385**	**611**

Results

Kim claimed to find a population of ‘flippers’, that is, children who gave the opposite response as adults (biggest -> smallest, and vice versa).

- About a third of her subjects

Two of our subjects conformed with this behavior

- They gave not only answers, but justifications consistent with having a ‘flipped’ definition for only.

Discussion

We frame these results in the space of possible meanings of scalar particles, based in part on a similar framing in Giannakidou (2007):

Scalar / existential	**Positive**	**Negative**
Bottom-of-scale (Least-likely)	*even*	*even*$_{FLIPPED}$*/especially?*
Top-of-scale (Most-likely)	*even*$_{FLIPPED}$*/especially?*	*even*

English *even* populates two quadrants in this matrix: our evidence suggests that these two spaces are not ranked equally by learners… why?

Discussion

There are two properties of the presuppositions in the lower-right corner that we think are relevant:

1. Association with negative environment
2. Noteworthiness of the scalar presupposition in a negative environment

Scalar / existential	**Positive**	**Negative**
Bottom-of-scale (Least-likely)	*even*	*even*$_{FLIPPED}$*/especially?*
Top-of-scale (Most-likely)	*even*$_{FLIPPED}$*/especially?*	*even*

NPIs

Tieu 2010 shows a similar asymmetry in production between NPI and Free Choice *any* -- there is a statistically significant difference between the onset of NPI *any* and FC *any.*

Grammatical Conservatism (Snyder 2007): Children wait until they have clear evidence of the grammatical parameters of a construction to produce it.

NPI environments often have clear indicators (e.g. *not*, *if…*)

Theories of *even*

An ongoing debate in the semantics literature concerns the nature of English *even,* given the ambiguity we just saw.

Ambiguity theory (Rooth 1985): *even* is actually two lexical items, $even_{POS}$ and $even_{NPI}$.

Single even story (K&P 1979) :There's a single *even*, which moves covertly outside of negative and other downward-entailing contexts to be interpreted.

Conclusion

- Children have an understanding of *even*'s scalar properties!
- Three stages of development:
  - 3yo - no clear understanding
  - 4yo - polarity sensitive understanding (NEG > POS)
  - 5-6yo - *even* in POS environments catches up
- We argue this polarity sensitivity can be understood as a result of the identifiability of *even* in negative environments
- " Flipped responses" - they do exist! About 20% of responses across age-groups
- "Flippers" - What do they say about children's scalar meaning spaces?

Thank you!

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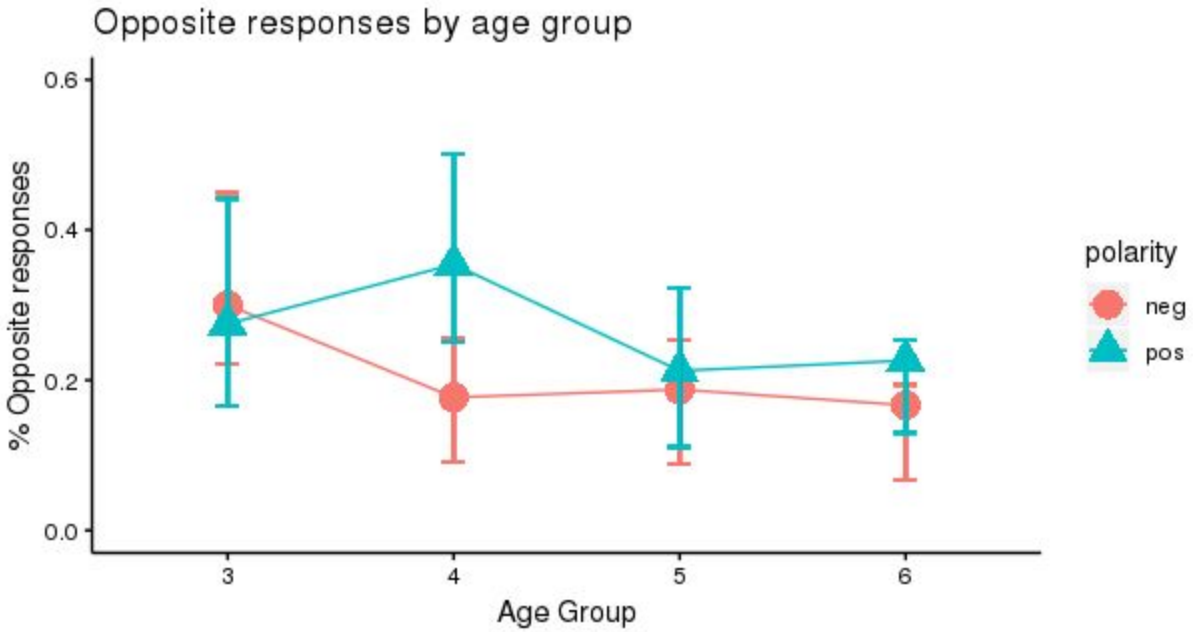
Opposite responses by age group
% Opposite responses
0.6
0.4
0.2
0.0
3
4
5
6
Age Group
polarity
neg
pos

AVERAGE of correct		age_group				
polarity	*story*	3	4	5	6	Grand Total
neg	capacity	20.00%	37.50%	70.00%	45.00%	45.95%
	fit	33.33%	78.26%	85.00%	89.47%	77.46%
	reach	44.44%	87.50%	80.00%	95.24%	82.43%
	weight	60.00%	91.30%	70.00%	95.24%	82.43%
neg Total		39.47%	73.40%	76.25%	81.48%	72.01%
pos	capacity	30.00%	25.00%	31.58%	40.00%	31.51%
	fit	60.00%	33.33%	70.00%	80.95%	60.00%
	reach	40.00%	66.67%	70.00%	85.71%	69.33%
	weight	60.00%	70.83%	90.00%	95.24%	81.33%
pos Total		47.50%	48.96%	65.82%	75.90%	60.74%

Adult study

- Norming study on 60 adults with stimuli from the child experiment, done on Mechanical Turk
- Adults performed at >80% accuracy
- No statistically significant difference between positive and negative environments in either accuracy or reaction times.

Conclusion: it seems that the previously observed polarity effect is an acquisition phenomenon, not a feature of the adult system

Sample justifications

Scalar:

“Because it’s rare that a tiny thing can lift a big thing” “teeny one” “littlest basket”

“Because it’s the biggest” “small mouses can usually fit”

“Because he was able to even though it was heavy”

Random:

“Look at the pink bunny!” “because I just knew it” “he’s the brownest”

“He’s two [years old]” “she looks like Sammy”

“That one has a little bow”