

# On the acquisition of *either* and *too*

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How do children learn about pairs of items that are in complementary distribution?

- e.g., polarity items (NPIs and PPIs)
- Today's talk: *either* and *too*

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*Either* and *too* are

- focus-sensitive
- presuppositional (additive)
- polarity sensitive

## Meet *either* and *too*

- (1) a. Sam is eating cake. Sam is eating ice cream **too**/**\*either**.  
b. Sam isn't eating cake. Sam isn't eating ice cream **either**/**\*?too**.
- (2) a. Someone sneezed. Someone coughed **too**/**\*either**.  
b. Noone sneezed. No one coughed **either**/**\*?too**.
- (3) a. Anna left. If Mary left **too**/**\*either**, the room is empty.  
b. Anna didn't leave. If Mary left **too**/**\*either**, the room is empty.
- NB: We will return to the status of *too* in negative sentences.

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What do children know about the competition between *either* and *too*?



## Child experiment: Design

Comparative felicity judgment task (Chierchia et al. 2001, Foppolo et al. 2012):

- Materials:
  - 8 target items (4 positive, 4 negative)
  - 4 filler items (2 positive, 2 negative), seen by all participants
- Participants:
  - 57 children aged 3-7, recruited at Boston daycares and the Museum of Science; of these, 47 L1 English acquirers completed the task.
    - 9 3-year-olds, 14 4-year-olds, 15 5-year-olds, 8 6-year-olds, 1 7-year-old (not included in data analysis)

## Child experiment: Design



Narrator: This is Max.





Narrator: Max is hugging a cat.

Puppet 1: Max is hugging a dog, too.

Puppet 2: Max is hugging a dog, either.

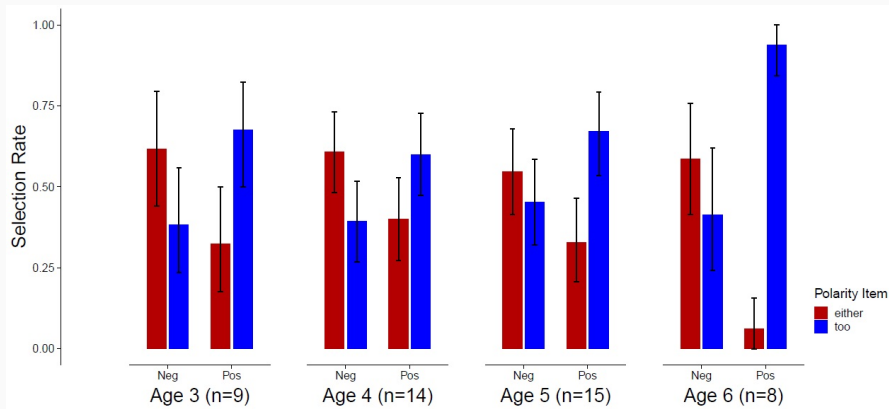
**Figure 1:** A positive target item

## Child experiment: Design

 <p data-bbox="64 586 144 607">⏪ ⏩ ⏴ ⏵</p>	 <p data-bbox="687 586 768 607">⏪ ⏩ ⏴ ⏵</p>
<p data-bbox="97 627 326 648">Narrator: This is Sam.</p>	<p data-bbox="724 627 1050 648">Narrator: Sam isn't eating cake.</p> <p data-bbox="724 658 1141 679">Puppet 1: Sam isn't eating ice cream too.</p> <p data-bbox="724 689 1166 710">Puppet 2: Sam isn't eating ice cream either.</p>

**Figure 2:** A negative target item

# Child experiment: Results



**Figure 3:** Mean rate of *either/too* selection, by polarity environment and age

## Child experiment: Results

Linear mixed effects logit model of responses constructed in R using package lme4 (Bates et al. 2015) with fixed effects of polarity (*pos/neg*) and age (3-5/6 y.o.) shows:

- Main effects: polarity and age
  - Polarity: Children are more likely to select *either* in negative sentences than in positive sentences ( $\text{Pr}(> |z|) = 0.000171$  \*\*\*).
  - Age: 6-year-olds less likely to select *either* overall ( $\text{Pr}(> |z|) = 0.009378$  \*\*). They effectively stop accepting *either* in positive sentences.
- Interaction: polarity\*age ( $\text{Pr}(> |z|) = 0.036657$  \*)
  - Contribution of interaction confirmed with a likelihood ratio test ( $p < 0.05$ ).

## Child experiment: Summary

Take-home message:

- Children aged 3-5 accept both polarity items in both environments.
- Children aged 3-5 trend toward the adult grammar but do not gradually converge on categorical judgements.
- 6-year-olds abruptly learn to reject *either* in positive sentences (but continue to accept both items in negative sentences).

## Child experiment: Discussion

Have 6-year-olds mastered the adult grammar?

(4) Sam isn't eating cake. Sam isn't eating ice cream **\*?too**.

- A parse where *too* takes scope over negation could be available.



PPI anti-licensed



PPI licensed!

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Do adults accept both *too* and *either* in negative sentences (with a preference for the NPI)?

MTurk felicity rating task (7-point Likert scale):

- Materials:
  - 32 target items (16 positive, 16 negative), Latin squared.
  - 40 filler items (20 positive, 20 negative), viewed by all participants.
    - Participants who did not rate at least 6 of 8 benchmarking fillers correctly were excluded.
- Participants:
  - 51 L1 U.S. English-speaking adults.
    - 6 excluded, leaving data from 45 participants.

# Adult control: Design



Eric is watering a blue flower.



Eric is watering a yellow flower, either.


Extremely unnatural        Perfectly natural

*Given the picture, how natural is this sentence as a description? Use keys or click boxes to answer.*


The figure shows two panels. The left panel features a cartoon boy with red hair, wearing a light blue shirt and dark shorts, holding two grey watering cans. He is watering a yellow flower on the left and a blue flower on the right. A green pine tree is on the far right. Below the illustration is the sentence "Eric is watering a blue flower." The right panel features the same illustration. Below it is the sentence "Eric is watering a yellow flower, either." At the bottom of the right panel is a scale from "Extremely unnatural" to "Perfectly natural" with seven numbered boxes (1-7) for input. Below the scale is the instruction: "Given the picture, how natural is this sentence as a description? Use keys or click boxes to answer."

**Figure 4:** A positive target item

# Adult control: Design



Taylor isn't playing with a car.



Taylor isn't playing with a train, too.

Extremely unnatural

1	2	3	4	5	6	7
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Perfectly natural

*Given the picture, how natural is this sentence as a description? Use keys or click boxes to answer.*

**Figure 5:** A negative target item

# Adult control: Results

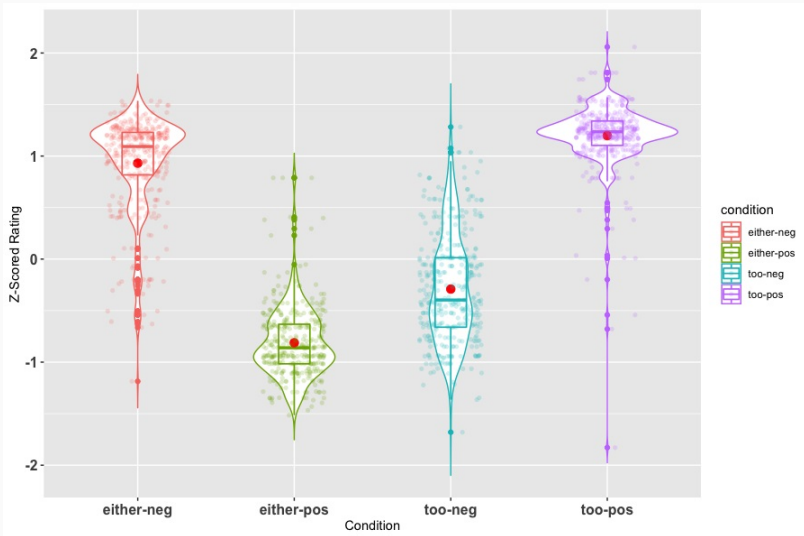


Figure 6: Z-scores of ratings

### Statistics:

- Maximally-specified convergent linear mixed effects model of z-scored ratings constructed in R using package lme4 (Bates et al. 2015), with fixed effects of polarity (*pos/neg*) and polarity-item (*either/too*), reveals a significant polarity by polarity-item interaction ( $p < 0.001$  \*\*\*).
  - *Either* is judged more acceptable in negative than in positive sentences; the opposite is true for *too* ( $t = 76.00$ ).
- *Too*-neg appears to cluster with *either*-pos.

Our take:

- Adults exhibit more or less categorical behaviour in our task.
- Between ages 5 and 6, it appears that children learn only half of the adult system.

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- Do children hear *either* more than *too*?
- Is the evidence available to children about NPI licensing clearer than the evidence about PPI licensing?

### Procedure:

- Custom R scripts extracted every instance of additive *either* and *too* from CHILDES corpora of typically-developing children spoken by: Mother, Father, Sister, Brother, Aunt, Uncle, Grandmother, Grandfather, Family Friend, Teacher, Adult.
- Each token was coded for polarity of environment.

## Corpus study: Child-directed adult speech

Polarity item	Total	Positive	Negative	Unclear
<i>Either</i>	701	28 (3.99%)	670 (95.58%)	3 (0.43%)
<i>Too</i>	7896	7782 (98.56%)	103 (1.30%)	11 (0.14%)

- 23 of the 28 positive *either* tokens were sentences like *Me either!*, uttered in response to a negative antecedent.
- 42 of the negative *too* tokens were sentences like *Don't I get some too?*, following a positive antecedent.

Take-home message:

- The input is overwhelmingly categorical.
- Children encounter very little potentially confusing evidence.

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Procedure:

- Same as above, except extracted tokens spoken by target child.

Polarity item	Total	Positive	Negative	Unclear
<i>Either</i>	242	22 (9.09%)	210 (86.78%)	10 (4.13%)
<i>Too</i>	5059	5007 (89.95%)	42 (0.83%)	10 (0.20%)

- 18 of 22 positive *either* tokens were sentences like *Me either!*, uttered in response to a negative antecedent.

## Corpus study: Child speech

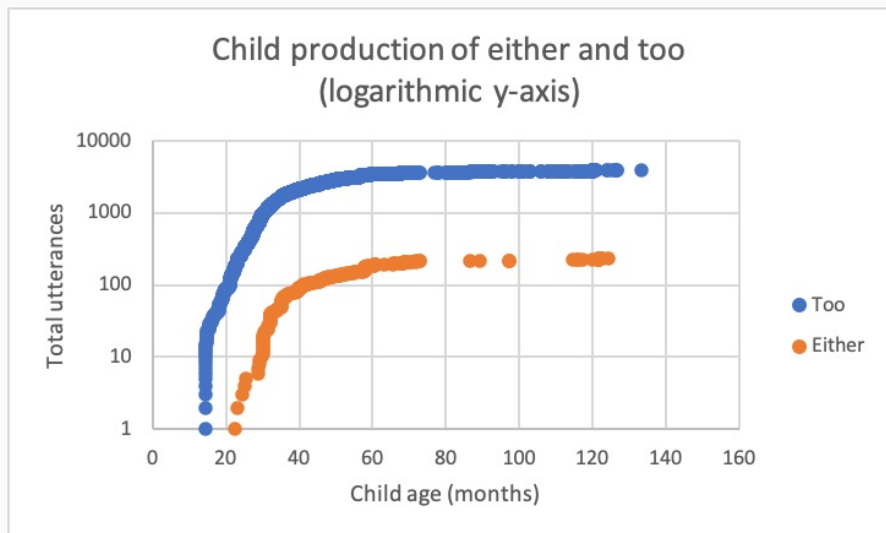


Figure 7: Children's cumulative productions of *either* and *too*



Take-home message:

- Children's production, like the input, is categorical.
- The growth curve in production has the same shape for both items.

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Several surprising findings:

- Comprehension lags behind production.
- Comprehension exhibits non-categorical trending in the direction of the adult grammar between ages 3 and 5.
  - This trending remains stable in the face of accumulating evidence.
- Comprehension of NPI *either* becomes adult-like at age 6 without corresponding mastery of PPI *too*.

How can we explain this learning trajectory?

Comprehension-production asymmetry:

- Usually goes in the opposite direction!
- Not obviously amenable to stories that have been told about other cases with this profile (see, e.g., ?).

Non-categorical trending behaviour in comprehension:

- What grammar produces it?
- The trending cannot be due to differences in informativity (see Foppolo et al. 2012).
  - Structural complexity might be an alternative.

The stability and the sudden change:

- Why does it appear to be insensitive to the accumulation of evidence?
  - What changes at age 6?
- ⇒ This may represent another case for an argument from the Abundance of the Stimulus for encapsulated learning (cf. Babyonyshev et al. 2001).

A preliminary sketch:

- The meanings of *either* and *too* must both be compatible with both environments.
  - E.g., Ahn's (2015) approach

Towards an analysis:

- Assume a modification of Ahn's (2015) analysis of *either/too*.
  - Instead of Chierchia's O/E operators, use *exh* and covert EVEN to deal with alternatives.

$$(7) \llbracket \text{either} \rrbracket(q)(p) = \lambda w: q \in \text{ALT}(p). q(w) \vee p(w)$$

$$(8) \llbracket \text{too} \rrbracket(q)(p) = \lambda w: q \in \text{ALT}(p). q(w) \wedge p(w)$$



Toward an analysis:

- Assume that children are adult-like in their use of *exh* (Chierchia et al. 2001).
  - *Exh* is restricted to environments where it leads to strengthening.

Toward an analysis:

- Assume that children aged 3-5 cannot access the lexicon when building alternatives but 6-year-olds can (Tieu et al. 2016).
  - Before age 6, (some) children strengthen disjunction to a conjunctive meaning (Singh et al. 2013).

(9) 5-year-old grammar

- a.  $ALT(p \vee q) = \{p \vee q, p, q\}$
- b.  $exh\ exh\ (p \vee q) = (p \vee q) \wedge \neg exh(p) \wedge \neg exh(q) = (p \wedge q)$

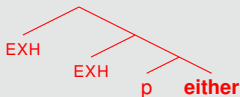
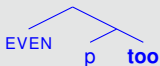
(10) 6-year-old grammar

- a.  $ALT(p \vee q) = \{p \vee q, p, q, p \wedge q\}$
- b.  $exh\ (p \vee q) = (p \vee q) \wedge \neg(p \wedge q)$  scalar implicature

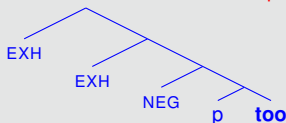
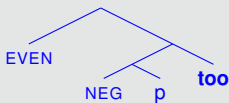
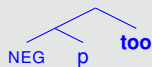
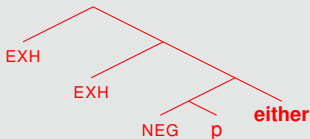
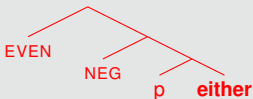
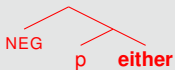
# Discussion

Acceptable, appropriate structures on hypothetical grammar for 3-5-year-olds:

## Positive sentences



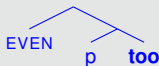
## Negative sentences



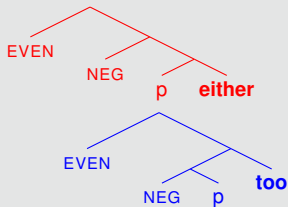
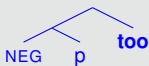
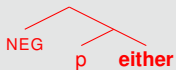
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Acceptable, appropriate structures on hypothetical grammar for 6-year-olds:

## Positive sentences



## Negative sentences



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We have seen that:

- Children aged 3-5 accept both items in both environments but trend in the direction of the adult grammar.
- 6-year-olds appear to master one item (*either*) before the other (*too*).
- Production is ahead of comprehension.

## Conclusion

- We need a theory of *either* and *too* that allows them to express the same meaning for children aged 3-5.
- We need a learning theory that predicts some sensitivity to environment without making use of evidence accumulation over an extended period of time **and** allows for an abrupt change of the grammatical system in one half of the paradigm but not the other.

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