Bootstrapping universal quantifiers: the role of genericity

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Why care about *each* and *every*?

Both can be used to label the same situations in the world

+ But both differ semantically in subtle ways

+ Learners are sensitive to these differences early

= **Acquisition Q:** what evidence do learners use to infer their meanings?
3 differences between *each* and *every*

Do they show up in parents’ speech?

What are the targets of learning?

*each*/every* are similar

Both are universal quantifiers

\[
\begin{align*}
\{ & each \} & \text{student is sleepy} \\
\{ & every \} & \text{are similar}
\end{align*}
\]

Both are bad with collective predicates (Vendler 1962; Dowty 1987; Gil 1995; Beghelli & Stowell 1997; Tunstall 1998; Winter 2002; Champollion 2017; ao.)

*each* student \{gathered/surrounded the teacher/is similar\}

?every student \{gathered/surrounded the teacher/is similar\}

all students \{gathered/surrounded the teacher/are similar\}
each/every are similar, but differ in important ways

**Ability to offer pair-list responses** (Williams 1986; Beghelli 1997; Szabolcsi 2010; 2015)

Which book did you give to \{each\} student?

![Images of books]

P-L: ✔️
P-L: ✗

---

Determine whether \{each\} student has a copy of Aspects

- “student₁ does; student₂ doesn’t; student₃ doesn’t”
- “no, only one of them does”
each/every are similar, but differ in important ways

Ability to offer pair-list responses (Williams 1986; Beghelli 1997; Szabolcsi 2010; 2015)

Compatibility with “generic” generalizations (Beghelli & Stowell 1997)

After a lifetime of investigation, Suzie came to a striking discovery:

\[
\begin{align*}
\text{Each} & \quad \text{language has over 20 color words} \\
\text{Every} & \quad \text{language has over 20 color words}
\end{align*}
\]

Suzie just discovered 4 new languages and interestingly,

\[
\begin{align*}
\text{Each} & \quad \text{language has over 20 color words} \\
\#\text{Every} & \quad \text{language has over 20 color words}
\end{align*}
\]

Gravity acts on every object

Every species of spider has eight legs

#Gravity acts on each object

#Each species of spider has eight legs

Sounds like contingent fact!
**Propensity for triggering group-representations** (e.g., Knowlton et al. BUCLD 2018)

Is {\textit{each}} \{\textit{every}\} circle blue?

- Adults & (3+ year old) children show better memory for group properties (#, center of mass) following \textit{every}
- Different ways of representing domain (\textit{individuals} / \textit{group})

3 differences between \textit{each} and \textit{every}

<table>
<thead>
<tr>
<th></th>
<th>\textit{each}</th>
<th>\textit{every}</th>
<th>Semantic difference to be learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair-list responses</td>
<td>✔</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td>“Generic” interpretations</td>
<td>✗</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Group-representation</td>
<td>✗</td>
<td>✔</td>
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Do they show up in parents’ speech?

What are the targets of learning?
What data might be available?

Pair-list responses
✔️ each ✗ every

Generic interpretations
✗ each ✔️ every

Group-representation
✗ each ✔️ every

In CHILDES NA English (over 1.7 million utterances):
WH-question & each: 11
With possible PL-responses: 1

Dad: What do you think each animal is about to do?

Child (3;04): Clean up that mess
What data might be available?

Pair-list responses
✔ each ✗ every

Generic interpretations
✗ each ✔ every

Group-representation
✗ each ✔ every

Center: (x,y)  Cardinality: 4  Shape:

Every circle is green

We gave each of your teddy bears some tea

Good for expressing accidental facts about a local domain vs. non-accidental generalizations

Every time we have a tea party, you spill!
Distributional footprints the generic asymmetry

Predicted low-level differences

Quantifying over individuals or times

Being in past or present tense

Being an argument or topic-setting expression

We gave each of your teddy bears some tea

Good for expressing accidental facts about a local domain vs. non-accidental generalizations

Every time we have a tea party, you spill!

each and every in child-directed speech

Sample: All corpora in the North American English portion of CHILDES (that had typically-developing children under 8 years old)

\[ 1,706,381 \text{ child-directed utterances} \]

<table>
<thead>
<tr>
<th></th>
<th>Each</th>
<th>Every</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>538 (0.0315%)</td>
<td>728 (0.0427%)</td>
<td>20,558 (1.2048%)</td>
</tr>
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Prorated, assuming 0.9 – 2.5 million utterances/year (Hart & Risley 1995; 2003)

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<tr>
<td>Range</td>
<td>284 – 788</td>
<td>384 – 1,067</td>
<td>10,843 – 30,119</td>
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</table>
Parents use *each* to talk about individuals in a local domain and *every* to express non-accidental generalizations (about situations).

➡️ Prediction: individuals for *each*; times for *every*
Is there a relative clause modifying the QP?

![Bar chart showing responses to questions about "each" and "every" in sentences like "We'll put one finger on each thing we count" and "You turn into a wild man every time we get out".]

What's being quantified over?

Parents use *each* to talk about individuals in a local domain and *every* to express non-accidental generalizations. ➤ Quantify over *individuals* vs. *times*
What’s the tense of the QP’s clause?

Parents use *each* to talk about individuals in a local domain and *every* to express non-accidental generalizations

- Quantify over individuals vs. times

- **Prediction:** present tense preference for *every*
  
  Every dog barked ⇐ no “generic” interpretation
  
  Every dog barks ⇐ easy to get “generic” reading

![Graph showing the tense preferences for *each* and *every*]

“Put sugar in each coffee”

“Every time I see ya, ya got something in your mouth”

<table>
<thead>
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<th>Tense</th>
<th>Each</th>
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<tr>
<td>Present</td>
<td>288</td>
<td>536</td>
</tr>
<tr>
<td>Future</td>
<td>117</td>
<td>51</td>
</tr>
<tr>
<td>Unknown</td>
<td>102</td>
<td>91</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Past</td>
<td>0</td>
<td>0</td>
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What’s the tense of the QP’s clause?

Parents use *each* to talk about individuals in a local domain and *every* to express non-accidental generalizations

- Quantify over individuals vs. times
- Being an imperative or in past tense vs. in present tense

Is the QP and argument or an adjunct?

Parents use *each* to talk about individuals in a local domain and *every* to express non-accidental generalizations

- Quantify over individuals vs. times
- Being an imperative or in past tense vs. in present tense
- Prediction: *each QP* appears as an argument
  
  *every QP* appears as topic-setting adjunct
Is the QP and argument or an adjunct?

Parents use *each* to talk about individuals in a local domain and *every* to express non-accidental generalizations:

- Quantify over individuals vs. times
- Being an imperative or in past tense vs. in present tense
- Use a QP as an argument vs. topic-setting expression
Genericity signals the difference (in principle)

Parents use *each* to talk about individuals in a local domain and *every* to express non-accidental generalizations

- Quantify over *individuals* vs. *times*
- Being an imperative or in past tense vs. in present tense
- Use a QP as an argument vs. topic-setting expression

3 differences between *each* and *every*

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Semantic difference to be learned

Do they show up in parents’ speech?

- *individuals* vs. *times*
- *past tense* vs. *present tense*
- *argument* vs. *topic-setting expression*

What are the targets of learning?
What’s the target of learning? (Knowlton, Pietroski, Halberda, & Lidz under review)

“Each/Every N is P”

First-order concept
\[ \forall x: N(x) \ [P(x)] \]

Parallel individuation
(e.g., Feigenson, Carey, & Spelke 2002)

- Multiple distinct entities represented simultaneously
- Doesn’t support generalization; properties shared are accidental

Second-order concept
\[ \exists X: \forall x [X(x) \iff N(x)] \ [P(X)] \]

Ensemble representation
(e.g., Ariely 2001; Whitney & Leib 2018)

- Vague membership boundary
- Exceptions tolerated
- Individuals represented in terms of summary statistics

Well-suited for non-accidental generalizations!

A sketch of a learning story

Different representations & supporting cognitive systems

Each: first-order concept / parallel individuation

Every: second-order concept / ensemble representation

Different uses & intended messages

Each: local, contingent claims about individuals

Every: broad, non-accidental generalizations

Different distributional footprints

Each: quantify over individuals, be an argument, etc.

Every: quantify over times, be a topic-setting adjunct, etc.
Thanks!

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