Acquiring the Universal Quantifiers:
*every* part together or *each* part on its own?

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Roadmap

- Multiple universal quantifiers; subtle meaning differences
  - Mandatory distributivity of *each*

(1) The preacher looked at each/every/all member(s) of his flock
Roadmap

• Multiple universal quantifiers; subtle meaning differences
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• Is acquisition sequential or simultaneous?

• New approach – implicit measure
  • Proof of concept: More vs. Most
  • Each vs. Every
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Distributivity and *Each /* Every /* All*

(2) a. Each boy sang happy birthday (well as a solo piece / # in perfect harmony)

b. Every boy sang happy birthday (well as a solo piece / in perfect harmony)

c. All the boys sang happy birthday (well as a solo piece / in perfect harmony)
Distributivity and *Each / Every / All*

(2) a. Each boy sang happy birthday (well as a solo piece / # in perfect harmony)
   b. Every boy sang happy birthday (well as a solo piece / in perfect harmony)
   c. All the boys sang happy birthday (well as a solo piece / in perfect harmony)

(3) a. *Each (of the) student(s) gathered
   b. ?Every student gathered
   c. All (of the) students gathered

(4) a. *Each (of the) soldier(s) surrounded the fortress
   b. ?Every soldier surrounded the fortress
   c. All (of the) soldiers surrounded the fortress

(5) It took {*each/every/all the} boy(s) to lift the piano
Distributivity and *Each / Every / All*

(5) It took {*each/every/all the} boy(s) to lift the piano

(6) Ask someone whether each dragon is dangerous

(7) Ask someone whether every dragon is dangerous
Distributivity and *Each / Every / All*

(5) It took {*each/every/all the} boy(s) to lift the piano

(6) Ask someone whether *each* dragon is dangerous

(7) Ask someone whether *every* dragon is dangerous *✗*

→ *Each* is mandatorily distributive

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Acquiring (the distributivity of) *each*

- **TVJT / Picture-selection / Picture-Evaluation**
  

- **Brooks & Braine 1996**
  
  - 4- & 5-yos (unlike adults) give collective interpretations to *each*-statements
  - Even 7-yos offer non-adult like interpretations ~25% of the time
Acquiring (the distributivity of) *each*

- *Each* is acquired in 2 parts:
  - **Universal** component
  - **Distributive** component

- Brooks & Braine 1996
  - 4- & 5-yos (unlike adults) give collective interpretations to *each*-statements
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Acquiring (the distributivity of) *each*

- Syrett & Musolino 2013 point out
  - Relative salience of collective pictures
  - Potential preference for singular interpretation of indefinite
  - Potential bleeding across item types
  - Testing preference, not availability
Acquiring (the distributivity of) *each*

- Syrett & Musolino 2013
  “Two boys each pushed a car”

- 3- & 4-yos can access distributive interpretations...
  • ...but still allow collective interpretations given adverbial *each*
Acquiring (the distributivity of) *each*

- Is *each*’s meaning learned in two parts?
  - Universal then distributive (e.g., Brooks & Braine, 1996)

- Or are learners sensitive to this property as soon as they know what *each* means?
  - Underlying competence is masked in prior work

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Implicit evidence

• Obvious TRUE/FALSE question

\[ \forall x: \text{Circle}(x)[\text{Blue}(x)] \]

\[ \text{CIRCLE} \subseteq \text{BLUE} \]
Implicit evidence

• Obvious TRUE/FALSE question
• Measure how the meaning changes what information participants represent

Each/Every circle is blue

∀x:Circle(x)[Blue(x)]

CIRCLE ⊆ BLUE

Good estimate of summary statistics (number, avg. size, center of mass, …)

Ariely 2001; Cohng & Treisman 2003; Feigenson et al. 2004; Burr & Ross 2008; Alvarez 2011; ao
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More, Most, & memory

“Did the {blue/yellow} team paint {more/most} of the dots?”

“Where was the middle of the {blue/yellow} dots?”

More: compare blue & yellow
Most: compare blue & total

Pietroski et al. 2009
Lidz et al. 2011
Tomaszewicz 2011
Wong et al. in perp

Adult work on English, Polish, & Cantonese
More, Most, & memory

More: compare blue & yellow
Most: compare blue & total

“Did the {blue/yellow} team paint {more/most} of the dots?”

“Where was the middle of the {blue/yellow} dots?”

Representing a group

Good estimate of summary statistics
(number, avg. size, center of mass, ...)
Ariely 2001; Cohg & Treisman 2003; Feigenson et al. 2004; Burr & Ross 2008; Alvarez 2011; ao

Did the blue team paint {more/most} of the dots?
Touch the center of the blue dots

→ Participants encode the focused set given either quantifier

More, Most, & memory

Distance from tap to actual set center

n=213, Ages: 3;11 – 8;3; Mean: 6;6

Most
More

focus (e.g. blue) non-focus (e.g. yellow)
More, Most, & memory

Distance from tap to actual set center

n=213, Ages: 3;11 – 8;3; Mean: 6;6

Did the blue team paint (more/most) of the dots?

Touch the center of the yellow dots

→ Only participants evaluating more-statements encoded the non-focused set!

More non-focus
More, Most, & memory

Distance from tap to actual set center

n=213, Ages: 3;11 – 8;3; Mean: 6;6

Most

More error
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Each vs. Every

“Is (each/every) circle blue?”

“Where was the middle of the circles?”
**Each vs. Every**

*Every*: consider circles as group  
*Each*: consider individual circles

“Is {each/every} circle blue?”

“Where was the middle of the circles?”

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Each vs. Every

Distance from tap to actual set center

Is {each/every} circle blue?

Touch the center of the circles

→ Participants encoded the set circles better following every-statements

n=76, Ages: 3;2 – 7;11; Mean: 6;0
Everything
Each vs. Every

Distance from tap to actual set center

n=76, Ages: 3;2 – 7;11; Mean: 6;0

Each vs. Every
Each vs. Every

- Sequential hypothesis predicts effect of age; contra the simultaneous hypothesis
- We find no age effect
  - As soon as participants know each, they use an individual-based strategy
  - Ditto for every and a group-based strategy

Conclusions

- Methodological: Information gathered during verification reflects subtle meaning differences
  - Even when that information is incidental to the T/F judgement
Conclusions

• **Methodological**: Information gathered during verification reflects subtle meaning differences
  • Even when that information is incidental to the T/F judgement

• **Empirical**: Learners are sensitive to the distributivity of *each* as soon as they acquire the word

• **Theoretical**: How do learners acquire this distinction?
  • For next year!
Thanks!

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Valentine Hacquard
Ellen Lau
Tara Mease
Zoe Ovans
Laurel Perkins
Mina Hirzel
Alex Silver
Allison Rhodes
Rebekah Senderling
Bekki Kline
Rosetta Previti
UMD Project on Children’s Language Learning