Inferential Cues for Determining Alternatives: a Visual World Eye-tracking Study

Christina Kim, Christine Gunlogson, Michael Tanenhaus & Jeffrey Runner
University of Rochester

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2 types of ‘online’ measures

Complexity/difficulty-based paradigms (self-paced reading, eye-tracking in reading)

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\text{Behavioral measure of processing difficulty (e.g. reading time)} = \text{structural/linguistic complexity}
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Expectation-based paradigms (Visual World eye-tracking, ERP)

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Expectation-based paradigms (Visual World eye-tracking, ERP)

\[ \text{Behavioral measure (e.g. eye-gaze)} = \text{expectations about how the input will unfold} \]
Only Matt got a perfect score.
(students in some class; some exam or homework)

Katie only has a bike.
(ways of getting to work)

Natalie only met Lucy.
(Bobby’s ex-gfs)
Quantiﬁer domain restriction and gel-ﬁlled bras

As Mark Liberman noted, security expert Bruce Schneier had some fun with this line from the Transportation Security Administration’s byzantine list of prohibited carry-on items:

We encourage everyone to pack gel-ﬁlled bras in their checked baggage.

Schneier’s riposte:

Everyone? Do I have to as well? Where should I go buy one?

Nobody ridiculed the TSA for matching up an ostensibly singular quantiﬁer (everyone) with an ostensibly plural personal pronoun (their). That sort of thing is old hat and hardly worth remarking upon (though Lord knows that doesn’t stop us from remarking upon it, e.g., here, here, here, here, here, here, here...). The humor, such as it is, instead hinges on a supposed ambiguity in determining the domain of the quantiﬁer everyone.
Katie only has a \([\text{bike}]_F\).

\[
\{\text{ways of getting to work}\}
\]

In general, what factors determine this set?
The idea is to (temporarily) restrict the domain of evaluation for the whole sentence or even the whole discourse. The pragmatics will help in choosing a suitable universe for the evaluation of a particular sentence, but the semantics can just operate abstracting away from any such choice of a universe.

von Fintel (1998)

Its reference [the context variable] is to be fixed pragmatically, subject to the constraint introduced by focus interpretation.

Rooth (1996)

The domain of quantification is understood as consisting of just three propositions, rather than the full set of propositions of the form “John introduced \( y \) to Sue”.

(24) John brought Tom, Bill, and Harry to the party, but he only introduced \( \text{Bill}_F \) to Sue.

Rooth (1996)
Outline

• Background

• Experiments 1-2: Explicit and indirect mention

• Experiment 3: Comparing different focus operators—only v. also

• Focus-specific vs. general discourse coherence effects

• Conclusions
Using the Visual World paradigm to investigate reference resolution for definite descriptions

- Tanenhaus, Spivey-Knowlton, Eberhard & Sedivy (1995):
  Uniqueness presupposition guides reference resolution in an ambiguous visual context

- Sedivy, Tanenhaus, Chambers & Carlson (1999):
  In the context of a definite, scalar adjectives are interpreted to satisfy uniqueness in a visual context

- Chambers, Magnuson & Tanenhaus (2004):
  Knowledge about the world constrains what is considered a possible referent (i.e. restricts the referential domain)
Knowledge about the world constrains what is considered a possible referent (i.e. restricts the referential domain).

“Put the whistle on the folder in the box.”

A question for experimental pragmatics

How do comprehenders construct relevant contexts for interpreting context-dependent meanings?

Focus operators like *only*:
How do comprehenders appropriately restrict focus alternatives on the basis of contextual information?
Restricting focus alternatives for *Only*

How do we measure preference for one alternative interpretation over another?

Visual World paradigm (Tanenhaus, et al 1995): ‘preferences’ are revealed by how much you look at a particular referent relative to others in a visual scene.
The Visual World paradigm

Click on the candy.

Target = candy
Cohort competitor = candles
Unrelated = anchors, sneakers
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Experiment 1: Previous mention

Is the set of alternatives you consider in a sentence like

‘Jane only has some candy’

constrained by the set of things just mentioned in the discourse?
Restricting focus alternatives for Only

Mark has some candy and some apples.
Jane only has some $[\text{candy}]_F$.

\[
\uparrow
\{\text{candy, cupcakes, apples, sandwiches, gum, \ldots}\}
\]

\{dry-erase markers, refrigerators, pickup trucks, \ldots\}
Mark has some candy and some pencils. 
*Jane only has some candy.*

target

cohort competitor
Mark has some candy and some pencils. 

*Jane only has some candy.*

**target**

cohort competitor
Experiment 1: Previous mention

No Mention + No Only
(1) Mark has some toothpicks and some pencils.
    Jane has some candy.

Mention + No Only
(2) Mark has some candy and some pencils.
    Jane has some candy.

No Mention + Only
(3) Mark has some toothpicks and some pencils.
    Jane only has some candy.

Mention + Only
(4) Mark has some candy and some pencils.
    Jane only has some candy.
Experiment 1 results

No Mention + No Only: late disambiguation, >500 ms.

‘Mark has some toothpicks and some pencils.’
‘Jane has some candy.’
Experiment 1 results

*Mention + No Only:* disambiguation $\sim$400 ms.

‘Mark has *some candy* and some pencils.’
‘Jane has *some candy.*’
Experiment 1 results

*Mention + Only:* earliest disambiguation, \(\sim 200\) ms.

‘Mark has **some candy** and some pencils.’

‘Jane only has **some candy**.’
Experiment 1 results

No Mention + Only: latest disambiguation, >500 ms.

‘Mark has some toothpicks and some pencils.’
‘Jane only has some candy.’
Experiment 1 results

Average point of disambiguation
Experiment 1

- *Mention effect*: earlier disambiguation when the target word was mentioned in the previous sentence.

- Mention effect strengthened by the presence of *only*—given the time it takes to program and launch an eye movement, listeners seem to be disambiguating the target at the very onset of the target word.

- The *informativity* of the context behaves the same way: (1) general facilitative effect of high informativity + (2) *only*-specific effect (strengthened facilitation with *only*)
Mark has some apples and some oranges. Jane only has ...
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Mark has some apples and some oranges. Jane only has ...
Experiment 2: Conceptual similarity

Two explanations for what people are doing in Exp 1:

(1) Given the items in the visual display, they rule out certain referents as unlikely (based on the previous discourse context, etc).

(2) Using the information from the discourse context, they start generating hypotheses about what items are likely to be in the alternative set.

If listeners are actively generating candidate alternatives, they might do this on the basis of something like conceptual similarity: predicts facilitation (early disambiguation) for same-category over different-category items, even without explicit Mention.
Experiment 2: Conceptual similarity

Mention
Mark has *some apples and some oranges.*
Jane only has *some apples.*

Novel + Same category
Mark has *some pears and some oranges.*
Jane only has *some apples.*

Novel + Different category
Mark has *some boots and some sandals.*
Jane only has *some apples.*
Experiment 2 results

Average point of disambiguation
Experiment 2 results

Average point of disambiguation
Experiment 2 results

Mentioned < Novel-SameCategory < Novel-DifferentCategory

‘Jane only has some apples’
Experiment 2

• *Mention effect:* Expectation for Mentioned items in the context of *only* (as in Experiment 1).

• *Conceptual similarity bias:* Same-category Novel items have an advantage over Different-category Novel items (‘indirect’ mention).

• Suggests listeners actively generate candidate alternatives, given the presence of *only* and the material in the preceding discourse.
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**Only v. also**

Comparing other lexical items should let us pull apart what parts of these results are due to the meaning contribution of a particular lexical item, and what parts reflect something general about how people construct contexts and continually modify them.

*Also* is similarly alternative-sensitive, but the way the focus relates to the alternatives is different from *Only.*
Only

Natalie only met \([Lucy]_F\).

Natalie met Lucy.
Natalie didn’t meet anyone but Lucy.
Also

*Natalie also met \([Lucy]_F\).*

Natalie met Lucy.
Natalie met someone other than Lucy.
Experiment 3

- *Only*: expect upcoming material to be a subset of the mentioned items
- *Also*: expect upcoming material to be a superset of the mentioned items

Mark has some apples and some oranges.

Jane only has some apples.
Experiment 3

- *Only*: expect upcoming material to be a subset of the mentioned items
- *Also*: expect upcoming material to be a superset of the mentioned items

Mark has some apples and some oranges.

Jane also has some pears.
Experiment 3 results

200-400 ms after target word onset:
subset preference for *only*, superset preference for *also*
Different sources of expectations

• Experiment 3: Different focus-sensitive lexical items give rise to different expectations about the resolution of the sentence → local effects (limited to scope of focus operator)

• General expectations about the coherence of a discourse?
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After the grueling stats exam, the first-years decided they deserved a delicious snack.

Judith proposed making smoothies with her new blender.

Everyone agreed, and started figuring out who had what kind of fruit at home to contribute.

Mark had some apples and some oranges. Jane only/also had...
Experiment 2b: Conceptual similarity

Mention
Mark has *some apples and some oranges.*
Jane only has *some apples.*
Jane also has *some apples.*

Novel + Same category
Mark has *some pears and some oranges.*
Jane only has *some apples.*
Jane also has *some apples.*

Novel + Different category
Mark has *some boots and some sandals.*
Jane only has *some apples.*
Jane also has *some apples.*
Experiment 2b results

Average point of disambiguation

![Bar chart showing the average point of disambiguation for Experiment 2b results. The chart compares Novel-SameCategory and Novel-DifferentCategory conditions for ‘ONLY’ and ‘ALSO’.
Experiment 2

- Expectation for conceptually similar items

Experiment 3

- *Only* - subset/mention bias
- *Also* - superset/novelty bias
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Summary

• Experiments 1-2:
  Focus alternatives are constrained by explicit mention, indirect (or ‘implicit’) mention via conceptual associates.

• Experiment 3:
  *Only* v. *Also*—Different focus operators give rise to different local predictions.

• Experiment 3 + 2b:
  General vs. focus-specific expectations about discourse content.
Future work

- We’ve been treating focus alternatives as analogous to quantifier domains, but whether the same factors influence domain restriction is an empirical question. Do the current findings extend to quantifier domain restriction?

   Everyone missed question 2.
   Everyone ends with a slide about future work.

   no one / many / most

   always / usually / never
Future work

- We’ve been treating focus alternatives as analogous to quantifier domains, but whether the same factors influence domain restriction is an empirical question. Do the current findings extend to quantifier domain restriction?

- A cue combination problem: how do prosody, discourse parallelism, discourse old/new status, other factors combine with each other? What happens when information sources of information conflict?

- Comprehenders must be tracking both the changing discourse topic and local dependencies (e.g. explicit mention in the last sentence). What’s the relationship between the two?
Thanks!

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