Morphosyntactic and Referential Cues to the Identification of Generic Statements

Phil Crone & Michael C. Frank
Stanford University SemFest

March 13, 2015
Two Puzzles about Generics

**Puzzle #1:** What is the appropriate formal semantic account of generic sentences?

1. Birds fly. (Even though some don’t.)
2. Mosquitos carry West Nile Virus. (Even though most don’t.)
3. Lions have manes.
4. A lion has paws.
5. The lion is the king of the jungle.
Two Puzzles about Generics

**Puzzle #1**: What is the appropriate formal semantic account of generic sentences?

- Why do generics allow for exceptions?
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- Why are multiple NP/DP types associated with genericity?
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**Puzzle #1**: What is the appropriate formal semantic account of generic sentences?

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Puzzle #2: How do listeners determine if a sentence should be interpreted as generic or non-generic?

A dog eats dog food.
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Two Puzzles about Generics

**Puzzle #2:** How do listeners determine if a sentence should be interpreted as generic or non-generic?

A dog eats dog food.
There are at least three types cues to whether a sentence should receive a generic interpretation.
Cues to Genericity

There are at least three types cues to whether a sentence should receive a generic interpretation.

  - Subject NP number & definiteness
  - Tense & Aspect
There are at least three types cues to whether a sentence should receive a generic interpretation.

- **Morphosyntax** (Carlson 1977, Lyons 1977, Krifka et al. 1995, Gelman & Raman 2003, Cimpian et al. 2011, etc.)
  - Subject NP number & definiteness
  - Tense & Aspect

- **Contextual Cues** (Gelman & Raman 2003, Cimpian & Markman 2008).
There are at least three types cues to whether a sentence should receive a generic interpretation.

  - Subject NP number & definiteness
  - Tense & Aspect

- Contextual Cues (Gelman & Raman 2003, Cimpian & Markman 2008).

- World knowledge (Cimpian & Markman 2008, Brandone & Gelman 2009).
Current Studies

Focus on morphosyntactic and contextual cues


Naturalistic examples. How important is context in comparison to morphosyntax?
Current Studies

Focus on morphosyntactic and contextual cues
- Number & definiteness of subject NP
Current Studies

Focus on morphosyntactic and contextual cues

- Number & definiteness of subject NP
- Referent of subject NP in context

Differences from previous studies


Naturalistic examples

How important is context in comparison to morphosyntax?
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- Number & definiteness of subject NP
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Differences from previous studies
- Naturalistic examples
- How important is context in comparison to morphosyntax?
Experiment 1

**Question**: How do number & definiteness features of NPs affect their interpretation as generic or non-generic?
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**One approach**: Find corpus containing subject NPs with different number/definiteness features and annotate these for genericity.
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But finding the right kind of corpus is difficult.
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**Question**: How do number & definiteness features of NPs affect their interpretation as generic or non-generic?

**One approach**: Find corpus containing subject NPs with different number/definiteness features and annotate these for genericity.

But finding the right kind of corpus is difficult.

- Too few generics overall
- Subject NPs of generic sentences of one morphosyntactic type
Experiment 1

Our approach: Have study participants create a corpus for us.
Experiment 1

Our approach: Have study participants create a corpus for us.

- Generate sentences beginning with four different subject NP types and indicate whether sentences are generic or non-generic
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<table>
<thead>
<tr>
<th></th>
<th>Definite</th>
<th>Indefinite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singular</td>
<td><em>The panda</em></td>
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</tr>
<tr>
<td>Plural</td>
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<td><em>Pandas</em></td>
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- Subject NPs evenly split between animate and inanimate
Experiment 1

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</tr>
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<tbody>
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<td>Singular</td>
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<td><em>A panda</em></td>
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<tr>
<td>Plural</td>
<td><em>The pandas</em></td>
<td><em>Pandas</em></td>
</tr>
</tbody>
</table>

- Subject NPs evenly split between animate and inanimate
- 48 sentences generated and rated by each participant
Part 1:

Please write a sentence starting with the phrase below:

Pandas
Pandas eat bamboo.

Is this sentence about a specific group of pandas or about pandas in general?

- Definitely about a specific group of pandas
- Probably about a specific group of pandas
- Not sure
- Probably about pandas in general
- Definitely about pandas in general
### Non-generic examples:

<table>
<thead>
<tr>
<th>Definiteness</th>
<th>Number</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indefinite</td>
<td>Singular</td>
<td>“A dog is sleeping on the porch.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“A light bulb was dropped and exploded.”</td>
</tr>
<tr>
<td>Indefinite</td>
<td>Plural</td>
<td>“Cats are circling the fishtank.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Kites were flying at the beach.”</td>
</tr>
<tr>
<td>Definite</td>
<td>Singular</td>
<td>“The bear is moving closer to us.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The bed is unmade.”</td>
</tr>
<tr>
<td>Definite</td>
<td>Plural</td>
<td>“The rabbits are digging holes in the yard.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The couches were dusty and old.”</td>
</tr>
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## Experiment 1

### Generic examples:

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<tbody>
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<td>Indefinite</td>
<td>Singular</td>
<td>“A cow eats grass.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“A bicycle is a convenient form of transportation.”</td>
</tr>
<tr>
<td>Indefinite</td>
<td>Plural</td>
<td>“Gorillas are primates.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Towels are useful after showering.”</td>
</tr>
<tr>
<td>Definite</td>
<td>Singular</td>
<td>“The camel uses his humps to conserve water.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The clock tells time.”</td>
</tr>
<tr>
<td>Definite</td>
<td>Plural</td>
<td>“The kangaroos carry babies in pouches.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The trumpets are loud.”</td>
</tr>
</tbody>
</table>
Experiment 1

- Singular
- Plural
- Definite
- Indefinite

Definiteness vs. Mean Genericity Rating

Mean Genericity Rating

- Plural
- Singular

Definiteness
Main effects of the following types of subject NPs producing more generic sentences:

- **Indefinites** ($\beta = 1.75, p < 0.01$)  
  (cf. Gelman & Raman 2003, Cimpian et al. 2011)
- **Plurals** ($\beta = 0.30, p < 0.01$)
- **Animates** ($\beta = 0.50, p < 0.01$)  
  (cf. Brandone & Gelman 2009)

Interaction between definiteness and number:
Bare plural subjects produced more generics ($\beta = 1.02, p < 0.01$).

New findings:
Definiteness and number independent cues to genericity.
Definite plurals produced more generics than definite singulars.
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Experiment 2A

**Question:** How does context affect the production of generic and non-generic sentences?
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- In particular, how does the availability of a referent for a subject NP affect production?
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- Participants saw images when producing sentences and were asked to describe these images in their sentences.
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**Question**: How does context affect the production of generic and non-generic sentences?

- In particular, how does the availability of a referent for a subject NP affect production?
- Participants saw images when producing sentences and were asked to describe these images in their sentences.
- Images showed either one or multiple instances of the subject NP. Exactly half of images matched this NP in number, and half mismatched.
Part 1:

Please describe the picture with a sentence starting with the phrase below:

Pandas
Part 1:

Please describe the picture with a sentence starting with the phrase below:

Pandas
Experiment 2A

Part 2:

Pandas eat bamboo.

Is this sentence about a specific group of pandas or about pandas in general?

- Definitely about a specific group of pandas
- Probably about a specific group of pandas
- Not sure
- Probably about pandas in general
- Definitely about pandas in general

Continue
Experiment 2A

- Singular Definite
- Plural Definite
- Singular Indefinite
- Plural Indefinite

Match Mismatch

Picture/Plurality Relationship

Mean Genericity Rating

- Plural Indefinite
- Singular Indefinite
- Plural Definite
- Singular Definite
Experiment 2A

- Similar definiteness/number effects as Experiment 1
Experiment 2A

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- Sentences generated with mismatching images were more generic ($\beta = 0.39, p < 0.01$)

Similar to Gelman & Raman (2003), but they hypothesized that this effect would only be seen with plural subject NPs and singular referents. We see effect across all morphosyntactic types.
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Experiment 2B

**Question**: How does context affect the interpretation of sentences as generic or non-generic?
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- Each participant in Experiment 2B matched with a single participant from Experiment 2A.
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**Question**: How does context affect the interpretation of sentences as generic or non-generic?

- Each participant in Experiment 2B matched with a single participant from Experiment 2A.
- Participants judged sentences produced in Experiment 2A in the context of a matching image. 24 sentences judged by each participant.
Experiment 2B

**Question**: How does context affect the interpretation of sentences as generic or non-generic?

- Each participant in Experiment 2B matched with a single participant from Experiment 2A.
- Participants judged sentences produced in Experiment 2A in the context of a matching image. 24 sentences judged by each participant.
- Sentences judged in Experiment 2B in the context of a matching or mismatching image. Participants were told that the sentences were written as descriptions of the images.
A Mechanical Turk worker saw this image:

And then described it with this sentence:

**Pandas eat bamboo.**

Is this sentence about a specific or about pandas in general?

- Definitely about a specific
- Probably about a specific
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Continue
A Mechanical Turk worker saw this image:

![Image of pandas](image.png)

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[Continue]
Experiment 2B

![Graph showing mean genericity rating for different categories (Singular Definite, Plural Definite, Singular Indefinite, Plural Indefinite) across match and mismatch conditions in picture/plurality relationship.](image-url)
Similar effects as Experiment 2A. Sentences judged with mismatching images were again rated as more generic ($\beta = 0.38, p < 0.01$).
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Experiments 2A and 2B reveal the importance of contextual cues in production and interpretation of genericity. A subject NP is more likely to be generic when it has no contextually available referent.
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But in both cases, the effect size was relatively small ($\beta = 0.39, \beta = 0.38$).
Experiment 2B

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- But in both cases, the effect size was relatively small ($\beta = 0.39, \beta = 0.38$).
- Perhaps contextual cues will play a larger role for particularly ambiguous sentences…
Experiment 3

**Question**: Do contextual cues play a larger role in determining whether a sentence should be interpreted as generic for more ambiguous sentences?
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- Collect 10 new ratings for sentences produced in Experiment 1 that received genericity ratings between 2 and 4.
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> Collect 10 new ratings for sentences produced in Experiment 1 that received genericity ratings between 2 and 4.

> Identify those sentences whose mean ratings were closest to 3.
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**Question**: Do contextual cues play a larger role in determining whether a sentence should be interpreted as generic for more ambiguous sentences?

- Collect 10 new ratings for sentences produced in Experiment 1 that received genericity ratings between 2 and 4.
- Identify those sentences whose mean ratings were closest to 3.
- Have new participants rate these sentences in a manner similar to Experiment 2B.
Experiment 3

The graph shows the count of generics rated by participants. The x-axis represents the genericity rating, ranging from 1 to 5. The y-axis represents the count, ranging from 0 to 600. The graph is divided into two sections: plural and singular. Within each section, there are bars indicating the number of participants who rated the generics at each specific rating level. The bars are labeled as definite and indefinite.
Experiment 3

Plural

Singular

Definite

Indefinite

Mean Genericity Rating

Count
Experiment 3

![Graph showing the relationship between Picture/Plurality Relationship and Mean Genericity Rating. The graph has two axes: Mean Genericity Rating on the y-axis and Picture/Plurality Relationship on the x-axis. The x-axis is divided into two categories: Match and Mismatch. The graph plots four points representing different categories: Singular Indefinite, Plural Indefinite, Plural Definite, and Singular Definite. The points are connected by lines that show a trend.](image-url)
Again, images judged with mismatching images produced more generics, but the effect was once again small ($\beta = 0.33, p < 0.01$).
Experiment 3

- Again, images judged with mismatching images produced more generics, but the effect was once again small ($\beta = 0.33, p < 0.01$).
- Contextual cues are not more important when morphosyntactic cues leave interpretation ambiguous.
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Contextual cues are not more important when morphosyntactic cues leave interpretation ambiguous.

Morphosyntactic and contextual factors appear to be independent cues to genericity.
Wrapping Up

Two puzzles about generics:

- What is the correct formal semantic account of generic sentences?
- How do language users determine if a sentence should be interpreted as generic?

Our studies investigated two types of cues relevant to the second puzzle: morphosyntactic cues and contextual cues.
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Wrapping Up

Morphosyntactic Cues

- Number and definiteness features independently cue genericity. Indefinite and plural NPs are associated with genericity.
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- Superadditive interaction effect supports generic interpretation for bare plurals.
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- Number and definiteness features independently cue genericity. Indefinite and plural NPs are associated with genericity.
- Superadditive interaction effect supports generic interpretation for bare plurals.
- Definite plurals stronger cue to genericity than definite singulars.
Wrapping Up

Contextual Cues

Genericity supported when there is no available referent for subject NP in both production and comprehension. Effect is relatively small compared to morphosyntactic effects, but consistent across NP types. Contextual cues no more important when morphosyntactic cues are ambiguous; morphosyntax and context cue genericity independently.
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Thank You!

Questions? Comments?
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mcfrank@stanford.edu
Why did definite plurals produce more generics than definite singulars?

Perhaps dependent measure was not truly representing genericity.

Definite plurals from Experiment 1 with high genericity ratings are, at least prima facie, generic:

"The cheetahs are the fastest runners of the animal kingdom."
"The gorillas are large and scary."
"The kangaroos carry their babies in pouches."
"The marbles are interesting (sic) toys."
"The footballs are great to throw around in the park."
"The chairs have legs."

Farkas & de Swart (2007) and Acton (2014) note uses of definite plurals with generic or generic-like interpretations in English.
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