Embedded Disjunctions and the Best Response Paradigm

Anton Benz, Nicole Gotzner

Centre for General Linguistics (ZAS)
Berlin

Disjunction Days
The issue: Embedded Implicature

Example

- Kate found her blue or her red marble.
  - Scalar: Kate did not find her blue and her red marble.
  - Clausal: ♦ / ♦ ¬ Kate did find her blue marble;
  - ♦ / ♦ ¬ Kate did find her red marble;

Un-embedded disjunctions:

- Not licensed if speaker knows world (cooperativity, quantity)
- Give rise to ignorance implicature

Aim:

- Experimental study of embedded disjunctions
- Context: Speaker knows exact state of world
Test sentences: Embedded Implicature of Disjunctions

- All of the girls found their red or their blue marble.
- Some of the girls found their red or their blue marble.
- All of the girls found their red, their blue, or their green marble.
- Some of the girls found their red, their blue, or their green marble.
Embedded Implicature

Test implicature of complex sentences:

(A) the embedded exclusive reading of disjunction, e.g. $\forall (r \lor b) \implies all \text{ either } r \text{ or } b$;

(B) the global implicature: $\exists (r \lor b)$ and $\exists (r \lor b \lor g) \implies none \ r \land b$, none $r \land g$, and none $b \land g$;

(C) the exhaustive implicature: $\forall (r \lor b)$ and $\exists (r \lor b) \implies none \text{ found their green marble}$;

(D) the *existence implicature* of the embedded disjunctions, for example $\forall (r \lor b) \implies all (r \lor b)$ to some $r \land \text{some } b$. 

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Theoretical problem

Example (Items)

1. All of the girls found their red or their blue marble.
2. Some of the girls found their red or their blue marble.

- Chierchia (2004): (2) $\Rightarrow$ some $(r \lor b)$ and $\neg$ all $(r \lor b)$
- Sauerland (2004): (1) $\Rightarrow$ $\neg$ all $(r \land b)$
- Franke (2009):
  (1) $\Rightarrow$ $\neg$ some $(r \land b)$
  (2) $\Rightarrow$ some $(r \lor b)$ and $\neg$ some $(r \land b)$
Theoretical problem

Example (Items)

1. All of the girls found their red or their blue marble.
2. Some of the girls found their red or their blue marble.
3. All of the girls found their red and their blue marble.
4. Some of the girls found their red and their blue marble.

- Franke (2009): (4) \( \rightarrow \) some \((r \land b)\) and \(\neg\) all \((r \lor b)\)
- none: explanation of: none found their green marble.
- only Sauerland (2004): (1), (2) \( \rightarrow \) some \(r\) and some \(b\).
Section 1

Previous Experimental Studies on Embedded Implicature)
Experiments on embedded implicature

Previous studies:

- Existence of embedded implicature still controversial
- Previous experimental paradigms show inconsistent findings and have all been criticized on methodological grounds

Best response paradigm (Gotzner & Benz, in revision): Design goals

- Develop organic action-based task to avoid metalinguistic judgments
- Connect scenario to game-theoretic model to derive precise predictions for utterance interpretation in context
- Experimental evidence for embedded implicature of *some* (under *every* and *some* itself)
The best response paradigm: Methods

Scenario:
- 4 girls who each own a set of 4 special edition marbles;
- marbles get lost during play (Degen & Goodman, 2014)
- girls have to clean up and find their marbles
- mother offers rewards to girls

Reward system:
- chocolate: girl finds all 4 of her marbles
- candy: girl finds fewer than 4 of her marbles
- gummy bears: girl finds none of her marbles (consolation prize)
Instructions

- Mother tells participants how many marbles each girl found
- Task: Participants are asked to buy sweets for the girls

Example

Sentence: **No girl found any of her marbles**

<table>
<thead>
<tr>
<th>Sweets</th>
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<th>X</th>
<th>No</th>
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<td>Gummy bear</td>
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<td>YES</td>
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</table>
Results

![Bar chart showing results for each_some and some_some categories with rewards for Bear, Candy, and Choc.]
Section 2

Embedded Disjunctions in the Best Response Paradigm
Critical Items

Example (Items)
1. All of the girls found their red or their blue marble.
2. Some of the girls found their red or their blue marble.
3. All of the girls found their red, their blue, or their green marble.
4. Some of the girls found their red, their blue, or their green marble.
Experiment on disjunction under embedding

Methods

- Same task and instructions as in best response paradigm
- New reward system:
  - chocolate: all 3 marbles
  - candy: 2 marbles
  - gummy bear: 1 marble
    - green gummy bear: green marble
    - red gummy bear: red marble
    - blue gummy bear: blue marble
  - pretzel stick: 0 marbles
Embedded Disjunctions in the Best Response Paradigm

Results

<table>
<thead>
<tr>
<th>All(rvb)</th>
<th>Some(rvb)</th>
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Reward:
- choc
- candy
- red bear
- blue bear
- green bear
- pretzel

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Embedded Disjunctions in the
Best Response Paradigm

Results

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Section 3

A Model of the Experiment
The Experiment as Signalling Game

Playing the game:
1. Mother = speaker knows actual world
2. Mother chooses an utterance
3. Subject chooses an action: buying sweets
4. Game ends
   - Game structure common knowledge
   - Game of pure coordination: preferences aligned

Preferences:
- Every girl should get her appropriate sweet
- No superfluous sweets should be bought
# Possible Worlds Defined by Reward System

- 6 different rewards
- reward system distinguishes $2^6 - 1 = 63$ worlds
- with 4 girls $\sum_i^4 \binom{6}{i} = 56$ can be realised

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<tr>
<th>pretzl</th>
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<th>green gb</th>
<th>red gb</th>
<th>candy</th>
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Inferring Interpretation from Choice of Sweets

Example

- **Target:** All of the girls found their red or their blue marble.
- **Choice:** red & blue gummy bears.

- 24 worlds semantically consistent with target
- 1 world consistent with choice

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+ 16 other worlds
Effect of Epistemic Uncertainty

Example

- **Target:** All of the girls found their red or their blue marble.
- **Choice:** red & blue gummy bears.

- 3 additional information states consistent with choice

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<th>inf. state</th>
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Evaluation of Result

Example

- **Target:** All of the girls found their red or their blue marble.
- **Choice:** red & blue gummy bears.

All information states verify:

(A) the embedded exclusive reading: $\forall (r \lor b) \rightarrow all \ either \ r \ or \ b$;

(C) the exhaustive implicature: $\forall (r \lor b) \rightarrow none \ found \ their \ green \ marble$;

(D') the existence implicature: $\forall (r \lor b) \rightarrow ♦ some \ r \land ♦ some \ b$.

With information state I only (world _blue_):

(D) the full existence implicature: $\forall (r \lor b) \rightarrow some \ r \land some \ b$. 
Inferring Interpretation from Choice of Sweets

Example

- **Target:** Some of the girls found their red or their blue marble.
- **Choice:** red & blue gummy bears, pretzels.

- 48 worlds semantically consistent with target
- 1 world consistent with choice

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+ 40 other worlds
Example

- **Target:** Some of the girls found their red or their blue marble.
- **Choice:** red & blue gummy bears, pretzels.

- 161 additional information states consistent with choice

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Evaluation of Result

Example

▶ **Target:** Some of the girls found their red or their blue marble.
▶ **Choice:** red & blue gummy bears, pretzels.

All information states verify:

(A) the embedded exclusive reading: \( \exists (r \lor b) \implies \text{some either } r \text{ or } b; \)
(B) the global implicature: \( \exists (r \lor b) \implies \text{none } r \land b, \text{ none } r \land g, \text{ and none } b \land g; \)
(C) the exhaustive implicature: \( \exists (r \lor b) \implies \text{none found their green marble}; \)
(D') the *existence implicature*: \( \exists (r \lor b) \implies \diamond \text{some } r \land \diamond \text{some } b. \)

With information state \( \{\square\blacksquare\checkmark\} \):

(D) the full *existence implicature*: \( \forall (r \lor b) \implies \text{some } r \land \text{some } b. \)
Discussion

Evidence for:

▶ Embedded implicature of disjunction.
▶ Exhaustive reading of embedded disjunctions.
▶ Weak existence implicature.

Problem:

▶ No existing theory can account for all observed readings
▶ How to ensure experimentally that listener is certain about state of the world?
Thank you for your attention!
Implicatures of complex sentences in error models. 

Experimental evidence for embedded scalar implicatures. 

Scalar implicatures, polarity phenomena, and the syntax / pragmatics interface. 
References II

Lost your marbles? The puzzle of dependent measures in experimental pragmatics.  

*Signal to Act: Game Theory in Pragmatics*.  

Embedded implicatures?!?  
Embedded scalars. 

[8] Nicole Gotzner and Anton Benz. 
The best response paradigm and a comparison of different models of implicatures of complex sentences. 
ms., 2015.

Scalar implicatures in complex sentences. 