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# The Interaction of Structural and Semantic Biases in Coherence and Coreference

## Hannah Rohde & Andrew Kehler



### 1. Goal

To test for an interaction of semantic and structural biases on comprehenders' expectations about (i) next mention (coreference) and (ii) discourse direction (coherence).

### 2. Previous Work: Semantic Biases

Sentence completions: Strong bias in contexts with implicit causality (IC) verbs to re-mention the causally implicated referent (Caramazza, Grober, Garvey, Yates 1974; McKoon, Greene, Ratcliff 1993; *inter alia*).

#### (1) Effect of verb on coreference

- Amanda amazed Brittany because **she** *ran a marathon*.
- Amanda scolded **Brittany** because **she** *was misbehaving*.

→ IC verb (and speakers' causal reasoning and event knowledge) influence coreference, yielding bias to re-mention Amanda in (1a) and Brittany in (1b)

Story continuations: Strong bias in IC contexts to continue the discourse with a sentence describing the cause of the IC event (Rohde & Kehler 2008).

#### (2) Effect of verb on coherence

- Amanda amazed<sub>IC</sub> Brittany. *She ran a marathon last year.*
- Amanda babysat<sub>NonIC</sub> Brittany. *Brittany's mother is grateful.*

→ IC verbs increase expectation for an upcoming Explanation relation (as opposed to Occasion, Result, Violated Expectation, Parallel, etc.)

### 3. Previous Work: Structural Biases

Comparing story continuations with full-stop and pronoun-prompt conditions suggests that pronouns overlay a subject bias on coreference preferences (Stevenson et al, 1994; *inter alia*).

#### (3) Prompt Types

- Amanda amazed Brittany. <= bias to re-mention Amanda
- Amanda amazed Brittany. She <= stronger bias to Amanda

→ Presence of a pronoun increases bias that subject is being re-mentioned

### References

- Garvey, C. & A. Caramazza. (1974). Implicit causality in verbs. *Linguistic Inquiry* 5, 459-464.  
 McKoon, G., S. Greene, & R. Ratcliff (1993). Discourse models, pronoun resolution, and the implicit causality of verbs. *Journal of Experimental Psychology* 19, 5, 1040-1052.  
 Rohde, H. & A. Kehler (2008). Demanding an Explanation: Implicit causality biases in discourse interpretation. Poster presented at the 21<sup>st</sup> CUNY.  
 Stevenson, R., Crawley, R., & Kleinman, D. (1994). Thematic roles, focusing and the representation of events. *Language and Cognitive Processes*, 9, 519-548.

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### 4. Story Continuation Experiment

**Goal:** Test interaction of semantic and structural biases by holding the propositional semantic content of a passage constant while varying the structural position of the causally-implicated referent.

**2 x 2 Design:** voice (active/passive) x prompt type (pro/no-pro)

**Task:** write natural continuation for context sentence and prompt

**Materials:** 20 subject-biased IC verbs

#### (4) Prompt Type & Voice

- Active\_NoPro** Amanda amazed Brittany. \_\_\_\_\_.
- Active\_Pro** Amanda amazed Brittany. She \_\_\_\_\_.
- Passive\_NoPro** Brittany was amazed by Amanda. \_\_\_\_\_.
- Passive\_Pro** Brittany was amazed by Amanda. She \_\_\_\_\_.

**Evaluation:** judges annotated for next mention & continuation type

### 5. Predictions

#### Coreference

Semantic biases alone: Preference for causally implicated referent (Amanda)

- Bias to subject (4a, 4b)
- Bias to non-subject (4c, 4d)

Integrated semantic & structural biases: Stronger preference for causally implicated referent (Amanda) in (4b) than (4a) because Amanda is in subject position and pronoun introduces a subject bias.

Weaker preference in (4d) than (4c) because Amanda is in the non-subject position but the pronoun introduces a subject bias.

- (4a) Bias to subject Amanda
- (4b) Increased bias to subject Amanda
- (4c) Bias to non-subject Amanda
- (4d) Reduced bias to non-subject Amanda

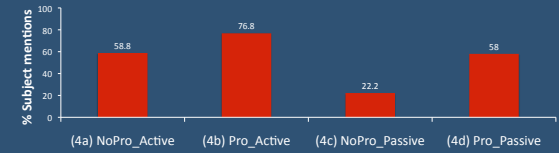
#### Coherence

Semantic biases alone: Preference for Explanations regardless of voice/prompt

Integrated semantic & structural biases: Stronger preference for Explanations in (4b) than (4a), but weaker preference in (4d) than (4c) because, in both cases, the pronoun shifts discourse biases in favor of subject-biased coherence relations.

- (4a) Bias to Explanations
- (4b) Increased bias to Explanations relative to (4a)
- (4c) Bias to Explanations
- (4d) Reduced bias Explanations relative to (4c)

### 6. Coreference Results

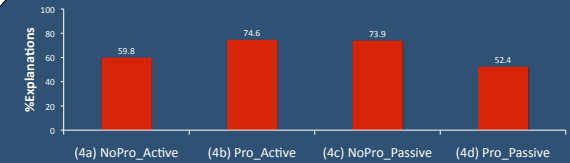


**Semantic bias:** Overall preference for causally implicated referent [Effect of voice:  $F(1,40)=22.88$ ,  $p<0.001$ ;  $F(1,19)=73.45$ ,  $p<0.001$ ]

**Structural bias:** Overall preference for subject is higher w/pronoun than no-pro [Effect of prompt:  $F(1,40)=43.12$ ,  $p<0.001$ ;  $F(1,19)=63.39$ ,  $p<0.001$ ]

**Interaction of biases:** Passive pronoun-prompt condition (4d) yields a reduced preference for the causally implicated referent (away from the non-subject 'Amanda' in 'Brittany was amazed by Amanda') [Interaction:  $F(1,40)=7.08$ ,  $p<0.05$ ;  $F(1,19)=6.38$ ,  $p<0.05$ ]

### 7. Coherence Results



→ Fewest Explanations in (4d): causally implicated referent is in non-subject position and pronoun shifts next-mention and coherence biases to subject.

[No effects of voice or prompt]

[Crossover Interaction:  $F(1,40)=18.46$ ,  $p<0.001$ ;  $F(1,19)=25.82$ ,  $p<0.001$ ;

Active pairwise:  $F(1,40)=4.73$ ,  $p<0.05$ ;  $F(1,19)=6.11$ ,  $p<0.05$ ;

Passive pairwise:  $F(1,41)=20.18$ ,  $p<0.001$ ,  $F(1,19)=9.56$ ,  $p<0.01$ ]

### 8. Conclusion

Even in contexts with strong semantic biases, the mere occurrence of a fully-ambiguous pronoun not only shifts interpretation biases toward the subject referent, but also influences comprehenders' expectations about how the discourse will be coherently continued.