

Thematic Role and Event Structure Biases in Pronoun Interpretation

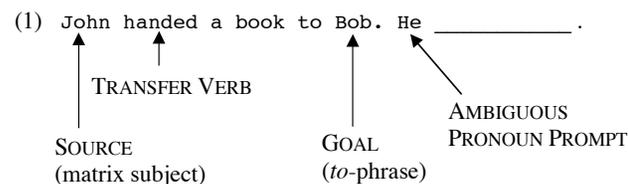
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I. INTERPRETING AMBIGUOUS PRONOUNS

▪ Goal preference

- Stevenson et al. (1994; see also Arnold 2001) tested strategies for pronoun interpretation using story completions like (1):



- Results: overall preference for non-subject Goal

▪ Existing models predict the wrong interpretation

- *Subject preference* (Crawley, Stevenson, & Kleinman 1990, *inter alia*): predict resolution to subject → Source
- *Grammatical parallelism* (Smyth 1994, Chambers & Smyth 1998): predict subject pronoun resolves to subject antecedent → Source

▪ Stevenson et al. considered two explanations:

1. Thematic-role-level preference for Goals over Sources
2. Event-level bias for focusing on end state of transfer

▪ Event Structure Hypothesis

- Stevenson et al. claim a bias towards focusing on the end state of an event
- End state of transfer events make the Goal salient – hence a preferred referent for a pronoun.

II. DISTINGUISHING BETWEEN THE TWO EXPLANATIONS

▪ Our proposal: manipulate end state focus through verbal aspect

- *perfective* – event is completed, compatible with end-state focus
- *imperfective* – event as ongoing, incompatible with end-state focus

Experiment: story completions following transfer-of-possession into sentence with verbs in the perfective (2) or imperfective (3).

(2) COMPLETED EVENT (PERFECTIVE):

John_{SOURCE} handed a book to Bob_{GOAL}. He _____.

(3) INCOMPLETE EVENT (IMPERFECTIVE):

John_{SOURCE} was handing a book to Bob_{GOAL}. He _____.

Equivalent thematic role relations with different verbal aspect

Predictions:

Thematic Role Preference

→ Goal preference for (2) and (3)

Event Structure Hypothesis

→ Larger percentage of Source interpretations for (3)

III. METHODOLOGY FOR STORY COMPLETION TASK

Subjects: monolingual English speakers (N=48)

Task: writing continuations for 21 passages similar to (2) and (3)

Stimuli: transfer-of-possession intro sentences with ambiguous pronoun prompt
Each participant saw half the sentences in the perfect and half in the imperfect.

Distractions: 29 non-transfer verbs for intro sentences; adverbs, proper names, and gender-unambiguous pronouns as prompts

Evaluation: judges determined the participants' pronoun interpretations in light of the story context and the elicited continuation.

IV. RESULTS: MANIPULATING ASPECT CHANGES INTERPRETATION

- Imperfective intros yielded significantly more Source resolutions (71%) than perfective intros (48%; $F(1,48)=51.597, p<0.0001$)

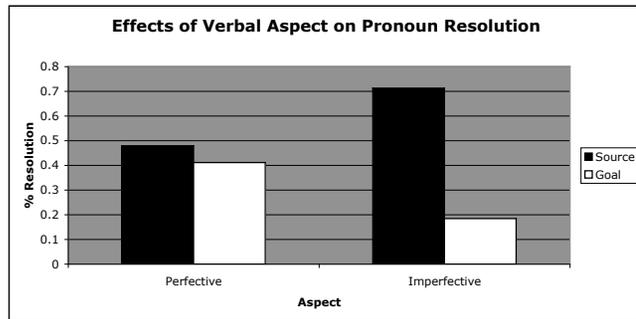


Fig. 2

- Results support Event Structure Hypothesis: pronoun interpretation changes as the structure of the event changes.

- Sample continuations from participant responses:
 - (4) Miriam sent a fruitcake to Rachel. She told Miriam she doesn't like fruitcakes.
 - (5) Miriam was sending a fruitcake to Rachel. She forgot Rachel was allergic to nuts
- 11% were ambiguous and set aside, but either interpretation for these still results in a significant effect.

Conclusion:

- Imperfective aspect results in increased percentage of Source interpretations.
- Participants' interpretations of ambiguous pronouns appear to reflect deeper event-level biases rather than surface-level thematic role preferences.

V. ADDITIONAL RESULTS: VERB CLASSES

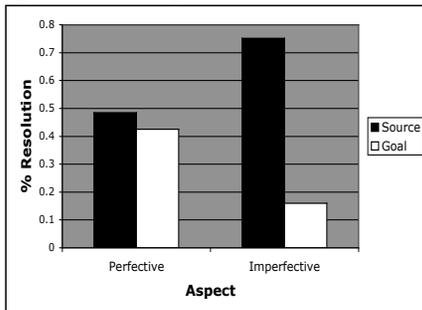
Verbs were classified prior to the experiment along two dimensions:

- co-location of event participants & guarantee of successful transfer

<u>Verb Class 1</u>	<u>Verb Class 2</u>	<u>Verb Class 3</u>
[co-located guaranteed transfer]	[co-located no guaranteed transfer]	[not co-located no guaranteed transfer]
<i>hand</i>	<i>throw</i>	<i>send</i>
<i>give</i>	<i>kick</i>	<i>mail</i>
<i>bring</i>	<i>toss</i>	<i>ship</i>
<i>give</i>	<i>roll</i>	<i>fax</i>
<i>pass</i>	<i>fling</i>	<i>forward</i>
<i>deliver</i>	<i>chuck</i>	<i>transmit</i>
<i>serve</i>	<i>lob</i>	<i>wire</i>

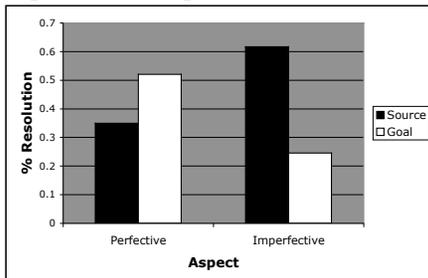
VI. EFFECTS OF COHERENCE

- Pronoun interpretation differs across verb classes (F(2,98)=15.058, p<0.0001)
No preference for perfective: Class 1



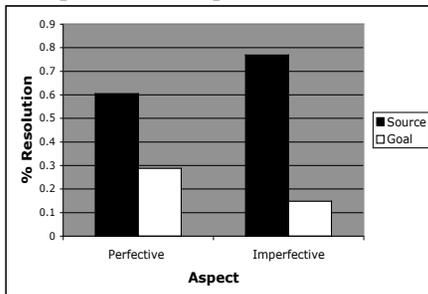
- Class 1 verbs with co-located participants and guaranteed transfer
- Ex. *hand, give, pass*
- Perfective intros yield similar percentage Goal interpretations as Source interpretations ($\chi^2=0.54$, p<0.5)

- **Goal preference for perfective: Class 2**



- Class 2 verbs with co-located participants but no guaranteed transfer
- Ex. *kick, roll, throw*
- Perfective intros yield more Goal interpretations than Source ($\chi^2=5.34$, p<0.02)

- **Source preference for perfective: Class 3**



- Class 3 verbs without co-located participants and no guaranteed transfer
- Ex. *mail, fax, send*
- Perfective intros yield more Source interpretations than Goal ($\chi^2=18.85$, p<0.0001)

- In all classes, the imperfective always yields more Source interpretations

- Pronoun interpretation strategies are side effects of the types of inference processes used to establish discourse coherence (Kehler 2002)

- **Goal preference is compatible with narration** – Occasion coherence relations connect the end state of one event with the initial state of the next event.

OCCASION RELATION: infer a change of state for a system of entities from S_2 , inferring the initial state for this system from the final state of S_1 .
 (adapted from Hobbs 1990)

Sample continuation from experiment

(6) Matt passed a sandwich to David. He said thanks and ate it.

→ OCCASION: GOAL

- **No reason to expect Goal preference for other types of coherence relations**

Sample continuations from experiment

(7) Matt passed a sandwich to David.

(a) He didn't want David to starve.

→ EXPLANATION: SOURCE

(b) He put fruit on his plate too.

→ PARALLEL: SOURCE

(c) He did so carefully.

→ ELABORATION: SOURCE

Superficial heuristics cannot explain these patterns – need a model of discourse to capture event-level mechanisms like coherence for pronoun interpretation (see Wolf et al. 2004 and Kertz et al. in preparation).

VII. FUTURE WORK

- **Referring expressions** – preferences emerge when participants can choose to use either a pronoun or a name (Stevenson et al. 1994; Arnold 2001)

- In interpretation, pronouns are resolved preferentially to the Goal
- With free choice in production, pronouns are not associated with Goals

(8) John gave the book to Mary. _____
(after Stevenson et al. 1994)

1st mentioned individual (Source) – repeated as pronoun

2nd mentioned individual (Goal) – repeated as name

- **Our distractors confirmed preferred referring expressions:**

Each of 48 participants saw 10 sentences with active Agent-Patient verbs.

Choice of referring expression with no pronoun prompt shows effect of referent's sentence position ($F(1,94)=50.798, p<0.0001$)

(9) Keith poisoned Sally with cyanide. Next _____

(a) Next he destroyed the evidence.

(b) Next Sally collapsed on the floor.

1st mentioned individual of intro: repeated as pronoun 66% of the time

2nd mentioned individual of intro: repeated using name 72% of the time

- **Repeated name effect for subjects** (Gordon et al. 1993)

- Although proper names disambiguate, their use can create reading time penalties in certain situations.
- Gordon et al. show that in cases where a pronoun would refer preferentially to the subject, using a full name induces reading time penalty.

- **Proposed reading time experiment:** test for repeated name effect in cases where a non-subject Goal is the preferred referent

(10) Sarah served chili to Emily.

(a) She_{SOURCE} warned that it was hot.

(b) She_{GOAL} said thanks.

(c) Sarah_{SOURCE} warned that it was hot.

(d) Emily_{GOAL} said thanks.

QUESTION 1: Is there still a repeated name effect for the subject, given the existence of another potential antecedent that is at least as, if not more, salient than the subject?

QUESTION 2: Does the repeated name effect extend to the non-subject Goal?

Summary

- **Our results support the conclusion that preferences for Goal interpretation are the result of event structure biases.**
- **Pronoun interpretation must be addressed within a broader theory of discourse comprehension rather than by appeal to superficial heuristics.**

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APPENDIX: STIMULI

Verb Classes:

<u>Class 1</u>	<u>Class 2</u>	<u>Class 3</u>
<i>bring</i>	<i>chuck</i>	<i>fax</i>
<i>carry</i>	<i>fling</i>	<i>forward</i>
<i>deliver</i>	<i>kick</i>	<i>mail</i>
<i>give</i>	<i>lob</i>	<i>send</i>
<i>hand</i>	<i>roll</i>	<i>ship</i>
<i>pass</i>	<i>throw</i>	<i>transmit</i>
<i>serve</i>	<i>toss</i>	<i>wire</i>

Sentence-completion passages:

(each participant saw perfective or imperfective, depending on verb)

1. Ben chucked/was chucking a wrench to Mark. He _____
2. Rebecca flung/was flinging a frisbee to Hannah. She _____
3. Nick kicked/was kicking a soccer ball to Justin. He _____
4. Charles lobbed/was lobbing a football to Jacob. He _____
5. Peter rolled/was rolling a toy truck to Jeremy. He _____
6. Jason threw/was throwing a hat to Andrew. He _____
7. Amanda tossed/was tossing a dish towel to Jenny. She _____
8. John brought/was bringing a glass of water to Robert. He _____
9. Brian faxed/was faxing a resume to Adam. He _____
10. Angela forwarded/was forwarding a gossip email to Kelly. She _____
11. Heather mailed/was mailing a letter to Amy. She _____
12. Miriam sent/was sending a fruitcake to Rachel. She _____
13. Katherine shipped/was shipping a package to Laura. She _____

14. Jane transmitted/was transmitting a message to Nicole. She _____
15. Richard wired/was wiring money to Fred. He _____
16. Sarah carried/was carrying a tray to Brittany. She _____
17. Roger delivered/was delivering a subpoena to Joe. He _____
18. Elizabeth gave/was giving a sweater to Ruth. She _____
19. Mike handed/was handing a book to Josh. He _____
20. Matt passed/was passing a sandwich to David. He _____
21. Jessica served/was serving chili to Emily. She _____

Distractors:

22. Pamela was stabbed by Colleen at midnight. Next _____
23. Keith poisoned Sally with cyanide. Next _____
24. Kevin was complaining about school. Brad _____
25. Brett was startled by Dan at the dance. As a result _____
26. Allison was approached by Tracy at a bar. Amazingly _____
27. Paul blinded Greg with a flashlight. As a result _____
28. Ryan hugged Alice after the game. He _____
29. Carl was escorted to court by Frank. Next _____
30. Bill amazed Ken with a double back flip. Next _____
31. Craig was beaten by Beth in the race. He _____
32. Casey was interviewed by Joel. Next _____
33. Melissa murdered George at midnight. She _____
34. Tina arrived home late. Candice _____
35. Sandra was attacked on the street by Jared. He _____
36. Alan surprised Clara with flowers. Later _____
37. Scott was hitting Zack with a pillow. As a result _____
38. Tom was waiting after class. Kristy _____
39. Dawn confused Neal with bad directions. Afterwards _____
40. Carolyn was worrying about finals. Henry _____
41. Ian found Jordan in an empty hallway. Quickly _____
42. Linda saw Becky through the window. Suddenly _____
43. Melanie helped Julia with the dishes. Next _____
44. Lisa was avoiding Mary after the party. As a result _____
45. Karen called Tiffany at home. Next _____
46. Margaret laughed out loud. Luis _____
47. Alyssa was deceived by Kim at a costume party. As a result _____
48. Katie answered Cindy with a smirk. As a result _____
49. Alicia was delayed by Monica on the way to school. As a result _____
50. Gina was followed by Susan. As a result _____