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Background and Motivation

► Kehler and Rohde (2013): the interpretation of ambiguous pronouns can be explained by a Bayesian model that relies on:

***P*(pronoun|referent)** – a production bias based on the likelihood of using a pronoun to refer to a given referent (mainly influenced by grammatical factors such as subjecthood);

***P*(referent)** – a next-mention bias based on semantic factors, e.g., coherence relations expected to occur in the ensuing context.

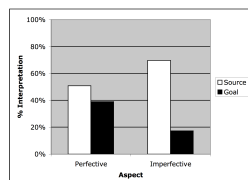
An example in transfer-of-possession context:

- (1) Tom_{source} served cake to Kyle_{goal}. He...
(2) Tom_{source} was serving cake to Kyle_{goal}. He...

► $P(\text{pronoun}|\text{source}) > P(\text{pronoun}|\text{goal})$ in (1) and (2) due to the subject preference associated to the use of overt pronouns in English.

► Perfective aspect favors coherence relations that focus on the event's end state; therefore $P(\text{goal}) > P(\text{source})$ in (1).

► Imperfective aspect favors coherence relations that focus on the ongoing event; therefore $P(\text{source}) > P(\text{goal})$ in (2).



Effects of verbal aspect on pronoun interpretation (Rohde, Kehler and Elman, 2006)

Results:

- more goal interpretations in perfective sentences;
- 50/50 in source/goal distribution in perfective contexts.

Results also hold true for Korean (Kim et al, 2009) and Japanese (Ueno and Kehler, 2010): overt pronoun interpretation is influenced by event structure, but not enough to show a preference for goals over sources in perfective contexts, probably due to a subject preference associated with this referential expression.

Our goals

► To investigate whether overt pronoun interpretation in Brazilian Portuguese is more sensitive to event structure than in English, Japanese and Korean, as this language shows no subject preference associated with the use of overt pronouns (Fonseca and Guerreiro, 2012; Teixeira et al., 2014). [Experiment 1]

► To test whether differences in $P(\text{pronoun}|\text{referent})$, a production bias, result in different goal/source distribution, while $P(\text{referent})$, determined by coherence-driven information, remains constant despite of changes in production bias. [Experiment 1]

► To assess whether the production of overt pronouns in Brazilian Portuguese shows a bias towards source or goal. [Experiment 2]

References

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ROHDE, H.; KEHLER, A.; ELMAN, J. (2006) Event structure and discourse coherence biases in pronoun interpretation. *Proceedings of the 28th Annual Conference of the Cognitive Science Society*, 697-702.
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Experiment 1: Event Structure

Methods and Design

Participants (n = 64) wrote story continuations to Brazilian Portuguese versions of stories like (3-5) below. Two trained judges categorized the responses by coherence relation and annotated whether pronouns were interpreted as referring to goals or sources.

2x3: Verbal Aspect x Verb Class, following Rohde et al.'s (2006)
18 experimental sentences, 6 for each Verb Class, 30 fillers

Verb Class 1 [participants co-located; guaranteed transfer]
(3) Tom served/was serving cake to Kyle. He...

Verb Class 2 [participants co-located; no-guaranteed transfer]
(4) Cesar rolled/was rolling the ball to Paul. He...

Verb Class 3 [participants not co-located; no guaranteed transfer]
(5) Carol sent/was sending an email to Claudia. She...

Results for pronoun interpretation

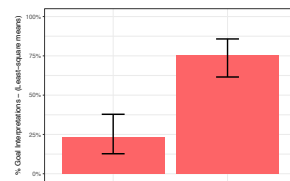


Fig 1. Effects of verbal aspect on goal interpretations, 95% C.I.

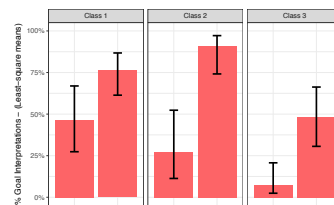


Fig 2. Effects of verb class on goal interpretations, 95% C.I.

- More goals following perfective sentences ($\beta = 2.343, p < 0.0001$)

Similar to findings in English, Japanese and Korean

- Goal proportion depends on verb semantics: Class 1 and Class 2 yielded more goals than class 3 ($\beta = 1.881, p < 0.001$)

Similar to findings in English

- Preference for goals in perfective contexts ($\beta = 0.9090, p < 0.01$)

Findings unique to Brazilian Portuguese

Results for Coherence relations

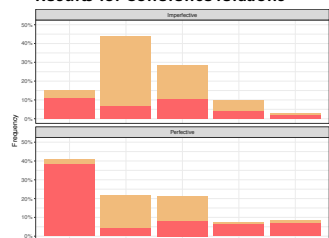


Fig 3. Effects of verbal aspect on coherence relations distribution and pronoun interpretation

► Verbal aspect changed the coherence relation distribution (occasion: $\beta = 1.9320, p < 0.0001$; elaboration: $\beta = -1.1532, p < 0.0001$)

► Occasions show a goal preference (perfective: $\beta = 3.271, p < 0.01$; imperfective: $\beta = 11.640, p < 0.04$)

► Elaborations show a source preference (perfective: $\beta = -4.662, p < 0.001$; imperfective: $\beta = 21.790, p < 0.0001$)

All findings similar to English

Experiment 2: Prompt type

Methods and Design

Participants (n = 130) wrote story continuations to Brazilian Portuguese versions of stories like (1) and (2). Two trained judges assessed whether the subject of the continuation clause referred to the source or goal and annotated whether this reference was made using a proper name, an overt pronoun or a null pronoun.

2x2: Verbal Aspect x Prompt-type (pronoun-prompt, as in Exp. 1, and free-prompt)
Same 18 experimental sentences and 30 fillers from Experiment 1

Results for pronoun interpretation

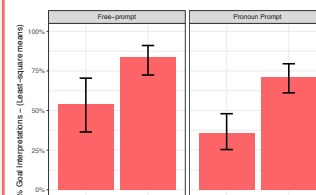


Fig 4. Effects of verbal aspect and prompt-type on goal interpretations, 95% C.I.

- Pronoun-prompt data replicate the findings of Experiment 1 for goal distribution across verbal aspect ($\beta = 1.7950, p < 0.0001$)

► There are more goal interpretations in the free-prompt condition ($\beta = 0.7364, p < 0.001$)

► No interaction across verbal aspect and prompt-type ($\beta = 0.6440, p > 0.05$)

All findings similar to English, Japanese and Korean

Results for rates of pronominalization

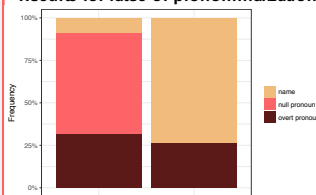


Fig 5. Choice of referential expression for sources and goals in the free-prompt condition

- More null pronouns when referring to the source ($\beta = -8.10007, p < 0.0001$)

Similar to findings in Korean and Japanese

- More proper names when referring to the goal ($\beta = 5.6001, p < 0.0001$)

Similar to findings in English, Japanese and Korean

- Overt pronouns are equally used to refer to source or goal ($\beta = 0.2103, p > 0.6$)

Findings unique to Brazilian Portuguese (in English and Korean the overt pronoun was a source preference for production of overt pronouns)

Conclusions

► Both $P(\text{pronoun}|\text{referent})$ and $P(\text{referent})$ influence overt pronoun interpretation in Brazilian Portuguese, as they do in English, Korean and Japanese.

► $P(\text{referent})$ is determined by coherence relations and it is not affected by cross-linguistic differences, playing a homogeneous role in pronoun interpretation across languages.

► Cross-linguistic differences in pronoun interpretation are due to differences in $P(\text{pronoun}|\text{referent})$.

► Overt pronouns in Brazilian Portuguese are more prone than proper names to refer to the subject of a previous clause; yet, overt pronouns are used indistinctively to refer to sources or goals.