Verb Aspect, Event Structure, and Pronoun Interpretation: An ERP Investigation

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Introduction

We conducted a story continuation task and an online ERP reading task to examine how the representation of the temporal structure of transfer-of-possession events affects comprehenders' expectations about which individual will be mentioned next. Event structure was manipulated by changing the aspect of the verb in the context sentence such that the events were either depicted as ongoing with imperfective aspect or as completed with perfective aspect (see examples below). In the story continuation task, people first read the transfer-of-possession sentences and then generated a second sentence that naturally continued the first sentences. In the reading task, we indexed comprehenders' expectations for participants in those same events by examining evoked brain potentials to pronouns (He/She) that began a subsequent sentence and unambiguously referred to either the Source or Goal participants in the first sentences. In both tasks, gender was balanced across experimental conditions.

Story Continuation stimuli:

Sue$_{(Source)}$ handed/was handing a timecard to Fred$_{(Goal)}$. _____.

Online reading stimuli:

Sue$_{(Source)}$ handed/was handing a timecard to Fred$_{(Goal)}$. She/He asked about the upcoming meeting.

Main Prediction

Perfective aspect describes events as completed, whereas imperfective aspect describes events as ongoing. Under the plausible assumption that Sources are more salient than Goals within ongoing transfer-of-possession events but that Goals are more salient than Sources within the end state, we would expect to find more continuations that mention the Goal in the perfective case than imperfective case, and that brain potentials to the Goal and Source pronouns should also reflect this reduction in Goal bias in the ERP task.

Story Completion Task

• Stimuli consisted of 72 target sentences containing transfer-of-possession events similar to the above example, and 72 filler sentences that described non-transfer-of-possession events involving one or two participants.

• Analysis from participants (N=54) was restricted to continuations in which either the Source or Goal was mentioned as the first word of the continuation (N=1859).

• We analyzed the percentage of next-mention Goal references following Perfective and Imperfective verbs when only pronouns were used, and we conducted a separate analysis for all continuations regardless of whether a pronoun was used (see Figure 1).

ERP Online Reading Task

• Stimuli consisted of the same sentences used in the completion task followed by a second sentence. These sentences always began with an unambiguous pronoun for the target trials but not for filler trials.

• Words were presented one a time for a duration of 300 ms and an SOA of 500 ms. Participants answered periodic comprehension questions.

• EEG was recorded at 64 scalp locations from 52 participants. ERPs were computed in epochs that extended 100 ms before the critical word in the target sentence to 1000 ms after word onset (see Figure 2 results).

ERP Components of Interest

1. Anterior Negativity (100-300, 300-500 ms) – morphosyntactic violations and ambiguity in pronominal reference have been associated with anterior negativities.

2. N400 (300-500 ms) – measure of semantic integration of words and preceding contexts. Typically find a larger negativity for incongruent or less expected words.

3. Syntactic Positive Shift/P600 (500-800 ms) – late positive shifts at central and posterior electrode locations have been observed following gender violations in pronominal reference.
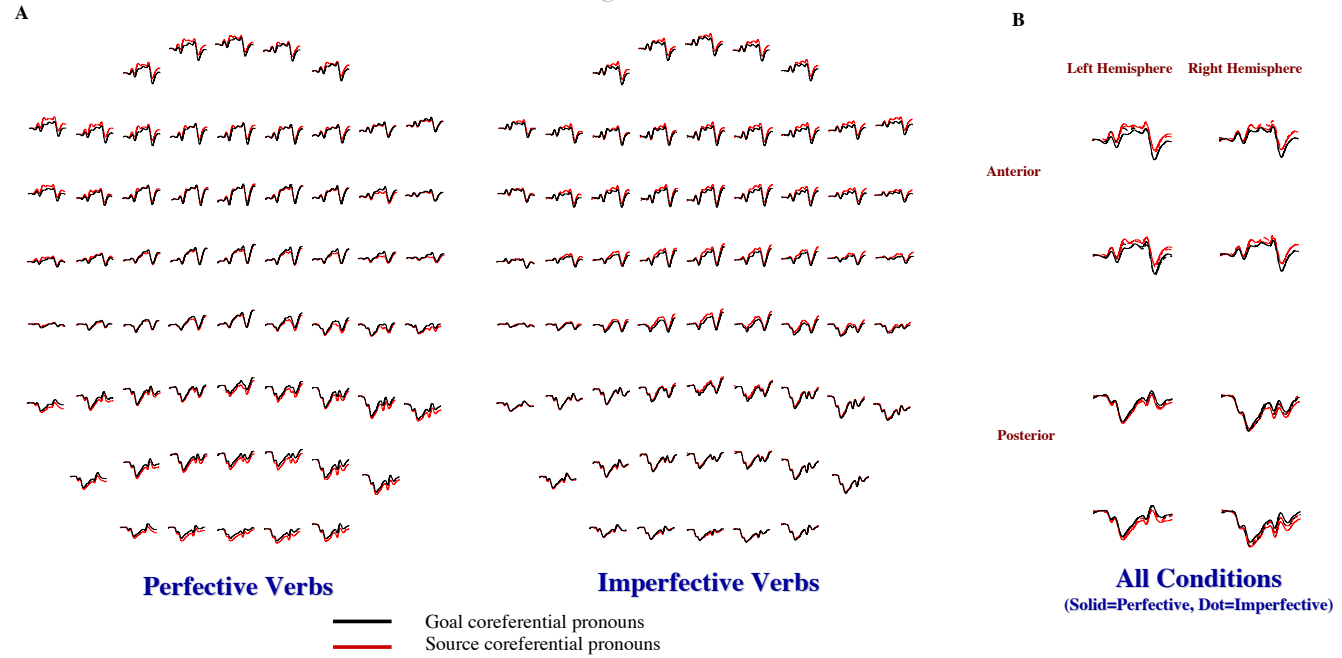
ERP Online Reading Results

Perfective Verbs **Imperfective Verbs**

— Goal coreferential pronouns
— Source coreferential pronouns

All Conditions
(Solid=Perfective, Dot=Imperfective)

Left Hemisphere Right Hemisphere

Anterior

Posterior

Figure 2. Panel A shows mean amplitudes (μV) for Goal coreferential pronouns (black lines) and Source coreferential pronouns (red lines) following perfective and imperfective verbs. Panel B shows the mean amplitudes for all conditions at selected anterior and posterior electrodes. Perfective conditions are shown with solid lines and Imperfective conditions have dotted lines.
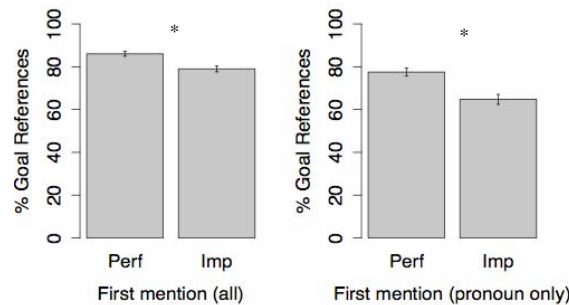
Story Completion Results

Figure 1. Next-mention biases by verbal aspect (with standard errors).

Discussion

• Story continuations demonstrated that both perfective and imperfective aspect yielded a first mention bias to the Goal, but the strength of the Goal bias was significantly greater for perfective than imperfective aspect. This pattern was found for analysis involving all continuations and for continuations that only began with pronouns.

• ERP results demonstrated that following perfective sentences, pronouns with a Source referent elicited brain potentials that were more negative at left anterior locations than pronouns with a Goal referent, and such pronouns also elicited more positive amplitudes at posterior locations (consistent with a P600 or "SPS"). Following imperfective verbs, Source pronouns elicited greater anterior negativity than Goal pronouns, but this effect had a broader distribution and a later onset than in the perfective condition.

• Both the ERP and story continuation results suggest that verb aspect interacts with event knowledge to influence expectations about upcoming coreference across sentence boundaries.

• Results are consistent with a recent offline study by Rohde, Kehler, & Elman (2006, Cogsci Proceedings) showing that pronouns are preferentially interpreted to refer to the Goal, and that this bias is greater for perfective than imperfective aspect.

• Results are not consistent with models of pronoun interpretation that posit a subject preference (Crawley, Stevenson, & Kleinman, 1990), first mention privilege (Gernsbacker & Hargreaves, 1988), or grammatical parallelism (Chambers & Smyth, 1998). In all of these models, Source rather than Goal coreferential pronouns should be most expected by comprehenders.