The effects of information structure and sentence structure on sentence processing

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There is extensive evidence that comprehenders prefer given information to precede new information in a sentence. This principle has primarily been tested by considering information-structural features encoded in syntax, e.g., given information expressed in definite NPs. We carried out a self-paced reading experiment to revisit the given-before-new principle and disentangle new-/givenness from syntactic features. Additionally, we consider the effects of clause ordering and the mapping between a clause's information status (given/new) and its type (matrix/subordinate). We find that given-before-new sentences are processed faster, and that this effect is even stronger when the given information is hosted by a subordinate clause.

1 Introduction

The literature on sentence processing has identified various principles that govern the processing of clauses (Scholman et al., 2022). The current project investigates two of these principles: the given-before-new principle (Gundel, 1988; Halliday, 1967a, 1976b; Prince, 1981) and the clause structure principle (Diessel, 2005, 2008; Fodor et al., 1974; Gibson, 1998; Holmes, 1973; Jansen, 2008; Troost et al., 2008). The given-before-new principle posits that comprehenders prefer given information to precede new information. While there is extensive evidence that this is the case, this principle has primarily been tested by considering the information-structural features encoded in syntax (e.g., definite NPs represent given information, indefinite NPs represent new information: Bock, 1977; Clifton & Frazier, 2004). The current project revisits the given-before-new principle while focusing on the discourse-status of information and analysing new-/givenness independently of syntactic structure. The clause structure principle proposes that sentences are harder to process if the main clause follows the subordinate clause, rather than vice versa. Both the given-before-new principle and the clause structure principle have been studied individually, in isolation, but little is known about the interaction between these principles in processing. While there have been theoretical proposals and evidence from offline studies that subordinate clauses – especially sentence-early and preposed subordinate clauses – tend to be more likely hosts for given information, and main clauses for new information (Diessel, 2001), this has not been sufficiently tested in online processing. Recent work, however, shows that locating given information in a subordinate clause indeed leads to faster processing times, but only when the subordinate clause is an adverbial (Scholman et al., 2022).

We ask whether the preferred mapping between a clause's information status (given/new) and its type (matrix/subordinate) extends to other types of subordinate clauses. We measure this mapping (henceforth "clause-type mapping of information) in appositive relative clauses (ARC). Corpus studies have shown that ARCs generally contribute new information to discourse (Loock, 2007, 2010). Gibson et al. (2005) analysed the processing of ARCs in sentence-early versus sentence-final position and did not find a difference between the two positions. However, they did not explicitly manipulate the information status of the ARCs, but rather assume that ARCs are, by virtue of being ARCs, taken as presenting new information. In addition, their study focused on the reading times of the ARCs and not the entire sentence. This leaves open the question of how information structure and sentence structure influence

the processing of full sentences with subordinate clauses. Our study aims to replicate Gibson et al.'s (2005) study with a more explicit manipulation of the information status of ARCs, while simultaneously exploring the given-before-new principle, the clause structure principle, and their interaction at the level of the full sentence.

2 Method

We conducted a self-paced reading experiment in which participants saw short narratives presented in chunks (moving-window paradigm). The order of clauses in the target sentence (matrix-ARC, ARC-matrix) was crossed with information order (given-new, new-given) and clause-type mapping of information (given matrix/new ARC, new matrix/given ARC). The content of either the matrix clause or the ARC was made discourse-old/inferred given information by providing a context preceding the target sentence. The other clause in the target sentence then was the only clause containing content which was discourse-new. Consider the following example in (1) in which the target sentence represents the matrix-ARC clause order, with given-before-new, yielding a given matrix/new ARC mapping (see the appendix for an overview of the other conditions for this item):

Context:

(1) My aunt loves to be part of the rumor mill, and just like my mom, takes any opportunity to engage in the latest stories. Because of this, I always pay close attention to what I'm saying around her. At my birthday party,

Target sentence:
my aunt was gossiping with my mom[SENTENCE-EARLY MATRIX CLAUSE, GIVEN INFORMATION], who was drinking rum & coke[SENTENCE-FINAL ARC, NEW INFORMATION].

Spillover region:
As I walked by, I heard they were talking about me. My mom got startled and spilled her drink all over my aunt.

Our study consisted of 32 items in four conditions (a 2x2 design captures all three factors as there is overlap between them) and we recruited 237 self-reported native speakers of American English. After excluding participants who failed to perform above chance on the attention checks we included, we analysed the data of 195 participants. Our main interest was the reading times for the full sentences, but we also measured and analysed the reading times of the individual clauses that make up the target sentence to probe whether a preference for ARCs to contain new information is reflected in processing. It should be noted that the clause-structure principle and clause-type mapping of information hypothesis make competing predictions: if an order of matrix-before-subordinate overlaps with given-before-new, clause-type mapping of given information in a subordinate and new information in a matrix clause cannot be realised. In addition to expecting an overall preference for given-before-new, we expect that the clause-structure principle is more likely to hold as it would overlap with the observation that ARCs generally contain new information.

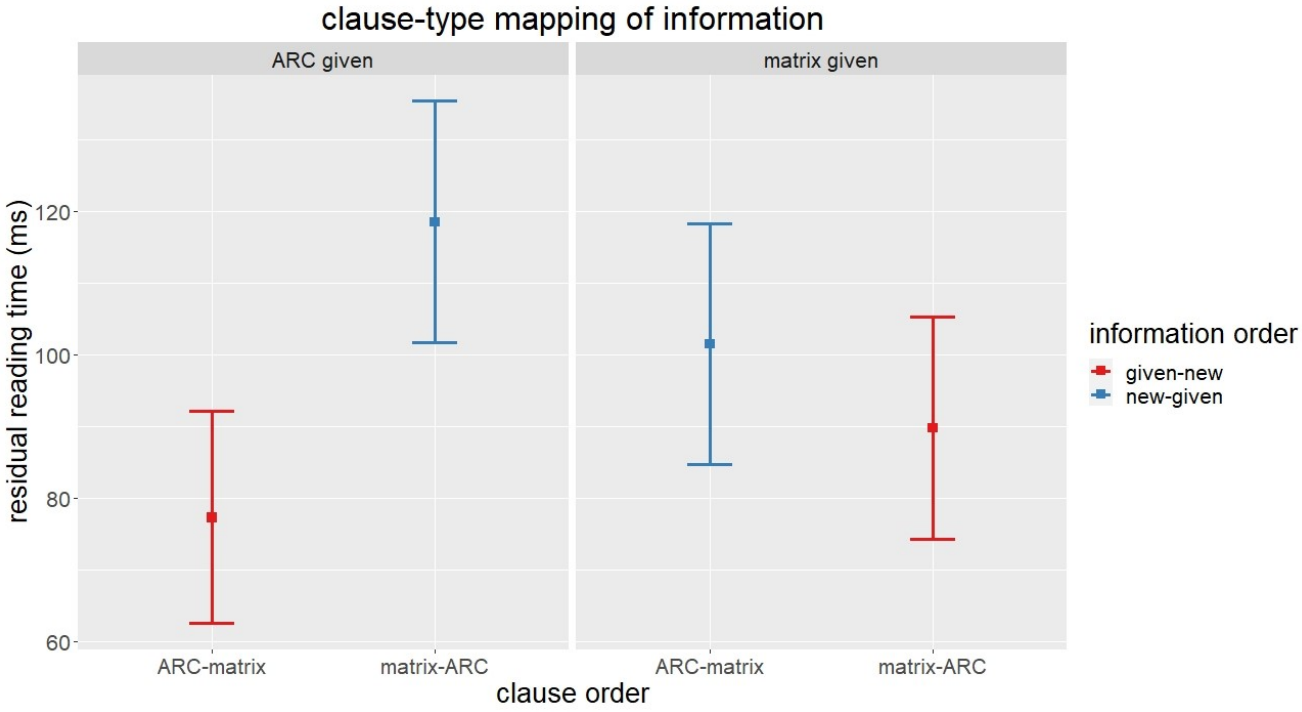
3 Results and conclusion

When reading times of the full sentence are considered, a preference for given-before-new is found (Figure 1). This extends prior work, showing that the given-before-new principle holds for sentences in which information status is manipulated at a discourse-level rather than by the syntactic nature of clauses. Furthermore, we find an interaction effect between clause-type mapping of information and clause ordering. This suggests that given information

expressed in sentence-early ARCs facilitates fastest processing, a finding that is in line with Scholman et al. (2022). We find no evidence to support the clause structure principle.

While no evidence for a direct effect of clause structure or information status was found at the level of the entire sentence, both of these had an effect at the clause level. When the reading times of individual clauses were considered, both main clauses and appositive relative clauses were read faster when their position was sentence-early, and when they contained given information. This suggests that even though ARCs might generally be more likely to contain new information, no preference for this generalisation is reflected in processing. That said, further research is needed to investigate this. Our results show that given information is always processed faster than new information, independent of position and/or clause type. How to reconcile these results with the corpus evidence that ARCs do generally contain new information remains an open question.

Figure 1: Residual reading times for the entire target sentence as a function of clause-type mapping of information, clause order and information order.



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Appendix – other conditions for example (1)

new ARC before given matrix clause:

(2) My aunt loves to be part of the rumor mill, and just like my mom, takes any opportunity to engage in the latest stories. Because of this, I always pay close attention to what I'm saying around her. At my birthday party, **my aunt, who was drinking rum & coke, was gossiping with my mom.** As I walked by, I heard they were talking about me. My mom got startled and spilled her drink all over my aunt.

new matrix clause before given ARC:

(3) My mom, like my aunt, is a big fan of drinking rum. She thinks she is really good at hiding it by adding some coke to it. Everybody knows what is actually in her glass of course. A few weeks ago, at my birthday party, **my aunt was gossiping with my mom, who was drinking rum & coke**. As I walked by, I heard they were talking about me. My mom got startled and spilled her drink all over my aunt.

given ARC before new matrix clause:

(4) My aunt, like my mom, is a big fan of drinking rum. She thinks she is really good at hiding it by adding some coke to it. Everybody knows what is actually in her glass of course. A few weeks ago, at my birthday party, **my aunt, who was drinking rum & coke, was gossiping with my mom.** As I walked by, I heard they were talking about me. My mom got startled and spilled her drink all over my aunt.