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The information structure of complex sentences: An empirical investigation into at-issueness

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Declaration of Authorship

I declare that the thesis has been composed by myself and that the work has not be submitted for any other degree or professional qualification. I confirm that the work submitted is my own, except where work which has formed part of jointly-authored publications has been included. My contribution and those of the other authors to this work have been explicitly indicated below. I confirm that appropriate credit has been given within this thesis where reference has been made to the work of others. My contribution in all cases was a first-author role: the development of the research question alongside my co-authors, the design and implementation of the methods, the full analysis, and the writing of the first draft and the catalyst in the revision of the papers.

The work presented in Chapter 2 is under revision in *Journal of Memory and Language* as 'Appositives, adverbials, and at-issueness: When clause type and position influence at-issue potential' by Wilke, H. A. (student), Hoek, J. & Rohde, H. (supervisors).

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Signed:

Date:

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Lay Summary

During conversations we often produce sentences that consist of multiple clauses. It is usually not the case that both clauses in such a sentence are of equal importance. Rather, one clause is expected to carry the main point of the sentence, whereas other clauses contain information that is more peripheral to the main point. For example, if I say to you *My friend Kathy, who owns a fluffy Persian cat, baked a cake for me* it is probably clear that the main point I want to convey is that my friend baked me a cake. A way to show this is by checking whether we can connect a next sentence to this information. If I follow the sentence with *It was a funfetti birthday cake*, it connects with the previous one without any issues. If instead I follow it with *It's the cutest cat I've ever seen*, you might be surprised that I talk about the cat instead of the cake (even if the cat arguably is more interesting). This is because the 'fluffy Persian cat' is hidden away in a subordinate clause in the middle of the sentence, making it appear less relevant than the 'cake'. My doctoral thesis investigates how expectations are formed about which clause in sentences with multiple clauses contains the more important information, and whether information that is assumed to be more important takes longer to process.

Findings in Chapter 2 suggest that the position of a clause in a sentence – whether it is in the beginning or at the end of a sentence – is the most important factor people use to infer which clause contains the more important information. Whether this clause is a main clause or a subordinate clause has much less influence on this. Findings in Chapter 3 suggest that whether information is expected to be important or not, does not change how long it takes for speakers to process it. Instead, whether information is old or new and in which order information appears influences processing. Old information is processed faster than new information, and if old information comes before new information in a sentence, these sentences are processed faster than when the order is reversed.

Taken together, these results suggest that information that is more important does not take longer to process, but rather a different feature – whether information is old or new, and the order of old and new information – is shown to influence how easy or difficult it is to process sentences. However, speakers do have expectations about which clauses they believe contain important information based on where clauses appear in a sentence. While it may be less pertinent that *a fluffy Persian cat* in the example above is packaged in such a way that it is not likely to be assumed to be more important than 'the baking of a cake', there are other situations in which this is more crucial. For example, policies for how universities communicate information to their student bodies, or even policies for how the government communicates with the public, could benefit from guidelines on how to structure communications such that important information appears where it is most expected to appear.

Abstract

This PhD project investigates the sentence-structural and information-structural features of complex sentences. Specifically, this thesis investigates the influence of sentence-structural features (clause type and clause position) on at-issue status, to then probe the effects of these sentence-structural features as well as information-structural features (new/givenness of information) on the processing of complex sentences.

At-issueness refers to the status of a clause within a sentence. Does its content express the main point of a sentence (at-issue content), or a point that is more peripheral (not-at-issue content)? A clause's at-issue status is relevant for interlocutors' understanding of how to build up a representation of unfolding discourse, what emphasis and attention to place on the content of a clause, and how to make predictions about what content will be picked up going forward in subsequent sentences. There are three main theories of at-issueness. These theories agree that matrix clauses can always achieve at-issue status and that temporal adverbial clauses (TACs) are not-at-issue. However, they make contrasting predictions about the at-issue status of Appositive Relative Clauses (ARCs). Q(uestion under discussion)-at-issueness, considers content at-issue if it can felicitously answer the question under discussion. Under this view, at-issue status is an immutable property of clauses resulting from their type, and ARC content can never achieve at-issue status. P(roposal)-at-issueness considers content at-issue if it proposes an update to the common ground and C(oherence)-at-issueness considers content at-issue if subsequent discourse can coherently connect to it. Both P- and C-at-issueness theories predict ARCs to have at-issue potential in sentence-final position. Under both of these views, at-issue status is a variable property that is influenced by clause type but also clause position. This thesis is an empirical investigation into C-at-issueness divided into two main parts. The first part (Chapter 2) investigates the C-at-issue status of clauses in sentences with an ARC and sentences with a TAC [experiments 1–6]. The second part (Chapter 3) investigates effects of C-at-issue status and other information-structural and sentence-structural features on sentence processing [Experiment 7].

Chapter 2 of this thesis investigates the C-at-issue status of TACs, ARCs and the matrix clauses that subordinate these. Sentences that consist of multiple clauses are generally expected to contain one (matrix) clause that carries the main point of the utterance, the at-issue content, and other (subordinate) clauses whose content is more peripheral and therefore not-at-issue. Under C-at-issueness, ARCs are expected to achieve at-issue status in sentence-final position, but TACs are not. The C-at-issue content then in

such sentences is expected to be more likely to connect to subsequent discourse than content that is not C-at-issue. In this chapter, the results of the first six self-paced reading experiments are reported in which reading times when an ambiguous pronoun *It* is disambiguated to a referent in a subordinate clause or a matrix clause in varying positions were measured. We find that not only ARCs, but also TACs can be C-at-issue in sentence-final position, and even more so than the matrix clause that precedes them, suggesting clause position is the most important factor in determining C-at-issue status. In sentence-early position, however, we do observe differences between matrix clauses and TACs/ARCs: only matrix clauses in this position are C-at-issue, suggesting that clause type does play a role in sentence-early position. This study highlights the importance of distinguishing between different theories of at-issueness, but it also observes an interdependence between the three theories: ARCs and TACs might never achieve Q-at-issue status, but when they are C-at-issue and/or P-at-issue, they can contain the question under discussion for content which subsequently is Q-at-issue. As such, research carried out within any of the three theories could benefit from complementary inclusion of one (or both) of the other theories.

In Chapter 3 of this thesis, the processing of complex sentences with an ARC is investigated [experiment 7]. If the ARC in these sentences is in early position, it does not compete for C-at-issue status with the matrix clause: only the matrix clause is expected to be C-at-issue. Consequently, only the matrix clause needs to be held in memory to make a potential connection to subsequent discourse. When the ARC is in sentence-final position, however, this ARC competes with the matrix clause preceding it for C-at-issue status. As such, both clauses need to be held in memory to create a potential discourse connection, which would lead to processing difficulty compared to the other situation in which only one clause is likely to carry the at-issue content. We refer to this as the *at-issueness* principle. This principle, in addition to three other ordering principles – the *given-new* principle (given before new information ordering facilitates processing), the *clause structure* principle (matrix clause before subordinate clause ordering facilitates processing) and the clause-type mapping of information principle (given information in subordinate clause and new information in matrix clause facilitates processing) – are investigated in this chapter. While these three ordering principles are well-established, it is not clear if they apply to sentences with an ARC. ARCs stand out among subordinate clauses for their matrix clause-like characteristics from both a syntactic and an information-structural perspective. While we find no evidence for the *at-issueness* principle, we replicate previous studies in finding evidence for predictions made by the *given-new* principle and the *clause structure* principle in sentences containing an ARC. In addition we find indirect evidence for the special status of ARCs through the observed

behaviour of matrix clauses in sentence-early position: These seem to have a grounding function here: the matrix clause provides the context which is necessary to support understanding of the ARC. This grounding function is something which has previously been attributed to subordinate clauses.

This project sheds more light on the C-at-issue status of clauses in sentences with a TAC and in sentences with an ARC through a series of self-paced reading experiments. Results suggests that C-at-issue status is more flexible than has previously been found, and is distinct from both Q- and P-at-issue status. However, it also observes an interdependence between the three theories, suggesting that they should be investigated in a complementary fashion. While the study in Chapter 3 does not reveal C-at-issue potential to affect the processing of sentences with an ARC, it highlights the relevance of established ordering principles. When the *at-issueness* principle was investigated in tandem with these, effects of C-at-issue status might have been obscured through greater effects of clause order and information order. This leaves open questions about how and *if* at-issue status can be observed through the processing of at-issue content, and by extension, if a relation between at-issue status and processing time can even be assumed.

Contents

Abbreviations

ARC	**A**ppositve **R**elative **C**lause
HIT	**H**uman **I**ntelligence **T**ask
HWAM	**H**ey, **W**ait **A** **M**inute
QUD	**Q**uestion **U**nder **D**iscussion
RF(C)	**R**ight **F**rontier (**C**onstraint)
SPR	**S**elf **P**aced **R**eading
TAC	**T**emporal **A**dverbial **C**lause

For Barbie & Max
May you both live forever so I will never have to miss you ♡

Chapter 1

At-issueness

When communicating, speakers make assumptions about which parts of sentences contribute the main point of a sentence, and which parts are more peripheral. While it may seem that these assumptions follow naturally from the content of what has been said, there are structural features that influence whether a proposition conveys, or can convey, the main – at-issue – point of a sentence. Sentences that consist of multiple clauses are assumed to contain one clause that contributes the at-issue point and one or more other clauses that are more peripheral and therefore not-at-issue. Whether a clause is – or can be – at-issue, is studied under the umbrella of "at-issueness" (Jasinskaja, 2016; Koev, 2018; Potts, 2005, 2007). This thesis is an empirical investigation into at-issueness and how at-issue status is reflected in, and influences processing.

Preamble

During conversations, speakers make choices about how they convey information to their interlocutor(s). The ways in which speakers package information can have different repercussions. The choice of phrasing or how something is said can influence what inferences listeners draw (Manner implicature: Grice, 1975). The choice of syntactic structure can signal what is old information and what is new information is, e.g., passives can be used to place old information early in a sentence (Ward & Birner, 2006). The choice of referential form of referring expressions can signal to an interlocutor whether something is old or new information (e.g, definiteness to signal old information and indefiniteness to signal new information: Abbott, 2006). Many of these choices about how to package information are influenced by general tendencies inherent to language, such as the tendency to present old information before new information in a sentence (*given-new* principle: Gundel, 1988). Consequently, it is not just the case that speakers

'choose' to often adhere to this ordering of information, but also, that they expect to encounter it. As such, the choices we make as speakers are informed by the expectations we have about what constitutes a well-formed discourse, and vice versa, the expectations we have about what constitutes a well-formed discourse are informed by the choices we – but perhaps more importantly, speakers in general – make about how to package information.

At-issueness is another dimension of information packaging: How do speakers package information in such a way that it is clear to their interlocutor which is the more important information? Is it the case – similarly to what the *given-new* principle predicts – that the important, at-issue, information is associated with a sentential position, and/or that it is ordered relative to less important, not-at-issue information? Or, should at-issue information instead be associated with certain clause types, such that matrix clauses are more likely to host at-issue information than subordinate clauses? As I will elaborate on in the rest of this chapter, these different perspectives are met with both support and resistance in the literature on at-issueness. The goal of this chapter is to present the overarching research questions of this thesis, to provide an overview of the existing theoretical and empirical research on at-issueness, and to motivate the subsequent empirical studies of this thesis.

1.1 Theories of at-issueness

Potts (2005, 7) describes at-issue content as those contributions to discourse that "carry the main themes of a discourse" and content that speakers are "most expected to have to negotiate with before it is accepted into the common ground" (Potts, 2007, 666). These two properties of at-issue content are identified by Koev (2018, 1) as two independent theories of at-issueness. The 'main theme' of discourse is characterised by its relevance to the question under discussion (QUD), i.e., at-issue content can answer a QUD. This is captured under Q(UD)-at-issueness theories (Beaver et al., 2017; Simons et al., 2010). The second property, common ground negotiation, i.e., at-issue content proposes an update to the common ground and can be negotiated with before it enters the common ground, is captured under P(roposal)-at-issueness theories (Koev, 2013; AnderBois et al., 2015; Farkas & Bruce, 2010; Murray, 2014). The third theory Koev identifies is C(oherence)-at-issueness, which views at-issue status as connected to the capacity for content to establish a coherent relation with subsequent discourse (Hunter & Asher, 2016; Jasinskaja, 2016). Under this theory, content is, or can be, at-issue when it is at the right-edge of the discourse structure (Right Frontier, Asher & Lascarides, 2003; Polanyi, 1988; Webber, 1991).

For each theory, there are different metrics that are employed to 'diagnose' whether a clause contributes the at-issue point of a sentence. For one type of clause, matrix clauses, predictions made by the three theories align: these can be at-issue in any sentential position. Consider example (1), in which the matrix clause, underlined in (1b), is assumed to contribute the at-issue point of its sentence. It felicitously answers the QUD that follows from (1a): *What did Kathy bake?*, which makes it Q-at-issue. Its content can be directly targeted with negation as shown in (1b-i), meaning it can be negotiated with before it enters the common ground and making it P-at-issue. Lastly, its content can be re-mentioned as the discourse continues, as shown in (1b-ii), which makes it C-at-issue:

(1)   a. Kathy spent all morning baking.
      b. <u>She baked a cake for Alex</u>, who owns a fluffy Persian cat.
         i. No she didn't, she baked him a pie.
         ii. It was a birthday funfetti cake.

When instead we employ these same diagnostics to target the sentence-final appositive relative clause (ARC), underlined and repeated below in (2b), predictions made by the different theories diverge. When the answer to the QUD is contained within the ARC, the sentence in (2b) does not seem a felicitous response to the QUD posed in (2a). Therefore, the ARC content is not considered Q-at-issue. However, it is possible to target the ARC content with negation, as shown in (2b-i), making it P-at-issue. It is also possible to extract content from the ARC to be discourse continuing as shown in (2b-ii), making it C-at-issue:

(2)   a. What kind of cat does Alex own?
      b. Kathy baked a cake for Alex, <u>who owns a fluffy Persian cat</u>.
         i. No he doesn't, he owns a Maine Coon.
         ii. It's the cutest cat I've ever seen.

Predictions made by the different theories diverge, especially when it concerns ARCs. As a result, ARCs have been the clause of interest in much of the theoretical investigations into at-issue status (AnderBois et al., 2011, 2015; Jasinskaja, 2016; Koev, 2013) as well as at least one empirical study spanning a series of experiments (Syrett & Koev, 2015). One consistent issue that presents itself throughout a majority of the at-issueness literature, however, is that at-issueness is viewed as a singular concept. As a result, analyses that find evidence for the not-at-issue status of ARCs from the perspective of Q-at-issueness (as shown in Example 2), are taken as evidence for the general – immutable – not-at-issue status of ARCs. In response, other studies might then argue that ARCs in fact *can*

be at-issue, presenting evidence from the P-at-issueness (2b-i) or C-at-issueness (2b-ii) perspectives. While the studies presented in this thesis probe the C-at-issue status of clauses, and categorically do not make predictions about Q-at-issueness or P-at-issueness, it is important to engage with all three theories. Firstly, the main clause of interest in this study – the ARC – has been at the heart of debates in at-issueness studies spanning all three theories. It has been the source of questions and discussions in all three theories. Secondly, while the three theories can be seen as distinctive, there is not just overlap, but, as I will elaborate on in the general discussion, also interdependence between the three theories.

This thesis is an empirical investigation into C-at-issueness through a series of self-paced reading (SPR, Just et al., 1982) experiments. Because of the diverging predictions different theories make about the at-issue status of ARCs, it is important we distinguish between theories to then delimit the scope of our experimental studies to C-at-issueness specifically. Our findings have direct implications for theories of C-at-issueness, but as I will discuss, also have potentially wider-ranging implications for studies of at-issueness in general. In the second chapter, I present six experiments which probe the C-at-issue status of matrix clauses, ARCs and temporal adverbial clauses (TACs). The aim of Chapter 2 is to answer the following two questions:

- What is the influence of clause type and clause position on the C-at-issue status of clauses in sentences with an ARC and sentences with a TAC?

- How can our findings be integrated into existing theories of (C-)at-issueness?

We find that clause position is the most important factor in predicting C-at-issue status: Any clause in sentence-final position (matrix clause, ARC or TAC) can be C-at-issue, and more so than the clause that precedes it. That said, matrix clauses in sentence-early position *can* be C-at-issue, whereas ARCs and TACs cannot. Following this, Chapter 3 investigates whether sentences with an ARC are processed faster when only the matrix clause can be C-at-issue (ARC-matrix clause order), compared to when both clauses can be C-at-issue (matrix clause-ARC order). This expectation that sentences are harder to process when both clauses can be C-at-issue will be referred to as the *at-issueness* principle, and will be investigated together with other ordering principles that have previously been shown to influence sentence processing, but for which it is not clear if their predictions apply to sentences with an ARC. The aim of Chapter 3 is to answer the following research question:

- Does the *at-issueness* principle accurately predict sentence processing in interaction with other ordering principles for sentences containing an ARC?

A more detailed introductions to Chapter 2 will be given at the end of the current chapter, and a more detailed introduction to Chapter 3 will be given at the end of Chapter 2.

In the remainder of the current chapter, I will present an overview of the three main strands of at-issueness: Q-, P- and C-at-issueness. I highlight where predictions made by these theories overlap and contrast for the clause types under investigation. I will provide evidence through diagnostic tests available for each theory, as well as empirical evidence when available to further support the diagnostic tests, for the at-issue status of matrix clauses, the varying at-issue status of ARCs, and the not-at-issue status of another type of subordinate clause, the TAC. Contrary to ARCs, the different theories do align in their predictions about TACs: these are considered not-at-issue in any sentential position. This makes them an ideal candidate to test in tandem with matrix clauses, for which all theories predict they *can* achieve at-issue status. Following this, I will review additional evidence for the special status of ARCs among subordinate clauses, but specifically compared to TACs: ARCs behave like matrix clauses in at least two distinctive ways. Firstly, ARCs can exhibit patterns that are usually constrained to a main/matrix clause environment (root phenomena, de Vries, 2012; Emonds, 1970; Green, 1976; Heycock, 2017; Hooper & Thompson, 1973), whereas TACs typically resist these patterns. Secondly, ARCs can contribute a speech act that is independent from the one in the matrix clause (de Vries, 2012; Emonds, 1970; Green, 1976; Heycock, 2017; Hooper & Thompson, 1973), whereas TACs are always part of the same speech act as the matrix clause (Hengeveld, 1989; Frey, 2012). To conclude this chapter, I will summarize the evidence that is relevant for the subsequent empirical study in Chapter 2, and how the evidence informs expectations for this study.

1.1.1 Q-at-issueness

The view of discourse as being structured by QUDs (Büring, 2003; Ginzburg, 1996, 2012; Roberts, 2012; Kuppevelt, 1995; Von Stutterheim & Klein, 1989) is fundamental to Q-at-issueness theory. These QUDs are usually not all uttered explicitly as questions, rather, more often than not they are implicit to discourse segments. Each sentence within a discourse is expected to address a QUD. Under this view, discourse-structural relations between sentences can be seen as following from the relations between questions they address (Kuppevelt, 1995; Von Stutterheim & Klein, 1989). The information structure of sentences is directly relevant for the QUD-based approach to analysing discourse. The internal structure of a sentence can reflect which part of the sentence is foregrounded (for example, a matrix clause) and which part is backgrounded (for example, an ARC).

Similarly to question-answer pairs, information which is relevant to the question is expected to be foregrounded material in the answer sentence, and information which is not or less relevant is expected to be backgrounded (see Roberts (1996)).

Under Q-at-issueness, those propositions in discourse that are both informative to the QUD and appropriately conventionally marked to answer the QUD, are considered Q-at-issue. This means that in order for content to be Q-at-issue, it is not just important that it provides a relevant answer to the QUD, but also that it is packaged such that the sentence containing the answer to the QUD, can be uttered in full as an answer to said QUD. This distinction was highlighted in examples (1) and (2) above, for which the Q-at-issueness diagnostics are repeated below in (3) and (4). The sentence in (3b) provides a felicitous response to the QUD posed in (3a), with the answer to the QUD being contained in the (foregrounded) matrix clause (underlined), making it Q-at-issue. If this pattern whereby foregrounded material is relevant to the QUD, is violated such that backgrounded material instead is relevant to the QUD, this leads to question-answer incoherence, as is shown in (4). Here, (3b) is repeated in (4b), where it is not a felicitous response to the QUD posed in (4a), with the answer to the QUD being contained in the (backgrounded) ARC (underlined). The ARC then would be analysed as not-at-issue under Q-at-issueness.

(3)   a. What did Kathy bake?
      b. <u>Kathy baked a cake for Alex</u>, who owns a fluffy Persian cat.

(4)   a. What kind of cat does Alex own?
      b. Kathy baked a cake for Alex, <u>who owns a fluffy Persian cat</u>.

While the examples above showcase the generally held assumption that under Q-at-issueness matrix clauses are always at-issue, but that ARCs can never achieve at-issue status, there are cases that highlight the potential for ARCs to be Q-at-issue. It is possible for an ARC to felicitously answer a partial QUD when the matrix clause answers the other part of this QUD (cf. Simons et al., 2010, 316):

(5)   a. What did Kathy bake and why?
      b. Kathy baked a cake for Alex, who just received a promotion.

The difference between (4b) and (5b) can be explained in terms of their sub-question structure (see Büring, 2003, 515). In (5), the QUD that is answered by the matrix clause in (5b), *What did Kathy bake?*, can be seen as a sub-question of the QUD answered by the ARC in (5b), *Why did Kathy bake a cake?*. The information provided in the

matrix clause (*Kathy baked a cake for Alex*) facilitates the *Why?* question, the answer to which is subsequently hosted by the ARC. This in contrast to the QUDs answered by the individual clauses in (4b): *What did Kathy bake?* (matrix clause) and *What kind of cat does Alex own?* (ARC), which can not be seen as exhibiting a similar sub-question structure. The QUD answered by the ARC (*What kind of cat does Alex own?*) cannot be seen as logically following from the assertion that *Kathy baked a cake for Alex.*

Note that in (5a), if we reduce the QUD to *Why did Kathy bake a cake?*, the sentence in (5b) seems to provide a less felicitous answer to this question, because the answer is packaged in an ARC and as such is not appropriately conventionally marked to felicitously do so. Consequently, one might still argue that at the very least the matrix clause is either more at-issue, or the more likely host for the at-issue content than the ARC in the same sentence. However, it is also possible for an ARC to appear more Q-at-issue than the matrix clause that subordinates it. The following example (6) from (Syrett & Koev, 2015, 571) evidences this:

(6)   a. Why is Mary fundraising for the upcoming Walk for Cancer?

   b. She took care of her husband, who had prostate cancer, for almost a year.

The QUD posed in (6a) is felicitously answered by the sentence in (6b), even though the content in this sentence that provides the answer to the QUD is hosted by an ARC. In this case, the content in the matrix clause is less relevant to the QUD, and as a result, seems less Q-at-issue. While it is imperative to understand that Mary's husband suffered from cancer in order to resolve the QUD in (6a), this information is mapped onto the object of the matrix clause, *her husband*, which is Q-at-issue. However, it should be noted that example (6) is different from (5) in that the matrix clause in (5b) answers a different QUD (*What did Kathy bake?*) than the ARC (*Why?*), whereas in (6b), both the matrix clause and the ARC are interpreted to be informative to the same QUD, posed in (6a). As such, there is a coherent sub-question structure like in (5), but in the case of (6), the QUD answered by the ARC (*What did Mary's husband suffer from?*) is a sub-question of the QUD answered by the matrix clause (*Who did Mary take care of?*). In contrast, in (5) the matrix clause answered a sub-question of the QUD that was answered by the ARC.

This relevance of the matrix clause becomes even clearer when we construct an example like (7). In this example it is again the ARC that provides the most relevant information towards resolving the QUD posed in (7a):

(7)   a. Why didn't John come to the party?

    b. Because he talked to his neighbour, who thought it was a terrible idea.

We could attempt to paraphrase the response in (7b) as *His neighbour thought it was a terrible idea*, and assume that this means the ARC is Q-at-issue, but this obscures the fact that John had to talk to his neighbour to find this out. In fact, if the interlocutors were both aware of John having a neighbour who really doesn't like this party, the content in the ARC would have been presupposed by only uttering *Because he talked to his neighbour*. While it is clear that ARCs can contribute content that is relevant to the QUD, and sometimes even more relevant than the matrix clause content, when doing so they rely on (at least part of) the assertion made in the matrix clause. The matrix clause then functions as the appropriately conventionally marked vehicle through which the assertion made in the ARC can felicitously answer the QUD. The ARC itself would still be considered to not be appropriately conventionally marked to do so, and not Q-at-issue.[1]   The sub-question structure is similar to that of (6b): the QUD answered by the ARC (*What did his neighbour say?*) is a sub-question of the QUD answered by the matrix clause (*Who did John talk to?*).

The analysis of TACs under Q-at-issueness is more straightforward in that they do not present any possible competition for at-issue status with the matrix clause that subordinates them. However, the relation the adverbial establishes between the matrix clause and the TAC does seem to be Q-at-issue. In example (8) below, the sentence containing the TAC in (8c-i) is a felicitous answer to both the QUD provided in (8a), which targets the matrix clauses, and the QUD provided in (8b), which targets the relation between the two clauses expressed by the adverbial. This same sentence, however, is not a felicitous answer to the QUD posed in (8c)), which targets the content in the TAC:

(8)   a. What did Kathy bake?

        b. When did Kathy bake a cake?

        c. What did Kathy buy?

            i. She baked a cake for Alex after she bought a spatula.

While from this example it does indeed seem that the relation expressed by *after* is Q-at-issue, it is important to note that the QUD in (8b) is one that can only be posed by repeating the assertion made in the matrix clause: *Kathy baked a cake (for Alex)*. As such, the matrix clause functions as the vehicle through which the relation expressed by *after* can be accessed. Moreover, the QUD *When did Kathy buy a cake?* answers a QUD inherent to the matrix clause *What did Kathy bake?* by being posed.

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[1]In a similar vein to example (7), Simons et al. (2010, 323) discuss how ARCs that seem to answer a (partial) QUD (as in their example (27)) are in fact not Q-at-issue.

To conclude, under Q-at-issueness, ARCs are not-at-issue, even if they indirectly contribute content that is relevant to the QUD. Rather, they can contribute relevant information to the assertion made in the matrix clause, which in turn answers the QUD and is Q-at-issue. In a similar fashion, the relation expressed by the adverbial in TACs contributes relevant information to the matrix clause assertion, but neither this relation nor the TAC content itself achieve Q-at-issue status.

1.1.2 P-at-issueness

Under P-at-issueness, clauses are at-issue when their content is a proposal to update the common ground (Koev, 2013; AnderBois et al., 2015; Farkas & Bruce, 2010; Murray, 2014). If a clause proposes an update to the common ground, meaning that its content can be negotiated with before it is accepted into the common ground, it is considered P-at-issue. The common diagnostic used in the at-issueness literature for testing whether a clause proposes such an update is the assent/dissent test (Murray, 2010; Tonhauser, 2012). If content can be directly assented or dissented with, it is considered P-at-issue. Consider again the sentence in (9), followed by two instances of the assent/dissent test. The first (9a) directly rejects the assertion made in the matrix clause, the second (9b) the assertion in the ARC:

(9) Kathy, who owns a fluffy Persian cat, baked a cake for Alex.
   a. No she didn't, she baked him a pie.
   b. # No she doesn't, she owns a Maine Coon.

While the matrix clause can be directly targeted with rejection, the ARC – here in sentence-early position – does not appear a felicitous target for direct rejection (cf. Amaral et al., 2007). Consequently, the matrix clause would be considered P-at-issue, but the ARC would not. If the order of clauses is reversed such that the matrix clause is in sentence-early position and the ARC in sentence-final position, as in (10), both clauses appear to be P-at-issue:

(10) Kathy baked a cake for Alex, who owns a fluffy Persian cat.
   a. No she didn't, she baked him a pie.
   b. No he doesn't, he owns a Maine Coon.

Direct rejection targeting the matrix clause (10a) as well as direct rejection targeting the ARC (10b) proceed felicitously. This in contrast to the Q-at-issue status of ARCs, which were analysed as immutably not-at-issue under Q-at-issueness in any position.

When we apply the assent/dissent diagnostic to a sentence containing a TAC, results align more with results from the Q-at-issueness diagnostic in example (8):

(11)   Kathy baked a cake for Alex after she bought a spatula.

    a. No she didn't, she baked him a pie.

    b. ? No she didn't, she baked it before (she bought a spatula).

    c. # No she didn't, she bought a baking mold.

The assertion in the matrix clause in (11) can be directly rejected, as shown in (11a), whereas the assertion in the TAC does not seem a felicitous target for direct rejection (11c). However, it does seem possible to negotiate with the relation expressed with the adverbial *after*, as shown with (11b). If, for example, *before* is focused prosodically in the response in (11b), it proceeds easily. In addition, because *before* has to be focused, it clearly shows that the relation is targeted and not the content. All things considered, the matrix clause does seem the most likely candidate for P-at-issueness in the example above. This finding is in contrast to what we observe in example (10), where both the matrix clause and the ARC seemed equally felicitous targets for direct rejection.

Another test available to diagnose the P-at-issue status of clauses, is the *Hey, wait a minute* test (HWAM, e.g., Amaral et al., 2007). Rather than testing if an assertion is P-at-issue, it tests for the not-at-issue status of content. Consider again the sentence in (9) repeated here in (12), but here followed with a HWAM response to the each clause:

(12)   Kathy, who owns a fluffy Persian cat, baked a cake for Alex.

    a. # Hey, wait a minute, didn't she bake him a pie?

    b. Hey, wait a minute, doesn't he own a Maine Coon?

The response that targets the matrix clause content in (12a) seems less felicitous than the response that targets the ARC content (12b), providing additional evidence that the matrix clause is P-at-issue and the ARC – in sentence-early position – is not. When we apply this diagnostic to the sentence with the TAC in (11), repeated below in (13), the relation expressed with *after* seems a felicitous target for HWAM, as shown in (13b):

(13)   Kathy baked a cake for Alex after she bought a spatula.

    a. # Hey, wait a minute, didn't she bake him a pie?

    b. Hey, wait a minute, didn't she bake him a cake before (she bought a spatula)?

    c. Hey, wait a minute, didn't she buy a baking mold?

For the HWAM response to be felicitous here, however, it would require prosodic focus marking on *before* in the response. As such, it is still not possible to fully rule out the relation expressed by *after* as P-at-issue. This observation, as well as the less felicitous response in (13a) where HWAM targets the matrix clause content, and the felicitous response in (13c) where HWAM targets the TAC content, fully overlaps with the results from the assent/dissent test in example (11). This overlap adds more certainty to the prediction that the matrix clause in sentences with a TAC is P-at-issue, and the TAC is not.

However, evidence from Syrett & Koev (2015, Experiment 1) leads them to question the validity of the HWAM test for not-at-issue status. They designed an experiment with several manipulations, in one of which participants were asked to choose between a HWAM response and a direct rejection, both of which targeted an ARC in one condition (14a), and a matrix clause in the other condition (14a), in varying positions (in the example below (14) the matrix clause is in sentence-final position and the ARC in sentence-early position):

(14)   My friend Sophie, who is a classical violinist, performed a piece by Mozart.

    a. ARC target

       i. That's not true. Sophie isn't a classical violinist.

       ii. Hey, wait a minute. Sophie isn't a classical violinist.

    a. matrix clause target

       i. That's not true, She didn't perform a piece by Mozart.

       ii. Hey, wait a minute. She didn't perform a piece by Mozart.

    (Syrett & Koev, 2015, 537)

While they found a significant difference such that HWAM was more often chosen for ARCs than direct rejection, they did not find an effect in the other direction for matrix clauses. In fact, HWAM was chosen to reject the matrix clause content 54.4% of the time. Consequently, they argue that HWAM might not be the most appropriate tool to diagnose not-at-issue status.

In Syrett & Koev (2015, Experiment 2), they tested which clause in sentences with an ARC was the more likely target for direct rejection, reflecting the assent/dissent test. They designed an experiment in which participants were asked to choose between two direct rejections. One of which targeted the matrix clause, and one of which targeted the ARC. Position of clauses varied between conditions. In (15a), the ARC is in sentence-early position and the matrix clause in sentence-final position. In (15b), the matrix clause is in sentence-early position and the ARC in sentence-final position:

(15)   a. My friend Sophie, who performed a piece by Mozart, is a classical violinist.

       i. No she's not. (target: ARC)

      ii. No she didn't. (target: matrix clause)

   b. The symphony hired my friend Sophie, who performed a piece by Mozart.

       i. No, she didn't. (target: ARC)

      ii. No, they didn't. (target: matrix clause)

(Syrett & Koev, 2015, 542)

In both conditions, participants chose to target the matrix clause with direct rejection significantly more often than the ARC. Sentence-final ARCs, however, were more often chosen as the target for direct rejection than sentence-early ARCs, which suggests that ARCs are more P-at-issue in sentence-final position than in sentence-early position. While these results show that matrix clauses in any position are more likely to be P-at-issue than ARCs in any position, they also show that the position of an ARC in a sentence impacts its P-at-issue potential.

To conclude, under P-at-issueness, ARCs can be at-issue in sentence-final position, or – at the very least – their potential to be at-issue increases in sentence-final position, but TACs are not at-issue in any position.

1.1.3   C-at-issueness

The view of discourse as structured by coherence relations (Asher & Lascarides, 2003; Hobbs, 1979; Kehler, 2002; Mann & Thompson, 1988) is central to C-at-issueness. Under this view, newly uttered clauses must attach to some part of the discourse preceding them through a coherence relation. Clauses are considered C-at-issue if "a freshly uttered segment can attach to it by some appropriate coherence relation" (Koev, 2018, 8). The expectation for discourse units to be connected in a meaningful way – under the assumption that discourse proceeds coherently – leads to comprehenders drawing inferences. Consider the example below (adapted from Hobbs, 1979, 67; Kehler, 2002, 2):

(16)   a. Kathy baked a cake for Alex. It's his birthday tomorrow.

   b. Kathy baked a cake for Alex. She likes cats.

Interpretation of the sentence pair in (16a) proceeds easily: the inference that the second sentence explains the event in the first sentence can be drawn naturally. The sentence pair in (16b) is more difficult to interpret because there is no obvious coherent connection between the two sentences (Koev, 2018, 7).

The example above serves to illustrate the difference between a coherent and a less coherent connection being established between discourse units, but under C-at-issueness it is more important to consider the *potential* for a coherent discourse connection to be established between a discourse segment and a yet-to-be-uttered subsequent discourse segment. This potential is captured under the Right Frontier Constraint (RFC, Asher & Lascarides, 2003; Polanyi, 1988; Webber, 1991). The RFC predicts that only discourse units that are placed at the right edge of the discourse-structure (the Right Frontier, RF) are available for attachment by a subsequent discourse segment. Coherence-based accounts of at-issueness take the RF to be inextricably linked with at-issue status: discourse units on the RF are C-at-issue (Hunter & Asher, 2016; Jasinskaja, 2016). The RF of discourse is defined as consisting of the last added discourse segment as well as any discourse segments the last added segment is discourse subordinate to (Hunter & Asher, 2016).

For example, in (17), adapted from Asher & Lascarides (2003, 8), a short series of events is described in (17a)-(17d). All of these events stand in a certain relation to each other, making them either available to establish a coherent attachment with subsequent discourse by virtue of being on the RF, or not. The first discourse segment (17a) scopes over the three that follow it (17b)-(17d), which provide an elaboration on what is mentioned in (17a). The segment in (17d) is the last added segment of the (17a)-(17d) sequence and is at the RF because of this. There are two segments that (17d) is structurally subordinate to: (17a) and (17b). (17d) is directly subordinate to (17b): *He devoured lots of cheese* is an elaboration of *He had a great meal*. (17b) is directly subordinate to (17a): *He had a great meal* is an elaboration of *Max had a great evening last night*. Through these subordinating relations, both (17a) and (17b) are at the RF and can establish coherent connections with subsequent discourse: The sequences (17a-17d)→(17d-i) and (17a-17d)→(17d-ii) thus proceed felicitously. The segment in (17c), however, is not at the RF. The last uttered segment is not structurally subordinate to it, rather the relation between (17c) and (17d) is coordinating.[2]   Consequently, attachment to the series of events in (17a-17d) with (17d-iii) does not proceed felicitously. Lastly, the segment in (17d) is at the RF by virtue of being the last-uttered segment. Attachment with (17d-iv) therefore proceeds felicitously:

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[2]Such a coordinating relation can also occur between matrix clauses and ARCs in the same sentence. Consider the sentence from example (15b), repeated here in (i) but with the adverb *then* added in the ARC. This leads to the relation between the matrix clause and the ARC being coordinating rather than subordinating:

(i)   The symphony hired my friend Sophie, who *then* performed a piece by Mozart.

As a result, the matrix clause is no longer expected to be at the RF, and therefore is not at-issue under C-at-issueness theories. In this thesis, the relation expressed between the matrix clause and the ARC in sentences with an ARC (in experimental items and examples, modulo the example in the current footnote) is always a subordinating one, never coordinating.

(17)   a. Max had a great evening last night.

    b. He had a great meal.

    c. He ate salmon

    d. He devoured lots of cheese.

        i. Tonight he has nothing planned.

       ii. He then won a dancing competition.

     iii. # It was Alaskan caught.

     iv. The Gorgonzola was his favourite.

(adapted from Asher & Lascarides, 2003, 8)

A simplified representation of the relations between the discourse segments in (17a)-(17d) is shown in fig. 1.1. In this figure, (17a), (17b) and (17d) are at the 'right edge' of the discourse structure and can subsequently establish a coherent connection with the subsequent discourse segments in (17d-i), (17d-ii) and (17d-iv) respectively. (17c), however, is one step removed from this right edge of the structure as it is being 'blocked' by (17d), with which it stand in a coordinating relation. Consequently, there is no felicitous attachment site available for (17d-iii).

FIGURE 1.1: Simplified representation of the discourse-structure of (17a)-(17d): segments connected with solid arrows. The possible subsequent segments (17d-i)-(17d-iv) are connected to their attachment site with dashed arrows (adapted from Asher & Lascarides, 2003, 13).
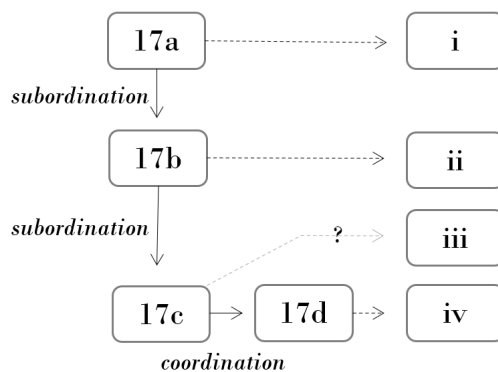
Unlike with Q- and P-at-issueness, there is no widely agreed-upon diagnostic to measure C-at-issue status other than RF-diagnostics. There have, however, been experiments that probed the C-at-issue status of clauses. Two such experiments employed ellipsis to measure at-issue status. Under C-at-issueness, it would be more likely for ellipsis to resolve to an antecedent in a clause that is at the RF, where it is available for attachment. In Frazier & Clifton (2005, Experiment 6), participants were given a sentence with a matrix clause and a TAC in varying positions (e.g., in (18) with the matrix clause in sentence early position and the TAC in sentence-final position), followed by a sentence with

the adverb *too*, which could be resolved to one of two possible verb phrase antecedents. Participants were asked to choose between two responses: one response resulted in verb phrase ellipsis to be resolved to an antecedent in the matrix clause (18a), the other to an antecedent in the TAC (18b):

(18) Mary laughed after she made a joke about the supervisor.
      Then Tina did too.
      a. Tina laughed. (target: matrix clause)
      b. Tina made a joke. (target: TAC)
      (Frazier & Clifton, 2005, 18-19)

They found that verb phrase ellipsis was resolved to the proposition of the matrix clause significantly more so than the proposition in the TAC, with matrix clause resolution being chosen 70% of the time. They found no effect of clause position. While this result shows that matrix clauses are always more C-at-issue than TACs, it does not completely rule out TACs as having the potential to be C-at-issue. Asher (2008), however, provides a possible explanation for this through the observed presuppositional nature of TACs. I similarly showed this with the assent/dissent diagnostic in section 1.1.2, which suggested that TACs are not felicitous targets for direct rejection. Because of their content being of a presuppositional nature, their content is only open for attachment when they stand in a causal relation to the content in the matrix clause. As such, the matrix clause serves as the vehicle through which the TAC content can be indirectly targeted. This is shown in example (19), in which there is causal relation between the TAC and the matrix clause in (19a), but not in (19b). Consequently, the follow-on clause *But I'm not sure what* only establishes a coherent connection with the preceding TAC in (19a):

(19) a. John died after he ate something poisonous, but I'm not sure what.
      b. ? John survived after he ate something poisonous, but I'm not sure what.
          (Asher, 2008)

In a similar vein, (Syrett & Koev, 2015, Experiment 3) tested whether the source of an elliptical question *Why?* was more likely to be hosted by a matrix clause or an ARC in the preceding sentence. Participants were given a sentence with a matrix clause and an ARC in varying positions (e.g., in (20) with the matrix clause in sentence-early position and the ARC in sentence-final position), followed by the question *Why?*. This question was then followed by two possible answers from which participants had to choose one: either they chose the answer that targeted the matrix clause as containing the answer to the question (21a), or an answer that targeted the ARC (21b):

(20)   The 'All Stars' Dance Company has chosen to audition Chloe, who decided to dress in a classical ballet style.

(21)   *Why?*

    a.   Because they think Chloe could be a good addition to their company. (target: matrix clause)

    b.   Because she wants to be taken seriously as a classical ballet dancer. (target: ARC)

(Syrett & Koev, 2015, 47)

They found that overall, participants chose the matrix clause and the ARC at similar rates for providing the answer to the *Why?* (matrix clause 51.7%, ARC 48.3%). This finding would mean that both clauses were equally likely targets for being C-at-issue. However, they found a difference when the position of clauses was taken into account. If the ARC was in sentence-early position, the matrix clause was chosen significantly more often as containing the answer to *Why?*, whereas when the ARC was in sentence-final position, it was chosen more often than the matrix clause. These results suggest that ARCs can be C-at-issue, and even compete with the matrix clause for C-at-issue status when they are in sentence-final position.

Lastly, Holler & Irmen (2007) employed pronoun resolution of ambiguous pronouns as an experimental diagnostic to measure if participants were more likely to choose an antecedent that was hosted by a clause that was on the RF. Similarly to example (17), they presented participants with short stories in which the sentences were standing in differing relations (subordinating or coordinating) to each other. The original experiment was presented in German, but Holler & Irmen (2007) provide translations for their examples, which I have used here. An example condition is shown in (22). This short story was followed by a sentence containing an ambiguous pronoun (*she/he*) for which the story provided two possible referents. Participants were then asked to choose which of the referents was the antecedent for this pronoun. The two possible antecedents for the ambiguous pronoun *she* in (22e-i) are in (22a) and (22d) (underlined). The possible antecedent in (22a), *the student*, is hosted by a clause that structurally subordinates both the segment in (22b) and the string of segments (22c)-(22d)-(22e). As a result, the segment in (22a) is at the RF. The other possible antecedent for *she* is contained (underlined) in the segment in (22d): *the fellow student*. The segment and the one that follows it (22e) stand in a coordinating relation. Consequently, (22d) is not at the RF:

(22)   a.   In the morning <u>the student</u> went to the university

    b. because it was time to attend the lecture in advantages and disadvantages of Kant's categorical imperative.

    c. The lecture hall was busy.

    d. <u>The fellow student</u> was as always in a bad mood

    e. and nobody listened.

        i. In the afternoon <u>she</u> still had many things to do.

(Holler & Irmen, 2007, 21)

(23)   Who was the one who had to do many things?

Participants chose referents hosted by a discourse segment at the RF significantly more often as antecedents than referents in discourse segments that were not at the RF. As such, it can be argued that ambiguous pronoun resolution is a productive diagnostic for measuring C-at-issue status. This is why we will be using a related methodology that uses coreference as a way to measure the C-at-issue status of matrix clauses, TACs and ARCs in the SPR-study presented in Chapter 2. Using a SPR-methodology is also what sets our study apart from the previous investigation into C-at-issueness: all of these used offline methodologies which may have missed subtleties or varying patterns that might become visible in participants' moment-by-moment processing.

To conclude, under C-at-issueness, ARCs in sentence-final position can be at-issue, but those in sentence-early position do not seem likely candidates to host at-issue content. TACs, in contrast, do not seem likely hosts for C-at-issue content in any position, but they cannot be completely ruled out as having C-at-issue potential based on the empirical evidence presented in this section. That said, this evidence does support the notion that matrix clauses are always more C-at-issue than TACs.

1.1.4   The special status of appositive relative clauses

A possible explanation for why ARCs and TACs differ with respect to their potential to contribute the (P- or C-)at-issue point of a sentence can be found in their syntactic characteristics. ARCs, unlike TACs, can exhibit root phenomena. These patterns, such as verb phrase preposing, negative constituent preposing, and topicalization, are generally constrained to main/matrix clause environments (de Vries, 2012; Emonds, 1970; Green, 1976; Heycock, 2017; Hooper & Thompson, 1973). Consider below in (24) the difference in meaning between ARCs and their restrictive relative clause counterparts when the verb phrase is preposed to the adverbial *unfortunately*:

(24) a. The driver, who took a wrong turn, unfortunately, managed to find the house anyway.

b. # The driver that took a wrong turn, unfortunately, managed to find the house anyway.
(Hooper & Thompson, 1973, 489-490)

When *unfortunately* is postposed to the verb phrase in the ARC as in (24a), it modifies the verb phrase in the ARC, leading to the interpretation that the driver 'unfortunately took a wrong turn', whereas when this same adverbial is postposed to the verb phrase in the restrictive relative clause (24b), *unfortunately* modifies the verb phrase in the matrix clause. In this case, the interpretation is that 'the driver unfortunately managed to find the house', which, while grammatical, seems infelicitous.

When instead the adverbial is preposed to the verb phrase, as in (25), *unfortunately* modifies the verb phrase in both the ARC (25a) and the restrictive relative clause example (25b):

(25) a. The driver, who unfortunately took a wrong turn, managed to find the house anyway.

b. The driver that unfortunately took a wrong turn, managed to find the house anyway.
(adapted from Hooper & Thompson, 1973, 489-490)

This same restriction we observe for restrictive relative clauses also applies to TACs. When the adverbial *unfortunately* is preposed to the verb phrase, it modifies the verb phrase in the TAC (26a), whereas when the verb phrase is preposed to the adverbial, it modifies the verb phrase of the matrix clause (26b), and as such, the entire sentence, leading to an infelicitous reading:

(26) a. The driver managed to find the house after he unfortunately took a wrong turn.

b. # The driver managed to find the house after he took a wrong turn, unfortunately.
(adapted from Hooper & Thompson, 1973, 489-490)

The possibility to modify the verb phrase in an ARC with a postposed adverbial, is one of many patterns that are generally restricted to main/matrix clause environments that can also occur in ARCs (and parenthetical relative clauses), but not TACs.

Another feature that distinguishes ARCs from TACs, is that ARCs are able to express a speech act that is illocutionary independent from the speech act expressed by the matrix clause (Frazier et al., 2018; Jasinskaja & Poschmann, 2018; Koev, 2013; Syrett & Koev, 2015), whereas TACs are always part of the speech act expressed by the matrix clause (Hengeveld, 1989; Frey, 2012). Frazier et al. (2018) claim that in the example below (27), the performative adverb *hereby* is acceptable in (27a), leading to two distinct speech acts being expressed by the matrix clause and the ARC in this sentence. However, including this same speech act adverb in a restrictive relative clause (27b), results in an odd sentence:

(27)   a.   This boy, who I hereby christen Jonathan, will grow up to be a giant among men.

　　　 b.   # This boy that I hereby christen Jonathan will grow up to be a giant among men.
　　　　　 (Frazier et al., 2018, 202)

When we attempt to modify the speech act in a TAC, this leads to an even more jarring reading. Compare the sentences in example (28). When the speech act adverbial *hereby* is inserted in the TAC, as in 28b, this leads to an unacceptable sentence:

(28)   a.   After I christen this boy, he will grow up to be a giant among men.

　　　 b.   # After I hereby christen this boy, he will grow up to be a giant among men.
　　　　　 (adapted from Frazier et al., 2018, 202)

Similarly to the examples above, modifying the speech act in an ARC by inserting a tag question (29a), doesn't lead to any problems for interpreting the sentence. However, when we do the same with a restrictive relative clause (29b), this leads to unacceptability. When the subject of the matrix clause depends on a restrictive relative clause for interpretation, it cannot be targeted with a question.

(29)   a.   Cameron – who was talking to Gloria a minute ago, wasn't he?
　　　　　 – has gone home.

　　　 b.   # The guy – that was talking to Gloria a minute ago, wasn't he?
　　　　　 – has gone home.
　　　　　 (adapted from Syrett & Koev, 2015, 567)

Similarly to restrictive relative clauses, TACs also do not allow for the insertion of a tag question which would distinguish the TAC speech act from the one expressed by the

matrix clause (30b). However, this can easily be solved by inserting an ARC within the TAC, which in turn can felicitously host the tag question (30c):

(30)   a. Cameron went home after he talked to Gloria, didn't he?

   b. # After Cameron talked to Gloria – didn't he? – he went home.

   c. After Cameron talked to Gloria – which he did, didn't he? – he went home.
       (adapted from Syrett & Koev, 2015, 567)

The above evidence lends support to a perspective whereby ARCs pattern with main/matrix clauses with respect to their capacity for exhibiting root phenomena and expressing an independent speech act, whereas TACs do not exhibit these main/matrix clause-like features. While the evidence presented in the current section and the preceding sections on at-issueness largely give rise to the same view – ARCs are more similar to main/matrix clauses than TACs –, the evidence points in different directions for ARCs in sentence-early position. Under none of the at-issueness theories do these ever seem to be capable of achieving at-issue status, but they can, just like their sentence-final counterpart, exhibit root phenomena and express an independent speech act in sentence-early position. While this difference cannot be explained in light of the evidence presented thus far, the experimental evidence in the next chapter sheds some light on this. We find that ARCs and matrix clauses pattern together in sentence-final position where they are both C-at-issue, but also in sentence-early position when both of these clauses are less C-at-issue than the clause that follows them. This poses no problem for the evidence presented in the current section, but it highlights a potential caveat in C-at-issueness theories, which do not predict matrix clauses have a different C-at-issue potential depending on their position in a sentence. I will come back to the ramifications I believe our findings have for C-at-issueness theories in the general discussion.

1.1.5   Summary

The different at-issueness theories make predictions that largely overlap for matrix clauses and TACs: matrix clause can (almost) always be at-issue, and TACs never seem likely hosts for at-issue content (with the potential exception of the relation expressed with the temporal adverbial). These same predictions also overlap with what follows from the discussion regarding root phenomena and the capacity for hosting an independent speech act: TACs do not behave like matrix clauses in either respect. However, predictions made by the different at-issueness theories diverge when it concerns ARCs: under Q-at-issueness these clauses never achieve at-issue status, but under both P- and C-at-issueness, their at-issue potential increases when they appear in sentence-final position.

Under P-at-issueness, ARCs have more at-issue potential in sentence-final position than in sentence-early position, but not more so than the matrix clause in either case. Under C-at-issueness, however, ARCs in sentence-final position seem to compete for at-issue status with the matrix clause that precedes them.

1.1.6   What's next?

The remainder of this thesis is divided over four chapters. Chapters 2 and 3 present empirical investigations into C-at-issueness. These chapters are followed by a General Discussion in Chapter 4, and the Conclusion in Chapter 5.

Chapter 2 investigates the C-at-issue status of clauses in sentences with a TAC [Experiments 1-3] and sentences with an ARC [experiments 4–6]. The aim of this chapter is to answer the following overarching research questions:

- What is the influence of clause type and clause position on the C-at-issue status of clauses in sentences with an ARC and sentences with a TAC?

- How can our findings be integrated into existing theories of (C-)at-issueness?

This chapter reports the results of six self-paced reading experiments [Experiments 1-6], in which reading times are measured when a temporarily ambiguous pronoun *It* is disambiguated to an antecedent in a TAC, and ARC, or a matrix clause. We find that matrix clauses, TACs and ARCs can be C-at-issue in sentence-final position, and more so than the clause that precedes them.

We find no evidence that clause type matters in sentence-final position: No differences were observed between matrix clauses and ARCs in this position with respect to their C-at-issue potential. When the C-at-issue status of sentence-early clauses is considered, however, we find that only matrix clauses have C-at-issue potential. This suggests that clause type does play a role in sentence-early position. Taken together, our findings suggest that theories of C-at-issueness could be adapted to include recency as the most important determiner of C-at-issue status, after which C-at-issue potential is further influenced by clause type and type of subordination for non-recent discourse segments. Furthermore, Chapter 2 highlights the importance of distinguishing between different theories of at-issueness. Subordinate clauses that are C-at-issue generally cannot directly answer a QUD, but they can pose a QUD which subsequently can be answered by a discourse segment that is Q-at-issue. We suggest that this allows for a perspective whereby C-at-issue discourse segments feed into Q-at-issueness by facilitating the QUD which makes a subsequent discourse segment Q-at-issue.

Chapter 3 investigates how the C-at-issue status clauses as well as other information-structural and sentence-structural features influence the processing of sentences containing an ARC. The aim of this chapter is to answer the following overarching research question:

- Does the *at-issueness* principle accurately predict sentence processing in interaction with other ordering principles for sentences containing an ARC?

This chapter reports the results of a self-paced reading experiment [Experiment 7] in which reading times of sentences with an ARC are measured. The order of the matrix clause and ARC in these sentences is manipulated (ARC-matrix vs. matrix-ARC) as well as the order of information (given-new vs. new-given). In doing so, predictions made by three established ordering principles are tested simultaneously, for which it is not clear they apply to sentences with an ARC: The *given-new* principle, the *clause structure* principle, and the *clause-type mapping of information* principle. In addition, we propose the *at-issueness* principle. If an ARC is in sentence-early position, it does not compete for C-at-issue status with the matrix clause: only the matrix clause is expected to be C-at-issue. Consequently, only the matrix clause needs to be held in memory to make a potential connection to subsequent discourse. ARCs in sentence-final position, however, competes with the matrix clause preceding it for C-at-issue status. As such, both clauses need to be held in memory to create a potential discourse connection. The *at-issueness* principle predicts that in the latter case, this leads to processing difficulty compared to when the clauses are in ARC-matrix order and only the matrix clause has C-at-issue potential.

We do not find evidence for the *at-issueness* principle. This suggests that C-at-issue status cannot be directly found reflected in the processing of sentences with an ARC. We also do not find evidence for the *clause-type mapping of information* principle, but we do for both the *given-new* principle and the *clause structure* principle. Given-new ordering of information facilitates processing, and matrix-ARC order of clauses facilitates processing in sentences with an ARC.

Chapter 2

Appositives, adverbials, and at-issueness: When clause type and position influence at-issue potential

This chapter engages with the following two overarching research questions of this thesis:

- What is the influence of clause type and clause position on the C-at-issue status of clauses in sentences with an ARC and sentences with a TAC?

- How can our findings be integrated into existing theories of (C-)at-issueness?

The answers to these research questions – the first one in particular – form the foundation for Chapter 3. In Chapter 3, we investigate whether C-at-issue status can be found reflected in the processing of clauses. We assume the C-at-issue status of matrix clauses and ARCs, based on the evidence as suggested by the result from the current chapter.

With the exception of section 2.16, Chapter 2 consists of the sections of an existing paper (Wilke et al., under revisionb).[1]

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[1]The work presented in this chapter has been presented at the following conferences:

- Wilke, H.A. (2023). "Redefining at-issueness as a gradable concept: The effect of clause type and clause position on at-issue potential". The 43rd TABU Dag Conference, June 15th–16th, 2023, Groningen, The Netherlands.
- Wilke, H.A., Hoek, J. & Rohde, H. (2022). "It was/wasn't what I expected: predicting the right antecedent". Workshop on Discourse alignment and prediction (SLE 2022), August 24th–27th, 2022, Bucharest, Romania.
- Wilke, H.A., Hoek, J., & Rohde, H. (2022). "At-issue status affects coreference via clause type and position". The 28th Architectures and Mechanisms for Language Processing Conference (AMLaP 2022), September 7th-9th, 2022, York, United Kingdom..
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Preamble

In Chapter 2 I will report the results from six experiments that probe the C-at-issue status of sentences with either a TAC or an ARC through a series of SPR-experiments. In contrast to previous experimental work, we take an online approach to measure at-issue status. In all of our experiments we employ pronoun resolution as a measure for C-at-issue status. Reading times are measured when am ambiguous pronoun *It* is disambiguated to a referent in matrix clause or a subordinate clause (ARC or TAC). The example below with sentences containing a TAC (31) is an example item from the first experiment. Here we measure whether the disambiguation region – *a very small cozy restaurant* – is read faster when it disambiguates *It* to the referent *a French bistro* in a sentence-early TAC (31a) or in a sentence-final matrix clause (31b).

(31)   a. My parents went out yesterday. After they dined at <u>a French bistro</u>,
           they went to a violin concert. *It* was
           a very small cozy restaurant. The food was exquisite.

        b. My parents went out yesterday. After they went to a violin concert,
           they dined at <u>a French bistro</u>. *It* was
           a very small cozy restaurant. The food was exquisite.

We follow this experiment up with two more experiments in which the position of the matrix clause and the TAC varies. We similarly test the C-at-issue status of ARCs in varying positions. The example below (32) shows an example item from the fourth experiment (the first experiment probing the at-issue status of ARCs). Here we measure whether the disambiguation region – *a quick trip to get some supplies* – is read faster when it disambiguates *It* to the referent *a shopping trip* in a sentence-early ARC (32a), a sentence-final matrix clause (32b), or a sentence-final ARC (32c):

(32)   a. My mom, who had just returned from <u>a shopping trip</u>,
           was having a chat with our neighbor. *It* was
           a quick trip to get some supplies. She is making a tiny gazebo for the birds
           in her backyard.

        b. My mom, who was having a chat with our neighbor,
           had just returned from <u>a shopping trip</u>. *It* was
           a quick trip to get some supplies. She is making a tiny gazebo for the birds
           in her backyard.

        c. My mom was having a chat with our neighbor,
           who had just returned from <u>a shopping trip</u>. *It* was

> *a quick trip to get some supplies.* She is making a tiny gazebo for the birds
> in her backyard.

This experiment is followed up with another experiment in which the position of the clauses hosting the referent is adapted, as well as one more experiment in which we specifically probe the at-issue status of sentence-early matrix clauses in sentences with an ARC. We expect – following from the evidence presented in 1.1.3 – that for these experiments, TACs will not show C-at-issue potential in any position, matrix clauses will show C-at-issue potential in both sentence-early and sentence-final position, and ARCs will show C-at-issue potential only in sentence-final position. One advantage of our methodology is that we can directly compare between clauses of different clause-types (matrix or subordinate) in the same position, whereas previous experimental work compared between two clauses that are part of the same sentence. While this work showed effects of position for ARCs, such that they appeared more P- and C-at-issue in sentence-final position compared to sentence-early position (Syrett & Koev, 2015), it cannot compare effects of clause type in this position: Are matrix clauses more C-at-issue in sentence-final position than ARCs in sentence-final position, for example? Our study sheds light on the effect of both clause type and clause position on C-at-issue status, and does so while taking an online approach.

2.1 Abstract

Sentences that consist of multiple clauses are generally expected to contain one (matrix) clause that carries the main point of the utterance, the at-issue content, and other (subordinate) clauses whose content is more peripheral and therefore not-at-issue. The traditional semantic view on at-issueness (Q-at-issueness) has held that the at-issue status of clauses is immutable and that, for example, Appositive Relative Clauses (ARCs) always contribute not-at-issue material. Discursive accounts (C-at-issueness) and more recent experimental research, however, show that the at-issue status of ARCs can change depending on their position in a sentence. In this paper, we report the results of six self-paced reading experiments in which we measure reading times when an ambiguous pronoun *It* is disambiguated to a referent in a subordinate clause or a matrix clause in varying positions. We find that not only ARCs but also temporal adverbial clauses can achieve C-at-issue status in sentence-final position, to the extent that they appear more at-issue than the matrix clause they follow. However, when clauses in early position are compared, clause type does matter: only matrix clauses have C-at-issue potential in this position. Our findings suggest that C-at-issue status can be associated with matrix clauses in general, but should also be potentially extended to be associated with

any sentence-final clause. In addition, this highlights the importance of distinguishing between different theories of at-issueness, but also the relevance of investigating further how they complement one-another, especially when analyzing the at-issue potential of subordinate clauses.

2.2 Introduction

Discourse is dynamic, and not everything that is part of discourse is equally important. Sentences that consist of multiple clauses often contain several assertions, of which one might be more relevant with respect to what has been previously said, while the other might be more relevant for subsequent discourse. This phenomenon – whether a clause contains the main (at-issue) assertion of a sentence, or one that is more peripheral (not-at-issue) – is studied under the umbrella of "at-issueness" (Jasinskaja, 2016; Koev, 2013; Potts, 2005; Beaver et al., 2017). Consider Example (33) below, in which the sentence with the appositive relative clause (ARC, (33b)) contains two assertions. The first assertion, *She baked a cake for Alex*, is more relevant to the preceding utterance in (33a), whereas the second assertion, *who owns a fluffy Persian cat*, is more relevant to the subsequent utterance in (33c):

(33)   a. Kathy spent all morning baking.
       b. She baked a cake for Alex, who owns a fluffy Persian cat.
       c. It's the cutest cat I've ever seen.

However, the final sentence of this piece of discourse, can just as easily be one that instead connects to the assertion in the matrix clause, as in (34c):

(34)   a. Kathy spent all morning baking.
       b. She baked a cake for Alex, who owns a fluffy Persian cat.
       c. It was a birthday funfetti cake.

In this setting, the assertion in the ARC contributes a point that is more peripheral to the one made in the matrix clause: it does not appear relevant to the sentence that precedes it (34a) nor to the sentence that follows it (34c). In contrast, the matrix clause content is relevant with respect to both (34a) and (34c). These examples showcase that the relevance of the individual assertions made in complex sentences depends on – and can change with – surrounding discourse. In (33b), both the matrix clause and the ARC can be seen as contributing the main – at-issue –assertion, depending on how the

sentence relates to prior or subsequent discourse, whereas in (34b), this same sentence is perceived as having only one clause that contributes the at-issue point of the sentence: the matrix clause.

Different theories of at-issueness make different predictions as to which clauses in complex sentences can be at-issue, depending on their clause type (matrix or subordinate) and their position in a sentence (sentence-early or sentence-final). The traditional semantic perspective on at-issueness – Q-at-issueness – views ARCs as categorically not-at-issue as they cannot answer a question under discussion (QUD, Q-at-issueness: Beaver et al., 2017; Simons et al., 2010). Indeed, if we were to pose the QUD *What kind of cat does Alex have?*, the response in (33b) would be infelicitous. Discursive accounts of at-issueness, however, can incorporate the perceived at-issue status of the ARC in (33b). Under these accounts (C-at-issueness, Hunter & Asher, 2016; Jasinskaja, 2016), clauses are (or can be) considered C-at-issue if they can establish a coherent connection with subsequent discourse by virtue of being on the right edge of the discourse structure (Right Frontier (RF), Asher & Lascarides, 2003; Polanyi, 1988; Webber, 1991). While both Q-at-issueness and C-at-issueness predict that matrix clauses can be at-issue in any position, predictions for subordinate clauses diverge. Previous research provides ample evidence for the Q- and P-at-issue status of clauses and which factors contribute to this. This paper contributes specifically to understanding which factors contribute to C-at-issue status, something which is still relatively understudied. Whereas Q-at-issueness considers which parts of discourse are important with respect to preceding discourse, C-at-issueness considers the importance of discourse segments with respect to subsequent discourse. As such, studying C-at-issueness links the concept of at-issueness to the broader umbrella of work on expectation-driven processing (Kamide et al., 2003; Kuperberg & Jaeger, 2016; Pyykkönen & Järvikivi, 2010; Rohde & Horton, 2014).

We investigate which clauses in complex sentences have the potential to be C-at-issue by measuring reading times when an ambiguous pronoun *It* in a sentence following a sentence with a subordinate clause is disambiguated to an antecedent in the matrix clause or the subordinate clause of the preceding sentence. We present six preregistered self-paced reading (SPR, Just et al., 1982) studies that investigate the C-at-issue status of matrix clauses and subordinate clauses in differing positions (sentence-early or sentence-final). We distinguish between two types of subordinate clauses that are categorically considered not-at-issue under Q-at-issueness: temporal adverbial clauses (TACs), for which previous studies also found no evidence they had C-at-issue potential in any position (Frazier & Clifton, 2005), and ARCs, which have previously been shown to have the potential to be C-at-issue in sentence-final position (Syrett & Koev, 2015). These prior studies on both TACs and ARCs, however, all employed offline methodologies. Our aim is to investigate whether these offline findings are also reflected in online processing. There are a number

of additional factors that could influence the perceived at-issue status of clauses, such as intonation in spoken language, or text indicators in written language such as bolding or italics. For the purpose of our experiments we did not manipulate for these factors.

As the results will show, we find similar patterns for sentences with a TAC and sentences with an ARC: both of these types of subordinate clauses can be C-at-issue in sentence-final position, and even more so than the matrix clause that precedes them. The key factor contributing to C-at-issue status is position in both cases, such that any sentence-final clause is always more C-at-issue than any sentence-early clause independent of clause type. When only clauses in sentence-early position are considered, however, matrix clauses were found to be more C-at-issue than both TACs and ARCs in this same position. In addition, sentence-early matrix clauses were found to be more C-at-issue than simple sentences that discourse-structurally subordinate the last-added segment. Our findings suggest that expectations for which clause in a complex sentence can be C-at-issue are primarily formed as a result of the position of a clause within a sentence, but that clause type and type of subordination do contribute to C-at-issue potential when it concerns discourse segments that are not last-added to the discourse structure.

2.3   At-issueness

As noted before, different theories of at-issueness make both overlapping and contrasting predictions as to which clauses in a complex sentence are – or can be – at-issue. We will provide a brief overview of the three main strands of at-issueness as proposed by Koev (2018): Q(UD)-at-issueness (Beaver et al., 2017; Simons et al., 2010), P(roposal)-at-issueness (AnderBois et al., 2015; Farkas & Bruce, 2010; Koev, 2013; Murray, 2014) and C(oherence)-at-issueness (Hunter & Asher, 2016; Jasinskaja, 2016) and the diagnostics they employ to measure at-issue status.

We specifically focus on how ARCs and TACs are analyzed in these theories with respect to their at-issue status. Each theory makes different predictions about the at-issue status of ARCs – ranging from their being analyzed as categorically not-at-issue (Q-at-issueness) to their being analysed as at-issue, but only in sentence-final position (P-at-issueness), to their patterning fully with matrix clauses with respect to their at-issue status (C-at-issueness). In contrast, all theories predict the same for TACs: these are always not-at-issue. The diverging predictions different theories make about the at-issue status of ARCs make it particularly important to clearly distinguish between theories. The experiments in this study have direct implications for C-at-issueness, but as we will discuss, are also relevant to the study of at-issueness in general.

2.3.1 Theories of at-issueness

2.3.1.1 Q-at-issueness

Under Q-at-issueness, those parts of discourse that can felicitously answer a Question Under Discussion (QUD), are assumed to be Q-at-issue (Beaver et al., 2017; Simons et al., 2010). In order for content to do this, it needs to be informative to the QUD, but it also needs to be appropriately conventionally marked. While subordinate clauses can contain information relevant to the QUD, their subordinate status generally leads to them not being appropriately conventionally marked to be able to answer the QUD. There are other factors associated with conventional marking, such as projectivity and definiteness (see Beaver et al., 2017; Simons et al., 2010), but for the purpose of this section, clause type (matrix/subordinate) is taken as the main indicator of conventional marking: matrix clauses are appropriately conventionally marked, subordinate clauses – at least those of the kind that we are discussing, ARCs and TACs – are not.

Consider examples (35) & (36) below. The sentence in (35b) provides a felicitous response to the QUD posed in (35a), as the answer is contained in the matrix clause (underlined), making it Q-at-issue. If instead the answer is contained in the ARC (underlined in (36b), this leads to an infelicitous reading. The ARC therefore would be analysed as not-at-issue under Q-at-issueness:

(35)   a. How does your dad get to work?

     b. <u>My dad has a carpool system with our neighbor</u>, who works at an accounting firm.

(36)   a. How does your dad get to work?

     b. My dad, <u>who has a carpool system with our neighbor</u>, works at an accounting firm.

The same pattern we observe for ARCs, also holds for TACs. The sentence in (37b) is a felicitous answer to the QUD posed in (37a), as the answer to this QUD is contained in the matrix clause (underlined). When the answer is contained in the TAC (underlined in (36b), the sentence is not a felicitous response to the QUD:

(37)   a. Where did your parent have dinner?

     b. <u>They dined at a French bistro</u> after they went to a violin concert.

(38)   a. Where did your parent have dinner?

    b. <u>After they dined at a French bistro</u>, they went to a violin concert.

As such, both ARCs and TACs are analyzed as categorically not-at-issue under Q-at-issueness. However, it is possible for any subordinate clause to provide a partial answer to the QUD felicitously, as long as the matrix clause also does so, as shown in example (39):

(39)   a. What did your parents do last night?
        b. They dined at a French bistro, after they went to a violin concert.

While this does seem to provide some evidence that TACs (and ARCs) *can* be Q-at-issue – at least to some extent – under Q-at-issueness, they can never fulfil the requirement of being appropriately conventionally marked. As such, both ARCs and TACs are categorically considered not-at-issue under Q-at-issueness.

2.3.1.2 P-at-issueness

Under P-at-issueness, content that proposes an update to the common ground is considered P-at-issue (AnderBois et al., 2015; Farkas & Bruce, 2010; Murray, 2014; Koev, 2013). For content to propose an update to the common ground it needs to be content that can be negotiated with before it is accepted into the common ground. The common way to test this under P-at-issueness, is by using the assent/dissent test (Murray, 2010; Tonhauser, 2012). If we apply this test to the sentence in (36b), repeated here in (40), it yields the same results as we previously found under Q-at-issueness. The matrix clause can be directly dissented with, as shown in (40a), but the ARC does not appear to be a felicitous target for direct rejection (40b):

(40)   My dad, who has a carpool system with our neighbor, works at an accounting firm.
       a. No he doesn't, he works at a bank.
       b. # No he doesn't, he always commutes by public transport.

However, when we consider the sentence in (35b), repeated here in (41), in which the order of clauses is reversed such that the ARC is in sentence-final position, both clauses appear to be appropriate targets for direct rejection:

(41)   My dad has a carpool system with our neighbor, who works at an accounting firm.

a. No he doesn't, he works at a bank.

b. No he doesn't, he always commutes by public transport.

Direct rejection targeting the matrix clause (41a) as well as direct rejection targeting the ARC (41b) proceed felicitously. As such, matrix clauses are always P-at-issue, but ARCs can only be P-at-issue in sentence-final position. This same pattern, however, is not repeated when we consider TACs. These are not analysed as P-at-issue in any position. Neither when the TAC appears in sentence-early position, as in (42), nor when it is in sentence-final position (43), can it be felicitously targeted with direct rejection (42a). In either case, the matrix clause provides a felicitous target for direct rejection:

(42)   After my parents dined at a French bistro, they went to a violin concert.

    a. # No they didn't, they dined at a pizzeria.

    b. No they didn't, they went to a piano concert.

(43)   My parents dined at a French bistro after they went to a violin concert.

    a. No they didn't, they dined at a pizzeria.

    b. # No they didn't, they went to a piano concert.

In summary, under P-at-issueness, TACs never achieve P-at-issue status, independent of their position in a sentence. ARCs, in contrast, are analysed as not-at-issue in sentence-early position, but can achieve P-at-issue status in sentence-final position.

2.3.1.3   C-at-issueness

Under C-at-issueness, the at-issue status of clauses is dependent on their potential to establish coherent connections with subsequent discourse (Hunter & Asher, 2016; Jasinskaja, 2016). Clauses are considered C-at-issue if "a freshly uttered segment can attach to it by some coherent discourse relation" (Koev, 2018, 8). Such an attachment is possible when a clause is at the RF (Asher & Lascarides, 2003; Polanyi, 1988; Webber, 1991). As such, any clause that is the last-uttered clause, including ARCs and TACs, is predicted to be C-at-issue, as well as the matrix clauses that subordinates these clauses. There is no widely agreed upon diagnostic to analyze C-at-issue status – like is the case for Q- and P-at-issueness – but experimental approaches into C-at-issue status employ anaphoric potential as a measure for C-at-issue potential (Frazier & Clifton, 2005; Holler & Irmen, 2007; Syrett & Koev, 2015).

Syrett & Koev (2015, Experiment 3) tested whether the source of an elliptical question *Why?* was more likely to be found in a matrix clause or an ARC. Participants were given a sentence with a matrix clause and an ARC in varying positions (e.g., in (44) with the matrix clause in sentence-early position and the ARC in sentence-final position), followed by the question *Why?*. Two possible answers were then given from which participants had to choose one: either the answer that targeted the matrix clause as containing the answer to the question (45a), or an answer that targeted the ARC (45b):

(44)   The 'All Stars' Dance Company has chosen to audition Chloe, who decided to dress in a classical ballet style.

(45)   *Why?*

    a. Because they think Chloe could be a good addition to their company. (target: matrix clause)

    b. Because she wants to be taken seriously as a classical ballet dancer. (target: ARC)

(Syrett & Koev, 2015, 582)

They found that participants chose the sentence-final clause more often for providing the answer to *Why?* than the sentence-early clause, independent of whether it was a matrix clause or an ARC. These results suggest that ARCs can be C-at-issue, and even compete with the matrix clause for C-at-issue status when they are in sentence-final position.

Frazier & Clifton (2005, Experiment 6) tested whether verb phrase ellipsis was more likely to resolve to an antecedent in a matrix clause, or an antecedent in a TAC. participants were given a sentence with a matrix clause and a TAC in varying position (e.g., in (46) with the matrix clause in sentence early position and the TAC in sentence-final position), followed by a sentence with the adverb *too*, which could be resolved to one of two possible verb phrase antecedents. Participants were asked to choose between two responses: one response resulted in verb phrase ellipsis to be resolved to an antecedent in the matrix clause (46a), the other to an antecedent in the TAC (46b):

(46)   Mary laughed after she made a joke about the supervisor.
    Then Tina did too.

    a. Tina laughed. (target: matrix clause)

    b. Tina made a joke. (target: TAC)

(Frazier & Clifton, 2005, 18-19)

Results show that the matrix clause was chosen as the more likely host for the antecedent resolving verb phrase ellipsis than the TAC, independent of the position of these clauses. This is unexpected considering that a sentence-final TAC – such as the one in (46) – is at the RF by virtue of being the last uttered discourse segment. However, Asher (2008) suggest that this is due to the presuppositional nature of content in TACs: this was also clear from the assent/dissent diagnostic in the previous section, which suggested TACs (in any position including sentence-final) cannot be felicitously targeted with direct rejection. Because of their presuppositional nature, their content is only (indirectly) open for attachment when it stands in a causal relation to the assertion made in the matrix clause. Example (47) below shows this distinction. In (47a), there is causal connection between the event in the TAC and the event in the matrix clause, whereas in (47b), there is not. Consequently, the clause that follows the TAC, *But I'm not sure what*, only establishes a coherent connection in (47a), but not in (47b):

(47) a. John died after he ate something poisonous, but I'm not sure what.

      b. ? John survived after he ate something poisonous, but I'm not sure what.
         (Asher, 2008)

A final distinction to be made here is between discourse segments that sentence-structurally subordinate the last-added discourse segment, and discourse segments that do so discourse-structurally but *not* sentence-structurally. Holler & Irmen (2007) employed pronoun resolution of ambiguous pronouns as an experimental diagnostic to measure if participants were more likely to choose an antecedent that was hosted by a clause that was on the RF by virtue of discourse-subordinating the last-added discourse segment. They presented participants with short stories in which the sentences were standing in differing relations (subordinating or coordinating) to each other (Asher & Lascarides, 2003; Asher & Vieu, 2005). The original experiment was presented in German; example (48) shows the translation that Holler & Irmen (2007) provide of a sample condition. This short story ended with a sentence containing an ambiguous pronoun (*she/he*) for which the story provided two possible antecedents. Participants were then asked to choose which of the antecedents was the antecedent for this pronoun. The two possible antecedents for the ambiguous pronoun *she* in (48f) are in (48a) and (48d) (underlined). The possible antecedent in (48a), *the student*, is hosted by a clause that discourse-structurally subordinates both the segment in (22b), which elaborates on (48a), and the string of segments (22c)-(22d)-(48e), which also provide an elaboration on (22a). As a result, the segment in (48a) is at the RF. The other possible antecedent for *she* is contained (underlined) in the segment in (48d): *the fellow student*. The segment and the one that follows it (48e) stand in a coordinating relation. Consequently, (48d) is not at the RF:

(48) a. In the morning <u>the student</u> went to the university

b. because it was time to attend the lecture in advantages and disadvantages of Kant's categorical imperative.

c. The lecture hall was busy.

d. <u>The fellow student</u> was as always in a bad mood

e. and nobody listened.

f. In the afternoon <u>she</u> still had many things to do.

(Holler & Irmen, 2007, 21)

(49) Who was the one who had to do many things?

Participants chose antecedents hosted by a discourse segment at the RF significantly more often as antecedents than antecedents in discourse segments that were not at the RF. As such, it can be argued that ambiguous pronoun resolution is a productive diagnostic for measuring C-at-issue status. However, the evidence presented in this section leaves open the question of whether subordination at the sentence-level influences C-at-issue potential differently than subordination at the discourse-level. This is a point Jasinskaja (2016, 21) engages with peripherally: she posits that the boundary between discourse segments (clause boundary vs. sentence boundary) influences their accessibility, such that segments that are at the RF, but are not the most recent segment, are more accessible when the boundary between them and the last-uttered segment is weaker (clause boundary) than when it is stronger (sentence boundary). While our main goal is to investigate the influence of clause type and clause position on C-at-issue status, we will also engage with the question of how subordination type (sentence-structurally, clause boundary vs. discourse-structurally, sentence boundary), influences C-at-issue potential.

In summary, prior experimental investigations into the C-at-issue status of ARCs, suggest that ARCs are not-at-issue in sentence-early position, but that they are C-at-issue in sentence-final position and even more so than the matrix clause that precedes them. TACs, in contrast, do not appear to be C-at-issue in any position. Our studies test if these findings from offline studies are also found reflected in an online setting.

Following Holler & Irmen (2007), we will be using a related methodology that uses coreference as a way to measure C-at-issue status. Using a SPR-methodology is also what sets our study apart from the previous investigation into C-at-issueness: all of these used offline methodologies which may have missed subtleties or varying patterns that might become visible in participants' moment-by-moment processing.

2.4 Main-clause-like ARCs

Outwith the at-issueness literature, ARCs have additionally been observed to represent a group of subordinate clauses with a special status compared to most other subordinate clauses. They have been shown to exhibit root phenomena, patterns that are usually constrained to a main/matrix clause environment such as verb phrase preposing, negative constituent preposing, and topicalization (de Vries, 2012; Emonds, 1970; Green, 1976; Heycock, 2017; Hooper & Thompson, 1973). In contrast, Temporal Adverbial Clauses (TACs) are among a class of subordinate clauses that typically resist root phenomena (Frey, 2012; Haegeman, 2007, 2010; Sawada & Larson, 2004).

Secondly, the special status of ARCs is supported by the observation that ARCs can contribute an independent speech act (Frazier et al., 2018; Jasinskaja & Poschmann, 2018; Koev, 2013; Syrett & Koev, 2015):

(50) a. Cameron – who was talking to Gloria a minute ago, wasn't he?
        – has gone home.
      b. [*]The guy – that was talking to Gloria a minute ago, wasn't he?
        – has gone home.
        (inspired by Syrett & Koev (2015, p. 567)

In (50a) the matrix clause is a statement, and the ARC contains a question. When the question is attached to a restrictive relative clause instead, as in (50b), this leads to unacceptability. When the head noun referent is not unique, it cannot be targeted with a question. Similarly, adverbial subordinate clauses cannot contribute independent speech acts (Haegeman, 2010; Hengeveld, 1989; Frey, 2012). This pattern is illustrated in (51):

(51) a. Cameron went home after he talked to Gloria, didn't he?
      b. [*]After Cameron talked to Gloria – didn't he? – he went home.
      c. After Cameron talked to Gloria – which he did, didn't he?
        – he went home.
        (adapted from Syrett & Koev (2015, p. 567)

In example (51a) the question scopes over the full sentence, but when it only scopes over the adverbial clause as in (51b), this configuration leads to unacceptability. This can easily be repaired though, by inserting an ARC to host the question clause (51c).

Lastly, when an ARC occurs in sentence-final position, it is expected to be available to be discourse-continuing by constituting the most recent speech act (Frazier et al.,

2018; Göbel, 2019). In such cases, the speech act boundary can be as strong as a sentence boundary (Jasinskaja, 2016), and a sentence-final ARC then resides at the right edge of the discourse structure where it is available to be discourse-continuing (Asher & Lascarides, 2003; Hunter & Asher, 2016; Polanyi, 1988; Webber, 1991) as an independent discourse segment, rather than a subordinated segment. As such, the ARC may compete for C-at-issue status with the matrix clause preceding it in such situations, as the matrix seems more removed from the RF by this speech act boundary.

Unlike ARCs, when a TAC occurs in sentence-final position, it is always part of the same speech act as the matrix clause it appears with.[1]   As a result, a TAC is expected to be less available to be discourse continuing than an ARC in this position. This expectation for TACs was evidenced by Frazier & Clifton (2005, Experiment 6), who found that TACs made bad attachment sites for subsequent discourse compared to matrix clauses.

2.5 Experiments

In contrast to previous experimental studies on at-issueness that have relied exclusively on offline measures like forced choice tasks (Frazier & Clifton, 2005; Syrett & Koev, 2015), acceptability judgment tasks (Antomo et al., 2021), and questionnaires (Holler & Irmen, 2007), we test comprehenders' online processing. We designed six self-paced reading (SPR, (Just et al., 1982)) experiments to measure reading times when subsequent discourse continues on content whose C-at-issue status is manipulated via the type and position of the clause in which the content is introduced. The six studies reported below are divided into two sets of three studies, the first set testing TACs and the second set testing ARCs. In what follows in the current section, we first present out hypotheses, to then introduce each set of experiments with a short summary of our findings.

2.5.1 Hypotheses

Following from the evidence presented in section 2.3, we propose three hypotheses. We posit that the matrix clause is the more likely host for C-at-issue content. We will refer to this distinction between matrix and subordinate clauses as the *clause type* hypothesis.

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[1]There are some exceptions to this, e.g., when a speaker uses a *before*-clause to coordinate interaction between speech participants. In such a case the TAC can express a speech act distinct from the main clause, as in (i). Our study focuses on TACs that are restrictive in nature, and describe a sequence between two related events.

(i)   Uhm well before we get into the detailed discussion of all of this have you got something else Mary?
      (Diessel, 2008)

Next, we posit that sentence-final clauses are more C-at-issue than sentence-early clauses – we will refer to this distinction as the *clause position* hypothesis. For ARCs, we expect that clause position can overrule clause type, and that sentence-final ARCs can be C-at-issue, even though they are subordinate clauses. We do not expect such an effect for TACs. Lastly, we posit that discourse segments that sentence-structurally subordinate the last-added segment are more C-at-issue than discourse segments that only do so discourse-structurally. We refer to this as the *type of subordination* hypothesis.

2.5.2   Temporal adverbial clauses

The first three experiments investigate sentences with TACs, specifically the processing of content originally mentioned in matrix clauses or TACs, which is picked up for re-mention in a subsequent sentence. Matrix clauses are assumed to provide better hosts for C-at-issue content than TACs in general, as predicted by the clause type hypothesis. We compare this prediction with that of the clause position hypothesis to assess whether the C-at-issue status of content introduced in TACs is also sensitive to the sentence-early versus sentence-late position of the TAC. The sentential position of clauses is manipulated differently in each experiment, allowing us to investigate both hypotheses together and in isolation. The results show that both hypotheses make accurate predictions, but when they are in competition, clause position is the more important factor. Below table table 2.1 gives an overview of the conditions that were compared in each experiment.

TABLE 2.1: Overview of the conditions compared in Experiments 1–3.

clause type	TAC		matrix clause	
clause position	sentence-early	sentence-final	sentence-early	sentence-final
Experiment 1	✓			✓
Experiment 2		✓	✓	
Experiment 3	✓		✓	

Experiment 1 compares the at-issue status of sentence-early TACs to that of sentence-final matrix clauses. Experiment 2 compares the at-issue status of sentence-final TACs to that of sentence-early matrix clauses. Experiment 3 compares the at-issue status of sentence-early TACs to that of sentence-early matrix clauses. While all of these conditions could have been combined in a single 2×2 design, this would have led to potential confounds associated with chronological order. For example, when the sentence-final TAC and sentence-final matrix clause conditions are compared in the same experiment, we would expect faster reading times for the sentence-final matrix condition under the *clause type* hypothesis. However, the sentence containing the sentence-final matrix clause would present the events in chronological order, whereas the sentence containing the sentence-final TAC would present the events in counter-chronological order.

Consequently, it would not be clear if faster reading times for the sentence-final matrix condition in such a comparison would be a result of clause type, or because of processing difficulty associated with counter-chronological order (Münte et al., 1998; Politzer-Ahles et al., 2017), or both. To avoid such confounds associated with chronological order, we have split up the experiments into pair-wise comparisons in which difficulty associated with counter-chronological order is not also associated with the condition for which we predict slower reading times.

2.5.3 Appositive relative clauses

The second three experiments target the processing of content originally mentioned in matrix clauses and ARCs, which is picked up for re-mention in a subsequent sentence. In two experiments, we test predictions of the clause position and clause type hypotheses, looking for evidence that sentence-final clauses and/or matrix clauses provide better hosts for C-at-issue content. We find evidence for both hypotheses, but they stand in a hierarchical relation such that clause position contributes more to C-at-issue potential than clause type. Following this, we compare the C-at-issue potential of sentence-early matrix clauses to the C-at-issue potential of simple sentences that are expected to be at the RF by virtue of discourse-structurally, but *not* sentence-structurally, subordinating the discourse segment that follows them. Here we find that sentence-early matrix clauses are more C-at-issue than simple sentences in a similar position. Taken together, these results suggest that C-at-issue potential is differently influenced by sentence-structure and discourse-structure.

TABLE 2.2: Overview of the conditions compared in Experiments 4–6

clause type	ARC		matrix clause		simple sentence
clause position	sentence-early	sentence-final	sentence-early	sentence-final	
Experiment 4	✓	✓		✓	
Experiment 5	✓		✓	✓	
Experiment 6			✓		✓

Experiment 4 compares the at-issue status of sentence-early ARCs to that of sentence-final ARCs and sentence-final matrix clauses. Experiment 5 compares the at-issue status of sentence-early ARCs to that of sentence-early matrix clauses and sentence-final matrix clauses. Experiment 6 compares the at-issue status of sentence-early matrix clauses to that of simple sentences that discourse-subordinate the last-added discourse segment: another simple sentence that directly follows it. Similarly to Experiments 1–3, it might seem that Experiments 4 and 5 could have been combined in a single 2×2 design, however, due to the nature of the item design, sentence-final matrix clauses and sentence-early

ARCs could not be compared in the same experiment because the re-mentioned content is always an inanimate object or event which was re-mentioned with the pronoun *It*:

(52)   My mom was having a chat with our neighbor, who had just returned from
       <u>a shopping trip</u>. It was *a quick trip* to get some supplies.

In (52), the pronoun *It* is disambiguated to 'a shopping trip' (underlined) when it is followed by 'a quick trip' (in italics). If the position of the ARC and the matrix clause is reversed, as in (53), this leads to an infelicitous reading in which 'a shopping trip' is interpreted as the subject of the ARC:

(53)   My mom had just returned from <u>a shopping trip</u>, who was having a chat with
       our neighbor. It was *a quick trip* to get some supplies.

While this could potentially have been addressed by making all possible antecedents animate, and use *She* as the ambiguous pronoun that subsequently is disambiguated to an antecedent in the preceding sentence, this would have led to a far more complex design:

(54)   My mom had just returned from visiting <u>her colleague</u>, who was having a chat
       with our neighbor. She was . . .

In such a design, the temporarily ambiguous pronoun would have more potential antecedents, and their accessibility would be further influenced by their syntactic role and the syntactic structure or surface packaging of the clause that contains a potential antecedent (Crawley et al., 1990; Frazier & Fodor, 1978; Frederiksen, 1981; Smyth, 1994). As such, it would be difficult to disentangle effects of at-issue status from other factors at play. For this reason, we opted for a simpler design in which less conditions were compared at one time.

2.6   Experiment 1: early TAC vs. final matrix

In all experiments, we measure comprehenders' processing at the point in a passage where an ambiguous pronoun is disambiguated to test whether this disambiguation is easier when the antecedent has been mentioned in a particular type of clause that occupies a particular location in a sentence. In this first experiment we contrast two conditions, one that enforces coreference between a pronoun and a referent mentioned in a location of maximal C-at-issue potential and one that enforces coreference between a pronoun

and a referent from a location of minimal C-at-issue potential. Specifically, we compare coreference to content in a sentence-final matrix clause versus content in a sentence-early TAC. In this experimental design, the predictions made by the clause type hypothesis -– which we assume is particularly relevant for sentences with TACs -– overlap with the predictions made by the clause position hypothesis. This comparison will nonetheless allow us to test whether these factors that have been implicated in the establishment of C-at-issue status matter at all during processing: matrix clauses and sentence-final clauses are more likely to be C-at-issue. An observed difference would indicate that these factors -–— either individually or together —- indeed impact C-at-issue status. Experiments 2 and 3 address the individual contributions of the two factors.

2.6.1 Method

2.6.2 Participants

We recruited 74 participants through Amazon Mechanical Turk. We removed those whose accuracy on comprehension questions was not above chance, leaving 55 participants for analysis. All were self-reported native English speakers between the ages of 23–67 (mean=39) living in the United States. These participants also participated in Experiment 4. All participants had to have at least 500 previously approved tasks (called Human Intelligence Tasks, HITs, on MTurk) and a 95% or greater HIT approval rate. They provided informed consent and were compensated USD 2.50 for their participation, which corresponds to a rate of roughly USD 10/hr. The participation criteria and compensation apply to all experiments reported in this paper.

2.6.3 Materials

The study had 16 target items in two conditions and 40 fillers. The target items consisted of three sentences: the first a context sentence, the second an antecedent-providing sentence with clause type and clause position manipulations, and the third a follow-on sentence with a temporarily ambiguous pronoun *It*. At the critical region in the third sentence, the pronoun was disambiguated to refer to an antecedent either in a sentence-early TAC (55a) or a sentence-final matrix clause (55b). The conditions are thus named for their 'coreference clause', the clause containing the antecedent for the pronoun *It*. The other clause in the second sentence will always contain a possible referent for *It* to make sure this pronoun is ambiguous upon encountering it.

(55) a. [**EARLY TAC**] My parents went out yesterday. After they dined at <u>a French bistro</u>, they went to a violin concert. It was
a very small cozy restaurant. The food was exquisite.

b. [**FINAL MATRIX**] My parents went out yesterday. After they went to a violin concert, they dined at <u>a French bistro</u>. It was
a very small cozy restaurant. The food was exquisite.

To provide a region for observing potential spillover (delayed) effects, the disambiguation region was followed by an additional clause, of which the first 3–4 words functioned as the spillover region. If that clause was no more than 4 words in total, the entire additional clause was the spillover region, as is the case in examples 55a & 55b above. These parameters for the spillover region are the same throughout all experiments reported in this paper. The items were distributed across 2 lists in a Latin Square design such that all participants saw half the target items in the EARLY TAC condition and the other half in the FINAL MATRIX condition. The distribution of the target items and fillers and the order in which participants saw these was fully randomized.

The 40 fillers consisted of two different sets. The first set were 24 items from a different experiment (Experiment 4) that probes the C-at-issue status of clauses in sentences with an ARC. The second set contained 16 short stories that did not contain any sentences with TACs or ARCs. Both sets followed the same first-person perspective and topics as described above. A little over a third of the items were accompanied by a comprehension question (true/false): six of the target items and 14 of the fillers. Participants whose performance was not significantly above chance (at least 70% of questions answered correctly) were excluded from the analysis. After exclusion, average performance on these questions was 87% answered correctly.

All target and filler items in all experiments were presented in a first person perspective. Altogether they constituted a series of anecdotes told by a single narrator about their personal life, friends and family. This was done to create a narrative that sounded as natural as possible with cohesion throughout, rather than presenting participants with seemingly unrelated or isolated sentences as it has been shown that this can add to processing difficulty (Roland et al., 2012). In addition, we designed all TAC-items such that causal inferences were unlikely to be made between the TAC and the matrix clause. This was done to prevent sentence-final TACs from entering the RF (cf. section 2.3.1.3).

2.6.4 Procedure

This and all experiments reported here were deployed on the IbexFarm web-based experimental presentation platform (Drummond, 2013). Participants carried out the experiment remotely on their own computers via a link distributed through an Amazon Mechanical Turk HIT. The experiments all use a non-cumulative SPR paradigm. In this paradigm, text is first displayed as dashes on a screen. These dashes each represent several words, which we will refer to as chunks. By pressing the space bar the words in a chunk are revealed. A subsequent space bar press reveals the next chunk, while hiding the previous chunk again. At three points during the experiment, the task was interrupted by a landscape image which required a mouse click in order to proceed, rather than a space bar press. This was done to reduce routinized space bar-pressing behavior, as well as to give participants natural breaks throughout the experiment.

Our target items consisted of 6-8 chunks. The first chunk is the context (first) sentence, followed by the TAC and matrix clause chunks of the second sentence (order of these depends on the condition). The fourth chunk consists of *It is/was* of the third sentence, which is followed by the disambiguation and spillover regions (in italics in (56)). We measure the exposure duration for each chunk. For the analysis we focus on the critical regions: the disambiguation and the spillover regions.

(56)   /My parents went out yesterday./After they dined at a French bistro,/
/they went to a violin concert./It was/
/*a very small cozy restaurant.*/*The food was exquisite.*/

The first four chunks – context sentence, TAC, matrix clause and *It is/was* – were presented on a single line. The disambiguation and the spillover region were presented on a subsequent line. This configuration was held constant for the target items in the first three experiments.

Before starting the experiment, participants were provided with several example items to familiarize themselves with the procedure. After completing the SPR part of the experiment, participants were asked to fill out a demographic questionnaire. Crucial questions here pertained to the languages they spoke growing up and in their current daily life. Participants for whom English was not a majority language growing up or in their current daily life were excluded from the analysis. All experimental materials, reported data, the preregistered hypotheses and analysis plan are available on the Open Science Framework page: https://osf.io/3s8y5/.

2.6.5 Analysis

Data was analyzed using R (R Core Team, 2013). In analyses in this paper, our outcome variable was residual reading time.[2] We constructed linear mixed-effects models (Baayen et al., 2008) using the `lme4` package (Bates et al., 2015). The variables *condition*, *trial number* and their interaction were fixed effects in our models, and as random effects we had intercepts for participants and items in all models. We added a by-item random slope for *condition*, and by-subject random slopes for *condition*, *trial number* and their interaction. We were not interested in any direct effects of *trial number*, but we included it as a fixed effect and random slope to account for any possible learning effects of *condition*. If the model with maximal random effect structure did not converge, we used the methods described in (Barr et al., 2013) to reach a model that does converge. To assess the effect of *condition*, we conducted likelihood ratio tests (`anova`, Girden (1992)) between the full model as described above, and a model without *condition*.

2.6.6 Predictions

Under both the clause type and clause position hypotheses, we expect that reading times for the disambiguation will be faster in the FINAL MATRIX condition, where the ambiguous pronoun *It* is disambiguated to an element in a sentence-final matrix clause, rather than an element in a sentence-early TAC.

2.6.7 Results

Table 2.3 presents the average residual reading times for the critical regions (disambiguation and spillover) by condition (EARLY TAC or FINAL MATRIX as the coreference clause). This data is visualised in Figure 2.1. The likelihood ratio test showed a significant difference between the full model and the model without condition for both the disambiguation ($\chi^2(1) = 15.3$, $p =< .001$) and the spillover region ($\chi^2(1) = 4.82$, $p = .029$), see Table 2.4. The significant effect of *condition* captures the fact that the disambiguation yielded faster reading times when it established coreference with an element from a sentence-final matrix clause, and slower when it established coreference with an element from a sentence-early TAC. We also find a significant effect of *trial number* for both regions, such that items were read faster as the experiment progressed, but in the absence of an

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[2]Residual reading times are obtained as follows: the average raw reading time per character is calculated for each participant. The difference from what would be the mean reading time for a segment following this average reading time per character is the residual reading time. If a participant reads faster than their own average, this difference will be a negative number (in milliseconds), and if slower, a positive number.

interaction effect with *condition* this does not imply a learning effect. Across experiments, unless stated otherwise, we find a main effect of *trial number* and no interaction with *condition*.

TABLE 2.3: Experiment 1: Mean residual reading times for the target regions in each condition. Here and in all results tables, by-participant standard error is shown in parentheses.

	early TAC	final matrix	*Means*
disambiguation	26.65 (26.83)	−150.24 (19.45)	−62.11 (16.81)
spillover	−61.39 (12.74)	−94.89 (10.39)	−78.14 (8.23)

FIGURE 2.1: Reading plot showing the residual reading times by condition for Experiment 1.
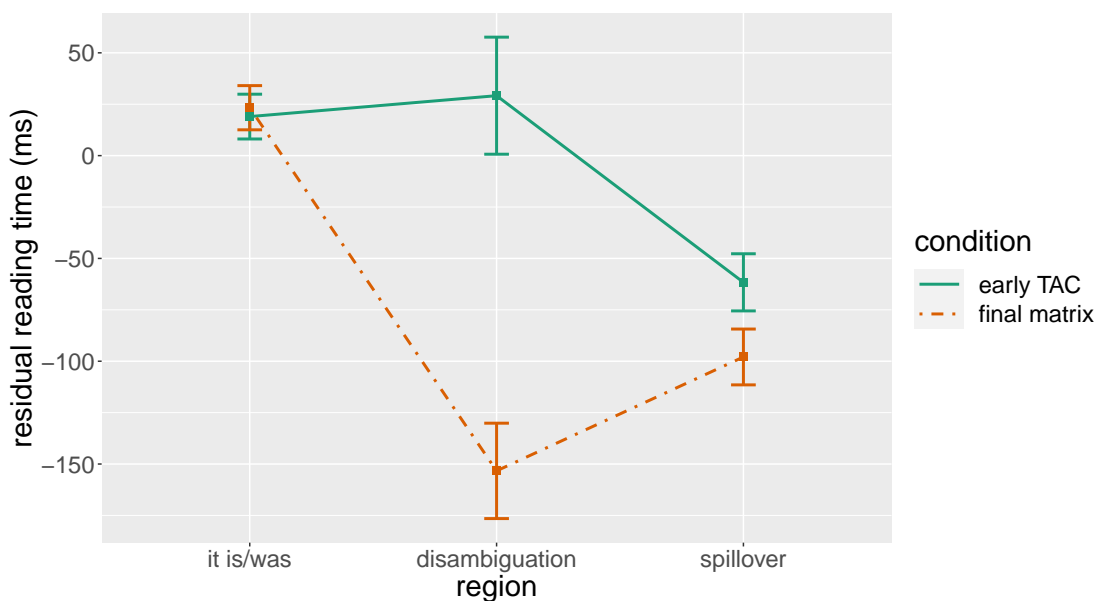
TABLE 2.4: Experiment 1 model results by region: Coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including 'condition', and the *p*-value for that test statistic.

	disambiguation				*spillover*			
	β	SE	$\chi^2(1)$	p	β	SE	$\chi^2(1)$	p
cond	179.39	38.34	15.30	**<.001**	34.06	15.52	4.82	**.03**
trial#	−11.30	3.48	10.46	**.001**	−8.27	1.72	22.85	**<.001**
cond × trial#	−2.77	6.97	0.16	.69	2.84	3.49	0.67	.41

2.6.8 Discussion

The results of Experiment 1 are consistent with both the clause type hypothesis and the clause position hypothesis: sentence-final matrix clauses are more C-at-issue than sentence-early TACs and consequently, establishing coreference with an element in a

sentence-final matrix clauses is processed faster. This result provides online evidence in keeping with Frazier & Clifton (2005)'s offline findings that content in TACs was less available to be discourse continuing than content in a matrix clause. However, it leaves open the question of whether faster processing – and C-at-issue potential – proceeded as a consequence of the position of the matrix clause, which would be predicted by the clause position hypothesis, or its clause type, which would be predicted by the clause type hypothesis. To distinguish these two hypotheses, we conducted two follow-up experiments. Experiment 2 compares two conditions with competing C-at-issueness factors and Experiment 3 tests the role of one factor when the other is held constant.

2.7   Experiment 2: final TAC vs. early matrix

Experiment 2 tests the relative strength of the clause position and clause type factors. Two conditions are set up, each combining one feature that is linked to high C-at-issue potential with another that is linked to low C-at-issue potential. The goal is to use the same coreference paradigm from Experiment 1 to test which factor more strongly influences comprehenders' coreference preferences (as our indirect measure of their perception of clause C-at-issueness). Specifically, we test whether coreference is more sensitive to clause position (the sentence-final position of a final/TAC clause) or clause type (the matrix type in an early/matrix clause).

2.7.1   Method

2.7.2   Participants

We recruited 111 participants through Amazon Mechanical Turk. We removed those whose accuracy on comprehension questions was not above chance, leaving 75 participants between the ages of 24–77 (mean=39) for analysis. These participants also participated in Experiment 5.

2.7.3   Materials

The design of the materials largely follows that of Experiment 1, but the passages here enforce coreference with an element from either the final TAC (57a) or the early matrix clause (57b).

(57)   a. [**FINAL TAC**] My parents went out yesterday. They went to a violin concert after they dined at <u>a French Bistro</u>. It was *a very small cozy restaurant.* The food was exquisite.

        b. [**EARLY MATRIX**] My parents went out yesterday. They dined at <u>a French bistro</u> after they went to a violin concert. It was *a very small cozy restaurant.* The food was exquisite.

We added four additional comprehension questions to the item set with TACs which checked if participants correctly interpreted the chronological order of events in these sentences. If participants understood the TACs to be in a coordinating relationship with the matrix clauses, the chronological order of events would be opposite to when it is understood as intended, as a subordinate clause. Adding these led to a slightly higher threshold of 71% correct for participants to perform above chance. We found no evidence that participants interpreted the relation between TACs and matrix clauses to be coordinating.

2.7.4   Procedure

The procedure followed that of Experiment 1.

2.7.5   Analysis

The statistical analysis followed that for Experiment 1.

2.7.6   Predictions

Under the clause position hypothesis, we expect faster reading times for the FINAL TAC condition, whereas the clause position hypothesis predicts faster reading times for the EARLY MATRIX condition. For sentences with TACs, C-at-issueness is predicted to be influenced more by clause type than by clause position (see Frazier & Clifton (2005)'s offline findings whereby TACs made worse attachment sites regardless of position). We therefore predict faster reading times for the EARLY MATRIX condition.

2.7.7   Results

Table 2.5 and Figure 2.2 present the average residual reading times for the critical regions by condition. In keeping with the clause position hypothesis, we find that the

FINAL TAC condition is read faster than the EARLY MATRIX condition, marginally so at the disambiguation ($\chi^2(1) = 3.05$, $p = .08$) and significantly so at the spillover region ($\chi^2(1) = 4.07$, $p = .03$), see Table 2.6.

TABLE 2.5: Experiment 2: Mean residual reading times for the target regions in each condition.

	final TAC	early matrix	*Means*
disambiguation	−104.64 (17.89)	−50.91 (18.73)	−77.7 (12.97)
spillover	−89.64 (12.66)	−51.57 (11.76)	−70.54 (8.65)

FIGURE 2.2: Reading plot showing the residual reading times by condition for Experiment 2.
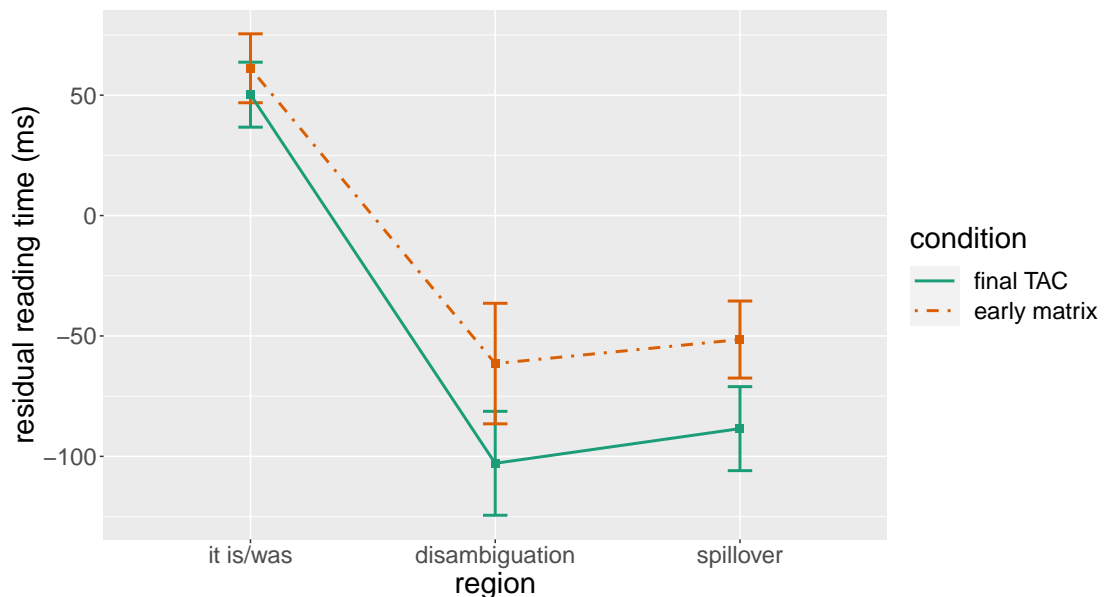
TABLE 2.6: Experiment 2 model results by region: Coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including 'condition', and the *p*-value for that test statistic.

	disambiguation				*spillover*			
	β	SE	$\chi^2(1)$	p	β	SE	$\chi^2(1)$	p
cond	−46.56	26.50	3.05	.08	−39.81	17.58	4.7	**.03**
trial#	−15.28	3.63	30.11	**<.001**	−10.93	1.65	43.04	**<.001**
cond × trial#	−1.44	5.32	0.07	.79	−2.97	3.37	0.79	.37

2.7.8 Discussion

Experiment 2 shows faster coreference processing when an antecedent is mentioned in a sentence-final TAC than in a sentence-early matrix clause. This result contradicts the proposal that clause type is the primary factor determining C-at-issueness in TAC sentences; rather, what we find is in line with the clause position hypothesis. This result

is also contrary to the findings of Frazier & Clifton (2005), who found that matrix clause content in sentences with a TAC was always judged as more likely to be picked up to be discourse-continuing regardless of clause position. That said, we cannot yet rule out a role for clause type in sentences like these. In the following experiment, we manipulate only clause type, holding clause position constant.

2.8 Experiment 3: early TAC vs. early matrix

In this third TAC experiment we isolate the effect of clause type from clause position, by holding clause position constant across conditions. We probe the predictions made by the clause type hypothesis by comparing processing when an ambiguous pronoun is disambiguated to an element in a clause with high C-at-issue potential (sentence-early matrix clause) to an element in a clause with low C-at-issue potential (sentence-early TAC). Any effect we find will inform us about whether C-at-issue status is influenced by clause type (matrix vs subordinate) for clauses in the same position (sentence-early), and consequently, if the clause type hypothesis is relevant for sentences with a TAC.

2.8.1 Method

2.8.2 Participants

We recruited 126 participants through Amazon Mechanical Turk. We removed those whose accuracy on comprehension questions was not above chance, leaving 76 participants between the ages of 24–72 (mean=39) for analysis. These participants also participated in Experiment 6.

2.8.3 Materials

The design of the materials largely follows that of Experiment 2, but here the passage enforces coreference with an element from a clause in sentence-early position, either in a TAC (58a) or a matrix clause (58b):

(58)   a. **[EARLY TAC]** My parents went out yesterday. After they dined at <u>a French Bistro</u>, they went to a violin concert. It was
a very small cozy restaurant. The food was exquisite.

        b. **[EARLY MATRIX]** My parents went out yesterday. They dined at <u>a French bistro</u> after they went to a violin concert. It was
a very small cozy restaurant. The food was exquisite.

In the previous two experiments, chronological order of events was held constant across conditions (Experiment 1, both chronological, Experiment 2, both counter-chronological). The current experiment is the first where we have one condition (EARLY MATRIX, (58b)) in which the order of the clauses violates the chronological order of events, and one in which the order of clauses and chronological order of events overlap (EARLY TAC, (58a)). If the predictions for the clause type hypothesis are upheld, faster reading times for the EARLY MATRIX condition (58b) would need to be visible beyond any slowdown associated with encountering the counter-chronological order.[3]   As we will see, the matrix clause coreference is indeed faster despite the potential difficulty associated with reading clauses in counter-chronological order.

2.8.4   Procedure

The procedure followed that of Experiment 1.

2.8.5   Analysis

The statistical analysis followed that for Experiment 1.

2.8.6   Predictions

Under the clause type hypothesis, we expect reading times will be faster in the EARLY MATRIX condition. The clause position hypothesis does not make any predictions here as the coreference clause is in sentence-early position in both conditions.

2.8.7   Results

Table 2.7 and Figure 2.3 present the average residual reading times for the critical regions by condition, showing faster reading times overall in EARLY MATRIX condition than in the EARLY TAC condition. For the main effect of *condition*, likelihood ratio tests show a significant effect at the disambiguation region ($\chi^2(1) = 5.62$, $p = .018$) and a marginal effect at the spillover region ($\chi^2(1) = 3.3$, $p = .069$), see Table 2.8.

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[3]For this reason we decided not to compare sentence-final conditions. If we had, the condition for which we would expect slower reading times – EARLY ARC – would violate the chronological order of events, whereas in the condition for which we would expect faster reading times – EARLY MATRIX – the order of events and chronological order would overlap. Consequently, it would not be clear if faster reading in the expected direction would be a result of chronological order, clause position or clause type.

TABLE 2.7: Experiment 3: Mean residual reading times for the target regions in each condition.

	early TAC	early matrix	*Means*
disambiguation	−61.87 (19.75)	−143.98 (16.76)	−102.86 (13.00)
spillover	−36.19 (13.08)	−66.74 (11.57)	−51.54 (8.73)

FIGURE 2.3: Reading plot showing the residual reading times by condition for Experiment 3.
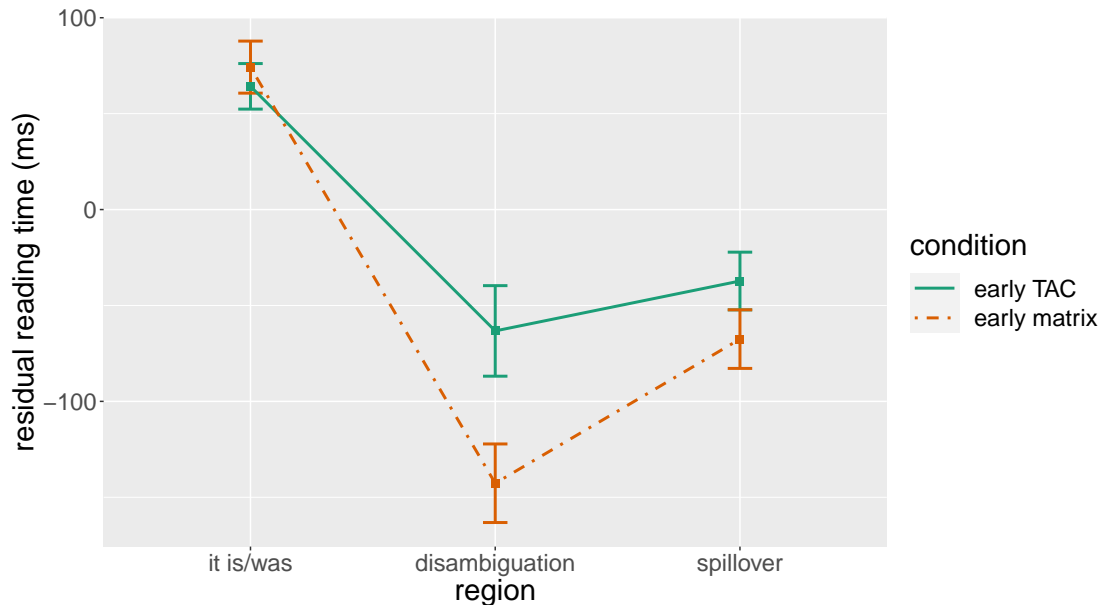
TABLE 2.8: Experiment 3 model results by region: Coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including 'condition', and the *p*-value for that test statistic.

	disambiguation				*spillover*			
	β	SE	$\chi^2(1)$	p	β	SE	$\chi^2(1)$	p
cond	68.54	28.62	5.62	**.02**	38.86	20.93	3.30	.07
trial#	−15.77	2.66	34.73	**<.001**	−7.56	1.79	16.68	**<.001**
cond × trial#	−8.78	5.36	2.69	.1	−5.13	3.65	1.96	.16

2.8.8 Discussion

In Experiment 3, reading times were faster when coreference was established with an element from a sentence-early matrix clause than with an element from a sentence-early TAC. This is in line with what the clause type hypothesis predicts and with results from Frazier & Clifton (2005). We can confirm that clause type does influence C-at-issue potential in sentences with a TAC, but seemingly only when there is no potential effect of position to counteract this.

2.9 Interim discussion: Temporal adverbial clauses

Together the first set of experiments show that both clause type and clause position influence which clause in sentences with a TAC is the more likely host for C-at-issue content. While we cannot say with certainty which of our hypotheses – the clause type hypothesis or the clause position hypothesis – makes more accurate predictions, our findings suggest it is the clause position hypothesis. This was evidenced by Experiment 2, in which the predictions for these hypotheses go in opposite directions and only those made by the clause position hypothesis were borne out in the results. These findings were in contrast to our expectations as well as the findings in Frazier & Clifton (2005). A possible explanation can be found in Clark & Sengul (1979); Gernsbacher et al. (1989), who find that a referent's recency can increase its accessibility. That would explain the results for Experiment 2, but it also opens the door to questioning whether anaphoric potential and C-at-issueness overlap. In the general discussion, we will revisit this topic.

2.10 Experiment 4: early ARC vs. final matrix vs. final ARC

In the first experiment of this series we will investigate both the clause position hypothesis and the clause type hypothesis by considering sentences with an ARC. We will be comparing processing when an ambiguous pronoun is disambiguated to an element in a clause with high C-at-issue potential (sentence-final matrix clause), a clause with low C-at-issue potential (sentence-early ARC), and a clause that has higher or lower C-at-issue potential depending on whether clause type or clause position matters more (sentence-final ARC). We assume the clause position hypothesis makes better predictions for sentences with ARCs, which would mean that the last-mentioned clause (sentence-final ARC) would also have high C-at-issue potential, and that consequently, disambiguating a pronoun to this clause would proceed easily. Additionally, our design allows us to test the clause type hypothesis by comparing the two conditions in which the ambiguous pronoun is disambiguated to a sentence-final clause to see if processing reflects the matrix versus subordinate status of that clause. If we find any effects, these can inform us about the validity of at least one of these hypotheses, and potentially both.

2.10.1 Method

2.10.2 Participants

This experiment was run together with Experiment 1 and the participant sample is thus the same.

2.10.3 Materials

The study had 24 target items in three conditions and 32 fillers. The critical manipulation was whether the *disambiguation* led to the pronoun *It* establishing coreference with an element from a sentence-early ARC (59a), a sentence-final ARC (59c), or a sentence-final matrix clause (59b).

(59)　a.　**[EARLY ARC]** My mom, who had just returned from a shopping trip, was having a chat with our neighbor. It was
a quick trip to get some supplies. She is making a tiny gazebo for the birds in her backyard.

　　　b.　**[FINAL MATRIX]** My mom, who was having a chat with our neighbor, had just returned from a shopping trip. It was
a quick trip to get some supplies. She is making a tiny gazebo for the birds in her backyard.

　　　c.　**[FINAL ARC]** My mom was having a chat with our neighbor, who had just returned from a shopping trip. It was
a quick trip to get some supplies. She is making a tiny gazebo for the birds in her backyard.

The items were distributed across three lists in a Latin Square design such that all participants saw a third (8) of the target items in each condition. The 36 fillers consisted of the 16 target items for Experiment 1, as well as the other 20 filler items described in the Experiment 1 materials.

2.10.4 Procedure

The procedure followed that of Experiment 1, with the exception of the first chunked region in the target items. In sentences with ARCs, the target items were chunked as follows (disambiguation and spillover region in italics):

(60)   /My mom,/who/had just returned from a shopping trip,/

was having a chat with our neighbor./It was/

a quick trip to get some supplies./She is making a/

tiny gazebo for the birds/in her backyard./

Whereas the first chunked region constituted a context sentence in the experiments with TACs, in the experiments with ARCs (Experiments 4–6) this region was the subject of the sentence containing an ARC. Additionally, the pronoun *who* was also presented as a separate chunk,[4]   yielding a total of 7–9 chunks for each target item.

2.10.5   Analysis

Statistical analysis was largely similar to that in the first three experiments, with some adjustments to accommodate the 3-level variable condition. We applied reverse Helmert contrast coding to the variable *condition* in the full model such that *factor 1* of this variable compared the FINAL ARC and FINAL MATRIX conditions – the two conditions for which the coreference clause is in the same (sentence-final) position– and *factor 2* compared the mean reading times of the sentence-final conditions to the EARLY ARC condition, in which the coreference clause is in sentence-early position. This allows us to probe both the effect of clause type and clause position on our target regions with one model. As likelihood ratio tests between the full model and the model without *condition* are not informative towards the significance of the individual factors, we only report t-values here as our measure for significance. We report the t-values obtained from the mixed model summary, and treat t-values of 2 and above as statistically significant.[5]

2.10.6   Predictions

Under the clause position hypothesis, we expect coreference to proceed more easily when an ambiguous pronoun is disambiguated to an element in a sentence-final clause. This would result in faster reading times for both the FINAL ARC and FINAL MATRIX conditions – where the referent for the ambiguous pronoun *It* is hosted by a sentence-final

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[4]We presented *who* in a separate chunk so that it would be possible for us to compare reading times of the same predicate in an ARC and a matrix clause.

[5]The analysis plan described in the preregistration is slightly different from the one described here: we originally planned to carry out subset analyses doing pair-wise comparisons between the conditions if we found a significant effect of *condition* on reading times for the target regions with the likelihood ratio test between the full model and the model without *condition*. However, we have since learned that the analysis of the full model with reverse Helmert contrast coding is more appropriate as it considers all the data simultaneously. We did also follow the preregistered strategy, for which we will report results in the supplementary materials for this experiment as well as for Experiment 5. These results show the same pattern with the exception of an effect on the spillover region in Experiment 5 that only occurred in the model with reverse Helmert contrast coding.

clause – compared to the EARLY ARC condition, where this same referent is hosted by a sentence-early clause. The predicted pattern would manifest as a main effect of *factor 2* on the disambiguation and/or spillover region with slower reading times for the level representing the EARLY ARC condition. Under the clause type hypothesis, the FINAL MATRIX is expected to be read faster than the FINAL ARC condition. This would be reflected by a main effect of *factor 1*, with faster reading times for the level representing the FINAL MATRIX condition.

2.10.7 Results

Table 2.9 and Figure 2.4 present the average residual reading times for the critical regions by condition. The summary of the models to which we applied reverse Helmert contrast coding to the variable *condition* are shown in table 2.10. For the disambiguation region, the EARLY ARC condition yielded slower reading times than the average reading times for the FINAL ARC and the FINAL MATRIX conditions combined, which is reflected by a significant effect of *factor 2*. We find no such effect on the spillover region. Contrary to the predictions of the clause type hypothesis, we find no difference between the FINAL ARC and the FINAL MATRIX conditions for either target region, reflected by the absence of an effect for *factor 1*.

TABLE 2.9: Experiment 4: Mean residual reading times for the target regions in each condition.

	early ARC	final ARC	final matrix	*Means*
disambiguation	34.82 (23.91)	−78.05 (22.5)	−74.1 (23.43)	−39.23 (13.51)
spillover	−49.22 (14.88)	−81.85 (13.19)	−64.59 (13.74)	−65.21 (8.06)

TABLE 2.10: Experiment 4 , all three conditions (*factor 1* compares final ARC to final matrix, *factor 2* compares early ARC to the mean residual reading time of *factor 1*): Model coefficient estimates, standard errors of those estimates and t-values.

	disambiguation			*spillover*		
	β	SE	t	β	SE	t
factor 1	−0.06	15.68	0.00	−6.94	9.00	−0.78
factor 2	35.93	9.06	**3.97**	7.52	5.20	1.45
trial#	8.28	1.90	**-4.36**	−9.00	1.08	**-8.31**
factor 1 × trial#	0.08	2.31	0.03	−0.91	1.34	−0.68
factor 2 × trial#	−1.45	1.36	−1.07	−1.42	0.78	−1.82

2.10.8 Discussion

The results of Experiment 4 are consistent with the clause position hypothesis: coreference with an element from a clause in sentence-final position were read faster than those

FIGURE 2.4: Reading plot showing the residual reading times by condition for Experiment 4.
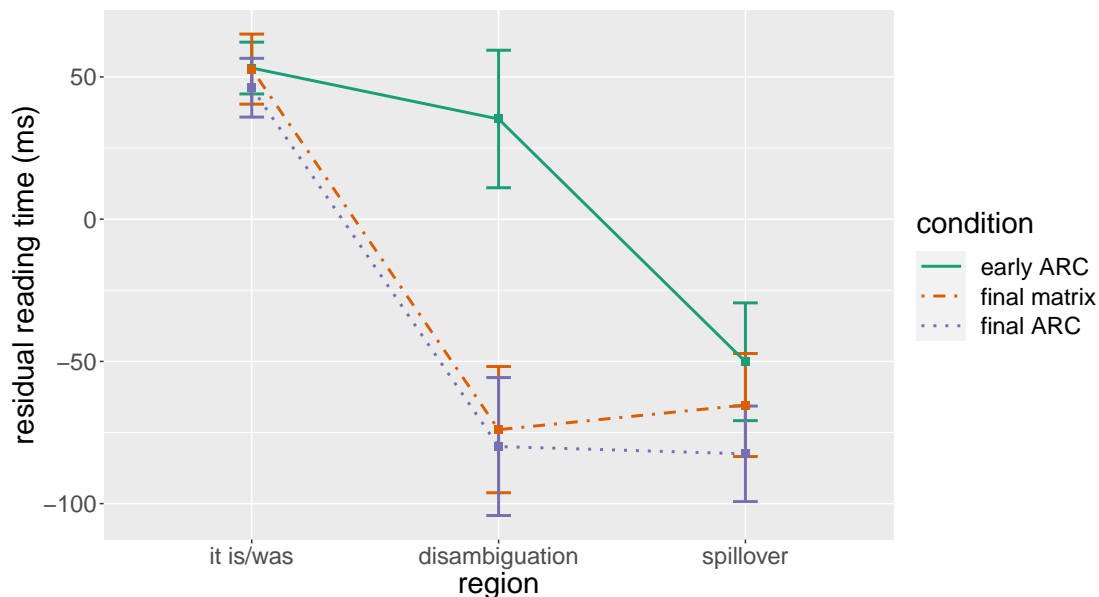
in sentence-early position. We find no evidence for the clause type hypothesis for these ARC sentences. These results are in line with offline evidence from Syrett & Koev (2015), who find that ARCs are more C-at-issue in sentence-final position than in sentence-early position. However, their results show that generally, matrix clauses are more C-at-issue than the ARC in the sentence they occur with. The design of the current experiment does not provide us with evidence regarding the question of whether matrix clauses are more C-at-issue than ARCs in the same position, so this is something we will probe again in the next experiment, where we will include a sentence-early matrix clause condition to test any potential effects of clause type in sentences with ARCs.

2.11 Experiment 5: early ARC vs. final matrix vs. early matrix

Experiment 5 again targets a sentence-final matrix clause (high C-at-issue potential) and a sentence-early ARC (low C-at-issue potential) but for the third condition we test a sentence-early matrix clause. What we believe to be the more informative hypothesis here – the clause position hypothesis – would predict this clause to have low C-at-issue potential. The clause type hypothesis, however, would predict the opposite. While we did not find any evidence for the clause type hypothesis in Experiment 4, we only compared the effect of clause type in sentence-final position. In the current experiment we investigate the role of clause type for clauses in sentence-early position. Here, an effect

of position – as we consistently find for sentence-final clauses – cannot hide a smaller effect of clause type in the way it might have done in Experiment 4.

2.11.1 Method

2.11.2 Participants

This experiment was run together with Experiment 2 and the participant sample is thus the same.

2.11.3 Materials

The design of the materials largely follows that of Experiment 4, but here the passage enforces coreference with an element from an sentence-early ARC (61a), sentence-early matrix clause (61c) or a sentence-final matrix clause (61b):

(61)   a. [EARLY ARC] My mom, who was having <u>a chat</u> with our neighbor, had just returned from a shopping trip. It was
about their plans for the weekend. They have a night out planned together.

   b. [FINAL MATRIX] My mom, who had just returned from a shopping trip, was having <u>a chat</u> with our neighbor. It was
about their plans for the weekend. They have a night out planned together.

   c. [EARLY MATRIX] My mom was having <u>a chat</u> with our neighbor, who had just returned from a shopping trip. It was
about their plans for the weekend. They have a night out planned together.

This experiment contained the four additional comprehension questions that were added in Experiment 2.

2.11.4 Procedure

The procedure followed that of Experiment 4.

2.11.5 Analysis

Statistical analysis was largely follows that for Experiment 4. The only difference is that for the reverse Helmert contrast coding of *condition*, *factor 1* compares the EARLY ARC

and EARLY MATRIX conditions, and *factor 2* compared the mean reading times of the sentence-early conditions to the FINAL MATRIX condition.

2.11.6 Predictions

The predictions for here largely follow those for Experiment 4. Under the clause position hypothesis, the sentence-final condition (FINAL MATRIX) is expected to be read faster than the sentence-early conditions (EARLY ARC and EARLY MATRIX). The predicted pattern would manifest as a main effect of *factor 2* with slower reading times for the level representing the EARLY ARC condition. Under the clause type hypothesis, the EARLY MATRIX condition is expected to be read faster than the EARLY ARC condition. This would be reflected by a main effect of *factor 1* with faster reading times for the level representing the EARLY MATRIX condition.

2.11.7 Results

Table 2.11 and Figure 2.5 present the average residual reading times for the critical regions by condition. The summary of the models to which we applied reverse Helmert contrast coding to the variable *condition* are shown in table 2.12. In keeping with the clause position hypothesis, for the disambiguation region, the FINAL MATRIX condition yielded faster reading times than the average reading times for the sentence-early conditions.

For the disambiguation region, the condition yielded faster reading times than the average reading times for the EARLY ARC and the EARLY MATRIX conditions combined, which is reflected by a significant effect of *factor 2*. We find no such effect on the spillover region. Regarding the clause type hypothesis, we find no effect of *factor 1* for the disambiguation region, but we do find an effect for this at the spillover region, such that reading times were faster in the EARLY MATRIX condition than in the EARLY ARC condition.

TABLE 2.11: Experiment 5: Mean residual reading times for the target regions in each condition.

	early ARC	early matrix	final matrix	*Means*
disambiguation	22.48 (21.22)	−16.02 (19.73)	−86.66 (18.18)	−26.69 (11.45)
spillover	−82.59 (12.17)	−113.00 (11.39)	−99.59 (11.59)	−98.63 (6.77)

FIGURE 2.5: Reading plot showing the residual reading times by condition for Experiment 5.
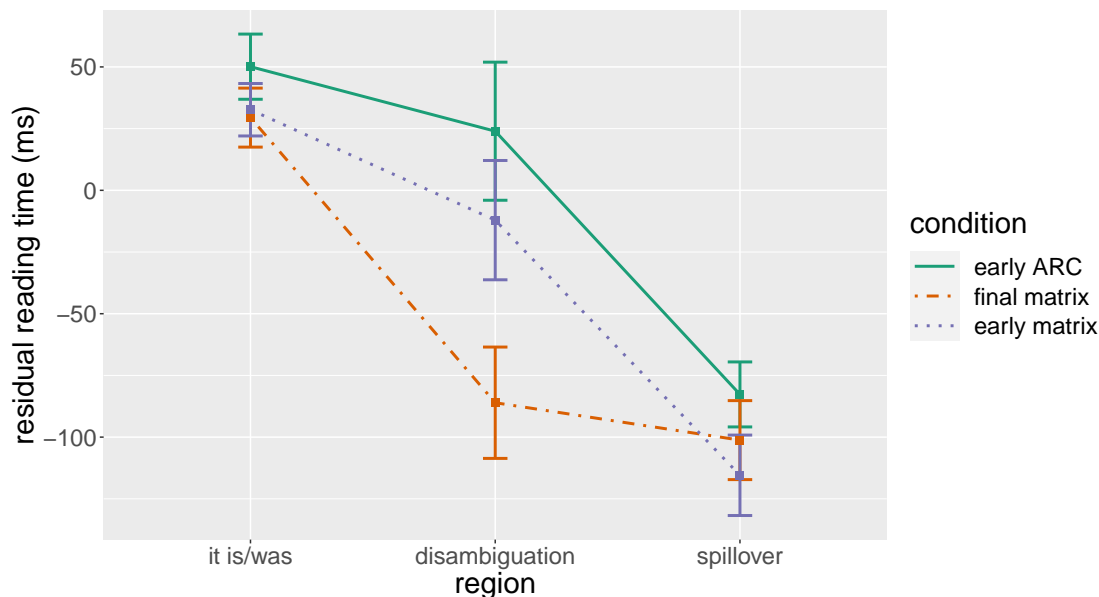
TABLE 2.12: Experiment 5 , all three conditions (*factor 1* compares early ARC to early matrix, *factor 2* compares final matrix to the mean residual reading time of *factor 1*): Model coefficient estimates, standard errors of those estimates and t-values.

	disambiguation			*spillover*		
	β	SE	t	β	SE	t
factor 1	-14.79	12.85	-1.15	-15.04	7.51	**-2**
factor 2	-31.90	7.42	**-4.3**	-0.82	4.33	-0.19
trial#	-11.09	1.55	**-7.16**	-8.00	0.90	**-8.86**
factor 1 $\times$ trial#	0.31	1.92	0.16	-0.56	1.12	-0.5
factor 2 $\times$ trial#	0.40	1.12	0.36	-0.63	0.66	-0.96

2.11.8   Discussion

In Experiment 5, reading times were faster when coreference was established with an element from a sentence-final matrix clause than with an element from either sentence-early clause, in line with results from Experiment 4. In addition, we found an effect at the spillover region when comparing a sentence-early matrix clause to a sentence-early ARC, with faster reading times in the EARLY MATRIX condition. This result is compatible with offline evidence from Syrett & Koev (2015), who found that sentence-early matrix clauses were judged more likely hosts for C-at-issue content than ARCs in this same position. While both the sentence-final matrix clause and the sentence-early matrix clause showed at-issue potential in this experiment, the disambiguation region was read faster when it followed the FINAL MATRIX condition than when it followed the EARLY MATRIX condition. Reading times at the spillover region for the EARLY MATRIX condition were faster only in comparison to the EARLY ARC condition. Taken together,

these two effects suggest that the C-at-issue status of clauses in sentences with an ARC is influenced both by clause position and clause type, but that clause position is the more important factor. In a final experiment, we are testing the *type of subordination* hypothesis. We consider again the C-at-issue status of sentence-early matrix clauses, but we compare this clause to a simple sentence that is expected to be at the RF by virtue of standing in a discourse-superordinating relation to the last-uttered segment: another simple sentence that elaborates on the one preceding it.

2.12   Experiment 6: simple sentence vs. early matrix

This third and final experiment in this series serves as an indirect test of the clause type hypothesis by further probing the C-at-issue status of sentence-early matrix clauses in sentences with an ARC. The previous two experiments provided clear evidence for the clause position hypothesis in these sentences, but we found some evidence that – at least for clauses in sentence-early position – the clause type hypothesis is also relevant, but this evidence appeared only at the spillover region whereas other effects in Experiments 1-5 robustly appeared at the disambiguation region (and sometimes, in addition, at the spillover region). To further investigate whether indeed sentence-early matrix clauses in sentences with an ARC do have C-at-issue potential, we compare them to a type of sentence that is not expected to have any C-at-issue potential: a sentence that is one step removed from the RF as it is followed by another – coordinating – sentence. Given its position in the discourse structure, such a sentence is not expected to be accessible as discourse-continuing and therefore not C-at-issue (Asher & Lascarides, 2003; Hunter & Asher, 2016; Polanyi, 1988; Webber, 1991). Consequently, this sentence is also not expected to productively host antecedents. This experiment will inform us about whether the clause type hypothesis is relevant in sentences with an ARC by testing whether the clause that had shown C-at-issue potential in Experiment 5 (a sentence-early matrix clause) indeed has more C-at-issue potential than an inaccessible simple sentence, which we would take as confirmation that the C-at-issue potential observed in Experiment 5 was not a spurious effect.

2.12.1   Method

2.12.2   Participants

This experiment was run together with Experiment 3 and the participant sample is thus the same.

2.12.3 Materials

The design of the materials largely follows that of Experiment 2, but here the passage enforces coreference with an element from a sentence-early matrix clause (62b) or a single sentence which is followed by another simple sentence (62a):

(62) a. [SIMPLE SENTENCE] My mom was having <u>a chat</u> with our neighbor. He had just returned from a shopping trip. It was *about their plans for the weekend.* Apparently they both bought tickets to the same show.

b. [EARLY MATRIX] My mom was having <u>a chat</u> with our neighbor, who had just returned from a shopping trip. It was *about their plans for the weekend.* Apparently they both bought tickets to the same show.

2.12.4 Procedure

The procedure followed that of Experiment 4 aside from one change to the chunking strategy: we did not separate *who* (or in the other condition *s/he*) into an individual chunk,[6] rather this element was part of the simple sentence (62a) or the ARC (62b) chunk. As a result, all target items consisted of 6–8 chunks.

2.12.5 Analysis

The statistical analysis followed that for Experiment 1.

2.12.6 Predictions

Experiment 5 showed that sentence-early matrix clauses have C-at-issue potential, lending support to the *clause position* hypothesis. We expect to find this effect repeated here when the C-at-issue potential of a sentence-early matrix clause is compared to the C-at-issue potential of a simple sentence that discourse-subordinates the most recent discourse segment. Both the sentence-early matrix clause and the simple sentence are at the RF, but we expect that the sentence-early matrix clause is more accessible by virtue of it sentence-structurally subordinating the most recent discourse segment (clause boundary), whereas the simple sentence discourse-structurally subordinates the most recent discourse segment (Sentence boundary).

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[6]We were not interested in comparing reading times of the early matrix clause predicate to that of the simple sentence, as this was not related to any of our hypotheses

2.12.7 Results

Table 2.13 and Figure 2.6 present the average residual reading times for the critical regions by condition. We find that the SMALL CAPS EARLY MATRIX condition is read faster than the SIMPLE SENTENCE condition with a significant effect of *condition* at the disambiguation region ($\chi^2(1) = 3.05$, $p = .08$), see table 2.14. We find no effect at the spillover region ($\chi^2(1) = 0$, $p = .998$).

TABLE 2.13: Experiment 6: Mean residual reading times for the target regions in each condition.

	simple sentence	early matrix	*Means*
disambiguation	−40.11 (20.23)	−116.79 (18.4)	−79.2 (13.69)
spillover	−79.11 (12.02)	−79.38 (11.00)	−79.25 (8.12)

FIGURE 2.6: Reading plot showing the residual reading times by condition for Experiment 6.
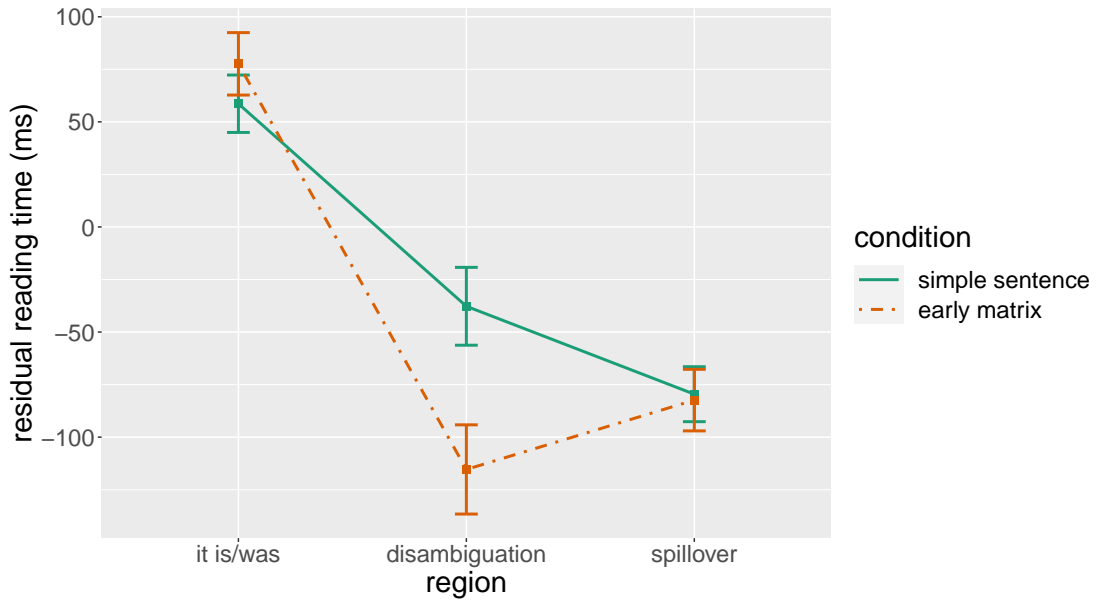
TABLE 2.14: Experiment 6 model results for disambiguation region: Coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including *condition*, and the *p*-value for that test statistic.

	β	SE	$\chi^2(1)$	p
cond	64.32	26.19	3.05	**.01**
trial#	−16.53	3.03	29.43	**<.001**
cond × trial#	4.53	6.10	0.50	.46

2.12.8   Discussion

In keeping with the results from Experiment 5, we find that matrix clauses have C-at-issue potential in sentence-early position in sentences with ARCs: reading times were faster when coreference was established with an element from a sentence-early matrix clause at the RF, than an element from a simple sentence that was at the RF by virtue of discourse-subordinating the most recent discourse segment. This suggests that within-sentence superordinate segments have more C-at-issue potential than superordinate segments outside of the sentence-boundaries: discourse segments that are at the RF by virtue of discourse-structural superordination only, and not sentence-structural superordination, are less C-at-issue than discourse segments that sentence-structurally subordinate the clause that follows them. Taken together, these results suggest that C-at-issue potential is differently influenced by sentence-structure and discourse-structure.

2.13   Interim Discussion: Appositive Relative Clauses

In sentences with ARCs, sentence-final clauses were always more C-at-issue than any sentence-early clause independent of clause type. Additionally, for clauses in sentence-final position their clause type did not yield any differences. When focusing on clauses in sentence-early position, however, clause type did have an influence: sentence-early matrix clauses showed C-at-issue potential here. This information may seem peripheral when we have already established that an ARC that follows such a matrix clause has greater C-at-issue potential, but it is important for two reasons. Firstly, it confirms prior theoretical claims about the C-at-issue status of sentence-early matrix clauses, as well as offline experimental evidence. Secondly, it means that our findings cannot be interpreted as just an effect of recency (Clark & Sengul, 1979; Gernsbacher et al., 1989), but that clause type is a relevant factor for sentence-early clauses in sentences with an ARC. Lastly, we find that sentence-structure is a more reliable indicator of C-at-issue potential than discourse-structure. This suggests that C-at-issue potential is a dynamic concept rather than a categorical one, influenced by structural within-sentence features, clause type and clause position, as well as discourse structure, whether a discourse segment is only discourse-structurally superordinate or also sentence-structurally.

2.14   General Discussion

Across six experiments, we investigated the C-at-issue potential of clauses in sentences with a TAC and in sentences with an ARC. We posited the clause type hypothesis,

assuming that matrix clauses would be more likely hosts for C-at-issue content. Alongside the clause type hypothesis we also posited the clause position hypothesis, assuming that sentence-final clause are more C-at-issue than sentence-early clauses. We did not expect clause position to be relevant in sentences with a TAC, where we expected only matrix clauses to have C-at-issue potential. In sentences with an ARC, however, we expected clause position to overrule clause type, such that ARCs in sentence-final position could be C- at-issue. The *type of subordination* hypothesis was found to make accurate predictions in the experiment it was tested (Experiment 6).

The clause position hypothesis was found to make accurate predictions in all experiments where it was tested (Experiments 1, 2, 4 & 5), whereas predictions made by the clause type hypothesis were only borne out in those situations where conditions were compared in which the clause containing the antecedent was in sentence-early position (Experiments 3, 5 & 6). Furthermore, when clause position and clause type were in competition by comparing a subordinate clause in sentence-final position to a matrix clause in sentence-early condition, the clause position hypothesis was found to make more accurate predictions than the clause type hypothesis. This was found to be the case in both sentences with a TAC (Experiment 2) and sentences with an ARCs (Experiment 4).

On balance, this pattern of results is more compatible with the *clause position* hypothesis than with the *clause type* hypothesis, but both hypotheses are relevant. The pattern we observe shows a hierarchical relation between the two hypotheses, such that the clause type hypotheses is only relevant for clauses for which we would not expect C-at-issue potential under the *clause position* hypothesis: those in sentence-early position. For sentences with ARCs, our results extend offline experimental findings in Syrett & Koev (2015) and are compatible with theoretical claims made in Jasinskaja (2016): ARCs and matrix clauses can both be C-at-issue in sentence-final position, and more so than the clause that precedes them. In sentence-early position, however, only matrix clauses show C-at-issue potential. This pattern was replicated in sentences with TACs. As far as it concerns the matrix clauses in these sentences this finding is uncontroversial, but to find that sentence-final TACs can be C-at-issue (Experiment 2) – and, similarly to sentence-final ARCs, even more so than the matrix clause that precedes them – was unexpected. Furthermore, we find that the *type of subordination* hypothesis – sentence-structural vs. discourse-structural – made accurate predictions about C-at-issue potential, such that discourse segments were more C-at-issue when they sentence-structurally subordinate the clause that follows them, than when they discourse-structurally subordinate the sentence that follows them (Experiment 6). We take these results to indicate that C-at-issueness is an even more dynamic concept than what has previously been found in empirical investigations. Our findings allow for a view of C-at-issueness whereby

different factors contribute to C-at-issue potential in a hierarchical fashion: sentence-final clauses have more C-at-issue potential than sentence-early clauses (independent of clause type), sentence-early matrix clauses have more C-at-issue potential than sentence-early ARCs/TAcs, and sentence-structurally superordinate clauses have more C-at-issue potential than discourse-structurally superordinate sentences.

While the theoretical implication made under C-at-issueness is that any last-uttered discourse segment is at the RF (Hunter & Asher, 2016; Polanyi, 1988; Webber, 1991), and therefore C-at-issue (Hunter & Asher, 2016; Jasinskaja, 2016), Asher (2008) argues that there are additional constraints for TACs such that these are only at the RF in sentence-final position if they stand in a causal relation to the matrix clause that precedes them. While we avoided the potential for a causal inference to be made between TACs and matrix clauses in our items – which, had we not done this, could have explained the perceived C-at-issue status of sentence-final TACs – it is possible that participants assumed a causal inference was implied, which led to faster reading times when *It* was disambiguated to a referent in the sentence-final TAC (63a) than when the referent was hosted by a sentence-early matrix clause (63b) (Example (57) from Experiment 2, repeated below in (63)).

(63)   a. **[FINAL TAC]** My parents went out yesterday. They went to a violin concert after they dined at <u>a French Bistro</u>. It was
a very small cozy restaurant. The food was exquisite.

        b. **[EARLY MATRIX]** My parents went out yesterday. They dined at <u>a French bistro</u> after they went to a violin concert. It was
a very small cozy restaurant. The food was exquisite.

However, if they indeed assumed there to be a causal relation, the absence of this would have become clear at the spillover region, *The food was exquisite*, which elaborates more on *a French bistro*. At this point the opportunity for a potential causal relation to be made clear in retrospect has passed. Moreover, the spillover region is where we found our main effect. As such, we do not believe that our results can be explained through this lens. However, rather than assuming that the presence of a causal relation between a sentence-final TAC and a sentence-early matrix clause licenses the C-at-issue status of sentence-final TACs, such a causal relation could be seen as a contributing factor for TACs in sentence-final position. Following from our results, we suggest that any sentence-final clause can be C-at-issue, but perhaps a follow-up study could reveal that these – TACs specifically, but possibly also other subordinate clauses – appear more C-at-issue when they stand in a causal relation to the matrix clause that precedes them. We leave the role of causal relations in predicting C-at-issue potential to future investigations.

A critique of our methodology can be found in Snider (2017, 2018), who argues that at-issueness and anaphoric potential are two distinct notions for which no overlap should be assumed. Therefore, anaphora-based diagnostics should not be taken as evidence for at-issue status. The majority of his argument rests on the notion that at-issueness is a singular concept, for which Q-at-issueness is taken as the all-determining foundation. Diagnostics for P-at-issue status and empirical evidence for both P- and C-at-issue status rely on anaphora-based diagnostics/methods. When such metrics are employed, sentence-final ARCs consistently appear at-issue. When Q-at-issue diagnostics are used, sentence-final ARCs do *not* appear at-issue. Consequently, Snider argues that anaphora-based metrics are not a reliable measure for at-issue status. While this can easily be addressed by subscribing to Koev (2018)'s different theories of at-issueness – as we have explicitly done – Snider (2017) makes an observation that highlights several important topics. His observation shows the relevance of distinguishing between different theories of at-issueness, how there is interdependence between them, and how our methodology in particular tackles the problem he claims to observe.

In (64a), a QUD is posed (in boldface), for which the subsequent answer appears in a matrix clause (in boldface in (64b)). However, the response to this QUD contains a sentence-early ARC which seems to be at-issue by virtue of hosting the antecedent for *that* in the next sentence:

(64) Context: Mark is a high school teacher. His parents come to visit during a school assembly. His father is looking around the auditorium, curious about Mark's students.

    a. Dad:
        Where are Mark's students sitting?

    b. Mom:
        Lisa, <u>who is Mark's favorite</u>, **is sitting in the front row.**
        He told me <u>that</u> in confidence, though, so don't tell anyone.

Snider claims that because the ARC – *who is Mark's favourite* – does not answer the QUD (the matrix clause does) the ARC is not-at-issue. However, in this case we can say that the matrix clause is Q-at-issue, looking backward to the previous utterance, and the ARC is C-at-issue, looking forward to the subsequent utterance. What this shows is that there is a link between Q- and C-at-issueness: they do not necessarily overlap, but they depend on each other such that what is C-at-issue, can contain the QUD for what is subsequently Q-at-issue. This observation can be extended to P-at-issueness, such that clauses that are not Q-at-issue but are P-at-issue, can contain the QUD that licenses the Q-at-issue status of subsequent discourse segment. This interdependence between

at-issueness theories seems a particular fruitful avenue to consider in future research. In doing so, it steers away from considering these theories as 'competing' theories. Instead, it focuses on how these theories inform each other and complement each other.

The above example (64) shows a case of a sentence-early ARC being C-at-issue as an argument against using anaphoric potential as evidence for at-issue status, because any theory of at-issueness would argue that sentence-early ARCs are not-at-issue. While we may not agree with the premise of this argument, our methodology shows the benefit of using an online measure here over offline measures or isolated examples like above. Consider the sentence containing an ARC from (59a), repeated below in (65a). As is clear, it is possible for the matrix clause to be Q-at-issue (in boldface) and the sentence-early ARC to be C-at-issue (underlined):

(65)   a. **Who was your mom talking to?**

        b. **My mom**, who had just returned from a shopping trip, **was having a chat with our neighbor**.

           She shouldn't be spending money though so don't tell anyone I told you that.

What this particular example obscures, however, is that even though it is possible to use anaphora-based metrics to show that a sentence-early ARC can be C-at-issue, this possibility reveals nothing about the likelihood of ARCs in this position to be C-at-issue. Our methodology measures whether comprehenders *expect* an antecedent to be hosted by a certain clause by measuring reading times when a temporarily ambiguous pronoun gets disambiguated. Our findings do not contradict Snider's observation that it is *possible* for not-at-issue clauses to host antecedents, but rather show that comprehenders generally do not expect this to be the case. As such, our methodology reveals a more fine-grained distinction that does not rule out what is possible, but that measures what is expected, and therefore, more likely.

A final note on a potentially confounding feature of our methodology stems from the observations made by Clark & Sengul (1979) and Gernsbacher et al. (1989) that the more recently a referent has been mentioned, the more accessible it is. Indeed, we find that sentence-final clauses were more C-at-issue than sentence-early clauses by virtue of their likelihood for hosting antecedents. We cannot fully rule out that effects of recency might have obscured effects that we attribute to C-at-issue potential, but this notion of recency is inherent to the RF. The last-uttered – or most *recently* uttered – discourse segment is on the RF, and as such it is available for subsequent discourse attachment. Moreover, we do find effects of clause type – both in sentences with a TAC (Experiment 2) and sentences with an ARC (Experiment 5) – showing that when a subordinate clause is not on the RF because it is not the most recent discourse segment, it is not C-at-issue,

and that a matrix clause is C-at-issue when it is at the RF by virtue of subordinating the most recent discourse segment. As such, we do not believe this effect of recency is confounding; rather, it fully aligns with predictions made by the RF. Moreover, Holler & Irmen (2007) find in an offline study that referents at the RF were more accessible than referents that were not at the RF, even if the referent that was not at the RF was the most recently mentioned referent. However, C-at-issueness theories might benefit from an addendum to their analyses of C-at-issue status as feature of the RF: When the RF predicts several discourse segments as having C-at-issue potential, the more recent segment is the more likely candidate.

That said, it still seems relevant to pursue an investigation into effects of recency vs. effects of the RF, to unequivocally determine whether recency is a confounding factor rather than a natural feature of the RF. It is possible to design an experiment in which the most recent possible referent for an ambiguous pronoun is not at the RF, whereas another less recent referent is on the RF. This would require a different type of methodology that does not engage with subordination at the level of clauses within individual sentences, but rather one that considers subordination at the discourse-level by taking a string of sentences which stand in subordinating and coordinating relations with each other (cf. Holler & Irmen, 2007).

2.15 Conclusion

In this paper, we investigated the C-at-issue status of clauses within sentences with a TAC and sentences with an ARC. We tested the clause type hypothesis and the clause position hypothesis across six experiments. We found that overall the clause position hypothesis made more accurate predictions about the at-issue status of clauses, but that the clause type hypothesis was relevant for clauses in sentence-early position. When both hypotheses were in competition, we only observed effects of clause position, which appeared as the more important factor in determining at-issue status.

We suggest that this reflects a pattern whereby the expectations for which clause in a sentence is C-at-issue are predominantly formed through the position of clauses. While this does not rule out the potential for matrix clauses to be C-at-issue in sentence-early position, we have shown that any sentence-final ARC or TAC was always more C-at-issue than the matrix clause preceding it. As such the RF seems a productive predictor for C-at-issue status, but when two discourse segments are at the RF – i.e., a sentence-early matrix clause and a sentence-final TAC or ARC – comprehenders assume the last-uttered discourse segment to be the more likely candidate for being C-at-issue, than the discourse segment preceding it. Therefore, C-at-issueness theories could be adapted to

include recency as the determining factor for what is the most likely C-at-issue discourse segment when multiple segments are at the RF. Additionally, when recency is not a contributing factor, C-at-issue potential seems to be further influenced by the type of subordination, such that discourse segments that are at the RF by virtue of sentence-structurally subordinating the last-added segment, are more C-at-issue than discourse segments that do so discourse-structurally.

Lastly, the current study highlighted the importance of distinguishing between different theories of at-issueness. The study in this paper is specifically relevant for C-at-issueness theories, and does not inform us about the Q- or P-at-issue status of clauses. However, our findings did lead to observations relevant for these other theories. When subordinate clauses are C-at-issue, they generally cannot directly answer a QUD, but they can pose a QUD which subsequently can be answered by a discourse segment that is Q-at-issue. As such, C-at-issue (but also P-at-issue) discourse segments feed into Q-at-issueness by being able to contain the QUD that identifies what subsequently is Q-at-issue. This notion can be integrated into future research to use different theories of at-issueness as complementary or informative to one-another, rather than assuming these theories are in competition to determine which one makes the most accurate predictions of at-issue status.

2.15.1 Ethics

All experiments in this study were carried out in accordance with the research ethics procedures of the Department of Linguistics and English Language at The University of Edinburgh (Ref # 374-1920/4). Informed consent was obtained from all participants prior to participation.

2.15.2 Data accessibility

The data that support the findings of this study are openly available in the Open Science Framework repository: https://osf.io/3s8y5/.

2.16 What's next?

The current study investigated the C-at-issue status of clauses in sentences containing an ARC or a TAC. Through a series of processing experiments, we showed that the C-at-issue status of clauses in these sentences varies depending on their position, as well as the type of clause they are in sentence-early position. Our findings here relied on the

reading times of a region that followed the sentence containing the clauses of interest: We measured reading times when a temporarily ambiguous pronoun *It* was disambiguated to a referent in one of the clauses in the preceding sentence. In the next chapter, the focus is still on sentences containing an ARC and the C-at-issue status of the individual clauses in such sentences, but I investigate how the C-at-issue status of these clauses influences how these sentences are processed.

Chapter 3

Processing appositive relative clauses: Effects of information structure and sentence structure

This chapter engages with the following overarching research question of this thesis:

- Does the *at-issueness* principle accurately predict sentence processing in interaction with other ordering principles for sentences containing an ARC?

The C-at-issue status of ARCs and matrix clauses we assume in Chapter 3, follows from the evidence presented in Chapter 2. The experiment in this chapter is referred to outside of this chapter as [Experiment 7]. This was also added as a label to the Tables and Figures in this chapter for reference to avoid potential ambiguity with [Experiment 1] in Chapter 2. Like the previous chapter, Chapter 3 consists of the sections of an existing paper (Wilke et al., under revisiona).[1]   I first provide a preamble with a

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[1]The work in this chapter has been published in a conference proceedings:

- **Wilke, H.A.**, Hoek, J. & Rohde, H. (2022). The effects of information structure and sentence structure on sentence processing. In: A. Abeillé, L. Brunetti, B. Hemforth, P. Miller, G. Thiberge, & E. Winckel (Eds.), *Proceedings of the 11th Linguistic Evidence Conference* (pp. 140–143).

And it has been presented at the following conferences:

- **Wilke, H.A.**, Hoek, J. & Rohde, H. (2022). "The effects of information structure and sentence structure on sentence processing". The 11th Linguistic Evidence Conference (LE 2022), October 6th–8th, 2022, Paris, France.
- **Wilke, H.A.**, Hoek, J., Los, B., Sorace, A. & Rohde, H. (2020). "The Role of Information Structure in Relative Clause Processing". The UK Cognitive Linguistics Conference 2020 (UK-CLC 2020), July 27th–29th, 2020, Birmingham, United Kingdom (virtual conference).
- **Wilke, H.A.**, Hoek, J., Los. B., Sorace, A. & Rohde, H. (2019). "Expectations for Novelty: The Role of Information Structure in Syntactic Processing". Discourse Expectations: Theoretical Experimental and Computational perspectives (DETEC 2019), September 27th-28th, 2019, Berlin, Germany.

more general introduction to Chapter 3 to connect it more cohesively within the general structure of this dissertation. From section 3.1, this chapter presents the manuscript of the existing paper Wilke et al. (under revisiona).

Preamble

Both information structure and sentence structure have been shown to influence the ease with which comprehenders understand, process and remember sentences. In multi-clause sentences, the ways in which the individual clauses relate to one another vary. These relations are the result of syntactic, semantic or pragmatic features, or any combination thereof. Previous literature has identified various principles underlying these relations that govern the processing of sentences and clauses. In the next chapter we will be testing four of these principles for two-clause constructions that contain a matrix clause and an ARC. Firstly, the well-known *given-new* principle (Chafe, 1976; Clark & Haviland, 1977; Gundel, 1988; Halliday, 1967b,a; Haviland & Clark, 1974; Prince, 1981), which poses that sentence processing is facilitated when the ordering of information follows a given-new ordering. Secondly, the *clause structure* principle (Diessel, 2005, 2008; Fodor et al., 1974; Gibson, 1998; Holmes, 1973), which predicts ease of processing for sentences in which the order of clauses is matrix-subordinate rather than vice versa. Thirdly, we consider the *clause-type mapping of information* principle (de Ruiter et al., 2020; Diessel, 2005; Gorrell et al., 1989), which combines information structural and sentence structural features: ease of processing is expected when given information maps onto a subordinate clause and new information onto a matrix clause. Lastly, we propose the *at-issueness* principle, which makes the opposite prediction from the *clause structure* principle. The *at-issueness* principle predicts ease of processing when the ARC is in sentence-early position where it is not-at-issue, and the matrix clause is the only clause contributing at-issue content. When the order is matrix-ARC however, both clauses can contribute at-issue content, leading to more processing difficulty (Jasinskaja, 2016; Koev, 2013; Syrett & Koev, 2015; Wilke et al., 2022, under revisionb). The at-issue status of subordinate clauses – ARCs in particular – has been investigated to some extent, but these studies have focused on establishing whether clauses are (or can be) at-issue. It is not yet clear if the at-issue status of clauses influences how fast these clauses are processed.

While at least the first two of these principles have been the topic of many studies, investigations into them have predominantly considered them in isolation (but see de Ruiter et al., 2020 and Scholman et al., 2022). The clause-type mapping of information

principle has primarily been evidenced for adverbial clauses (Diessel, 2005; de Ruiter et al., 2020; Scholman et al., 2022). This leaves open questions about how other types of subordinate clauses participate in this principle. We focus on ARCs specifically as their similarity to matrix clauses puts them in a different category from other subordinate clauses. As discussed in section 2.4, ARCs have been observed to exhibit syntactic patterns that are usually associated with main/matrix clauses (root phenomena, de Vries (2012); Emonds (1970); Green (1976); Heycock (2017); Hooper & Thompson (1973), they can express independent speech acts (Frazier et al., 2018; Koev, 2013; Syrett & Koev, 2015), and they can host at-issue content (Jasinskaja, 2016; Koev, 2013; Syrett & Koev, 2015). None of these are characteristics associated with adverbial clauses, which have been the focal point in many prior studies that investigated the principles we consider here. Consider below example containing an adverbial clause with *while*:

(66)   While John was dancing, he was drinking beer.

The clauses that make up the sentence in (66) are in subordinate-matrix order. It is easy enough to comprehend, but when the order of clauses is reversed, as in (67), this seems to be a less marked sentence, that – according to the *clause structure* principle – should be easier to process:

(67)   John was drinking beer while he was dancing.

Now consider this same sentence again in (68), but with a context sentence preceding it that makes the content in the subordinate clause given information:

(68)   John was dancing at a wedding party.
       He was drinking beer while he was dancing.

The order of information in this sentence now is new-given. According to the *given-new* principle, sentences are easier to process when given information precedes new information. This can be achieved by providing a different context sentence:

(69)   John was drinking beer at a wedding party.
       He was drinking beer while he was dancing.

Indeed, this same sentence seems less marked in (69) than in (68). Consequently, it should be easier to process.

The rest of this chapter engages with the following overarching research question of this thesis – *Does the at-issueness principle accurately predict sentence processing in interaction with other ordering principles for sentences containing an ARC?* – by carrying out an SPR-study on sentences containing an ARC. We explore which of the principles under investigation describe the conditions under which processing is eased for two-clause constructions that consist of a matrix clause and an ARC. We measure the reading times of these clauses together and individually to probe the predictions of these four principles. The experiments presented manipulate the order of clauses (*clause structure* principle and *at-issueness* principle), as well as the order of information (*given-new* principle) and which type of information is mapped onto which clause (*clause-type mapping of information* principle).

3.1 Abstract

In a self-paced reading experiment, we investigate the processing of complex sentences containing a matrix clause and a subordinate clause, specifically, an appositive relative clause (ARC). We test the predictions made by three long-standing ordering principles: the *given-new* principle (given before new information ordering facilitates processing), the *clause structure* principle (matrix clause before subordinate clause ordering facilitates processing) and the *clause-type mapping of information* principle (given information in subordinate clause and new information in matrix clause facilitates processing). Because of the special status ARCs have among subordinate clauses, for example through their capacity for contributing at-issue content in sentence-final position, we propose an additional fourth principle: the *at-issueness* principle. This principle predicts ease of processing when the order of clauses is ARC-matrix clause. We find no evidence for the *at-issueness* principle, but our results show that predictions made by the *given-new* principle and the *clause structure* principle hold for sentences with an ARC. In addition, we find that the matrix clause in sentences with an ARC has a grounding function usually associated with subordinate clauses. We suggest this is due to the matrix-clause like nature of ARCs with respect to both their syntactic structure and their expected information status.

3.2 Introduction

In producing utterances, speakers are faced with choices about how to package the information they want to convey. Some of those choices take place clause-internally –

e.g., in decisions regarding the use of different syntactic constructions to arrange constituents into preferred orderings. These orderings in turn can ease or impede processing for comprehenders. Clause internally, given-before-new orderings for instance facilitate processing and comprehension (Brown et al., 2012; Haviland & Clark, 1974). In more complex sentences, the clauses themselves are subject to ordering constraints, with speakers making further decisions about how to package content into clauses and how to order clauses in the discourse.

Existing work points to principles that guide these decisions and in turn facilitate or disrupt comprehension. These principles sometimes converge and together favor a particular packaging of information in a complex sentence, but more interestingly they can also compete. To illustrate, compare the passages in (70) and (71). In both passages, content is introduced in one sentence and then re-mentioned in a subsequent complex sentence that also introduces new content (given content underlined, new content in bold).

(70)   Linda submitted a paper, two job applications, and wrote a conference abstract. <u>She did so</u> while **juggling a household and a part-time job**.

(71)   Linda submitted a paper, two job applications, and wrote a conference abstract. **She juggled a household and a part-time job** while <u>she did so</u>.

In the second sentence in (70), the given information precedes the new information (*given-new* principle, Chafe (1976); Clark & Haviland (1977); Gundel (1988); Halliday (1967b,a); Haviland & Clark (1974); Prince (1981)) and the matrix clause precedes the subordinate clause (*clause structure* principle, Diessel (2005, 2008); Fodor et al. (1974); Gibson (1998); Holmes (1973)). In (71), it is the new information that comes first, this time with the given information packaged in a subordinate clause and the new information appearing in a matrix clause (*clause-type mapping of information* principle, de Ruiter et al. (2020); Diessel (2005); Gorrell et al. (1989)). The question is whether such variations in orders and mappings have repercussions for processing. There are obviously more combinations than shown in (70-71) and none are ruled in or out by the grammar alone. The intuition is that clause position, type, and content are all candidate factors for determining the ease with which comprehenders process complex sentences.

This paper systematically tests the principles that have been proposed for governing the packaging and structuring of information. We present a reading time study that goes beyond prior work in considering the predictions from four different principles and testing them in complex sentences that contain a distinctive type of subordinate clause: the appositive relative clause (ARC), which has been identified as a structure that shares

a number of properties with matrix clauses. These properties include clause-internal syntactic properties (de Vries, 2012; Emonds, 1970; Green, 1976; Heycock, 2017; Hooper & Thompson, 1973) as well as properties relating to the coherence relations that matrix clauses and ARCs can establish with the surrounding discourse (Jasinskaja, 2016; Syrett & Koev, 2015; Wilke et al., under revisionb, 2022). ARCs raise novel questions about how consistently these ordering principles apply across contexts and how sensitive comprehenders are to their application during real-time processing of sentences containing an ARC. The special status of ARCs among subordinate clauses gives rise to a novel principle – one that we introduce and will refer to as the *at-issueness* principle.

The results of the reading-time study show that predictions made by the *given-new* principle and the *clause structure* principle apply to constructions containing an ARC, but the *clause-type mapping of information* principle and *at-issueness* principle do not. When we consider the reading times for the ARCs and matrix clauses individually, however, we observe patterns that cannot be clearly attributed to any of the principles, suggesting that the available approaches need to be adapted to cover a broader range of structures and clause types.

The following sections will provide an overview of the four principles under investigation and discuss how the current state of the art for each principle still leaves open a set of questions we intend to address with the present study. For each existing principle, we discuss expectations for ARCs specifically, especially compared to other subordinate clauses. We follow these with a more general review of ARCs and at-issueness, which serves as the backdrop for the fourth principle we propose: the *at-issueness* principle.

3.2.1 Existing principles under investigation

Given-new principle

The *given-new* principle posits that sentences are easier to process and comprehend when given information precedes new information. (Haviland & Clark, 1974; Clark & Haviland, 1977; Prince, 1981). When given information appears in the beginning of a sentence, it provides the comprehender with an established foundation on which they can then build new content as it is added later in the sentence (Dahí, 1976). This principle has been well attested through different methodological approaches. For example, sentence recall tasks (Bock, 1977), acceptability judgment tasks (Clifton & Frazier, 2004), production experiments (Arnold et al., 2000) and processing experiments (Brown et al., 2012; de Ruiter et al., 2020; Scholman et al., 2022) all show evidence of the given-new principle. That said, the vast majority of experimental evidence has relied on the distinction between given and new information as features encoded in syntax. All of the

previously mentioned experimental evidence (with the exception of de Ruiter et al., 2020; Scholman et al., 2022) treat givenness as a feature of definiteness, and newness a feature of indefiniteness. In the acceptability judgment task from Clifton & Frazier (2004), for example, a sentence like *The pitcher threw the umpire a ball* (definite signalling given, indefinite signalling new, given-before-new order) was deemed more acceptable than a sentence like *The pitcher threw an umpire the ball* (indefinite signalling new, definite signalling given, new-before-given order). Prince (1992) however, describes numerous ways in which givenness and newness can be achieved, some of which are directly related to the syntactic nature of constituents (like (in)definiteness), while others depend directly on the pragmatic context.

Here we focus on the pragmatic notion of givenness: information that has been brought up in discourse and is therefore shared – common ground – knowledge between the speaker and the hearer. As such, the information has a 'familiar' – given – status when it is re-mentioned at a later point in the discourse. In our study we provide contextual cues to make a piece of information familiar. We give a certain habitual event familiar status by mentioning it in a context and establishing it in the mind of the comprehender, and then mention another occasion of this event in one of the clauses in the target region. For example, to test whether a sentence like (73) with an ARC is processed more easily depending on the order of information, we precede this sentence with either context (72a) which makes *gossiping* familiar/given information (resulting in a given-new ordering in (73)), or context (72b) which makes *drinking gin & tonic* familiar/given information (resulting in a new-given ordering in (73)). With this strategy we aim to disentangle information status from syntactic structure.

(72)   a.   My aunt loves to be part of the rumor mill, and just like my mom, takes any opportunity to engage in the latest stories. At my birthday party...

       b.   My mom, like my aunt, is a big fan of drinking gin. She thinks she is really good at hiding it by adding some tonic to it. At my birthday party...

(73)   My aunt was gossiping with my mom, who was drinking gin & tonic.

Sentences with ARCs have been investigated in the past to test which information orders are preferred. In one study, ARCs were compared with another type of subordinate clause, the restrictive relative clause (Gibson et al., 2005, Experiment 2). ARCs were assumed to contribute new rather than old information to a discourse, whereas restrictive relative clauses were assumed to contribute given information. The context preceding the target sentences was manipulated accordingly, so that the ARCs contained new information, but the restrictive relative clauses did not. In line with the *given-new* principle,

Gibson et al. (2005) hypothesized that restrictive relative clauses, contributing given information, would be read faster in sentence-early position and ARCs, contributing new information, would be read faster in sentence-final position. They compared reading times between restrictive relative clauses and ARCs in both sentence-final position where they modify the matrix clause object (as in example (73)), and in sentence-early position where they modify the matrix clause subject. In line with the predictions, the restrictive relative were read faster in sentence-early position than in sentence-final position. However, no effects were found for the ARCs. Gibson et al. (2005) suggest that a possible explanation for this null result can be found in the design of their items: while the content of the restrictive relative clauses was always fully given information, the ARCs contained a mixture of given and new information. This could have led to a tradeoff where the given content facilitated faster reading times for the sentence-early ARCs, and the new content facilitated faster reading times for the sentence-final ARCs.

One goal of the current study is therefore to replicate Gibson et al. (2005)'s study with a more explicit manipulation of the information status of ARCs by contrasting ARCs that contain only familiar/given information with ARCs that also contain new information. We will report reading times of the individual clauses to follow Gibson et al. (2005)'s design, but because the *given-new* principle makes predictions about the ordering of information in a sentence, our main focus will be on the reading times of the ARC and the matrix clause together.

Clause structure principle

The *clause structure* principle (also known as the *frame structure* principle, Diessel, 2005, 2008; Fodor et al., 1974; Gibson, 1998; Holmes, 1973) posits that sentences with a subordinate clause are easier to process when the matrix clause comes before the subordinate clause (74a) than when clauses are in the opposite order (74b):

(74)   a. My aunt was gossiping with my mom, who was drinking gin & tonic.

        b. My aunt, who was drinking gin & tonic, was gossiping with my mom.

In the case of (74a), the arguments of the matrix clause are all adjacent, whereas in (74b), the subordinate clause interrupts the matrix clause and the matrix clause head noun needs to be held in memory until the matrix clause can be completed, leading to greater processing difficulty. The *clause structure* principle is supported by evidence from sentence recall and sentence comprehension studies (Fodor et al., 1974; Holmes, 1973) as well as processing experiments (Gibson, 1998; Gibson et al., 2005). Additionally,

evidence from corpus studies shows that this ordering of clauses in a sentence is also the more frequent one (Diessel, 2005, 2008).

While there are processing studies that have investigated the *clause structure* principle at the full sentence level (de Ruiter et al., 2020; Scholman et al., 2022), those that specifically investigate sentences with a relative clause more commonly focus on the relative clause (ARC and/or restrictive relative clause) in isolation and how its processing is influenced by its sentential position (Gibson, 1998; Gibson et al., 2005; Santi et al., 2019). Moreover, prior studies report different findings depending on the type of relative clause they investigate. Sentence-final restrictive relative clauses were harder to process than those in sentence-early position (Gibson et al., 2005; Santi et al., 2019), but for ARCs the results were inconclusive (Gibson et al., 2005). This leaves open the question of whether these results would be different if the relative clauses were considered together with the matrix clause, as processing ease or difficulty might not be attributable to just the ARC in isolation in these sentences. If processing differences here are only visible when considering the full sentence, it would explain why Gibson et al. (2005) did not find any effects when only considering processing of the ARC.

Clause-type mapping of information principle

The *clause-type mapping of information* principle posits that ease of processing is optimal when given information is hosted by a subordinate clause and new information by a matrix clause. This principle was first proposed by Gorrell et al. (1989), who found that children performed better at a comprehension task when given information appeared in a subordinate clause than when this same information occurred in a matrix clause. They found that children were more sensitive to this mapping of information (given-in-subordinate) than to the ordering of information (given-before-new). The ordering preference encapsulated in the *clause-type mapping of information* principle receives additional support from corpus data in that adverbial clauses more often host given information, especially in preposed position (Diessel, 2005). In line with this, a processing advantage is reported for sentences in which the given information is hosted in a preposed adverbial clause (de Ruiter et al., 2020; Scholman et al., 2022). However, neither of these studies found evidence for the *clause-type mapping of information* principle for adverbial clauses in a sentence-final position. Rather, it is hypothesised that when a subordinate clause is in sentence-final position, it serves to add new information to the assertion made in the matrix clause, whereas when it is in preposed position and contains given information, it has a grounding function: It provides the context which supports understanding of what follows in the subsequent clause, and this function is assumed to facilitate processing (Chafe, 1984; Scholman et al., 2022; Thompson, 1985).

If it is the case that the preferential mapping of given information to a subordinate clause only holds when the subordinate clause is in a preposed position, ARCs pose a problem, as they can never be preposed in English (#*Who was drinking rum and coke, my aunt was gossiping with my mom*). In sentences with an ARC, either the subject of the matrix clause or the full matrix clause precedes the ARC and provides the antecedent necessary to be able to interpret the relative pronoun in the ARC. In fact, the ARC could be omitted entirely and the matrix clause would still be conceptually complete. Restrictive relative clauses, in contrast, are necessary to identify a referent in the matrix clause and their omission would impact how the matrix clause referent is interpreted (Verhagen, 2001, p. 340).

This dependence of the ARC on the matrix clause for an antecedent that enables the interpretation of the ARC is independent of sentential position, as an ARC can never fully precede their subordinating matrix clause. As such, the matrix clause could be argued to have a grounding function in both sentence-early and sentence-final position in sentences with an ARC, whereby the matrix clause provides the context which is necessary to support understanding of the ARC. Consequently, we expect matrix clauses in such sentences to be more likely hosts for given information in both sentence-early and sentence-final position, and ARCs for new information. This idea is supported by corpus studies that have shown that ARCs nearly always host new information (Loock, 2007, 2010). If it is not the subordinate clause that has the grounding function in sentences with an ARC, but the matrix clause, it could mean that ARCs are actually easier to process when they contain new information, in contrast to a preference for given information in other types of subordinate clauses. Gibson et al. (2005) also assumed that ARCs are more likely hosts for new information, and that they should therefore be expected to be processed more easily later in a sentence, in line with the *given-new* principle. They did not find this effect, but this might have been due to their design, which compared ARCs that contained a mix of given and new information in both conditions.

In order to investigate not only the *given-new* principle, but also the *clause-type mapping of information* principle, we follow a design similar to Gibson et al. (2005), but add to this an explicit manipulation of information status of both clauses determined by context, as shown in (72)-(73). The sequence of (72a)→(73) results in given information being hosted by the matrix clause and new information by the ARC, which is the mapping of information for which we expect ease of processing if the matrix clause indeed has a grounding function in sentences with an ARC. In contrast, the sequence of (72b)→(73) results in given information being hosted by the ARC and new information by the matrix clause, which we expect will lead to processing difficulty.

3.2.2 ARCs and at-issueness

As noted above, ARCs have been identified as potentially exceptional cases for the principles reviewed. Beyond the reasons already mentioned, there are additional reasons to expect that ARCs will behave differently from other subordinate clauses with respect to how sentences they are part of are processed. One is that ARCs can exhibit root phenomena, i.e., syntactic patterns that are usually constrained to main/matrix clause environments, such as verb phrase preposing, negative constituent preposing and topicalization (de Vries, 2012; Emonds, 1970; Green, 1976; Heycock, 2017; Hooper & Thompson, 1973). In contrast, adverbial clauses – the type of subordinate clause that prior research often considers when investigating ordering principles – are among a class of subordinate clauses that typically resist these root phenomena (Frey, 2012; Haegeman, 2007, 2010; Sawada & Larson, 2004).

In addition, ARCs exhibit matrix-clause like behaviour in the way they can establish coherence relations with surrounding discourse. ARCs in sentence-final position (like matrix clauses in any position) can contribute the main (at-issue) point of a sentence (Jasinskaja, 2016; Syrett & Koev, 2015; Wilke et al., under revisionb, 2022). At-issueness refers to the status of clauses within a sentence. In prior work on at-issueness, clause content can be analyzed as expressing either the main point of a sentence (at-issue content) or a point that that is more peripheral (not-at-issue content) (Jasinskaja, 2016; Koev, 2018; Potts, 2005, 2007). ARCs have long been a focal point in at-issueness studies, with debate as to their at-issue status and the mechanism that determines their status. The semantic approach to at-issueness views at-issueness as an immutable property of clauses that is determined by their clause type (Potts, 2005, 2012). Under this approach, matrix clauses are always considered at-issue, and ARCs are categorically considered not-at-issue because they are subordinate clauses. Discursive approaches to at-issueness (Hunter & Asher, 2016; Jasinskaja, 2016), however, posit that ARCs in sentence-final position can contribute at-issue content as they are at the right edge of the discourse structure (Right Frontier: Asher & Lascarides, 2003; Polanyi, 1988; Webber, 1991) and can thus be taken up for subsequent discussion. A possible metric for establishing which content in a clause is available to be taken up in subsequent discourse is the availability of felicitous coreference. Examples (75) and (76) illustrate how varying the position and clause type in which content is introduced can determine its availability for subsequent mention with a pronoun "It":

(75) My aunt, who was drinking gin & tonic, was gossiping with my mom.

    a. It was clearly about our new neighbour.

    b. # It was mostly gin and barely any tonic.

(76) My aunt was gossiping with my mom, who was drinking gin & tonic.

    a. It was clearly about our new neighbour.

    b. It was mostly gin and barely any tonic.

The above examples suggest a pattern whereby matrix clauses can always be at-issue as they can contribute discourse continuing material (i.e., the pronoun in (75a) and (76a) can felicitously refer to matrix clause content). In contrast, ARCs can only be at-issue and provide content to be picked up in subsequent discourse if they are in sentence-final position (i.e., the pronoun in (76b) can felicitously refer to ARC content, but the pronoun in (75b) cannot). This pattern has been attested experimentally (Syrett & Koev, 2015; Wilke et al., 2022, under revisionb).

3.2.2.1 At-issueness principle

Given that at-issue content always has the potential to be more relevant to subsequent discourse than not-at-issue content, we posit that comprehenders take longer to process at-issue content than not-at-issue content on the assumption that discourse-relevant content needs to be more fully understood and encoded. At-issue content needs to be held in memory to potentially connect with subsequent discourse, whereas not-at-issue content can be skipped over more easily as it is not likely to be taken up for subsequent discussion. Consequently, a sentence in which a matrix clause follows an ARC – which is not expected to be at-issue – will be faster to process than a sentence in which an ARC follows a matrix clause, in which case both clauses can contribute at-issue content. We refer to this pattern as the *at-issueness* principle, whereby sentences with an ARC should be faster to process when the ARC is in sentence-early position, where it is not-at-issue, than in sentence-final position, where the ARC and the matrix clause can both be at-issue.[2]

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[2]Different theories of at-issueness make different predictions about which clauses in complex sentences can be at-issue. Here, we focus specifically on C-at-issueness (Hunter & Asher, 2016; Jasinskaja, 2016), under which ARCs in sentence-final position can be at-issue. In contrast, under Q-at-issueness (Beaver et al., 2017; Simons et al., 2010), ARCs in any position are not considered likely hosts for at-issue content as they cannot felicitously answer a QUD. Consequently, under Q-at-issueness, we would expect no difference in processing depending on the position of the ARC: only the matrix clause is considered to be at-issue. As such, differences in processing in the current study cannot be explained by Q-at-issueness, but could possibly be explained by C-at-issueness depending on how these differences manifest. Incidentally, predictions made by P-at-issueness theories (AnderBois et al., 2015; Farkas & Bruce, 2010; Koev, 2013; Murray, 2014) overlap with those made by the *At-issueness* principle. However, because the *At-issueness* principle is posited following experimental evidence for the C-at-issue status of ARCs from Chapter 2, we do not assume this evidence to also be applicable to P-at-issueness, and focus on C-at-issueness. Any further mention of at-issueness in this chapter then refers to C-at-issueness unless specified.

3.3 The Experiment

In this experiment we investigate these four – the *given-new, clause structure, clause-type mapping of information* and *at-issueness* – principles in two-clause constructions that consist of an ARC and a matrix clause. Our experiment uses self-paced reading (SPR, Just et al., 1982) to measure comprehenders' processing of sentences consisting of an ARC and a matrix clause in passages in which the preceding context establishes the information status of particular content. The goal is to see whether processing times are influenced by the order of information, the order of the clauses, and the mapping between clause type and information status. We manipulate two factors in our items: information order (given-new vs new-given) and clause order (matrix-ARC vs ARC-matrix). Consider below an example condition with the target region in italics. In this example, the order of information is GIVEN-NEW, the order of clauses is MATRIX-ARC, and the given information (underlined) appears in the matrix clause:

(77)   GIVEN(MATRIX)-NEW(ARC)
       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 <u>was gossiping with my mom</u>, who was drinking gin & tonic.
       As I walked by, I heard they were talking about me. My mom got startled and
       spilled her drink all over my aunt.

We make the assumption that the information in the matrix clause receives given status by having been made part of the common ground in the context preceding the target region, where the reader of the narrative is made aware of the speaker's aunt's inclination to gossip. Upon encountering the target region and reading that the speaker's aunt is indeed gossiping, the gossiping is new with respect to the situation in which it is happening, but given with respect to the reader's general knowledge concerning what they know about the speaker's aunt. The given status of the matrix clause content is especially clear when we contrast this information – *my aunt was gossiping with my mom* – to the information provided in ARC: *who (my mom) was drinking gin & tonic.* With no mention of either drinking or gin & tonic in the narrative prior to reaching the target region, this information is unfamiliar and new.

When we change the order of clauses in the target region, this leads to the following condition:

(78) NEW(ARC)-GIVEN(MATRIX)

> 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 gin & tonic, <u>was gossiping with my mom</u>.*
> As I walked by, I heard they were talking about me. My mom got startled and spilled her drink all over my aunt.

Here, the order of information is NEW-GIVEN, the order of clauses is ARC-MATRIX and the given information appears in the matrix clause.

When we keep the order of clauses in the target region the same as in (78), but adapt the context preceding the target region to make the ARC contain given information and the matrix clause new information, this leads to the following condition:

(79) GIVEN(ARC)-NEW(MATRIX)

> My aunt, like my mom, is a big fan of drinking gin. She thinks she is really good at hiding it by adding some tonic to it. Everybody knows what is actually in her glass of course. A few weeks ago, at my birthday party,
> *my aunt, who <u>was drinking gin & tonic</u>, 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.

In this condition, the reader of the narrative is made aware of the speaker's aunt's penchant for drinking gin & tonic – which reappears in the ARC content. The matrix clause predicate – *was gossiping* – in contrast, is now completely new information. The order of information is GIVEN-NEW, the order of clauses is ARC-MATRIX and the given information appears in the matrix clause.

Lastly, when we change the order of clauses in the target region and make *my mom* the participant of the narrative with the penchant for drinking gin & tonic (as it now reappears in the ARC, of which *my mom* is the subject rather than *my aunt*), this leads to the final condition:

(80) NEW(MATRIX)-GIVEN(ARC)

> My mom, like my aunt, is a big fan of drinking gin. She thinks she is really good at hiding it by adding some tonic 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 <u>was drinking gin & tonic</u>.*

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

The order of information is NEW-GIVEN, the order of clauses is MATRIX-ARC and the given information appears in the ARC.

Our main interest is the processing time of both clauses in the target region combined, because this full-sentence analysis will allow us to observe effects of information order, clause order, information mapping and at-issueness. Following the full-sentence analysis, we will also report reading time analyses for the clauses in isolation. In doing so we are able to more directly replicate the experimental design from Gibson et al. (2005) – who analyzed reading times for just the ARCs – but with a more explicit manipulation of information status and conditions that have contrasting information status.

3.3.1 Predictions

Predictions made by each principle align with the predictions we make for the current experiment for the ARC and the matrix clause together, with the exception of the *clause-type mapping of information* principle, for which we expect an effect in the opposite direction to what the principle predicts (faster reading times when the ARC hosts new information and the matrix clause hosts given information).

Table 3.1 below shows the predictions made by each of the principles we investigate about which conditions will yield faster processing. As noted earlier, there is reason to reconsider how the *clause-type mapping of information* principle applies to sentences with an ARC and posit instead an effect in the opposite direction (faster reading times when the ARC is the clause to host new information). We thus include one additional principle here – the *reverse mapping* principle – to account for our expectation that in sentences with an ARC, ease of processing will result from new information being hosted by the ARC and given information by the matrix clause. As shown in Table 3.1, each of the principles makes different predictions about which conditions will yield faster processing. The *given-new* principle favors the two conditions with given-before-new ordering. The *clause structure* principle favors the two conditions with matrix-before-ARC ordering. The *clause-type mapping of information* principle favors sentence configurations in which given information appears in subordinate clauses and new information appears in the matrix clause. The *reverse mapping* principle predicts faster reading times when given information is hosted by the matrix clause and new information by the ARC. The *at-issueness* principle posits slower reading for sentences in which both clauses must be fully encoded since they both contain content that needs to be available for subsequent re-mention (i.e., configurations with a matrix clause followed by a sentence-late ARC) and

relatively faster reading times for sentences in which only one clause contains content that is a candidate for subsequent mention (i.e., configurations with a sentence-early ARC).

TABLE 3.1: Overview of all patterns related to our predictions exhibited by each condition. Patterns that are expected to facilitate faster processing receive a check mark for those conditions that exhibit these patterns [Experiment 7].

principle	*condition*			
	ARC_{given} $-\text{matrix}_{new}$	matrix_{given} $-\text{ARC}_{new}$	$-\text{ARC}_{new}$ $-\text{matrix}_{given}$	matrix_{new} $-\text{ARC}_{given}$
given-new	✓	✓		
clause structure		✓		✓
clause-type mapping	✓			✓
reverse mapping		✓	✓	
at-issueness	✓		✓	

Predictions we make for the ARC and matrix clause combined can also be observed at the level of the individual clauses. For the *given-new* principle, this means we would expect an interaction effect between the information status and position of either or both clauses such that an effect of faster reading times for given information would be stronger in sentence-early position than in sentence-final position, or that an effect of faster reading times for new information would be stronger in sentence-final position than in sentence-early position. For the *clause structure* principle, this means we expect faster reading times for the matrix clause when it is in sentence-early position, where all of its arguments are adjacent, than when it is in sentence-final position, where the subject has to be held in memory from sentence-initial position until the matrix clause can be completed. We do not have expectations for ARCs individually following from this principle. For the *clause-type mapping of information* principle, we expect faster reading when the ARC contains given information and slower reading times when it contains new information, and we expect faster reading times for the matrix clause when it contains new information and slower reading times when it contains given information. For the *reverse mapping* principle we expect the effect of information mapping to go in the opposite direction: we expect faster reading times for ARCs when they contain new information, and faster reading times for matrix clauses when they contain given information. Lastly, for the *at-issueness* principle, we expect faster reading times for the ARC in sentence-early position where it is not-at-issue than when it is in sentence-final position where it can be at-issue. We do not have expectations for matrix clauses individually following from this principle.

3.3.2 Method

3.3.2.1 Participants

We recruited 234 participants through Amazon Mechanical Turk. We removed those whose accuracy on comprehension questions was not above chance (n=34), and those who did not report having English as a first language (n=5), leaving 195 participants for analysis. All of these were self-reported native English speakers between the ages of 20–72 (mean=40) living in the United States. All participants had to have at least 500 previously approved tasks (called Human Intelligence Tasks, HITs, on MTurk) and a 95% or greater HIT approval rate. They provided informed consent and were compensated USD 10 for their participation, which corresponds to a rate of roughly USD 10/hr.

3.3.2.2 Materials

The study had 32 target items in four conditions and 32 fillers. The target items were short narratives that consisted of 4–6 sentences. The critical region, consisting of an ARC and a matrix clause predicate, always appeared in the second half of the short narrative. The first half of the short narrative served to provide the predicate in either the ARC or the matrix clause in the target region with inferrably given information: this information will have a familiar status by having been made part of the common ground in the preceding discourse. The predicate in the other clause always contained information that is both discourse-new and hearer-new. We will refer to the two conditions resulting from the order of information as GIVEN-NEW (77 & 79) and NEW-GIVEN (78 & 80). The order of the ARC and the matrix clause also varied across conditions, resulting in the ARC-MATRIX (78 & 79) and MATRIX-ARC (77 & 80) conditions.

To provide a region for observing potential spillover (delayed) effects for reading times of the full sentence, the critical region was followed by an additional clause, of which the first 3–4 words functioned as the spillover region (*As I walked by* in (77-80)). If that clause contained only 3-4 words in total, the entire additional clause was the spillover region. While our main focus is on the combined reading times of the ARC and the matrix clause predicate, in a secondary analysis we also consider the clauses as individual regions. In this setting it is not possible to measure any delayed effects as the region following the individual clauses cannot be held constant across conditions.

The items were distributed across 4 lists in a Latin Square design such that all participants saw half of the target items in the GIVEN-NEW condition and the other half in the NEW-GIVEN condition. These lists were then further subdivided such that all participants saw half of the items in both of these lists in the ARC-MATRIX condition and the

other half in the MATRIX-ARC condition. The distribution of the target items and fillers and the order in which participants saw these was fully randomized.

The 32 fillers consisted of two different sets. The first set were 20 items from an unrelated experiment that used items of similar length and style. The second set contained 12 short stories that did not contain any sentences with an ARC. Both sets followed the same first-person perspective and topics as described below. A quarter of all items were accompanied by a comprehension question (true/false): eight of the target items and eight of the fillers. 34 participants, whose performance was not significantly above chance (at least 75% of questions answered correctly), were excluded from the analysis. After exclusion, average performance on these questions was 86% answered correctly.

All target and filler items were presented in a first person perspective. Altogether they constituted a series of anecdotes told by a single narrator about their personal life, friends and family. This was done to create a narrative that sounded as natural as possible with cohesion throughout (though none of the items specifically related to each other), rather than presenting participants with seemingly unrelated or isolated sentences, as it has been shown that this can add to processing difficulty (Roland et al., 2012). In addition, verbs that are known to contribute an implicit causality bias (Ferstl et al., 2011) were not used in our target regions. This was done to avoid any causal inference being made between the matrix clause and the ARC, as it has been shown that when a relative clause stands in a causal relation to a matrix clause this can impact reading times (Hoek et al., 2021).

3.3.2.3 Procedure

The experiment was deployed on the IbexFarm web-based experimental presentation platform (Drummond, 2013). Participants carried out the experiment remotely on their own computers via a link distributed through an Amazon Mechanical Turk HIT. The experiment uses a non-cumulative SPR paradigm. At six points during the experiment, the task was interrupted by a landscape image which required a mouse click in order to proceed, rather than a space bar press. This was done to reduce routinized space bar-pressing behavior, as well as to give participants natural breaks throughout the experiment.

Our target items consist of 14-18 chunks. The first 4-9 chunks make up the context in which either the ARC predicate or the matrix clause predicate is made familiar/given information. The first chunk following this is the subject NP of the matrix clause of the critical region, after which the critical region follows which is made up of a chunk containing the matrix clause predicate and one containing the ARC (in varying orders:

matrix-ARC or ARC-matrix depending on the condition). The critical region is thus divided into two chunks, for which we add up the reading times in our primary analysis. The next chunk is the spillover region, which is followed by up to 6 more chunks which complete the short narrative. We measure the exposure duration for each chunk. For the primary analysis we focus on the critical regions and the spillover regions for any delayed effects. For the secondary analyses we focus on the reading times of the individual ARCs and matrix clause predicates, with no region to observe delayed effects. See fig. 3.1 below for the chunked version of (79), with the critical region in italics.

FIGURE 3.1: Example of chunked condition: chunks are in square brackets. For convenience, the critical region has been put in italics (unlike in the actual experiment).

[My aunt,] [like my mom, is a] [big fan of drinking gin. She thinks] [she is really good] [at hiding it by] [adding some tonic 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 gin & tonic,*] [*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.]

The items were presented over 3–5 lines. The critical region was always presented on either the second or third line, on a single line together with one chunk preceding it and the spillover region.

Before starting the experiment, participants were provided with several example items to familiarize themselves with the procedure. After completing the SPR part of the experiment, participants were asked to fill out a demographic questionnaire. Crucial questions here pertained to the languages they spoke growing up and in their current daily life. Participants were only included in the analysis if English was their majority language growing up and in their current daily life. All experimental materials and reported data are available here: https://osf.io/3tjwv/.

3.3.2.4 Analysis

Data was analyzed using R (R Core Team, 2013). Our outcome variable was residual reading time.[3] We constructed linear mixed-effects models (Baayen et al., 2008) using the lme4 package (Bates et al., 2015).

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[3]Residual reading times were obtained as follows: the average raw reading time per character was calculated for each participant. Punctuation was disregarded for this calculation. The difference from what would be the mean reading time for a segment following this average reading time per character is the residual reading time. If a participant reads faster than their own average, this difference will be a negative number (in milliseconds), and if slower, a positive number.

Primary analysis

For our primary analysis plan we model the combined reading times of the ARC and the matrix clause predicates, with factors for *information order* (given first vs new first) and *clause order* (matrix first vs ARC first) and their interaction. We applied contrasts to both of these factors such that each factor was sum-coded: *information order*, given-new=−0.5/new-given=0.5 and *clause order*, ARC-matrix=−0.5/matrix-ARC=0.5). Because we carry out three analyses on the data that makes up the critical region variable (ARC & matrix clause predicate), the Bonferroni adjusted alpha level for all three analyses of data in that region is .016 (.05/3). The data in the spillover region is only analysed once and is therefore not subject to this adjusted alpha level.

Secondary analysis

Our secondary analysis models the reading times of the individual clauses that make up the target region. For both the ARC and the matrix clause predicate, we model the reading time with factors for *information status* (given vs new) and *clause position* (sentence-early vs sentence-final) and their interaction. Factors in this analysis were also sum-coded: *information status*, given=−0.5/new=0.5 and *clause position*, early=−0.5/final=0.5. The Bonferroni adjusted alpha level for these analyses is .016 (.05/3).

In both analyses, the factors representing the conditions, *trial number* and their interactions were fixed effects in our models. We were not interested in any direct effects of *trial number*, but we included it as a fixed effect and random slope to account for any possible learning effects of either condition in all models. The numerical value for *trial number* was centered.

As random effects, we had intercepts for participants and items in all models. We added by-item random slopes for the two conditions and their interaction, and by-subject random slopes for the two conditions, *trial number*, and their interactions. If the model with maximal random effect structure did not converge, we used the methods described in Barr et al. (2013) to reach a model that did converge. To assess significance, we conducted likelihood ratio tests (`anova`, Girden (1992)) between the full model and a model without the condition (or interaction) of interest.

3.3.3 Results

Table 3.2 presents the average residual reading times for the critical region and the spillover region by condition (GIVEN-NEW/NEW-GIVEN and ARC-MATRIX/MATRIX-ARC). This data is visualised in Figure 3.2 for the critical region and in Figure 3.3 for the spillover region. At the critical region, the GIVEN-NEW order was read faster than the NEW-GIVEN order ($\chi^2(1) = 7.3$, $p < .001$), see Table 3.3. We do not find this effect of information order repeated at the spillover region, but we do find an effect here of *clause order* ($\chi^2(1) = 5.33$, $p = .02$), see Table 3.4. The spillover region was read faster when it followed the critical region in MATRIX-ARC order than when it followed ARC-MATRIX order. We also find a significant effect of *trial number* for both the critical region and the spillover region such that items were read faster as the experiment progressed, but in the absence of an interaction with either condition this does not imply a learning effect. The results are additionally reported in table 3.5, which specifies for which conditions faster reading times were observed, and for which region. Filled cells represent the conditions for which faster reading times needed to be observed for the associated principle in this row to make accurate predictions, following table 3.1. If faster reading times were observed in the same region (critical region or spillover region) for both conditions associated with the relevant principle, predictions made by this principle are borne out in the data. As table 3.5 shows, this is only the case for the *given-new* and the *clause structure* principles. While for both conditions associated with the *clause type mapping of information* principle faster reading times were observed, these were observed at different regions. As such, predictions made by this principle are not borne out in the data.

TABLE 3.2: Mean residual reading times for the critical region and spillover region in each condition. By-participant standard error is shown in parentheses [Experiment 7].

region	given-new		new-given		
	ARC-matrix	matrix-ARC	ARC-matrix	matrix-ARC	*Means*
critical	283.02 (15.29)	293.37 (15.78)	324.4 (15.54)	322.36 (15.54)	305.81 (7.75)
spillover	15.63 (5.98)	4.36 (5.98)	11.16 (6.03)	−1.96 (5.72)	7.3 (2.96)

Table 3.6 presents the average residual reading times for the individual clause regions (ARC and matrix) by condition (GIVEN/NEW and EARLY/FINAL). This data is visualised in Figure 3.4. The likelihood ratio test showed a significant difference between the full model and the model without the *information status* condition for ARCs ($\chi^2(1) = 12.55$, $p = < .001$) and matrix clauses ($\chi^2(1) = 15.02$, $p = < .001$), see Table 3.7. This significant effect of *information status* captures the fact that the clauses were read faster when the information in them was GIVEN than when it was NEW. We find a similar effect of position for both ARCs ($\chi^2(1) = 57$, $p = < .001$) and matrix clauses ($\chi^2(1) = 51.17$,

TABLE 3.3: Model results for the critical – *ARC & matrix* – region: Coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including 'condition', and the *p*-value for that test statistic. All *p*-values in boldface are significant at the Bonferroni corrected alpha level [Experiment 7].

| | *ARC & matrix* | | | |
	β	SE	$\chi^2(1)$	p
information order	38.4	14.22	7.3	**<.001**
clause order	1.83	14.23	0.02	.9
trial#	−12.94	1.34	75.6	**<.001**
information order × clause order	−0.15	46.15	0	1
information order × trial#	1.14	1.6	0.53	.47
clause order × trial#	0.63	1.58	0.16	.69
information order × clause order × trial#	−2.49	3.15	0.62	.43

TABLE 3.4: Model results for the spillover region: Coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including 'condition', and the *p*-value for that test statistic [Experiment 7].

| | *spillover* | | | |
	β	SE	$\chi^2(1)$	p
information order	−4.82	5.09	0.89	.34
clause order	−11.74	5.09	5.33	**.02**
trial#	−4.57	0.44	85.76	**<.001**
information order × clause order	−0.21	12.52	0	.99
information order × trial#	−0.39	0.55	0.5	.48
clause order × trial#	−0.19	0.55	0.11	.74
information order × clause order × trial#	−0.09	1.1	0.01	.94

FIGURE 3.2: Errorbar plot showing the residual reading times for the critical region in all conditions [Experiment 7].

$p = < .001$): both clauses were read faster in EARLY position than in FINAL position. In addition, we find an interaction between *information status* and *position* for the

FIGURE 3.3: Errorbar plot showing the residual reading times for the spillover region in all conditions [Experiment 7].
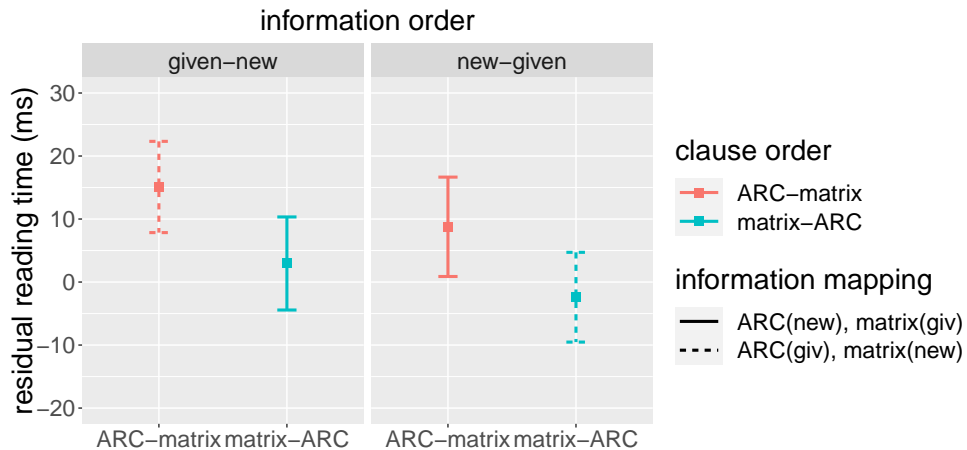
TABLE 3.5: Overview of all patterns related to our predictions exhibited by each condition. Filled cells represent conditions for which faster reading times needed to be observed in order to evidence predictions made by the associated principle. Faster reading times could either be observed at the critical region (crit), the spillover region (so), or at neither ($\times$).

principle	*condition*			
	ARC_{given} $-\mathrm{matrix}_{new}$	matrix_{given} $-\mathrm{ARC}_{new}$	$-\mathrm{ARC}_{new}$ $-\mathrm{matrix}_{given}$	matrix_{new} $-\mathrm{ARC}_{given}$
given-new	crit	crit & so		
clause structure		crit & so		so
clause-type mapping	crit			so
reverse mapping		crit & so	$\times$	
at-issueness	crit		$\times$	

matrix clauses ($\chi^2(1) = 6.13$, $p = < .01$), such that the effect of givenness (faster reading times for GIVEN than NEW) was larger in the EARLY position (fastest reading times were GIVEN/EARLY). We find a significant effect of *trial number* for both ARCs and matrix clauses. For matrix clauses *trial number* additionally comes up in an interaction with *information status*, such that GIVEN matrix clauses were read faster as the experiment progressed.

TABLE 3.6: Mean residual reading times for the individual clause regions in each condition. By-participant standard error is shown in parentheses [Experiment 7].

	given		new		
	early	final	early	final	*Means*
ARC	−164.14 (9.99)	−87.32 (10.34)	−94.98 (9.77)	−14.87 (11.32)	−90.4 (5.23)
matrix	−177.2 (8.62)	−75.33 (9.69)	−91.58 (9.36)	−37.49 (9.66)	−95.38 (4.72)

TABLE 3.7: Model results for the individual clause regions: Coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including 'condition', and the *p*-value for that test statistic. All *p*-values in boldface are significant at the Bonferroni corrected alpha level [Experiment 7].

	ARC				*matrix clause*			
	β	SE	$\chi^2(1)$	p	β	SE	$\chi^2(1)$	p
info.status	68.69	17.8	12.55	**<.001**	80.59	18.71	15.02	**<.001**
position	74.97	9.91	57	**<.001**	62.83	8.77	51.17	**<.001**
trial#	−6.09	0.54	126.63	**<.001**	−5.92	0.48	152.62	**<.001**
info.status × pos.	−2.98	19.84	0.2	.88	−43.41	17.54	6.13	**.01**
info.status × trial#	0.39	1.07	0.13	.71	−3.26	0.95	11.08	**<.001**
pos. × trial#	−0.35	1.07	0.1	.75	−1.54	0.95	2.63	.11
i.s. × pos. × trial#	−2.33	2.15	1.19	.28	−2.14	1.9	1.28	.26

FIGURE 3.4: Errorbar plot showing the residual reading times for the ARCs and the matrix clause predicates in all conditions [Experiment 7].
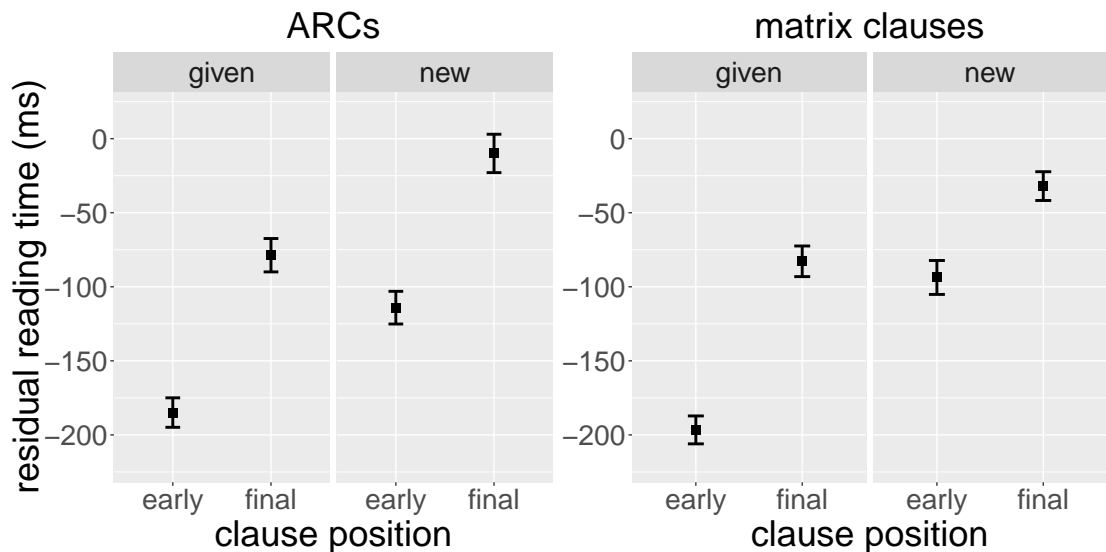
3.4 General discussion

The goal of this study was to investigate how four ordering principles – the *given-new, clause structure, clause-type mapping of information* and *at-issueness* principles – affect the processing of complex sentences containing an ARC, and to see whether effects we find can be more so attributed to one of the two clauses (ARC or matrix clause) in these sentences. We carried out a self-paced reading experiment to test this.

In line with previous studies, there were clear effects of two principles: the *given-new* principle and the *clause structure* principle. Our findings suggest that both of these principles apply to sentences with an ARC similarly as they have previously been found to apply to sentences containing different types of subordinate clauses. The same is not the

case for the *clause-type mapping of information* principle, but considering the different characteristics of ARCs compared to other subordinate clauses – adverbial clauses in particular – with respect to their internal structure and expected information status of their content, we did not expect this principle to apply to sentences with an ARC. That said, our suggestion that in sentences with an ARC, reading times would be faster when information mapping proceeds in the opposite direction (*reverse mapping* principle: new information in the ARC, given information in the matrix clause), was also not borne out in our data when considering the full sentences. To accommodate the matrix-clause like characteristics of ARCs we proposed a fourth principle: the *at-issueness* principle, but we find no evidence for this at the level of the full sentence. We take the absence of an effect of information mapping in our experiment to suggest that ARCs – indeed – have a special status among subordinate clauses, but that this distinction as it pertains to their potential to contribute the at-issue point of a sentence, is not represented in processing. However, considering that ARCs have been observed to most often provide new information to discourse, and that the given information in our items was a new instance of a discourse-old event, this might have contributed to matrix-ARC order facilitating processing over ARC-matrix order, obscuring any potential effects of at-issueness. While this might warrant a follow-up investigation into how the at-issue status of clauses influences processing, it would be impossible to fully disentangle factors related to at-issueness from other ordering principles. If there is an expectation for ARCs to contain new information, especially in sentence-final position, such that when an ARC is in this position it facilitates processing of the sentence, it is difficult to imagine a situation in which it is possible to provide evidence for ARCs in this position taking longer to process due to their at-issue status.

When we consider the ARCs and matrix clauses individually, we find that any clause containing given information is read faster than when it contains new information. While at first glance this might be taken as evidence that both ARCs and matrix clauses are more likely hosts for given information, this is not a conclusion we can draw based on our findings. Rather, our results suggest that given information is processed faster than new information independent of clause type or position. However, corpus data revealed that ARCs contribute new information to discourse over 95% of the time (Loock, 2007, 2010). If, then, given information is consistently processed faster than new information, it is not possible with the processing study we designed to show a 'preference' for new information over given information in any individual clause. A similar issue arises when we consider the effect of position for the individual clauses: both ARCs and matrix clauses were read faster in early position. For matrix clauses, this aligns with predictions made by the *clause structure* principle, for which we also find evidence when we consider the full sentence. For ARCs, however, this aligns with predictions made by the *at-issueness*

principle, for which we did not find evidence elsewhere. In addition, this finding for the ARCs is different from what Gibson et al. (2005) find. They suggest that because the ARCs in their experiment contained a mixture of given and new information, this could have led to a trade-off effect leading to a null result. However, this cannot explain why we *did* find a difference between positions. Consequently, it follows that the information status of ARC content is not responsible for any processing differences – or lack thereof – between ARCs in different positions. Additionally, if it were the case that information status was responsible for such differences, this would have manifested as an interaction effect between information status and ARC position in our study. We did find such an interaction effect for matrix clauses. The effect of faster reading times for these was greater in sentence-early position than in sentence-final position. This interaction suggests that matrix clauses, instead of ARCs, may have a grounding function when they appear in initial position in sentences with an ARC, similarly to what de Ruiter et al. (2020) and Scholman et al. (2022) find for adverbial clauses in this position. For matrix clauses to have such a grounding function in sentences with an ARC was in line with our expectations.

With the exception of the interaction we find for matrix clauses, evidence from the individual clauses – both in our study and in Gibson et al. (2005) – highlights the importance of looking at the full sentence. Evidence from individual clauses is confounded by a general effect of faster reading times for clauses containing given information and those in sentence-early position. Because new information is always processed more slowly than given information, any comparisons at the level of individual sentence-final clauses will inevitably yield results that suggest that given information facilitates processing in that position. Similarly, because clauses in sentence-early position will always be read faster than clauses in sentence-final position, any comparisons between ARCs in these two positions are bound to yield results that suggest that ARCs in sentence-early position are read faster. It is only possible to observe ease of processing for clauses containing new information in sentence-final position, or for appositives in sentence-final position, when reading times for the full sentence are considered.

3.5 Conclusion

In this paper we investigated the influence of the *at-issueness* principle and three other principles – The *given-new* principle, the *clause structure* principle and the *clause-type mapping of information* principle – on the processing of sentences containing an ARC. We found that predictions made by the *given-new* principle and the *clause structure*

principle were borne out in our data: sentences were read faster when the order of information was given-new, and a delayed effect of matrix-ARC order at the spillover region suggests that matrix-ARC order facilitates processing as well. Both of these findings are uncontroversial, but somewhat surprising considering the special status ARCs have among subordinate clauses. Considering the potential for both the matrix clause and an ARC to contribute the at-issue point of a sentence when the ARC is in sentence-final position, whereas only the matrix clause can contribute the at-issue point of a sentence when the ARC is in sentence-early position, we expected that matrix-ARC order would lead to processing difficulty as both clauses can contain relevant information for subsequent discourse in this order (as predicted by the *at-issueness* principle). In addition, we expected to find effects of clause-type mapping such that sentences would be easier to process when the ARC contained new information, as corpus studies have shown that ARCs almost always contribute new information to discourse. We not find either of these effects, however, we did find an interaction effect for matrix clauses when these were analyzed individually. The effect of faster reading times for these was greater in sentence-early position than in sentence-final position. This interaction suggests that matrix clauses may have a grounding function in sentences with an ARC, an effect that previously has been suggested for sentence-initial subordinate clauses and empirically demonstrated for sentence-initial adverbial clauses. ARCs being more likely hosts for new information might indirectly contribute to matrix clauses appearing to have a grounding function in sentences with an ARC.

Taken together, our findings replicate previously observed patterns predicted by well-established principles, while also underlining the special status ARCs have among subordinate clauses. This special status did not lead to sentences containing ARCs violating the *given-new* principle or the *clause structure* principle, but it did reveal a shift of the grounding function in these sentences from the subordinate clause to the matrix clause. Considering that ARCs have been observed to most often contribute new information, and that they syntactically depend on the matrix clause for an antecedent, this result was in line with our expectations. However, as far as we know, ours is the first study that has found evidence to suggest that matrix clauses have a grounding function in sentences with an ARC, so further research is needed to determine whether this interaction effect we find for matrix clause in sentence-early position indeed can be ascribed to such a grounding function.

Lastly, our study highlights a potential confound in methodologies (including our own) that focus on the processing of individual clauses. Effects of information status and clause position were present in our analysis across the board, such that any matrix clause or ARC containing given information was read faster than when it contained new information, and any matrix clause or ARC in sentence-early position was read faster than

when it was in sentence-final position. If a clause containing given information or clause in sentence-early position is always read faster, it is impossible to observe when certain clauses containing new information or being in sentence-final position facilitates processing. This is why it should be noted that when an investigation aims to find evidence for new information to facilitate processing, or having a certain clause in sentence-final position to facilitate processing, such effects of information status and clause position should be investigated by looking at the full sentence.

3.5.1 Ethics

All experiments in this study were carried out in accordance with the research ethics procedures of the Department of Linguistics and English Language at The University of Edinburgh (Ref # 438-1819/5). Informed consent was obtained from all participants prior to participation.

3.5.2 Data accessibility

The data that support the findings of this study are openly available in the Open Science Framework repository: https://osf.io/3tjwv/.

Chapter 4

General Discussion

4.1 Summary

At-issue content is content that is understood as expressing the main point of an utterance. This thesis was an empirical investigation into C-at-issueness, which is one of the three main strands of at-issueness: Q-, P- and C-at-issueness (Koev, 2018). These three theories of at-issueness distinguish themselves through their characterization of the 'main point', and how to diagnose whether content contributes the main – at-issue – point of an utterance or a point that is more peripheral (not-at-issue). Q-at-issueness considers content at-issue when it provides a felicitous answer to a QUD (Beaver et al., 2017; Simons et al., 2010). P-at-issueness considers content at-issue if it proposes an update to the common ground and can be negotiated with before it enters the common ground (Koev, 2013; AnderBois et al., 2015; Farkas & Bruce, 2010; Murray, 2014). C-at-issueness considers content at-issue if it is available to establish a coherent connection with subsequent discourse (Jasinskaja, 2016; Koev, 2018; Potts, 2005, 2007). This thesis set out to answer three overarching research questions:

- What is the influence of clause type and clause position on the C-at-issue status of clauses in sentences with an ARC and sentences with a TAC?

- How can our findings be integrated into existing theories of (C-)at-issueness?

- Does the *at-issueness* principle accurately predict sentence processing in interaction with other ordering principles for sentences containing an ARC?

Chapter 2 of this thesis investigated how sentence-structural influence the C-at-issue status of clauses in sentences with a TAC and sentences with an ARC. Taken together,

the results suggest that C-at-issue status mostly results from the position of clauses in a sentence: any clause in sentence-final position appears more C-at-issue than any clause preceding it. However, in sentence-early position effects of clause type were observed such that only matrix clauses could achieve C-at-issue status. The following sections of the General Discussion will illustrate how the findings from Chapter 2 have ramifications for C-at-issueness theories in section 4.2, as well as at-issueness theories in general in section 4.3. In particular, I will discuss how the importance of distinguishing between Q-, P- and C-at-issueness also leads to more opportunities for investigating their interdependence, by engaging with them in a complementary fashion rather than as if they are in a competition for which theory is the best at diagnosing at-issue status.

The findings of Chapter 3 suggest that the C-at-issue status of clauses in a sentence does not predict how long it takes to process the sentence. Rather, other principles relating to information structure and sentence structure make more accurate predictions. I will engage more with findings from Chapter 3 and how these illustrate the difficulty and perhaps impossibility of disentangling at-issue status from other structural features that influence sentence processing in section 4.4.

In the last two sections of the General Discussion I will address potential ways in which the methodology employed in this thesis could be improved upon and expanded (section 4.5) and what open questions remain, or have developed from the empirical investigations in this thesis, as well as suggestions for how these could be addressed (section 4.6).

4.2 Implications for C-at-issueness theories

While the findings of Chapter 2 largely overlap with predictions made by C-at-issueness theories as to what can be C-at-issue, our results suggest that C-at-issueness theories can make more fine-grained predictions. The first avenue for discussion here is the observation that in sentence-final position clauses of different clause types pattern together with respect to their C-at-issue status, but in sentence-early position they do not: here we find that matrix clauses have more C-at-issue potential than both TACs and ARCs. While the latter finding is uncontroversial, the former – that C-at-issueness does not seem to discriminate between different clause types in sentence-final position – is a finding that can be applied to update theories of C-at-issueness.

C-at-issueness theories consider C-at-issue status as overlapping with the RF: if a discourse segment is at the RF, it is (or can be) C-at-issue. When several discourse segments are at the RF, however, C-at-issueness theories do not make predictions about which segment is most likely to be C-at-issue and connect with subsequent discourse. While it

might be sufficient from a theoretical perspective to note that all discourse segments at the RF are C-at-issue – as they can all establish a coherent connection with subsequent discourse – in practice, it is not the case that all of these segments at the RF *will* be attached to. The methodology used in Syrett & Koev (2015, Experiment 3) is designed such that one clause in a sentence containing an ARC has to be picked by participants as containing the answer to a subsequent *Why?* question (see Examples (20)-(21)). They found that when ARCs were in sentence-final position they were chosen as the more likely host for containing the answer to *Why?* than the matrix clause preceding them. This suggests that ARCs in sentence-final position compete with the matrix clause preceding them for C-at-issue potential.

Results from Experiment 4 & 5 in Chapter 2 further evidence this finding in an on-line setting by showing that ARCs in sentence-final position are more C-at-issue than sentence-early matrix clauses. In fact, sentence-final ARCs pattern with sentence-final matrix clauses with respect to their C-at-issue status as shown in Experiment 4. More-over, sentence-early ARCs do *not* pattern with sentence-early matrix clauses in the same way: sentence-early matrix clauses were more C-at-issue than sentence-early ARCs as shown in Experiment 5. As such, sentence-final ARCs indeed seem to compete with the matrix clause preceding them for C-at-issue potential, rather than being the only pos-sible candidate for C-at-issue status (as is the case for matrix clauses in sentence-final position). Taken together, this suggests that the RF fully overlaps with C-at-issue sta-tus, but that effects of clause position and clause type should be considered to stand in a hierarchical relation when predicting which clause is the most likely candidate for C-at-issue status in sentences with an ARC: Clause position takes precedence over clause type, such that in sentences with an ARC the sentence-final clause is always the more likely candidate for being C-at-issue. However, when clause position fails to make positive predictions, i.e., in sentence-early position, clause type is the determining factor: matrix clauses can be C-at-issue in sentence-early position and ARCs cannot. The results from Experiment 4 suggest that when two clauses are at the RF, i.e., when the order of clauses is matrix-ARC, position should be taken into account before clause type, meaning that the ARC is more likely to be at-issue than the matrix clause. If clause position is taken into account before clause type, C-at-issueness theories are more likely to make accurate predictions about which clause is C-at-issue.

All of the above was also evidenced for sentences with a TAC (Experiments 1-3) with the exception of one thing: we did not carry out an analysis to potentially show that sentence-final TACs and sentence-final matrix clauses pattern together with respect to their C-at-issue status. This is due to a potentially confounding methodological issue that arises when these two clauses are compared, which is something I will address in section 4.5.

The second avenue for discussion here is an observation made by Asher (2008). He claims that whether a sentence-final TAC is C-at-issue, depends on whether there is causal relation available between the TAC and the matrix clause that subordinates it. If there is not such a causal relation, the sentence-final TAC is not C-at-issue. In the experiment with TACs in Chapter 2, the items were explicitly designed to avoid a possible inference of a causal relation between the TAC and the matrix clause to be likely. Therefore it does not seem likely that in the experiments with TACs in Chapter 2 participants assumed a causal relation between the TAC and the matrix clause, leading to faster reading times when *It* was disambiguated to a referent in a sentence-final TAC compared to a sentence-early matrix clause (Example (57) in Experiment 2, Chapter 2). The observation that sentence-final TACs achieved C-at-issue status in spite of the absence of a causal relation between the TAC and the matrix clause, indicates that further research is required before it can be suggested that C-at-issueness theories should be updated or not based on possible causal inferences being made between clauses. I will make a suggestion for a possible way to approach this in section 4.6.

However, it is possible that an inference of causal relations *can* explain why Frazier & Clifton (2005, Experiment 6) found that the matrix clause was deemed the more likely source for hosting the antecedent for *Too* than the TAC in (2.3.1.3) repeated below in (4.2):

(81)   Mary laughed after she made a joke about the supervisor.
       Then Tina did too.
       a. Tina laughed. (target: matrix clause)
       b. Tina made a joke. (target: TAC)
       (Frazier & Clifton, 2005, 18-19)

If participants assumed a causal relation to be present between the TAC and the matrix clause in (81), they would assume that *Mary laughed* because *she made a joke about the supervisor*, which is a likely assumption. Following Asher (2008), the TAC and the matrix clause are both at the RF and are both available for attachment: the matrix clause by virtue of being a matrix clause, and the TAC by virtue of being in sentence-final position *and* standing in a causal relation to the matrix clause. However, in order for the causal relation expressed between the matrix clause and the TAC in (81) to be repeated with subsequent ellipsis, the antecedent for *too* needs to be hosted by the matrix clause, as follows from (81a). If the antecedent for *too* instead is hosted by the TAC, 'Mary's joke' instead stands in a different – additional – causal relation to 'Tina's (subsequent) joke'. While this is not impossible, it does seem that Frazier & Clifton (2005)'s results can be

explained by a preference for repeating an existing causal relation, rather than assuming a novel one.

4.3   Interdependence between at-issueness theories

Throughout this thesis I have highlighted the importance of distinguishing between different theories of at-issueness. Firstly, it is important to do so because failing to make explicit within which theory investigations are being carried out can lead to incorrectly identifying clauses (often ARCs) as being generally not-at-issue. In addition, when theories are conflated rather than distinguished, any opportunity for employing the different theories in a complementary fashion becomes obscured. As such, distinguishing between theories opens up possibilities for understanding how they inform each other, rather than just viewing them as making diverging predictions for types of at-issueness that are not necessarily related. In the current section I will discuss how I believe C-at-issueness, but potentially also P-at-issueness, feeds into Q-at-issueness, and how we can use this observation to further develop research within all theories of at-issueness.

The crucial point I will be making here follows from an observation made by Snider (2017), who suggests that anaphora-based metrics – like the one employed throughout the experiments in Chapter 2 – is not a reliable measure for at-issue status. Methodological implications resulting from this have been discussed in section 2.14, and will be summarised again below in section 4.5. In the current section I focus on how his critique of anaphora-based metrics for measuring at-issue potential highlights a feature of clauses – TACs and ARC in particular – that are identified as P- and/or C-at-issue through such metrics: they can contain the QUD for what is subsequently Q-at-issue.

To illustrate why he believes anaphora-based metrics are not a reliable metric for measuring at-issue status, Snider (2017) gives the following example (82), previously discussed in (64). The QUD that is posed in (82a) (in boldface) is answered by the matrix clause in the subsequent sentence (in boldface in (82b)). In the following sentence, the pronoun *that* (underlined) has its antecedent in the sentence-early ARC in (82b) (underlined). He then argues that this is evidence for why this anaphora-based metric for at-issueness is unreliable, since it was already unequivocally clear through the QUD posed in (82a), that the matrix clause in (82b) is at-issue by virtue of containing the answer to this QUD:

(82)   Context: Mark is a high school teacher. His parents come to visit during a school assembly. His father is looking around the auditorium, curious about Mark's students.

a. Dad:

   Where are Mark's students sitting?

b. Mom:

   Lisa, <u>who is Mark's favorite</u>, **is sitting in the front row.**

   He told me <u>that</u> in confidence, though, so don't tell anyone.

(Snider, 2017, 7)

The initial problem here is that generalisations are being made about at-issue status that are only applicable to Q-at-issueness theories. In doing so, the suggested C-at-issue status of the sentence-early ARC[1] is brushed off as irrelevant because it does not rely on a QUD-metric. More importantly, though, is that the interdependence between Q-at-issueness and C-at-issueness becomes clear through this example: The clause that appears C-at-issue – *who is Mark's favourite* – contains the information necessary to form the QUD for what follows: *How do you know Lisa is Mark's favorite?*. This QUD is subsequently answered by the matrix clause in the next sentence: *He told me that in confidence.*

This observation gives rise to a pattern whereby clauses that are C-at-issue can be felicitous hosts for QUDs, and Q-at-issue content answers the QUD posed by C-at-issue content. This pattern is also present in our experimental items in Chapter 2. Consider the example conditions from Experiment 1 (55), repeated here in (83). The indefinite nature of the possible antecedents for *It* throughout the experimental items – *a French bistro* and *a violin concert* in (83) – systematically licenses and triggers potential questions which ask for a specification of these antecedents (see Onea & Zimmermann, 2019, 74-48. If we consider the QUD inherent to *they dined at a French bistro* to be *What kind of French bistro?*, this QUD only remains on the stack when it is in sentence-final position, as in (83b). When the QUD is inherent to the sentence-early TAC, as in (83a), it is clear that the following clause – *they went to a violin concert* – does not answer this QUD but poses a different QUD (for example, *What kind of violin concert?*). As such the QUD *What kind of French bistro?* is removed from the stack as it is no longer accessible by virtue of not being at the RF (cf. Jasinskaja, 2016, 7-10). When the QUD is inherent to the sentence-final matrix clause, as in (83b), which is at the RF, it can subsequently be answered by the follow-on sentence *It was a small cozy restaurant*, which is Q-at-issue:

(83)   a. My parents went out yesterday. After they dined at <u>a French bistro</u>, they went to a violin concert. It was <u>a very small cozy restaurant</u>.

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[1]The observed C-at-issue status of this particular sentence-early ARC is also a potential problem for C-at-issueness theories, which do not predict sentence-early ARCs to have C-at-issue potential. This is a problem our methodology addresses, which will be discussed in section 4.5.

b. My parents went out yesterday. After they went to a violin concert, they dined at <u>a French bistro</u>. It was <u>a very small cozy restaurant</u>. .

Taken together, these examples underline the complementary (and at times overlapping) distribution of Q- and C-at-issue content. While our data does not allow for additional comparisons that include P-at-issueness, it is likely that P-at-issue content patterns together with C-at-issue content in this respect, as those clauses that are P-at-issue but not Q-at-issue are clauses that also always have C-at-issue potential as the analyses and empirical evidence in section 1.1.2 and section 1.1.3 have shown. That said, P-at-issueness seems to be more constrained with respect to what can be at-issue compared to C-at-issueness, so it remains an open question how theories of P-at-issueness can be adequately distinguished from C-at-issueness theories to participate in this observed complementary distribution of Q- and C-at-issue content.

In summary, the distinctive analyses of what constitutes at-issue content under different theories of at-issueness gives rise to a framework under which these theories can be investigated in a complementary fashion. Such a framework would focus on how the differences between theories allow for more fine-grained investigations into at-issueness, rather than continued discussion about which theory makes more accurate predictions.

4.4 Processing (not-)at-issue content

In Chapter 3, we found no evidence that C-at-issue status was reflected in processing when we considered the full sentence region. If the C-at-issue status of clauses results in slower reading times for these clauses, we would have seen this reflected in the processing of sentences with only one clause that had C-at-issue potential (the matrix clause in ARC-matrix clause order) compared to sentences with two possible candidates for hosting C-at-issue content (both clauses in matrix clause-ARC order), such that sentences in ARC-matrix clause order would be read faster than sentences in matrix clause-ARC order (the *at-issueness* principle). Instead, we find the opposite: matrix clause-ARC order was read faster. However, we did find that sentence-final clauses (both matrix clauses and ARCs) took longer to process than sentence-early clauses, which could be attributed to C-at-issue status. However, in the case of both sentence-final matrix clauses and sentence-final ARCs, this can also be explained by structural features. There is a long-distance dependency between the matrix clause subject and the matrix clause predicate when the matrix clause is in sentence-final position, possibly leading to processing difficulty (Gibson et al., 2013, 153). In the case of sentence-final ARCs the *wh*-pronoun modifies the matrix clause object, which is subsequently reinterpreted as the subject of the ARC.

Sentence-early ARCs, in contrast, modify the matrix clause subject, keeping the syntactic role of the matrix clause subject consistent with the syntactic role of the *wh*-pronoun in the ARC. As a result, the perspective shift that occurs in sentence-final ARCs might take longer to process than sentence-early ARCs (Gibson et al., 2013, 150).

The absence of any effects that can clearly be attributed to C-at-issue status leaves open a question about how C-at-issue status is reflected in processing. Can we assume a relation between C-at-issue status and processing? We assumed in Chapter 3 that C-at-issue content, being potentially relevant for subsequent discourse, would cause more processing time than content that is not C-at-issue and therefore not likely to be relevant for subsequent discourse. Consequently, when there is more than one clause in a sentence that has the potential to be relevant for subsequent discourse, this leads to more processing time than when only one clause has the potential to be C-at-issue. However, results in Chapter 2 suggests that even when a sentence contains two clauses that have the potential to be C-at-issue, one clause – the sentence-final clause – is expected to be the more likely candidate for being C-at-issue by virtue of being the last-added discourse segment. As a result, it is expected to be more salient than other segments that precede it even if these segments can also be C-at-issue. If this is reflected in processing, it would explain why we did find sentence-final clauses – which are the most likely candidate for hosting C-at-issue content – to be processed slower than sentence-early clauses and we can attribute this finding to the C-at-issue potential of sentence-final clauses.

Another explanation for predictions made by the *at-issueness* principle not being borne out in our data could be that the principles for which we did find effects reflected in our results (the *given-new* principle and the *clause structure* principle) obscured any potential effects of C-at-issue status. The *clause structure* principle predicts the opposite clause order from the *at-issueness* principle to facilitate processing. For any effects of C-at-issue status to be observable, they need to (1) be present (as in, it needs to be the case that C-at-issue status is indeed reflected in processing), and (2), these effects then need to be more pronounced than those that result from the clause order which is predicted to facilitate processing under the *clause structure* principle. Taken together, it does not seem that investigations into the processing of C-at-issue content are likely to shed light on the relation between C-at-issue status and processing, as it is not possible to disentangle C-at-issue status from clause order and clause position: these factors are predictors for C-at-issue status.

4.5   Reflection on Methodologies

In this section I will discuss and address potential concerns with respect to the methodology in this thesis. These concerns will be addresses individually for Chapter 2 and Chapter 3 below.

4.5.1   Chapter 2

The critique of anaphora-based metrics as diagnostics for at-issue potential by Snider (2017, 2018) – such as the one employed in all experiments in Chapter 2 – has been discussed in section 2.14. In summary, Snider posits that Q-at-issueness metrics (i.e., being able to answer the QUD overlaps with at-issue status) are a more reliable measure for at-issue status than anaphora-based metrics, and provides evidence through anaphora-based metrics that wrongly diagnose not-at-issue content as being at-issue. Because the experimental investigations in Chapter 2 are explicitly addressing C-at-issueness, and do not claim to make any predictions towards Q-at-issue status, the use of anaphora-based metrics does not seem problematic. For a more detailed discussion of this point, see section 2.14.

In that same section we also address the potential problem with interpreting recency effects as symptoms of C-at-issue status. Clark & Sengul (1979) find that the most recently uttered referent is the most accessible referent, and Gernsbacher et al. (1989) find that referents in the most recently uttered clause are more accessible than those in clauses preceding the most recent clause. Taken together, findings from Clark & Sengul (1979); Gernsbacher et al. (1989) suggest that recency and accessibility overlap, both at the level of the sentence (more recent clauses are more accessible) and the level of the clause (more recent referents are more accessibly). While these findings give rise to an interpretation of our results in which recency effects can be seen as obscuring or even overriding effects of C-at-issue potential, I would argue that there is no reason to believe effects of recency and effects of C-at-issueness need to be disentangled. The notion that recency increases a referent's or clause's accessibility is inherent to the RF: Last-uttered discourse segments (and as such, the referents contained in them) can establish a coherent connection with subsequent discourse, and are therefore C-at-issue. In addition, we also found evidence of C-at-issue potential unrelated to recency in Experiment 2 and Experiment 5, where sentence-early matrix clauses appeared more C-at-issue than sentence-early TACs or ARCs. As such, I do not take recency to be a potentially confounding factor, rather, it is one of the more (if not most) relevant predictors for C-at-issue status.

That said, it is possible to investigate C-at-issue status in such a way that recency is fully counterbalanced. If the accessibility of a recent referent that is not at the RF is compared to the accessibility of a referent that is less recent, but is at the RF, any effects of recency would indicate that recency is not a perfect predictor for C-at-issue status.

4.5.2 Chapter 3

A potential problem in the methodology of Experiment 7 can be identified in the way that givenness was manipulated in the items. We manipulated givenness through habitual events that were introduced in the context, which were then repeated in the target region. As such, the habitual event itself was part of the common ground, and therefore had a familiar status, but when it was then subsequently re-mentioned, it was presented as a new instance of this familiar event. Consider Examples (72)-(73), the relevant parts of which are repeated in (84) below. The event of *My aunt was gossiping* has been foreshadowed by the context in (84a). From this context, we learn that 'my aunt' loves to gossip and does so frequently. However, when then in the target region in (84b), *My aunt was gossiping with my mom* is assumed to be given information, this is not exactly the case. In fact, with respect to previous discourse the instance of this event is completely new:

(84) a. My aunt loves to be part of the rumor mill, and just like my mom, takes any opportunity to engage in the latest stories. At my birthday party...

   b. My aunt was gossiping with my mom, who was drinking gin & tonic.

This potential ambivalence is not necessarily problematic: it is clear that this event which we have manipulated to have a more familiar status, is more 'given' than the other event in the target region in (84b) *who was drinking gin & tonic.* In addition we find effects for given-new ordering and for givenness in general consistently throughout our analyses. This leads me to believe that this manipulation in itself was a productive metric for attributing given status to clauses. However, it might have led to a similar issue that was observed in Gibson et al. (2005, Experiment 2), who noted that their results might have been influenced by the fact that ARCs in their stimuli contained a mixture of both given and new information. Due to the fact that ARCs are more likely hosts for new information, as observed by Loock (2007, 2010), the fact that given information in our items was technically – also – new information might have influenced the processing of ARCs in Experiment 7 in ways that could have obscured effects of information status. However, if the ARCs containing given information were indeed perceived as contributing given information to discourse, rather than a mixture of given

and new information, this could have led to additional effects of surprisal for the GIVEN ARC conditions, considering that ARCs generally contribute new information (Loock, 2007, 2010). Such effects of surprisal could have led to reading times slowing down for given ARCs. While such an effect was not observed in the data, it is possible that this would have manifested as a spillover effect. The experimental design did not allow for such a spillover effect to be observed for the individual ARCs, as it was only possible to observe spillover effects for the reading times of the full sentence regions. A different design which focuses only on reading times of individual ARCs could address this in a future study.

It is not clear from our results that our manipulation of givenness was a confounding factor; in fact, our data does not indicate this, but it is possible that our results would have been different had this manipulation of givenness been completely unambiguous such that given information in our items could not have been interpreted as new information from any perspective.

A second potential issue lies in our manipulation of clause-type mapping of information. Due to the nature of our design, evidence of clause-type mapping of information would have manifested as an interaction effect between information order and clause order. This is indeed what we observed at the individual clause level for matrix clauses, for which the effect of faster reading times was greater in sentence-early position than in sentence-final position, suggesting that matrix clauses had a grounding function in this position. However, this effect was not repeated at the full sentence level. This leaves open questions of whether (1) our interpretation of this interaction can be extended to apply to sentences with an ARC in which the matrix clause is in sentence-early position and (2), if this is the case, why we did not find this effect repeated at the full sentence level. If we had employed a methodology which explicitly manipulated clause-type mapping of information as a factor, this might have been avoided. However, because of the overlap between the factors – e.g., given-new combined with ARC-matrix automatically leads to clause-type mapping being inherent such that the result is given-in-ARC and new-in-matrix – it is hard to imagine a design in which these factors do not overlap and hence can possibly be disentangled.

4.6   Further research

This section will engage with possible avenues for future research following from questions that remain open, or questions that have developed from the studies in this thesis.

As was mentioned in section 4.2, there is reason to believe that the presence or absence of a causal relation between a TAC and a matrix clause influences a TACs potential for being C-at-issue. Such an effect of causal inference can be probed with a follow-up study designed after example (47) from Asher (2008), adapted here in (85). I would expect the disambiguation region *a chicken burger that had gone off* to be read faster when it disambiguates *It* to a referent in a TAC that stands in causal relation to the matrix clause that subordinates it (85a) and is therefore C-at-issue, than when *It* is disambiguates to a referent in a TAC that does not stand in a causal relation to the matrix clause in the same sentence (85b), which makes it less C-at-issue than this same TAC in (85a):

(85) a. John was admitted to a hospital after he ate something poisonous. It was
          a chicken burger that had gone off.

      b. John went to a bowling alley after he ate something poisonous. It was
          a chicken burger that had gone off.

This experiment can be followed-up with an experiment that probes if the matrix clause is more (or less) C-at-issue depending on whether the TAC that follows it allows for a causal inference to be made. In (86), the disambiguation region – *on the outskirts of the city* – helps disambiguate *It* to *a hospital* in (86a), and to *a bowling alley* in (86b):

(86) a. John was admitted to a hospital after he ate something poisonous. It was
          on the outskirts of the city.

      b. John went to a bowling alley after he ate something poisonous. It was
          on the outskirts of the city.

If the causal relation between the TAC and the matrix clause in (86a) makes the TAC more available for subsequent attachment, making it compete for C-at-issue status with the matrix clause that precedes it, we would expect slower reading times for the disambiguation in this condition, than when such a causal relation is not easily inferrable, as is the case in (86b). Results from these experiments would elucidate on the differing C-at-issue potential of the individual clauses in sentences with a sentence-final TAC, depending on the presence or absence of an inferrable causal relation between the two clauses. However, it would still leave open the question of why sentence-final TACs that do *not* stand in a causal relation to the matrix clause show more C-at-issue potential than the matrix clause that precedes them, as was the case in Experiment 2 of Chapter 2 (section 2.7).

Another possible problem to highlight that does not affect the current methodology, but one that needs to be addressed in follow-up studies, is the chronological order of

events in sentences with a TAC headed by the adverbial 'after' (or 'before'). Not all after-clauses could be compared because effects that could be associated with not-at-issue status could also possibly be associated with a potentially more difficult to process counter-chronological order of events (Münte et al., 1998; Politzer-Ahles et al., 2017). Consequently, a follow-up experiment comparing sentence-final TACs (87a) to sentence-final matrix clauses (87b) – which could have shed light on whether clause type has an effect in sentence-final position in sentences with a TAC – was not carried out:

(87)   a. My parents went out yesterday. They went to a violin concert after they dined at <u>a French bistro</u>. It was *a very small cozy restaurant*.

   b. My parents went out yesterday. After they went to a violin concert, they dined at <u>a French bistro</u>. It was *a very small cozy restaurant*.

The order of events in (87b) is chronological, whereas the order of events in (87a) is counter-chronological. This means that any potential effects of slower reading times when *It* is disambiguated to a referent in the sentence-final TAC could also be attributed to counter-chronological order of events. A simple solution would be to use a different adverbial: *before*:

(88)   a. My parents went out yesterday. They went to a violin concert **before** they dined at <u>a French bistro</u>. It was *a very small cozy restaurant*.

   b. My parents went out yesterday. **Before** they went to a violin concert, they dined at <u>a French bistro</u>. It was *a very small cozy restaurant*.

In this setting, the difficulty that could result from a counter-chronological order of events would now be associated with the condition in which the sentence-final matrix clause provides the antecedent for *It*, as in (88b). If the disambiguation region is still read faster in this condition it would suggest that TACs in sentence-final position are less C-at-issue than matrix clauses in this same position, as in (88a). Such an effect would highlight that there is a difference between TACs in ARCs and their potential to be C-at-issue.

The studies in this thesis investigated phenomena in English that are expected to cause difficulty for second language speakers and for which second language speakers are expected to show a different pattern (e.g., different frequency and different distribution of these structures) in their usage than native speakers. These phenomena – order of information (given-before-new vs. new-before-given), clause-type mapping of information (given-in-subordinate vs. new-in-subordinate) and at-issue status (at-issue vs. not-at-issue) – are among phenomena that are expected to cause problems even when learners

have reached near-native proficiency. It is suggested these problems may arise because these phenomena are at the syntax-pragmatics interface (Sorace, 2011; Sorace & Filiaci, 2006; Sorace & Serratrice, 2009; Tsimpli & Sorace, 2006). When several strategies can be employed to express the same meaning, this leads to residual optionality for L2 speakers (Sorace, 2000, 2011). Residual optionality refers to a divergence from the corresponding native grammar of the L2, such that the 'option' that is closer to the L1 grammar of the L2 speaker will more likely be employed than the native-like option. It is hypothesised that this is due to cognitive constraints that result from accessing a non-native grammar. A possible avenue for future research then would be to investigate how individual differences in language proficiency (near-native vs. native) influence, for example, expectations about which clause is likely to contribute the C-at-issue point of a sentence. Is this influenced by clause position more so than clause type for near-native speakers of English similarly as it is for native speakers of English, and what is the influence of the native language of near-native speakers of language? This could similarly be probed for the ordering principles investigated in Chapter 3.

A final suggestion for future research would be theoretical investigations into the interdependence of different theories of at-issueness. For example, the relation between Q- and C-at-issueness I highlighted in (4.3) and (83) is one whereby C-at-issue content feeds into Q-at-issue content, in that C-at-issue clauses contain the QUD for which the answer is provided by subsequent Q-at-issue content. This Q-at-issue content then either is also C-at-issue and connects to subsequent discourse, or it is contained in a sentence which has another clause which is C-at-issue, and facilitates connection to subsequent discourse segments. Consider example (89) below, adapted from the materials for Experiment 4 in (59). The first sentence *What was your mom doing outside?* provides the QUD which is answered by the matrix clause in (89a), which is Q-at-issue. This matrix clause is followed by an ARC (89b), which is C-at-issue (but not Q-at-issue). The follow-on sentence in (89c), then, is both Q- and C-at-issue, as it answers the QUD inherent to the C-at-issue clause in (89b) *What kind of shopping trip?* and it contains the QUD – *Why did he buy supplies?* – answered by the next sentence in (89d). This sentence is also both Q- and C-at-issue. The final sentence in (89e) connects back to the initially only Q-at-issue clause in (89a) which stands in a subordinating relation to all subsequent discourse segments, and therefore is available for attachment by virtue of being at the RF. As a result, the matrix clause in (89a) now appears to be C-at-issue in addition to being Q-at-issue:

(89)   What was your mom doing outside?

       a. My mom was having a chat with our neighbor$_{[Q\&C-at-issue]}$.

       b. who had just returned from a shopping trip$_{[C-at-issue]}$.

    c. It was a quick trip to get some supplies$_{[Q\&C-at-issue]}$.

    d. He is making a tiny gazebo for the birds in his backyard$_{[Q\&C-at-issue]}$.

    e. My mom was desperate to head inside, but could only get away when our neighbor was distracted by a passing blue-feathered macaw.

While none of this is necessarily problematic – theories of Q- and C-at-issueness together can explain this pattern – this interdependence is not something that (to my knowledge) has been addressed in the at-issueness literature thus far. What are the theoretical implications of this? Is this interdependence cyclical, and can we view discourse as constructed by clauses that are either Q-at-issue or C-at-issue (or both)? And is there a distinct role for P-at-issueness in this interdependence? A dynamic update model of discourse as proposed in Farkas & Bruce (2010) suggests a possible role for P-at-issueness in this interdependence: both assertions and polar questions raise an 'issue' that subsequently is expected to be resolved. Their model, however, considers those assertions that are added to the context set as individual speech acts, whereas complex sentences – in particular sentences containing a sentence-final ARC – can contribute multiple assertions, but also multiple independent speech acts. As such, a dynamic model that can incorporate the different roles of C-at-issue and Q-at-issue content, is necessarily more complex.

I have already explained the relevance of such future research in section 4.3, but it is worth noting again that this line of research could be beneficial to the field of at-issueness as a whole. Research on at-issueness has largely focused on providing additional evidence for just one of the three theories, to the extent where this evidence is then taken as proof that other theories are less valid. I believe that the interdependence I have highlighted between Q- and C-at-issueness in section 4.3 is an important direction to pursue future research in. This is not just because I believe it would be particularly interesting, but also (and I would say, more importantly) because it helps steer away from the tradition of looking at at-issueness theories as being in competition with each other. Instead, the focus of future research on at-issueness can be in the pursuit of understanding how different theories of at-issueness complement and inform one another.

Chapter 5

Conclusion

The discourse-status of content – e.g., whether information is important (at-issue) or less relevant (not-at-issue), or whether content contributes given or new information to discourse – can be reflected in the ways in which content is packaged and ordered within a sentence. The goal of this thesis was to better understand how this packaging of information works in complex sentences. I specifically focused on C-at-issueness, which considers content to be at-issue if subsequent discourse can coherently connect to it. In contrast, Q-at-issueness considers content at-issue if the sentence containing it can felicitously answer the current QUD. These different views – C-at-issueness looking forward to determine at-issue status; Q-at-issueness looking backward – lead to diverging predictions about which content in sentences can achieve at-issue status. The goal of this thesis was to better understand which factors contribute to the C-at-issue potential of clauses in complex sentences, and what the resulting ramifications are for C-at-issueness theories and theories of at-issueness in general. In addition, I investigated if the C-at-issue status of clauses is reflected in processing, such that clauses that are C-at-issue are associated with longer processing times.

Results of Chapter 2 suggest that C-at-issue status is primarily determined by the position of clauses within a sentence: sentence-final clauses are more C-at-issue than sentence-early clauses. However, for sentence-early clauses – for which an effect of position cannot be associated with C-at-issue status – effects of clause type were observed in that matrix clauses were more C-at-issue than TACs or ARCs in this same position. While C-at-issueness theories predict that any clause at the RF is (or can be) C-at-issue, findings from Chapter 2 suggest that there is a hierarchical relation between clause position and clause type here. When multiple clauses are at the RF, effects of position override effects of clause type to shape expectations about which content is C-at-issue. Clauses that are

at the RF by virtue of being the last-uttered discourse segment are more C-at-issue than clauses that are at the RF by virtue of subordinating the last-uttered discourse segment.

Chapter 3 investigated whether C-at-issue status is reflected in processing. In doing so, this investigation additionally accounted for potential effects of several principles that make predictions about which order of clauses and which order of information in sentences facilitates processing. Specific orders of information (given-before-new) and clauses (matrix-before-ARC) were found to facilitate processing, but no conclusive evidence was found for reading times being affected by C-at-issue status. I take this to suggest that either C-at-issue status is not reflected in processing, or that other – stronger – effects of information order and clause order, obscure potential effects of C-at-issueness.

The general implications for C-at-issueness theories are that predictions made by the RFC can be subdivided into categories of recent and not-recent material at the RF. This allows for more fine-gained predictions to be made about C-at-issue status. More importantly, however, observations made in this thesis led to implications for at-issueness theories in general. The observed interdependence between Q- and C-at-issueness – such that C-at-issue status feeds into Q-at-issue status by means of containing the QUD for what subsequently is Q-at-issue – allows for avenues of possible research within at-issueness that move away from considering at-issueness theories as being in competition with eachother. Instead, it opens the door for researching different theories of at-issueness in a complementary fashion. With such an approach, we will make faster progress in developing our understanding of how inferences are drawn about the relevance or importance of information, and how expectations about how discourse might progress are subsequently shaped through these inferences.

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Appendix A

Experiment 4: preregistered analysis

When we compare the full model to a model without *condition*, reading times vary by condition at the disambiguation region ($\chi^2(2) = 15.68$, $p = < .001$) but not the spillover region ($\chi^2(2) = 2.69$, $p = .26$). Consequently, we carried out pair-wise analyses for the disambiguation only. The EARLY ARC condition yielded slower reading times than both the FINAL ARC and the FINAL MATRIX conditions (which did not differ from each other). See tables A.1 to A.3 for an overview of results for each individual pair-wise comparison.

TABLE A.1: Experiment 4 disambiguation, sentence-early ARC vs. sentence-final ARC: Model coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including *condition*, and the *p*-value for that test statistic.

	β	SE	$\chi^2(1)$	p
condition	-108.03	31.18	11.96	$<$**.001**
trial number	-8.79	2.32	14.23	$<$**.001**
condition $\times$ trial number	4.62	4.67	0.99	.32

TABLE A.2: Experiment 4 disambiguation, sentence-early ARC vs. sentence-final matrix clause: Model coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including *condition*, and the *p*-value for that test statistic.

	β	SE	$\chi^2(1)$	p
condition	108.87	31.77	11.70	$<$**.001**
trial number	-9.16	2.37	14.78	$<$**.001**
condition $\times$ trial number	-4.83	4.75	1.04	.31

TABLE A.3: Experiment 4 disambiguation, sentence-final ARC vs. sentence-final matrix clause: Model coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including *condition*, and the *p*-value for that test statistic.

	β	SE	$\chi^2(1)$	p
condition	0.02	32.76	0.00	1
trial number	−6.84	2.31	8.66	**.003**
condition × *trial number*	−0.29	4.59	0.00	.95

Appendix B

Experiment 5: preregistered analysis

When we compare the full model to a model without *condition*, reading times vary by condition at the disambiguation region ($\chi^2(2) = 19.72$, $p =< .001$) but not the spillover region ($\chi^2(2) = 4.05$, $p = .13$). Consequently, we carried out pair-wise analyses for the disambiguation only. The FINAL MATRIX condition yielded faster reading times than both the EARLY ARC and EARLY MATRIX conditions (which did not differ from each other). See tables B.1 to B.3 for an overview of results for each individual pair-wise comparison.

TABLE B.1: Experiment 5 disambiguation, sentence-early ARC vs. sentence-early matrix clause: Model coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including *condition*, and the *p*-value for that test statistic.

	β	SE	$\chi^2(1)$	p
condition	-30.15	26.24	1.33	.25
trial number	-11.57	1.96	34.39	**<.001**
condition $\times$ trial number	1.05	3.95	0.07	.79

TABLE B.2: Experiment 5 disambiguation, sentence-early ARC vs. sentence-final matrix clause: Model coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including *condition*, and the *p*-value for that test statistic.

	β	SE	$\chi^2(1)$	p
condition	109.23	31.96	10.23	**.001**
trial number	-10.83	1.91	32.25	**<.001**
condition $\times$ trial number	-1.40	3.85	0.13	.71

TABLE B.3: Experiment 5 disambiguation, sentence-early matrix clause vs. sentence-final matrix clause: Model coefficient estimates, standard errors of those estimates, chi-squared value from the likelihood ratio test comparing each model to a model not including *condition*, and the *p*-value for that test statistic.

	β	SE	$\chi^2(1)$	p
condition	81.44	30.60	6.82	**.01**
trial number	−11.00	1.85	34.84	**<.001**
condition × trial number	−0.28	3.71	0.01	.94

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