Disambiguation of case alignment pattern, not gap position, impedes the processing of filler/gap dependencies in a split ergative language

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Abstract: Crosslinguistic psycholinguistic research often finds that processing filler/gap dependencies is easier when the gap is in subject position rather than object position. Exceptions to this generalization, though, have been noted for ergative languages and for gap-before-filler constructions (e.g., prenominal relative clauses). Hence, pressing theoretical questions concern how and why processing is affected by gap position, morphological markedness, and dependency linearity. Four reading time studies on Georgian investigate by leveraging the language's complex grammar, which enables linear order and clause internal case alignment to be independently manipulated. Results indicate that what most reliably impedes processing are cues that disambiguate case alignment: namely preverbal ergative nouns, and certain clause final verbs. Evidence that subject gaps are easier than object gaps is at best qualified, and there is little evidence that gap markedness or filler/gap order affects comprehension. This suggests that comprehenders deprioritize active gap processing when navigating morphosyntax as complex as Georgian's.

Keywords: sentence processing; filler/gap dependencies; subject gap advantage; ergativity; word order; Georgian

1. Introduction

The morphosyntactic expression of filler/gap dependencies, like relativization and wh-movement, is crosslinguistically diverse. But whatever their language's grammatical landscape, comprehenders will be faced with the same fundamental parsing challenges. They must recognize that there is a filler/gap dependency, and identify its two dependents. Those elements, the filler and the gap, can in principle be in either order, and can be separated by unbounded syntactic distance. Just how the comprehension system meets these parsing challenges, in the face of any given set of grammatical particulars, is an important topic in psycholinguistic theory.

Appropriate for many languages seems to be an active model of filler/gap processing: rather than waiting for bottom-up evidence of the whole filler/gap dependency, the parser applies top-down reasoning to predict its properties.[1] Favoured parses seem to be those which are the most representationally economical, and/or the most rational given one's linguistic knowledge — for example, parses that minimize the dependency length, or which put the gap in a syntactic position that the grammar guarantees. In many languages, or at least in those that are overrepresented in psycholinguistic research, these factors incentivize the active prediction of a subject gap over an object gap. Investigation into the nature of this active parsing strategy and its relation to subject gap advantages has been a fruitful engine of crosslinguistic research (Fodor 1978, Frazier 1987, Lau & Tanaka 2021, and many others).

[1] We use prediction based terminology for clarity and consistency, but do not mean to exclude other theoretical mechanisms. Many of our ideas could be reframed in terms of integration, allotting activation to parallel parses, etc.

This paper contributes by asking whether there are languages where an active strategy for processing filler/gap dependencies is unattractive, even for neurotypical adult native speakers. That is, in what grammatical landscapes would it be more rational for parsers to wait for bottom-up evidence of the whole dependency? If there are any such grammars, it must be those that give rise to incremental linguistic configurations where: (i) the choice between competing parses — varying, say, in the syntactic position of the gap — does not affect filler/gap dependency length; and/or (ii) no relevant phrase structural or morphosyntactic property of the parse is guaranteed to be encountered. We argue that both statements apply to Georgian, the focus of this paper. In this language, the choice between a subject- and object-gap parse does not affect linear dependency length, because word order is flexible and subjecthood/objecthood relations are often disambiguated only by morphology on a clause final verb. What is more, no particular parse-property is guaranteed due to the diversity of clause types available to the language.

This foreshadows our ultimate conclusion about Georgian sentence processing (in particular), and about how the comprehension system might adapt to grammatical variation (more generally). Such a position is motivated by two pairs of self-paced reading studies whose design is motivated the growing crosslinguistic literature on filler/gap processing. Specifically, the studies test how relative clause processing is affected by case alignment pattern and filler/gap order: two parameters that appear to modulate parsing behaviour. Accusative alignment patterns and filler-before-gap constructions are well studied and consistently give rise to subject gap advantages, but the picture is less clear for ergative patterns and gap-before-filler orders. Weak subject gap advantages, or even object gap advantages, have been reported in languages with these under-researched properties (e.g., Carreiras et al. 2010 for Basque; Lin & Garnsey 2011 for Mandarin; Polinsky et al. 2012 for Avar; Wagers et al. 2018 for Chamorro).

Georgian, then, is an ideal language to investigate filler/gap processing. Being a split-ergative language with a rich array of relativization strategies, its grammar allows both case alignment pattern and filler/gap order to be manipulated without changing lexicalization. Our experiments did just that. They find processing difficulty at clause medial ergative nouns and clause final verbs in certain contexts. Previously, ergative effects have been observed in Georgian relative clauses (Lau et al. 2023), and interpreted as evidence of a subject gap advantage: after all, an ergative noun must be a subject, and an overt subject within a relative eliminates the possibility of a subject gap. However, in the present studies, which tested more syntactic configurations, no other cues which eliminate a subject gap parse cause processing difficulty. Indeed, there is no unequivocal evidence that subject- and object-gap relatives are differentially processed, nor evidence that processing is affected by gaps' case features or the linear order of filler and gap. Rather, what unites our key results is that they are all associated with the disambiguation of case alignment pattern. The emerging picture for Georgian sentence processing is one in which comprehenders' strategy for parsing filler/gap dependencies is not as aggressively active as it is for comprehenders of familiar English-like languages. Instead, they seem to wait for bottom-up evidence before parsing a noun's grammatical role or committing to a gap's syntactic position. And this is arguably the rational strategy, given the number of morphosyntactic balls that Georgian grammar forces them to juggle. Thus, by taking a theoretically nuanced perspective on a language with typologically rare properties, the present study contributes to our understanding of how the language processing system adapts to grammatical variation (in the spirit of MacWhinney & Bates 1989, Bornkessel-Schlesewsky & Schlesewsky 2015).

2. Background

2.1 Active filler/gap processing and the subject gap advantage

Across many languages, constructions, and methodologies, psycholinguistic research has observed a subject gap advantage: a processing asymmetry across transitive filler/gap dependencies, such that the version with a gap in subject position is easier to process than the version with a gap in object position. The phenomenon has been discussed extensively; see Gibson (1998), Kwon et al. (2010), and especially Lau and Tanaka (2022) for reviews. An appealing theoretical explanation is that the subject gap advantage emerges from a general active parsing strategy: upon encountering initial evidence of a filler/gap dependency, comprehenders actively predict that the gap will be in subject position. Any disconfirming evidence — like an overt subject along the dependency path — will force comprehenders to expend extra resources to revise the parse.

But just why might the prediction of a subject gap be attractive? Possible explanations lie in representational economy, memory limitations, and experience with naturalistic language use. In terms of syntactic representations, subject gaps are more economical because they minimize the abstract structural length of the dependency. At least in familiar English-like languages, this representational assumption is not controversial: transitive subject position is standardly taken to be hierarchically superior to direct object position, and filler/gap dependencies like relativization are taken to involve a syntactic relation between a clause internal argument position and a clause peripheral one. If the cognitive resources necessary to process such a relation increase with the number of nodes in the phrase structure it crosses, and if the parser actively seeks to minimize that processing effort, then a subject gap prediction is the most rational one to make. This can be viewed as part of a general preference for building minimal structures (Frazier & Fodor 1978, de Vincenzi 1991).

Limitations on working memory's ability to process linearly organized strings is another reason why a subject gap might be favoured. As the filler/gap dependency unfolds, the parser must identify the filler and the gap while also parsing elements that intervene between them. It is a reasonable assumption, then, that linearly shorter dependencies with fewer interveners will tax memory less (e.g., Gibson 1998, Lewis & Vasishth 2005). Consider a relative clause in a familiar English-like language, where initial evidence of the dependency comes from a relative pronoun ("the poet who…"). Whereas an object gap will be bottom-up evident only after also encountering the relative clause subject and verb ("the poet who you interviewed _ yesterday"), a subject gap will be evident as soon as grammatically possible ("the poet who _ interviewed you yesterday"). So, actively predicting a subject gap will be most rational if the parser seeks to minimize the effort necessary to process the various syntactic dependencies unfolding in parallel.

Finally, comprehenders' linguistic experience might also push them towards subject gaps. Experience can be operationalized in terms of surprisal values derived from naturalistic corpus data (Hale 2001), or in terms of generalizations about the set of possible parses (Keenan & Comrie 1977). In either case, subject gaps come out on top in a familiar English-like language. Subject gaps tend to outnumber object gaps in such languages (e.g., Roland et al. 2007), so an active strategy straightforwardly derived from such frequencies will prefer subject gaps. Moreover, English-like grammars tend to privilege the subject category (namely, the nominal in Spec-TP; see McCloskey 1997): making it obligatory across clause types, and/or expressing it with uniform morphosyntax. Parsers wielding this type of knowledge will also predict the gap to be in subject position, since no other argument position is guaranteed.

In the above discussion, the refrain of 'in a familiar English-like language' is an important one. That subject gap prediction is the most rational one is fundamentally contingent on several grammatical

parameters which vary crosslinguistically. It happens that the languages that are overrepresented in psycholinguistic research happen to be those which conspire for subject gaps: languages with accusative morphosyntactic alignment, strict subject-before-object word order, and filler-before-gap relatives. And indeed, evidence of a subject gap advantage is often weaker when typologically underrepresented types of grammars are investigated.

Take ergative languages, for instance. Ergativity refers to the morphosyntactic pattern in which a marked category (the 'ergative' case or type of agreement) is assigned to transitive subjects, while an unmarked category ('absolutive') is assigned to direct objects and intransitive subjects. This contrasts with accusativity, in which the unmarked category ('nominative') is assigned to all subjects, while the marked one ('accusative') is reserved for direct objects. Ergative languages are rarer than accusative ones, and just a handful have been investigated psycholinguistically to date. Results are mixed. On the one hand, a clear subject gap advantage is observed for two Mayan languages, Ch'ol and Q'anjob'al, targets of Clemens et al.'s (2015) picture selection studies. On the other hand, object gap advantages are reported for Basque, in Carreiras et al.'s (2010) self-paced reading and ERP studies, and also for Niuean, in Tollan et al.'s (2019) visual world study. Finally, Polinsky et al.'s (2012) self-paced reading study on Avar finds no asymmetry between transitive subject gaps and object gaps, at relevant sentence regions where the gap/filler dependency is evident.

What about ergativity makes it theoretically significant, possibly contributing to this mixed empirical picture? For one, grammatical subjecthood is often fraught in these languages. Definitionally, ergativity dissociates case and/or agreement from phrase structural/thematic prominence. Moreover, for some ergative languages, it is clear that ergative-marked transitive subjects and absolutive-marked intransitive subjects do not occupy the same phrase structural position (e.g., Bittner & Hale 1996, Royer & Coon 2025) — contrasting with the syntactic homogeneity of English-like subjects, which all occupy Spec-TP. For such a language, what is guaranteed about a clause is not that there will be a subject, but rather that there will be an absolutive argument: either an intransitive subject or a direct object. This is how Carreiras et al. (2010) and Tollan et al. (2019) explain their object gap advantages: in Basque[2] and Niuean, what is most rational to predict about a filler/gap dependency is that the gap will be associated with the featurally unmarked, distributionally widespread absolutive case.

A finding that complements this reasoning is the ergative effect which Polinsky et al. (2012) observe in Avar: longer reading times for nouns in ergative case than absolutive case. All else equal, this could be interpreted as a subject gap advantage: overt ergative nouns foil a subject gap prediction. However, the Avar ergative effect is observed within a prenominal relative clause, before the gap-before-filler dependency is evident. Therefore, Polinsky et al. give an alternative explanation, framed in terms of incremental informativity. Ergative, by virtue of being featurally marked and distributionally restricted, more drastically reduces the space of possible continuations. It forces comprehenders to commit to a transitive parse, rather than being incrementally compatible with either transitive or intransitive ones like absolutive is.

These studies on Basque, Niuean, and Avar demonstrate how ergative grammars can shape real-time processing behaviour differently than accusative ones do — making the subject gap advantage observed for Ch'ol and Q'anjob'al particularly remarkable (Clemens et al. 2015). One salient property of Mayan ergativity is that it only manifests in verbal agreement; the other languages surveyed have ergative case marking. Perhaps this difference contributes to the observed processing differences. In any case, what

[2] However, see Clemens et al. (2015) for an alternative explanation for the prima facie object gap advantage in Basque, rooted in morphological ambiguities that Carreiras et al.'s design hinged on.

is clear from both typological and formal syntactic investigation is that ergativity is not a homogeneous phenomenon (Dixon 1994, Polinsky 2016). So a priority for psycholinguistics should be to investigate more typologically diverse languages, especially ones where ergativity manifests in different ways, to better understand the subject gap advantage and its relation to more general active processing strategies.

The other priority we wish to highlight is investigating languages with more diverse word order possibilities. Particularly relevant are those with gap-before-filler constructions (e.g., prenominal relatives), rather than the better studied filler-before-gap ones (e.g., postnominal relatives, or *wh*-questions with fronting). All else equal, they serve as a useful foil to English-like languages, insofar as the dependency's linear distance is minimized with an object gap, rather than a subject gap. The best studied language of this type is Mandarin, where findings have been mixed. Some studies find an object gap advantage, some a subject gap advantage, and some no asymmetry; Vasishth et al.'s (2013) replications and meta-analysis ultimately support a subject gap advantage. Gap-before-filler comprehension has also been studied in Japanese (Ueno & Garnsey 2008, Montag & MacDonald 2009) and Korean (Kwon et al. 2010, 2013), and there the subject gap advantage is much clearer. Hence linear distance per se does not seem to be a strong factor impacting filler/gap processing.

Nevertheless, there is reason to think that the differential distribution of cues across filler-before-gap and gap-before-filler constructions has important consequences. Evidence comes from Wagers et al.'s (2018) studies on Chamorro, a language that is typologically unusual in having relative clauses with both filler-first and filler-last order. Most relevant are their conditions that were globally ambiguous between subject- and object-gap parses. Given filler-before-gap order, there was a clear subject gap advantage in picture selections and initiation times. But for the gap-before-filler relatives, there was a much higher proportion of object-gap interpretations. Wagers et al. propose that this difference stems from the way that independent syntactic dependencies unfold across different word orders. For filler-before-gap relatives, the relativization dependency and the subject/verb agreement dependency can be saturated simultaneously by pursuing a subject gap parse. For gap-before-filler relatives, an object-gap parse means that the agreement dependency can be saturated upon encountering the relative clause internal coargument; wherever the gap is parsed, it will only be possible to saturate the relativization dependency by waiting for the filler.

Well established are the theoretical reasons why ergative alignment and gap-before-filler constructions should influence processing strategies, but further empirical investigation is necessary to tease apart predictions. Particularly useful will be split ergative languages (i.e., ones with both accusative and ergative patterns, appearing in different contexts), and languages with both filler-first and filler-last constructions (i.e., ones like Chamorro). They offer a way to manipulate grammatical parameters while holding constant as much as possible — something comparison across languages cannot do. Our focus, Georgian, has both useful properties: split ergativity and flexible filler/gap order. Section 2.2 gives key grammatical facts. Section 2.3 summarizes the small amount of previous psycholinguistic work on Georgian. Section 2.4 synthesizes the background to make predictions about filler/gap processing in this language.

2.2 Grammatical background on Georgian

Georgian is a member of the South Caucasian language family (Shanidze 1980 [1953], Aronson 1990). Detailed below are the properties most relevant to the present studies: split ergativity and relativization. Note first a few other facts. Orthographically, Georgian is written in a unique alphabetic script. Morphologically, most words are complex: nouns inflect for case with suffixes; verbs inflect for tense, argument structure, and agreement, with combinations of prefixes and suffixes. Syntactically, it is weakly head final. SOV or SVO is the basic word order, but all other permutations are possible;

scrambling is generally connected to discourse structure, and it affects prosody (Skopeteas et al. 2009, Skopeteas & Fanselow 2010). Verbs agree in person and number with the subject and also with certain objects (Foley 2021). Null pronouns are possible in all argument positions. Demographically, Georgian speakers have high rates of literacy and familiarity with digital technology, making standard sentence processing methodologies viable.

There are three core case categories in Georgian: traditionally labelled nominative, ergative, and dative. In terms of featural markedness, various diagnostics show that nominative is the least marked, ergative is intermediate, and dative is the most marked category.[3] In terms of morphosyntactic alignment — that is, the distribution of case categories across grammatical roles — Georgian exhibits a complex split ergative pattern, conditioned by tense (Harris 1981, Nash 2017). There are three groups of inflectional tense categories, defined by morphological rather than semantic characteristics, each with a characteristic case alignment pattern. There are about eleven total tenses, but here we illustrate with just one from each group. In the aorist tense, transitive subjects are assigned ergative and direct objects are nominative (S_{ERG}>O_{NOM}). In the future, subjects are nominative and objects are dative (S_{NOM}>O_{DAT}). In the perfect, which has evidential semantics, the mapping is the opposite of the future (S_{DAT}>O_{NOM}). This core pattern is illustrated by data points in Table 1.

X	**S**	**O**	**V**	**Alignment**
p'ark'-ʃi park-in	*mxat'var-ma* painter-ERG	*ekʰim-i* doctor-NOM	*da-i-nax-a* see:**AOR**	S_{ERG}>O_{NOM}
"The painter saw the doctor in the park."				
p'ark'-ʃi park-in	*mxat'var-i* painter-NOM	*ekʰim-s* doctor-DAT	*da-i-nax-av-s* see:**FUT**	S_{NOM}>O_{DAT}
"The painter will see the doctor in the park."				
p'ark'-ʃi park-in	*mxat'var-s* painter-DAT	*ekʰim-i* doctor-NOM	*da-u-nax-av-s* see:**PERF**	S_{DAT}>O_{NOM}
"The painter has / must have seen the doctor in the park."				

Table 1. The three case alignment patterns in Georgian, illustrated with simple monotransitive SOV clauses across three tenses.

While transitive clauses are our focus, it is important to mention that intransitive subjects can be marked by any of the three cases.[4] This means that Georgian is not a classically ergative language, even in the aorist tense, and that the terms 'ergative case' and 'nominative case' used for Georgian should not be

[3] Suppletion and syncretism patterns in the paradigms of certain pronouns indicate that nominative lacks a feature that ergative and dative share (*is* 'that.NOM' vs. *man* 'that.ERG', *mas* 'that.DAT'), and that nominative and ergative lack a feature that dative has (*vin* 'who.NOM/ERG' vs. *vis* 'who.DAT'). Further evidence of the markedness of dative is the fact that its agreement properties are restricted compared to nominative and ergative. Hence we can define a case feature system in terms of two privative features: NOM = {}, ERG = {F_1}, DAT = {F_1,F_2}. In this sense, having more features is being more marked.

[4] Different classes of intransitive subjects behave differently. Unaccusative/telic subjects are always nominative, while unergative/atelic subjects shift case across tenses just like transitive subjects (Harris 1981, Nash 2021). There are also some subjects, of both transitive and intransitive predicates, which are lexically specified to be dative in all tenses (Skopeteas et al. 2012).

mistaken for 'classical ergative' (all and only transitive subjects) or 'classical nominative' (all and only subjects). Importantly, due to the heterogeneity of intransitives, no case value is guaranteed to be in a given clause. Moreover, subjecthood in Georgian is defined not in terms of a dedicated syntactic position like Spec-TP, but rather in terms of relative thematic/abstract prominence (Harris 1981). Thus, no phrase structural position is guaranteed to be within a given clause either.

This typologically unique morphosyntactic system has important consequences for sentence comprehension (Skopeteas et al. 2012, Foley 2020). Crucially, in combination with flexible word order and null pronouns, case is not always a reliable cue to a noun's grammatical role. Nominative and dative nouns are highly ambiguous; both could be parsed as either a subject or an object. What role they should be mapped to can be discerned from two types of cues. The verb can be the crucial cue, since its tense morphology will entail one of the three case alignments. An ergative argument can also disambiguate case/role mapping. Ergative only appears in the aorist tense's S_{ERG}>O_{NOM} alignment pattern; therefore, even without bottom-up evidence of tense (i.e., while still in the preverbal field), an ergative noun will unambiguously signal both its own role, and also that of any nominative or dative coarguments that precede or follow it. Put simply, in preverbal position, ergative is a highly informative cue to case alignment, while nominative and dative are not.

In every clause, Georgian comprehenders will have to navigate a complex case alignment system. On top of that, in relative clauses they must also process a filler/gap dependency. The language has a rich array of relativization strategies (Foley 2013, Bhatt & Nash 2022), and three types are relevant here. All three can have gaps in any argument position, and can be inflected for any tense.

First is the *wh*-relative. As Table 2 illustrates, this is a filler-before-gap construction. The dependency is unambiguously cued by a *wh*-phrase relative pronoun, which obligatorily appears in the leftmost position of the relative clause. The relative pronoun will be inflected for the case of the gap. Thus, the gap's syntactic position will be signalled by some combination of case cues on the relative pronoun, case on a coargument noun within the relative, and tense cues on the verb — in a manner not different than for arguments of an ordinary main clause.

HdN	**[$_{RC}$ whP**	**X**	**CoArg**	**V]**
mxat'var-i, painter-NOM	*romel-ma-ts^h* which-ERG-REL	*p'ark'-ʃi* forest-in	*ek^{h}im-i* doctor-NOM	*da-i-nax-a* see:**AOR**
"the painter [$_{RC}$ who _ saw the doctor in the park]"				
mxat'var-i, painter-NOM	*romel-i-ts^h* which-NOM-REL	*p'ark'-ʃi* forest-in	*ek^{h}im-ma* doctor-ERG	*da-i-nax-a* see:**AOR**
"the painter [$_{RC}$ who the doctor saw _ in the park]"				

Table 2. Data illustrating Georgian's *wh*-relative construction, in the aorist tense

A second type of relative, the *rom*-relative, is also postnominal; see Table 3. However, its incremental cues are somewhat different than in a *wh*-relative. *Rom*-relatives lack a relative pronoun, and so the gap's case is never overtly expressed. Nevertheless, the gap's position can still be accurately deduced from coarguments and the verb. Another important difference is the element that signals a filler/gap dependency: the complementizer *rom*. A syntactic quirk of this word is that it does not appear at the left edge of the relative clause (as the complementizer *that* does in English relatives). Rather, *rom* appears either immediately before the verb, or in some other preverbal position following at least one constituent. The non-initial placement of this complementizer means that an unambiguous cue to a

filler/gap dependency is delayed within a *rom*-relative. (However, the orthographic convention of putting a comma before any type of relative clause is probably a good cue on its own.)

HdN	**[$_{RC}$ X**	**{Comp}**	**CoArg**	**{Comp}**	**V]**
mxat'var-i, painter-NOM	*p'ark'-ʃi* park-in		*ekʰim-i* doctor-NOM	*rom* COMP	*da-i-nax-a* see:**AOR**
mxat'var-i, painter-NOM	*p'ark'-ʃi* park-in	*rom* COMP	*ekʰim-i* doctor-NOM		*da-i-nax-a* see:**AOR**
Both word orders: "the painter [$_{RC}$ that _ saw the doctor in the park]"					
mxat'var-i, painter-NOM	*p'ark'-ʃi* park-in		*ekʰim-ma* doctor-ERG	*rom* COMP	*da-i-nax-a* see:**AOR**
mxat'var-i, painter-NOM	*p'ark'-ʃi* park-in	*rom* COMP	*ekʰim-ma* doctor-ERG		*da-i-nax-a* see:**AOR**
Both word orders: "the painter [$_{RC}$ that the doctor saw _ in the park]"					

Table 3. Data illustrating Georgian's *rom*-relative construction, in the aorist tense.

The final relativization strategy is the *rom*-correlative. Superficially, this is the gap-before-filler/prenominal version of the *rom*-relative (Table 4). Strictly speaking, the syntax of correlatives is a different than that of relatives (Dayal 1996, Bhatt & Nash 2022), which the English translations approximate.[5] In any case, it is important to note that *rom*-correlatives involve more incremental ambiguities than *rom*-relatives. The non-initial position of *rom* means that any constituents that precede the complementizer are parsable as arguments of a simple root clause. Moreover, *rom* itself does not unambiguously signal a filler/gap dependency. The complementizer is also used to build other adjunct clauses, which can have temporal (*when…*) or rationale (*because…*) interpretations. Crucially, such an adjunct clause will not contain a gap linked to a filler. However, arguments can be freely omitted in Georgian. So, even if a *rom*-clause at the beginning of a sentence is missing an argument, there is no guarantee for comprehenders that a gap/filler dependency is unfolding. Instead, that missing argument could be a null pronoun, perhaps part of a cataphoric dependency.

[5] Correlative clauses do not obligatorily form constituents with their head nouns. Rather, they are typically adjoined to the matrix clause, forming a topic/comment structure. The head noun within the matrix clause must be marked with a demonstrative. A correlative clause can contain a gap, as all examples here do; in this case, it is semantically similar to a headless relative (≈ "the one that…"). Another possibility is that the correlative contains a copy of the modified noun; then, it is similar to an internally headed relative. See Bhatt & Nash (2022).

[$_{RC}$ X	**{C}**	**CoArg**	**{C}**	**V,]**	**HdN**	**V**
p'ark'-ʃi park-in		*ekʰim-i* doctor-NOM	*rom* COMP	*da-i-nax-a,* see:**AOR**	*is mxat'var-i* DEM painter-NOM	*ts'a-vid-a* leave:AOR
p'ark'-ʃi park-in	*rom* COMP	*ekʰim-i* doctor-NOM		*da-i-nax-a,* see:**AOR**	*is mxat'var-i* DEM painter-NOM	*ts'a-vid-a* leave:AOR
Both word orders: ≈ "[$_{RC}$ The one that _ saw the doctor in the park,] that painter left." (**correlative reading**, with a filler/gap dependency) or "[$_{Adjunct}$ When/because *pro* saw the doctor in the park,] that painter left." (**adjunct-clause reading**, with cataphora)						
p'ark'-ʃi park-in		*ekʰim-ma* doctor-ERG	*rom* COMP	*da-i-nax-a,* see:**AOR**	*is mxat'var-i* DEM painter-NOM	*ts'a-vid-a* leave:AOR
p'ark'-ʃi park-in	*rom* COMP	*ekʰim-ma* doctor-ERG		*da-i-nax-a,* see:**AOR**	*is mxat'var-i* DEM painter-NOM	*ts'a-vid-a* leave:AOR
Both word orders: ≈ "[$_{RC}$ The one that the doctor saw _ in the park,] that painter left." (**correlative reading**, with a filler/gap dependency) or "[$_{Adjunct}$ When/because the doctor saw *pro* in the park,] that painter left." (**adjunct-clause reading**, with cataphoric dependency)						

Table 4. Data illustrating Georgian's *rom*-correlative construction, in the aorist tense. As explained in the text, correlatives can be globally ambiguous with other adjunct clauses that contain a cataphoric null pronoun ("*pro*") instead of a gap ("_").

In sum, two grammatical aspects of Georgian are particularly relevant to the processing of filler/gap dependencies. First is split ergativity. Across tenses of the same verb, the clause's case alignment pattern (the mapping between case and grammatical role) can either be S_{ERG}>O_{NOM}, S_{NOM}>O_{DAT}, or S_{DAT}>O_{NOM}. The incremental cue that disambiguates case alignment will either be ergative case (i.e., on a preverbal argument), or tense morphology (on a verb that is not preceded by ergative). The second key property of Georgian syntax is relativization. Both filler-before-gap and gap-before-filler orders are possible. Filler-first relatives can be built either with a *wh*-phrase relative pronoun (which bears case features of the gap), or with the complementizer *rom* (which does not bear features of the gap, and which appears in non-initial position within the relative). Filler-last relatives, which in technical grammatical terms are correlatives, can also be built with *rom*. For *rom*-relatives and *rom*-correlatives, the gap's position must be triangulated from the verb and a coargument's case.

Finally, note that throughout we speak of the processing of a gap's syntactic position (i.e., grammatical role), rather than its linear position. Georgian's flexible word order means that the gap cannot be said to have a particular linear position, in any filler/gap dependency. (Likewise, null pronouns cannot be said to have linear positions.) Rather, maximal bottom-up evidence for a missing argument will only ever come at the end of a clause — potentially well after the verb, due to word order flexibility. At that point, enough overt nouns to satisfy the verb's argument structure either will or will not have appeared. Therefore, a head-focused model of parsing is probably appropriate for Georgian (cf. Pickering & Barry 1991, Gibson & Hickok 1993).

2.3 Psycholinguistic background on Georgian

To date, a just a few psycholinguistic experiments have been conducted in Georgian. The most relevant are Lau et al.'s (2023) ERP and self-paced reading studies, which targeted aorist rom-relatives. They used a two-condition design where gap position (SRC / subject gap relative vs. ORC / object gap relative) was disambiguated by case marking of the postverbal coargument noun. Table 5 illustrates.

HdN	**[RC XP**	**C**	**V**	**CoArg]**
xabaz-ma, baker-ERG	*pʰost'-is garetʰ* post_office-GEN outside	*rom* COMP	*ts'a-a-kʰtsʰi-a* trip:**AOR**	*pʰost'alion-i* mailman-NOM
"the baker [RC that _ tripped the mailman outside the post office]…"				
xabaz-ma, baker-ERG	*pʰost'-is garetʰ* post_office-GEN outside	*rom* COMP	*ts'a-a-kʰtsʰi-a* trip:**AOR**	*pʰost'alion-ma* mailman-ERG
"the baker [RC that the mailman tripped _ outside the post office]…"				

Table 5: Sample itemset from Lau et al. 2023

At the disambiguating postverbal region, Lau et al. observe increased anterior negativity for ORC's ergative coargument compared to the SRC's nominative one, and likewise slower reading times. They interpret this ergative effect as evidence of a subject gap advantage: comprehenders posit a subject gap, but must revise that parse upon encountering an overt ergative subject. Given these findings, Georgian seems to resemble Mayan (Clemens et al. 2015) more than Basque or Niuean (Carreiras et al. 2010, Tollan et al. 2019), insofar as comprehenders seem to exhibit a subject gap advantage, rather than an object/absolutive gap advantage.

However, a possible confound casts some doubt on Lau et al.'s interpretation. Their design crucially compared postverbal objects to postverbal subjects. Georgian is not a rigidly verb-final language; postverbal constituents are common. Nevertheless, postverbal subjects are syntactically, prosodically, and information-structurally marked, especially compared to postverbal objects (Skopeteas et al. 2009, Skopeteas et al. 2018). So, an alternative explanation for Lau et al.'s ergative effect has nothing to do with gap position per se, but rather the markedness of a particular word order (OVS).

Complementing Lau et al.'s (2023) study on ergative in relative clauses is Skopeteas et al.'s (2012) study on nominative and dative in ordinary main clauses. They conducted a forced choice acceptability judgement study on transitive sentences. The subject/object relations (and thus word order) of preverbal arguments were disambiguated by the tense of the clause final verb, which was displayed after a delay. Target stimuli were all grammatical, manipulating word order (SOV or OSV) and tense/case alignment (future/S_{NOM}>O_{DAT} or perfect/S_{DAT}>O_{NOM}). Word order did not have a significant effect on reaction times, but case alignment did: S_{DAT}>O_{NOM} sentences were endorsed more slowly than the S_{NOM}>O_{DAT} ones. Skopeteas et al. conclude that the perfect/S_{DAT}>O_{NOM} pattern is harder to process because it involves a more marked case/role mapping: dative is the most morphosyntactically marked case, but subject is the most prominent grammatical role.

2.4 Predictions for the present studies

With this background in mind (Section 2.1–2.3), let us summarize predictions for Georgian that are motivated by crosslinguistic findings about filler/gap processing (Section 2.1).

The Structural Theory posits a processing advantage for structures that have a gap in subject position, rather than object position. This is due to the inherent representational economy of subject gap

constructions. Hence, any disambiguation away from a possible subject gap parse should cause processing difficulty. In Georgian, the key cues include: (i) ergative coarguments; and (ii) ORC verbs not preceded by ergative.

The Markedness Theory, motivated by findings from Basque (Carreiras et al. 2010) and Niuean (Tollan et al. 2019), posits an advantage for gaps that are featurally unmarked. For Georgian, it should be difficult to process incremental evidence that the gap is not nominative (its least marked case). Such cues include: (i) ergative and dative relative pronouns within *wh*-relatives; (ii) nominative coarguments in any type of relative clause.

The Linearity Theory predicts asymmetries in the processing of filler-before-gap and gap-before-filler constructions (i.e., *rom*-relatives and *rom*-correlatives). If findings from Mandarin (Vasishth et al. 2013) and Chamorro (Wagers et al. 2018) are representative, the filler-last order might lead to a weaker subject gap advantage — though, as mentioned above, Georgian's flexible word order means this would likely not be due to the linear position of the gap per se. Another reasonable prediction is a baseline advantage for gap-before-filler order: a main effect of order, rather than an gap/order interaction. To understand why, consider what intervenes between the head noun and the unambiguous cue to gap position. As explained in Section 2.2, gap position in *rom*-(cor)relatives is not fully disambiguated until the end of the clause. In correlatives, this occurs immediately before the head noun. So, the comprehender will not have to process any more intervening material before being able to saturate the gap position with the lexical content of the filler. In contrast, in postnominal *rom*-relatives, several preverbal elements can intervene between the filler and relative-final gap-disambiguator. Processing intervenors while accurately maintaining the filler in memory could tax the processing system, leading to slower RTs across *rom*-relatives compared to *rom*-correlatives.

3. Materials and methods

Two pairs of self-paced reading studies (Studies 1–4) were conducted across two experimental sessions (Session A and B). Studies 1 and 2 targeted *wh*-relatives in a design that manipulated gap position and case alignment; Studies 3 and 4 targeted *rom*-(cor)relatives, crossing gap position and filler/gap order. Data for Studies 1 and 3 were collected together during Session A; Studies 2 and 4, during Session B. Both experimental sessions were conducted remotely, using the internet based experimental platform Ibex Farm (Drummond 2007).

3.1 Experimental design

For Studies 1 and 2, a syntactic template was devised with a 2×3 factorial design crossing gap position (SRC, ORC) and tense/alignment (aorist/S_{ERG}>O_{NOM}, future/S_{NOM}>O_{DAT}, perfect/S_{DAT}>O_{NOM}) of the target *wh*-relative. The critical regions, comprising the head noun and the relative clause, are schematized in Table 6.

Condition	HdN	*wh*P	XP	NP	V
SRC, AOR	*mxat'var-i,* painter	*romel-ma-ts^h* which:ERG	*p'ark'-ʃi* park-in	*ek^{h}im-i* doctor-NOM	*da-i-nax-a, …* see:**AOR**
	"the painter [$_{RC}$ who _ saw the doctor in the park] …"				
ORC, AOR	*mxat'var-i,* painter	*romel-i-ts^h* which:NOM	*p'ark'-ʃi* park-in	*ek^{h}im-ma* doctor-ERG	*da-i-nax-a, …* see:**AOR**
	"the painter [$_{RC}$ who the doctor saw _ in the park] …"				
SRC, FUT	*mxat'var-i,* painter	*romel-i-ts^h* which:NOM	*p'ark'-ʃi* park-in	*ek^{h}im-s* doctor-DAT	*da-i-nax-av-s, …* see:**FUT**
	"the painter [$_{RC}$ who _ will see the doctor in the park] …"				
ORC, FUT	*mxat'var-i,* painter	*romel-sa-ts^h* which:DAT	*p'ark'-ʃi* park-in	*ek^{h}im-i* doctor-NOM	*da-i-nax-av-s, …* see:**FUT**
	"the painter [$_{RC}$ who the doctor will see _ in the park] …"				
SRC, PERF	*mxat'var-i,* painter	*romel-sa-ts^h* which:DAT	*p'ark'-ʃi* park-in	*ek^{h}im-i* doctor-NOM	*da-u-nax-av-s, …* see:**PERF**
	"the painter [$_{RC}$ who _ has seen the doctor in the park] …"				
ORC, PERF	*mxat'var-i,* painter	*romel-i-ts^h* which:NOM	*p'ark'-ʃi* park-in	*ek^{h}im-s* doctor-DAT	*da-u-nax-av-s, …* see:**PERF**
	"the painter [$_{RC}$ who the doctor has seen _ in the park] …"				

Table 6. Design schema for Studies 1 and 2 (on *wh*-relatives, manipulating case alignment). Shaded words bear cues that disambiguate case alignment; at or after the relative pronoun, this also disambiguates gap position.

There were a few minor design differences between the two *wh*-relative studies, concerning constituent order, length, and featural counterbalancing. In Study 1: (i) a one-word adverb preceded the head noun, and a four-word matrix clause continuation followed the relative; (ii) the relative-internal adjunct phrase ("XP") was two words long; (iii) the coargument noun phrase ("NP") was two words long, the first word being an adjective modifier that showed case concord with the noun;[6] (iv) there was two-way counterbalancing for animacy: in one half of itemsets, the relative clause arguments referred to humans; in the other half, they referred to animals. As for Study 2: (i) there was no adverb preamble, and the post-RC continuation was three words; (ii) the adjunct XP was one word long, and it came between the coargument NP and the verb (i.e., constituent order was "whP – NP – XP – V"); (iii) the coargument

[6] Whether an adjective exhibits case concord is morphophonologically determined: adjectives with consonant final stems do (e.g., *mayal-i ek^{h}im-i* "tall-NOM doctor-NOM" vs. *mayal-ma ek^{h}im-ma* "tall-ERG doctor-ERG") while vowel final adjectives do not (e*axalgazrda ek^{h}im-i* "young doctor-NOM" vs. *axalgazrda ek^{h}im-ma* "young doctor-ERG").

NP was two words long, but the initial adjective did not show case concord with the noun; (iv) there was three-way animacy counterbalancing across itemsets: a third each human, animal, and inanimate.

For Studies 3 and 4, another sentence template was devised with a 2×2 factorial design crossing gap position (SRC, ORC) and linear order of the relativization dependency (filler-before-gap, gap-before-filler) of the target *rom*-(cor)relative. The critical regions, comprising the head noun and the relative clause, are schematized in Table 7.

Condition	**{HdN}**	**NP**	**C**	**XP**	**V**	**{HdN}**
SRC, REL	*is mxat'var-i,* DEM painter	*ek^{h}im-i* doctor-NOM	*rom* COMP	*p'ark'-ʃi* park-in	*da-i-nax-a,* see:**AOR**	…
	"that painter [$_{RC}$ that _ saw the doctor in the park]…"					
ORC, REL	*is mxat'var-i,* DEM painter	*ek^{h}im-ma* doctor-ERG	*rom* COMP	*p'ark'-ʃi* park-in	*da-i-nax-a,* see:**AOR**	…
	"that painter [$_{RC}$ that the doctor saw _ in the park]…"					
SRC, CORR		*ek^{h}im-i* doctor-NOM	*rom* COMP	*p'ark'-ʃi* park-in	*da-i-nax-a,* see:**AOR**	*is mxat'var-i…* DEM painter
	≈ "[$_{RC}$ the one that _ saw the doctor in the park,] that painter…"					
ORC, CORR		*ek^{h}im-ma* doctor-ERG	*rom* COMP	*p'ark'-ʃi* park-in	*da-i-nax-a,* see:**AOR**	*is mxat'var-i…* DEM painter
	≈ "[$_{RC}$ the one that the doctor saw _ in the park,] that painter…"					

Table 7. Design schema for Studies 3 and 4 (on *rom*-(cor)relatives, manipulating filler/gap order). Shaded words contain cues that disambiguate case alignment; after the relative clause and the head noun, this information also disambiguates gap position (i.e., that there is a missing argument, and it is a gap).

Again, we note a few minor design differences. In Study 3: (i) the coargument NP was presented in the same SPR window as the complementizer *rom*; (ii) the adjunct XP was two words long; (iii) the matrix clause continuation was four words long; (iv) there was two-way animacy counterbalancing of itemsets: human and animal. In Study 4: (i) the coargument NP was two words long, with a non-agreeing adjective preceding the noun; (ii) the complementizer was presented in its own SPR window; (iii) the adjunct XP was one word long; (iv) the matrix clause continuation was three words long; (v) there was three-way animacy counterbalancing: human, animal, and inanimate. The most significant difference is the presentation of the complementizer. As discussed in Section 2.2, words that precede *rom* in a correlative are incrementally parsable as constituents of an ordinary root clause, which lacks a filler/gap dependency. Finally, note that the head noun was presented in the same SPR window as a demonstrative (*is* "that"), since this element is obligatory in a correlative.

3.2 Logistics

3.2.1 Materials

For experimental Session A, we constructed 36 itemsets for Study 1 (in the case alignment design, with

wh-relatives; Table 6), 24 itemsets for Study 3 (in the linearity design, with *rom*-(cor)relatives; Figure 6), and an additional 40 filler items of similar length and complexity. For Session B, 36 and 24 new itemsets were constructed for Study 2 (alignment design) and Study 4 (linearity design), along with 40 more fillers. The order of target items and fillers was shuffled. For the target stimuli, each participant saw one version of each itemset (six instances of every condition), distributed using the Latin Square method. Every experimental item was followed by a yes/no comprehension question.

3.2.2 Methods and procedure

Sessions A and B had the same methods and procedure. Stimuli were displayed with a moving window self-paced reading method, using the internet based platform Ibex Farm (Drummond 2007). Upon accessing either of the experimental sessions, participants read instructions, gave their informed consent, and answered some demographic questions. Before the experimental stimuli, there were a few practice trials. Afterwards, there were a few optional debriefing questions. All experimental procedures and stimuli were approved by the Institutional Review Board of the University of California Santa Cruz, IRB project number HS1386.

3.2.3 Participants

For Session A, a total of 58 native speakers of Georgian residing across Georgia were recruited as participants. Their average age was 22.8 years; 44 were women; all but four reported competence in a second language (mostly English or Russian). For Session B, another 62 participants were recruited. Their average age was 22.5; 41 were women; all but seven reported competence in a second language. All participants were paid for their time.

3.2.4 Analysis

Data were trimmed due to comprehension accuracy and extreme RT values. First, we excluded all observations from participants who answered less than 70% of comprehension questions on filler items (this eliminated two low-accuracy participants for Session A, and six for Session B). Then, we excluded all observations from trials with incorrect comprehension responses (this trimmed 14.7% of the total observations from accurate participants in Session A, and 17.8% from Session B). Finally, all remaining observations faster than 100 ms or slower than 10,000 ms were also excluded (trimming 1.1% of accurately comprehended observations from Session A, and 0.24% from Session B). The remaining RT observations were log transformed.

The regions of analysis were every critical region and one additional spillover region after it. Critical regions were those containing important parsing cues: the relative pronoun, the coargument noun phrase, the verb. For Studies 3 and 4, we also analysed the head noun region, which either preceded or followed the relative clause.

Log RTs were analysed with linear mixed effects models, using the package *lme4* (Bates et al. 2015) in *R* (version 4.6.0); *t*-tests were conducted with Satterthwaite's method using *lmerTest* (Kuznetsova 2017). Random effect structure for participants and items was maximized (Barr 2013). Fixed effects were GAP, TENSE, and their interaction (Studies 1 and 2) or GAP and relativization TYPE (Studies 3 and 4). The GAP factor was sum coded: –1/2 for SRC and +1/2 for ORC. The TYPE factor was also sum coded: –1/2 for REL (filler-first *rom*-relative) and +1/2 for CORR (filler-last *rom*-correlative). The TENSE factor was Helmert coded: TENSE1 compared FUT to PERF (–1/2 and +1/2), and TENSE2 compared AOR (–2/3) to the mean of FUT and PERF (each +1/3). By singling out the aorist, this coding reflects that tense's theoretically significant property of licensing ergative, the most informative case category. Significant interactions were investigated by estimating marginal means and conducting post hoc pairwise

comparisons, using the package *emmeans* (Lenth et al. 2020).

Item-level response accuracy was also analysed. We ran binomial logistic mixed effects models using *lme4::glmer*, with contrast coding for the experimental factors as above.

4. Results

4.1 Comprehension accuracy

Comprehension question response accuracy across the four studies is given in Table 8. Mixed effects models found no significant effects of the design factors on accuracy in Study 1, Study 3, or Study 4. There was a significant main effect of TENSE2 in Study 2 (Est. = –0.34, SE = 0.15, z = –2.2, p = 0.027), such that conditions in the aorist tense were more likely to be comprehended accurately than those in the future or perfect.

Study 1	**SRC**	**ORC**
AOR	0.82 (0.052)	0.88 (0.044)
FUT	0.82 (0.052)	0.85 (0.047)
PERF	0.82 (0.052)	0.88 (0.044)

Study 3	**SRC**	**ORC**
REL	0.85 (0.048)	0.87 (0.045)
CORR	0.88 (0.44)	0.88 (0.044)

Study 2	**SRC**	**ORC**
AOR	0.84 (0.048)	0.88 (0.043)
FUT	0.84 (0.049)	0.84 (0.048)
PERF	0.81 (0.052)	0.81 (0.052)

Study 4	**SRC**	**ORC**
REL	0.82 (0.051)	0.80 (0.053)
CORR	0.80 (0.054)	0.79 (0.054)

Table 8. By-participant mean accuracies for Studies 1 through 4, with standard errors, across design factors.

4.2 Reading times: Studies 1 and 2

4.2.1 Study 1

Reading times across each SPR window are plotted in Figure 1.

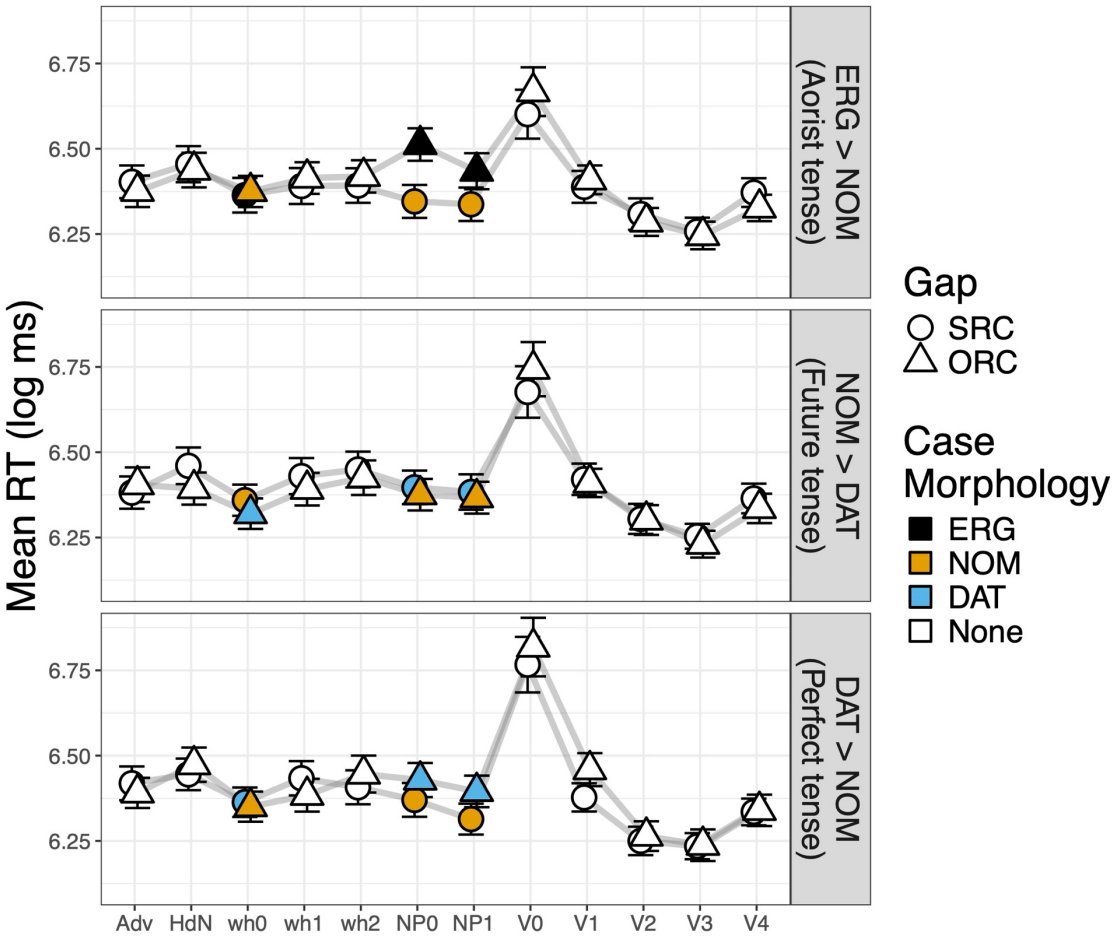

Figure 1. Mean log RTs at each SPR window for Study 1, with by-participant standard errors. Shape indicates gap position, and colour indicates incremental case cues.

At the relative pronoun region (wh0), linear mixed effects modelling found no significant effects of GAP or TENSE.

At the spillover region immediately following the relative pronoun (wh1), there were no significant effects.

At the first word of the coargument noun phrase (NP0), which in this study was an adjective with case concord morphology, modelling results are given in Table 9. There was a significant main effect of TENSE2, such that the aorist conditions were read more slowly than the future and perfect ones. There was also a significant TENSE2:GAP interaction. Post hoc pairwise comparisons found a significant effect of GAP for the aorist tense (Est. = –0.14, SE = 0.033, df = 150, t = –4.2, p < 0.001), such that the ORC condition was slower, but no significant effects for the other tenses.

Study 1, NP0	Est.	SE	df	*t*	*p*
TENSE1 (FUT vs. PERF)	0.0011	0.022	61	0.052	0.96
TENSE2 (AOR vs. FUT/PERF)	–0.044	0.019	300	–2.3	0.021 *
GAP (SRC vs. ORC)	0.031	0.023	31	1.3	0.19
TENSE1:GAP	0.068	0.043	1600	1.6	0.11
TENSE2:GAP	–0.17	0.037	1500	–4.5	< 0.001 ***
LogRT ~ TENSE*GAP + (1+TENSE+GAP|Participant) + (1+GAP|Item)					

Table 9. Results of linear mixed effects modelling of log RTs at the NP0 region of Study 1. Effect structure is given in *lme4::lmer* syntax.

At the second word of the coargument noun phrase (NP1), the noun itself, modelling results are given in Table 10. There was a significant TENSE2:GAP interaction. Post hoc pairwise comparison again found a significant effect of GAP for the aorist tense (Est. = –0.073, SE = 0.031, df = 300, t = –2.3, p = 0.020), but not for the other tenses.

Study 1, NP1	Est.	SE	df	*t*	*p*
TENSE1 (FUT vs. PERF)	–0.026	0.022	110	–1.2	0.25
TENSE2 (AOR vs. FUT/PERF)	–0.020	0.018	450	–1.1	0.26
GAP (SRC vs. ORC)	0.027	0.020	63	1.4	0.17
TENSE1:GAP	0.098	0.041	1600	2.4	0.018 *
TENSE2:GAP	–0.068	0.036	1600	–1.9	0.059
LogRT ~ TENSE*GAP + (1+TENSE+GAP|Participant) + (1|Item)					

Table 10. Results of linear mixed effects modelling of log RTs at the NP1 region of Study 1. Effect structure is given in *lme4::lmer* syntax.

At the verb region (V0), modelling results are given in Table 11. There was a main effect of TENSE1, such that future verbs were read more quickly than perfect ones, and a main effect of TENSE2, such that aorist verbs were read more quickly than future and perfect ones.

Study 1, V0	Est.	SE	df	*t*	*p*
TENSE1 (FUT vs. PERF)	0.076	0.030	210	2.5	0.012 *
TENSE2 (AOR vs. FUT/PERF)	0.12	0.028	80	4.4	< 0.001 ***
GAP (SRC vs. ORC)	0.046	0.032	42	1.5	0.15
TENSE1:GAP	–0.027	0.061	55	–0.45	0.65
TENSE2:GAP	–0.022	0.053	110	–0.41	0.68
LogRT ~ TENSE*GAP + (0+TENSE*GAP|Participant) + (1+GAP|Item)					

Table 11. Results of linear mixed effects modelling of log RTs at the V0 region of Study 1. Effect structure is given in *lme4::lmer* syntax.

At the spillover region immediately following the relative-clause verb (V1), there were no significant effects.

4.2.2 Study 2

Reading times across each SPR window are plotted in Figure 2.

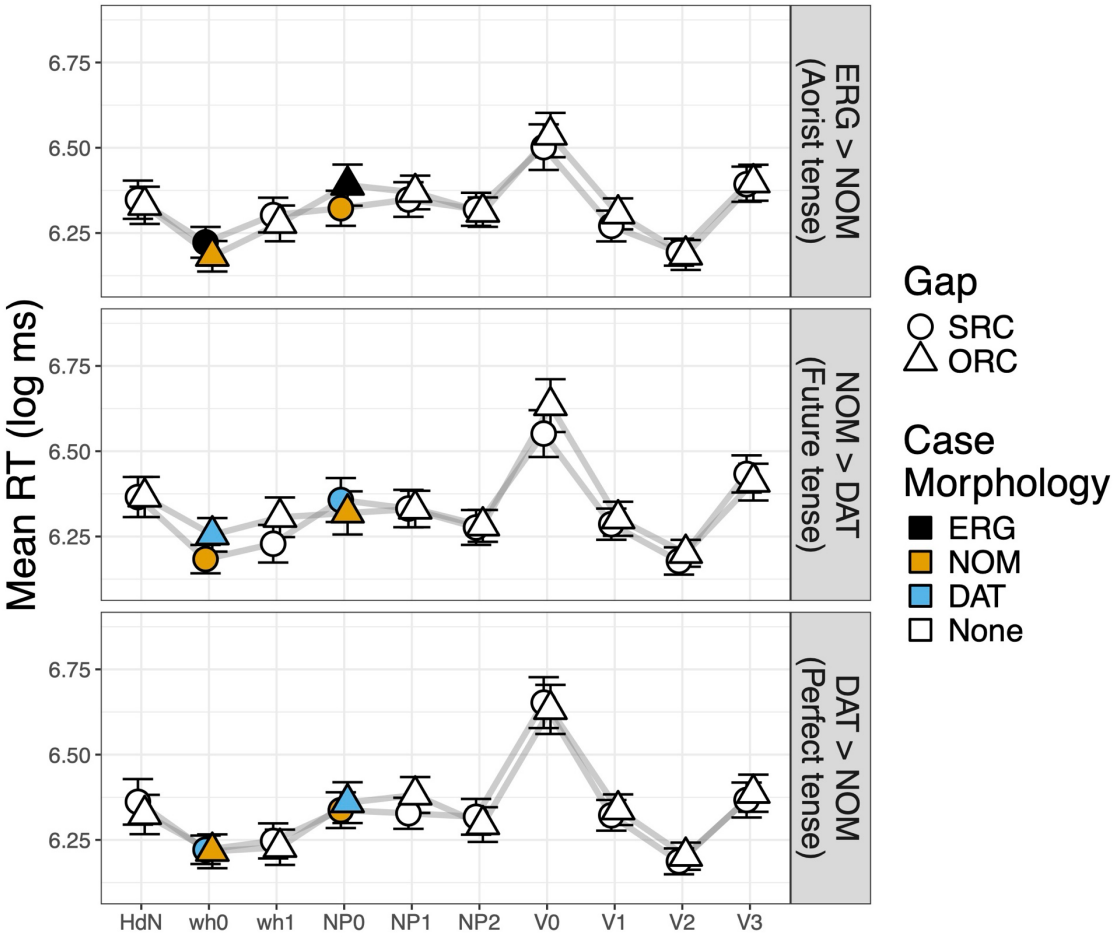

Figure 2. Mean log RTs at each SPR window for Study 2, with by-participant standard errors. Shape indicates gap position, and colour indicates incremental case cues.

Linear mixed effects modelling found no significant effects at the relative pronoun (wh0), at the immediately following spillover region (wh1), at the coargument noun (NP0), or at the immediately following spillover region (NP1).

At the verb region (V0), modelling results are given in Table 12. There was a main effect of TENSE1, such that future verbs were read more quickly than perfect ones, and a main effect of TENSE2, such that aorist verbs were read more quickly than future and perfect ones.

Study 2, V0	Est.	SE	df	*t*	*p*
TENSE1 (FUT vs. PERF)	0.070	0.031	150	2.2	0.027 *
TENSE2 (AOR vs. FUT/PERF)	0.10	0.026	410	3.8	< 0.001 ***
GAP (SRC vs. ORC)	0.025	0.025	73	1.0	0.33
TENSE1:GAP	–0.077	0.061	1600	–1.3	0.21
TENSE2:GAP	–0.010	0.052	1600	–0.20	0.84
LogRT ~ TENSE*GAP + (1+TENSE+GAP|Participant) + (1|Item)					

Table 12. Results of linear mixed effects modelling of log RTs at the V0 region of Study 2. Effect structure is given in *lme4::lmer* syntax.

At the spillover region immediately following the relative-clause verb (V1), modelling results are given in Table 13. There was a main effect of TENSE1, such that this region was read more slowly in the perfect tense than in the future tense.

Study 2, V1	Est.	SE	df	*t*	*p*
TENSE1 (FUT vs. PERF)	0.046	0.023	79	2.4	0.018 *
TENSE2 (AOR vs. FUT/PERF)	0.031	0.021	67	1.5	0.14
GAP (SRC vs. ORC)	0.032	0.018	92	1.8	0.075
TENSE1:GAP	0.013	0.042	1600	–0.32	0.75
TENSE2:GAP	–0.012	0.034	1600	–0.32	0.75
LogRT ~ TENSE*GAP + (1+TENSE+GAP|Participant) + (1|Item)					

Table 13. Results of linear mixed effects modelling of log RTs at the V1 region of Study 2. Effect structure is given in *lme4::lmer* syntax.

4.2.3 Interim discussion

There are a few important findings from these studies on postnominal *wh*-relatives. First is an ergative effect: longer reading times for ergative coargument nouns in the ORC aorist condition, compared to nominative ones in the SRC aorist condition. Second are tense effects at the relative clause final verbs: aorist verbs were read most quickly, followed by future verbs, then perfect verbs.

The ergative effect is the only evidence from this pair of studies that case morphology affects processing; there were no significant effects at the case marked relative pronouns, and no significant differences between nominative and dative coargument nouns within the future and perfect relative clauses. Moreover, the ergative effect is the only evidence here that gap position (SRC vs. ORC) affects processing: there were no significant effects of GAP at verbs in the future and perfect conditions, where tense morphology is the crucial subjecthood/objecthood disambiguator. For this reason, we do not interpret the ergative effect as evidence of reanalysis away from a subject gap prediction — i.e., as a subject gap advantage (cf. Lau et al. 2023). Rather, we suggest that ergative causes processing difficulty because it disambiguates case alignment. That is, it signals the comprehender to link not only the ergative noun to subject position, but also any clausemate nominative noun to direct object position

(instead of subject position, a grammatical parse available in other tenses).[7]

The tense effects observed at the verb region further support this interpretation. In the aorist conditions, alignment is disambiguated by a preverbal ergative argument. Elsewhere, only nominative and dative nouns precede the verb. In such configurations, tense cues are necessary to parse their roles: future entailing the S_{NOM}>O_{DAT} pattern, and perfect the S_{DAT}>O_{NOM} pattern. This difference accounts for the main effects of TENSE2 — i.e., that the aorist verbs are read more quickly than the mean of future and perfect ones. As for the main effects of TENSE1 — i.e., that future verbs are read more quickly than perfect ones — this does not immediately follow from the alignment disambiguation interpretation. Instead, it seems to signal an independent processing cost for the perfect/S_{DAT}>O_{NOM} pattern, which is the most morphosyntactically marked of the language's three patterns. This cost for perfect verbs is consistent with Skopeteas et al.'s (2012) findings and theorization on the parsing of nominative and dative arguments.

That said, two null results in Studies 1 and 2 are slight wrinkles for the alignment disambiguation interpretation. First, the lack of ergative effects at the relative pronoun region is unexpected, since ergative disambiguates alignment whenever it occurs before a verb. One possibility is that the self-paced reading methodology was not sensitive enough to detect difficulty at a relative pronoun: a high frequency functional item, with low baseline reading times. Another possibility is that alignment disambiguators only cause processing difficulty when they follow arguments that were previously ambiguous for grammatical role: here, such cues were ergative coargument nouns (which follow nominative relative pronouns) and future/perfect verbs (which follow one nominative and one dative argument). In other words, perhaps the ergative and tense effects are costs specifically for retroactively assigning roles to unparsed nouns stored in memory, rather than costs for parsing roles per se.

A second wrinkle is the fact that the ergative effect is robust in Study 1, but it is not significant in Study 2. There were a few small design differences that may have contributed to this (Section 3.1). Animacy counterbalancing is a prime suspect: unlike in Study 1, in Study 2 one third of itemsets had inanimate arguments. Animacy is well known to affect sentence processing. Inanimate head nouns lead to weaker subject gap advantages (Mak et al. 2002, Gennari and MacDonald 2008), and inanimate transitive subjects routinely cause processing difficulty even outside of filler/gap dependencies (Ferreira 2003, Bornkessel-Schlesewsky & Schlesewsky 2015). For this reason, we conducted an exploratory post-hoc analysis on the coargument noun region in the aorist conditions of Study 2. A linear mixed effects model found no significant effects of GAP, ANIMACY, or their interaction (p values > 0.1).[8] However, pairwise comparisons did find some evidence that the GAP contrast was meaningful for the animate data (contrast: SRC – ORC; Est. = –0.095, SE = 0.043, df = 510, t = –2.2, p = 0.028), but not the inanimate data (contrast: SRC – ORC; Est. = –0.027, SE = 0.060, df = 510, t = –0.44, p = 0.66). In other words, there is modest evidence in Study 2 that the ergative effect is limited to animate itemsets. Implications of this possible animacy effect are discussed in Section 5. For reference, Figure 3 partitions results of Study 2 by animacy.

[7] If there were any dative nouns in these conditions, ergative would also signal that they are to be parsed as indirect objects, rather than subjects or direct objects.

[8] The ANIMACY factor was sum coded: –1/2 for the two thirds of itemsets with human or animal arguments, and +1/2 for the one third of itemsets with inanimate arguments. Only the minimally complex model, with random intercepts for item and participant, converged without singularity errors; in *lme4::lmer* syntax, LogRT ~ ANIMACY*GAP + (1|Participant) + (1|Item).

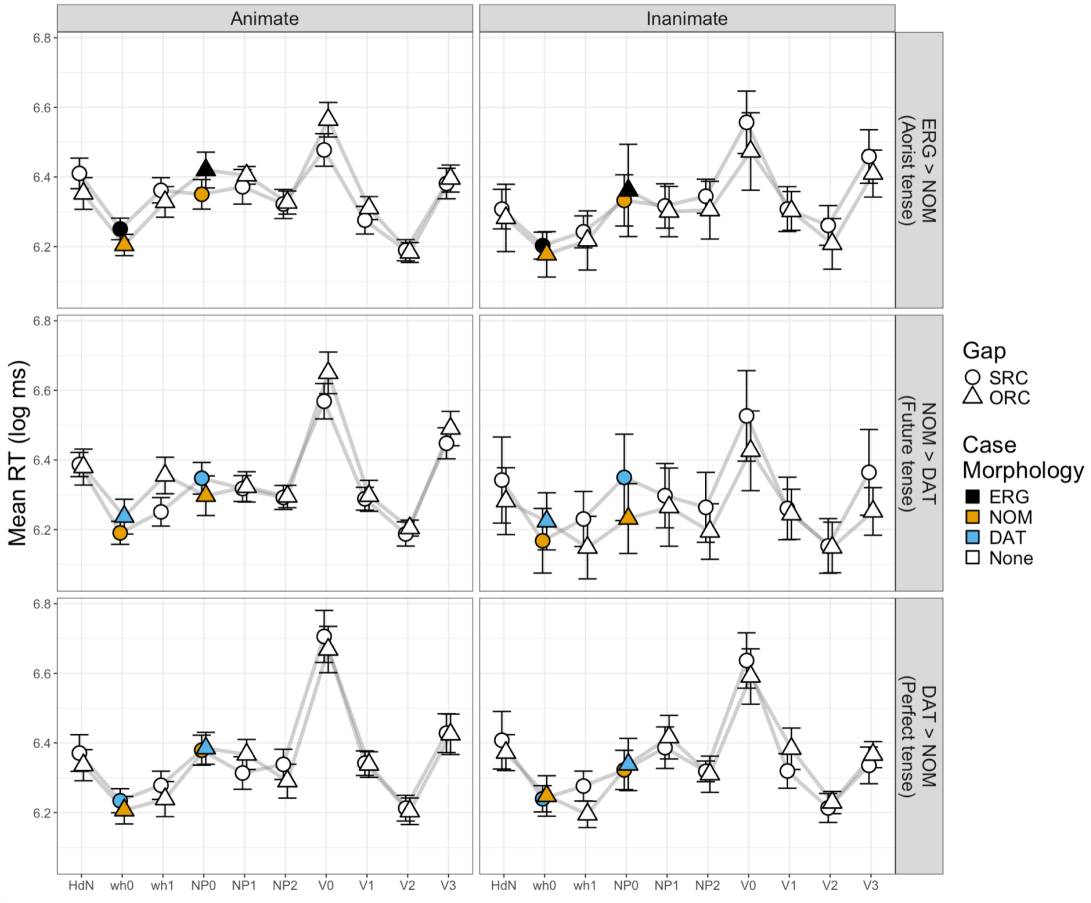

Figure 3. Mean log RTs at each SPR window for Study 2, partitioned by itemset animacy, with by-item standard errors. Shape indicates gap position, and colour indicates incremental case cues.

4.3 Reading times: Studies 3 and 4l

4.3.1 Study 3

Reading times across each SPR window are plotted in Figure 4.

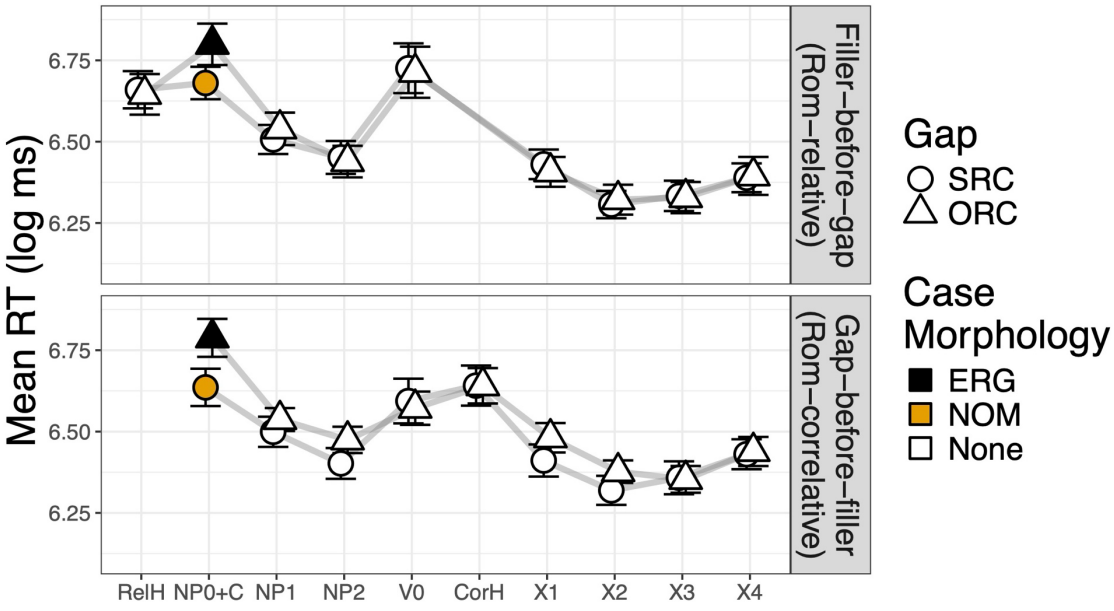

Figure 4. Mean log RTs at each SPR window for Study 3, with by-participant standard errors. Shape indicates gap position, and colour indicates incremental case cues.

At the head noun (RelH/CorH), linear mixed effects models found no significant effects.

At the coargument noun (NP0+C), which in this study was presented with the complementizer *rom*, modelling results are given in Table 14. There was a significant main effect of GAP, such that this region was read more slowly in the ORC conditions than in the SRC conditions.

Study 3, NP0+C	**Est.**	**SE**	**df**	***t***	***p***
TYPE (REL vs. CORR)	–0.053	0.027	22	–1.9	0.065
GAP (SRC vs. ORC)	0.12	0.030	60	4.0	< 0.001 ***
TYPE:GAP	–0.019	0.052	54	–0.38	0.71
LogRT ~ TENSE*GAP + (1+TYPE*GAP|Participant) + (1+TYPE*GAP|Item)					

Table 14. Results of linear mixed effects modelling of log RTs at the NP0+C region of Study 3. Effect structure is given in *lme4::lmer* syntax.

At the spillover region immediately following the coargument (NP1), there were no significant effects.

At the verb (V0), modelling results are given in Table 15. There was a main effect of TYPE, such that verbs were read more slowly in postnominal relatives than in prenominal correlatives.

Study 3, V0	Est.	SE	df	*t*	*p*
TYPE (REL vs. CORR)	–0.15	0.047	33	–3.1	0.0038 **
GAP (SRC vs. ORC)	–0.026	0.033	21	–0.80	0.44
TYPE:GAP	–0.034	0.058	1000	–0.67	0.50
LogRT ~ TENSE*GAP + (1+TYPE|Participant) + (1+TYPE+GAP|Item)					

Table 15. Results of linear mixed effects modelling of log RTs at the V0 region of Study 3. Effect structure is given in *lme4::lmer* syntax.

At the spillover region (X1), which immediately followed either the verb in postnominal relative conditions or the head noun in prenominal correlative conditions, there were no significant effects.

4.3.2 Study 4

Reading times across each SPR window are plotted in Figure 5.

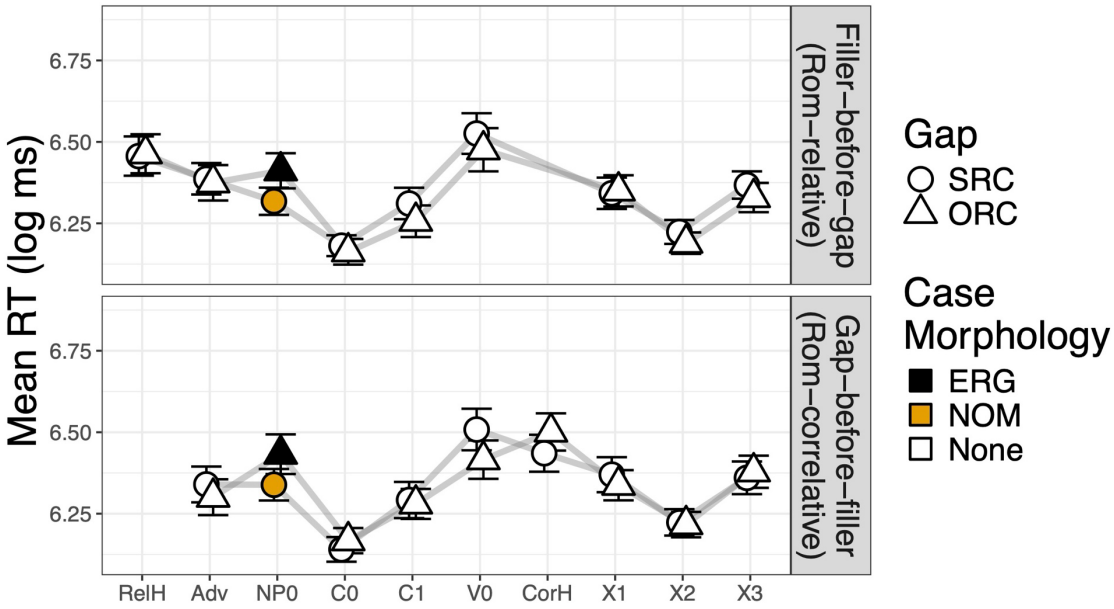

Figure 5. Mean log RTs at each SPR window for Study 4, with by-participant standard errors. Shape indicates gap position, and colour indicates incremental case cues.

At the head noun (RelH/CorH), linear mixed effects models found no significant effects.

At the coargument noun (NP0), which in this study was presented separately from the complementizer *rom*, modelling results are given in Table 16. There was a significant main effect of GAP, such that this region was read more slowly in the ORC conditions than in the SRC conditions.

Study 4, NP0	**Est.**	**SE**	**df**	***t***	***p***
TYPE (REL vs. CORR)	–0.024	0.027	240	0.90	0.37
GAP (SRC vs. ORC)	0.090	0.026	1000	3.5	< 0.001 ***
TYPE:GAP	–0.0012	0.051	1000	0.023	0.98
LogRT ~ TENSE*GAP + (1+TYPE|Participant) + (1|Item)					

Table 16. Results of linear mixed effects modelling of log RTs at the NP0 region of Study 4. Effect structure is given in *lme4::lmer* syntax.

At the spillover region immediately following the coargument, here the complementizer (C0), there were no significant effects.

At the verb (V0), modelling results are given in Table 17. There was a main effect of GAP, such that verbs were read more slowly in SRC conditions than in the ORC conditions.

Study 4, V0	**Est.**	**SE**	**df**	***t***	***p***
TYPE (REL vs. CORR)	–0.047	0.043	28	–1.1	0.29
GAP (SRC vs. ORC)	–0.067	0.029	970	–2.3	0.022 *
TYPE:GAP	–0.041	0.058	970	–0.70	0.49
LogRT ~ TENSE*GAP + (1+TYPE|Participant) + (1+TYPE|Item)					

Table 17. Results of linear mixed effects modelling of log RTs at the V0 region of Study 4. Effect structure is given in *lme4::lmer* syntax.

At the spillover region (X1), which immediately followed either the verb in relative conditions or the head noun in correlative conditions, there were no significant effects.

4.3.3 Interim discussion

The key results for Studies 3 and 4 were found at the clause internal coargument and the clause final verb, just as in the first pair of studies. At the coargument, there was a clear ergative effect in the *rom*-(cor)relatives of Studies 3 and 4, replicating the finding from *wh*-relatives in Study 1. This demonstrates that the ergative effect is not contingent on previous evidence of the gap's case, supplied by a relative pronoun. Arguably, it also shows that the ergative effect is not even contingent on evidence of a filler/gap dependency. In Study 3, the ergative coargument was copresented with the complementizer *rom*. This element gave comprehenders evidence of an embedded clause, but not necessarily of a correlative. Recall that a sentence-initial *rom*-clause can in principle be an adjunct clause that contains a null cataphoric pronoun rather than a gap (see Section 2.2 and Table 4). Moreover, in Study 4, the ergative coargument was presented entirely before the complementizer. Hence it was parsable as the argument of an ordinary main clause, lacking any sort of special dependency. For these reasons, the correlative conditions further support the interpretation of the ergative effect advanced in Section 4.2.3: a cost for committing to a case alignment pattern, rather than a cost for detecting a non-subject gap.

The other significant results were found at the verb regions: a main effect of relativization TYPE in Study 3 (an advantage for correlatives) and a main effect of GAP in Study 4 (an advantage for the ORC conditions). Since this pair of studies held tense constant (aorist across conditions), these findings do not directly parallel the tense effects found in Studies 1 and 2. There, we attributed the advantage for aorist over other tenses to the fact that future and perfect verbs happen to disambiguate their clauses'

case alignment. A similar story can explain the gap effect in Study 4. *Rom*-(cor)relatives lack case marked relative pronouns. This means that only for the object gap conditions will there be a preverbal alignment disambiguator — namely, an overt ergative argument. In the subject gap conditions, the sole preverbal argument is nominative, making alignment ambiguous up until the aorist verb. Therefore, we interpret the cost for subject gap verbs in Study 4 as another alignment disambiguation effect.

As for the correlative advantage found at verbs in Study 3, the explanation must lie elsewhere; disambiguation of alignment unfolds identically across the two types of relatives. We suggest that this effect is evidence of a processing cost for full semantic integration of a transitive verb and both its arguments. All three elements are available at the verb in filler-first *rom*-relatives, but only two are in filler-last correlatives. The advantage for correlative verbs could be attributable, for instance, to a lack of interference effects between two nouns stored in memory (Lewis & Vasishth 2005).

Notably, though, there were no interactions between GAP and relativization TYPE: no evidence that filler-before-gap order favours subject gaps, while gap-before-filler order favours object gaps. In this way Georgian differs from Chamorro, where Wagers et al. (2018) attribute order/gap interactions to the overlapping pressures on maximizing incremental wellformedness. Importantly, the relevant Chamorro conditions were globally ambiguous between subject and object gaps. The language's combination of flexible verb initial word order, neutral case alignment, and subject/verb agreement pushes comprehenders to parse the coargument of a gap-before-filler relative as the subject. This satisfies the outstanding agreement dependency introduced by the clause initial verb, but it also excludes the possibility of a subject gap: thereby accounting for the large proportion of object gap interpretations in their gap-before-filler condition. On the other hand, in a filler-before-gap configuration, the filler can check off both the relativization and the agreement dependencies: strongly favouring subject gaps.

Grammatically, Georgian differs from Chamorro in several important ways. It also has subject/verb agreement, but verbs appear at the end of a clause. Moreover, while the grammatical roles of arguments (overt and null) are often incrementally ambiguous, they are never globally ambiguous. So, in a gap-before-filler correlative, by the time comprehenders encounter the verb's agreement morphology, it will always be clear whether the agreement dependency is saturated by the previously encountered coargument, or by the upcoming correlative head noun. The only difference for filler-before-gap configurations is that the head noun will have already been encountered.

A final issue to discuss for Studies 3 and 4 is animacy. Recall that there is some exploratory evidence from Study 2 that the ergative effect obtains with two animate arguments, but not with two inanimate arguments (Section 4.2.3). Itemsets for Study 4 were counterbalanced for animacy just as in Study 2 (Section 3.1). Nevertheless, the ergative effect was significant in Study 4. However, in an exploratory post-hoc analysis testing the interactions of GAP and ANIMACY at the (cor)relative coargument, the ergative effect (i.e., main effect of GAP) did not reach significance (Est. = 0.078, SE = 0.036, df = 11, t = 2.2, p = 0.052).[9] As with Study 2, pairwise comparisons suggest that the ergative effect is significant for the two thirds of itemsets with animate arguments (contrast: SRC – ORC; Est. = –0.094, SE = 0.036, df = 14, t = –2.6, p = 0.020), but not significant for the inanimate itemsets (contrast: SRC – ORC; Est. = –0.062, SE = 0.064, df = 5.6, t = –1.0, p = 0.38). See discussion below (Section 5). For reference, Figure 6 shows RTs from Study 4 partitioned by animacy.

[9] This linear mixed effects model collapsed the TYPE factor distinguishing relatives and correlatives. The GAP and ANIMACY factors were sum coded as described in fn. 8. The most complex model that converged included by-participant intercepts, and by-item slopes for GAP, ANIMACY, and their interaction; in *lme4::lmer* syntax, LogRT ~ ANIMACY*GAP + (1|Participant) + (0+ANIMACY*GAP|Item).

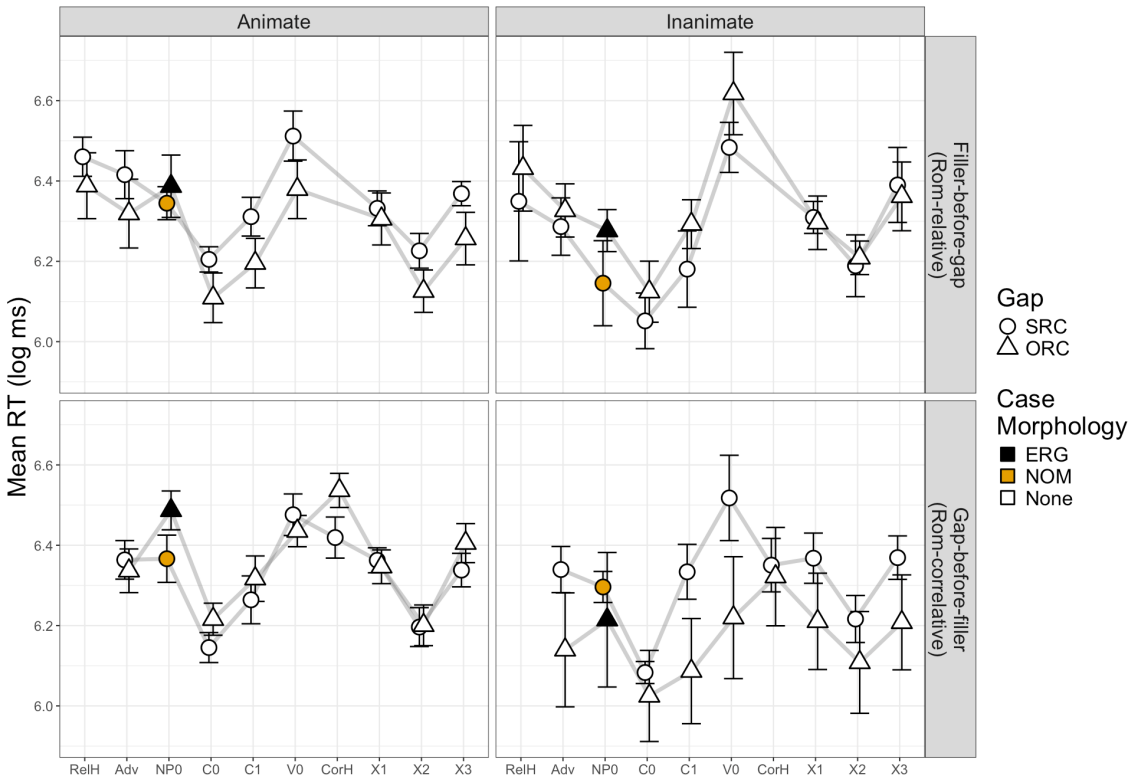

Figure 6. Mean log RTs at each SPR window for Study 4, partitioned by itemset animacy, with by-item standard errors. Shape indicates gap position, and colour indicates incremental case cues.

5. General discussion

The present study on Georgian investigated how filler/gap processing is affected by case alignment and word order. These factors have been identified in the crosslinguistic literature as important factors for understanding the robust, but not universal, advantage for subject gaps over object gaps. In languages with ergative rather than accusative case alignment, and in constructions with gap-before-filler rather than filler-before-gap order, the subject gap advantage is often weakened or even reversed. Georgian has a typologically rare combination of split ergative case alignment and flexible filler/gap order. That makes it a useful testing ground for theories attributing processing difficulty to factors like structural and linear dependency length, informativity of morphological cues, and real-time memory burdens. We leveraged Georgian's grammar with one design that manipulated case alignment pattern (Studies 1 and 2, targeting *wh*-relatives in three tenses/alignments), and another that manipulated filler/gap order (Studies 3 and 4, targeting filler-first *rom*-relatives and filler-last *rom*-correlatives).

Reading time disruptions were found at clause internal coargument nouns, and clause final verbs. In Studies 1, 3, and 4, ergative coargument nouns were harder to process than nominative ones: this is the ergative effect. In Studies 1 and 2, aorist verbs were easier to process than future verbs, which were easier than perfect ones: the aorist tense effect, and the perfect tense effect. In Study 3, verbs were easier to process in *rom*-correlatives than in *rom*-relatives: a correlative effect. In Study 4, aorist verbs that were preceded by ergative coarguments were easier than those that were not: a *rom*-ORC effect. As discussed in Sections 4.2.3 and 4.3.3, the ergative effect, the aorist tense effect, and the *rom*-ORC effect together converge on a clear theory of Georgian filler/gap processing: what taxes comprehension are cues that disambiguate the clause's case alignment.

This pattern does not straightforwardly align with predictions articulated in Section 2.4. Most notably,

the Structural Theory finds little support in our data. It predicted an across-the-board subject gap advantage, following from the general phrase structural superiority of subjects. However, here the only evidence compatible with a subject gap advantage comes from the ergative effects. This is because overt ergative coarguments eliminate the possibility of a subject gap parse, in addition to disambiguating case alignment. If the SRC-foiling interpretation of the ergative effect were on the right track, though, we should also have observed subject gap advantages at disambiguating verbs: contrary to fact.

Moreover, the ergative effect was observed within correlatives in Studies 3 and 4, where the relativization dependency was not yet bottom-up evident. Only filler/gap processing is relevant to the Structural Theory; it makes no predictions about ordinary main clauses. Hence our finding very much resembles the ergative effect found by Polinsky et al. (2012) for Avar, on nouns parsable as main clause arguments. Note that Avar is a classically ergative language, where ergative case is found on all and only transitive subjects. Polinsky et al. therefore interpret their ergative effect as a cost of informativity with respect to argument structure: ergative in Avar eliminates the possibility of an intransitive clause, the most minimal kind. Georgian, though, is not classically ergative, as its ergative case can mark intransitive subjects (Section 2.2, fn. 4). For this reason, we do not attribute our ergative effect to the elimination of intransitive parses. Nonetheless, there is a common thread: entropy reduction. Whether ergative eliminates certain argument structures or certain case alignment patterns, in both Avar and Georgian it dramatically reduces the space of possible continuations. The entropy reduction hypothesis (Hale 2003, 2006) predicts processing difficulty for cues like these ergative nouns — in addition to a much broader set of effects, across all corners of a language. An important direction for future research is to connect these observations about ergative languages to more general processing patterns: for instance, whether disambiguation of argument structure or case alignment differs from other types of entropy transitions, and if so, why.

That said, our alignment disambiguation interpretation cannot explain the ergative effect that Lau et al. (2023) found for Georgian, at postverbal coarguments in *rom*-relatives. In that configuration (Table 5), tense morphology of the clause medial verb is the crucial disambiguator. Lau et al. interpret their ergative effect as a subject gap advantage: bona fide support for the Structural Theory. As noted in Section 2.3, though, their design has a possible confound: the markedness of postverbal subjects in Georgian (Skopeteas et al. 2018). Lau et al.'s ergative effect could be a cost for an unusual word order, not a cost for an object gap. There is a straightforward way to test this in future work: by comparing the processing of SVO and OVS word orders in ordinary main clauses, without any filler/gap dependency.

Let us now turn to the Markedness and Linearity Theories. The former was motivated by advantages observed for absolutive object gaps in Basque (Carreiras et al. 2010) and Niuean (Tollan et al. 2019). For Georgian, it predicts an advantage for parses with nominative gaps over ergative or dative ones; nominative is the least featurally marked case category in Georgian (fn. 3), and it has the widest syntactic distribution (marking transitive subjects, intransitive subjects, or direct objects). In our studies, though, there was no evidence that nominative gaps are privileged; perhaps this is related to the fact that nominative is likely but not guaranteed to appear in a Georgian clause. Some notion of markedness does seem to be relevant in our studies though; we invoked it to explain the cost of perfect verbs relative to future ones (Section 4.2.3). Both tenses disambiguate case alignment, but the perfect tense disambiguates to the more marked S_{DAT}>O_{NOM} pattern. Our perfect-tense effect echoes what Skopeteas et al. (2012) found for ordinary main clauses, meriting future work on how and why this alignment pattern causes processing difficulty.

As for the Linearity Theory, a version of it was originally proposed to explain the subject gap advantage in languages like English (King & Just 1991, Gibson 1998): given S-before-O word order in a filler-

before-gap construction, a subject gap minimizes the linear length of the dependency and thus the burdens it places on memory. The crucial prediction is that S-before-O, gap-before-filler contexts should give rise to an object gap advantage (cf. Vasishth et al. 2013 on Mandarin). In Studies 3 and 4, there is no evidence of such an interaction effect. However, Section 2.4 also articulated a prediction for a main effect of filler/gap order. This is because gap-before-filler order delays full semantic integration of the dependency until after the relative clause. Study 3's correlative effect, observed at the clause final verb, seems to bear out this prediction.

To conclude, let us return to the aetiology of the subject gap advantage and its relation to active processing strategies. In Section 2.1, we surveyed reasons that might lead comprehenders to actively predict a subject gap; in short, many grammars stack the deck in favour of subjects. For Georgian, then, why might there be no subject-gap/object-gap asymmetries? Why instead are there such clear costs for the disambiguation of case alignment? We suggest that this language is not one that dramatically favours any particular argument position. The combination of flexible word order, null pronouns, and a three-way split ergative case system make Georgian an especially tricky language to navigate when it comes to identifying grammatical roles (Skopeteas et al. 2012, Foley 2020). Moreover, there is no structural or morphological category guaranteed to be in a clause. For comprehenders facing this degree of morphosyntactic entropy (Foley 2025), perhaps the rational strategy is to forgo active gap processing, and instead to wait for bottom-up evidence of clause-wide argument/verb relations (namely, an alignment cue) before committing to the gap's position.

One important question is whether this nonactive strategy is unique to filler/gap contexts, or if it is more general. Alignment cues are key for parsing all clauses in Georgian, including ordinary main clauses. Even there, it might be that comprehenders are cautious about assigning subjecthood/objecthood relations. Alternatively, it might be that comprehenders do actively predict nouns' grammatical roles in main clauses, but the added burden of a filler/gap dependency disincentivizes them from using the default active strategy in relatives.

One hint that the nonactive strategy is context-dependent, rather than general, comes from the exploratory analyses on animacy (Section 4.2.3 and 4.3.3). For both Study 2 and Study 4, there is some post-hoc evidence that the ergative effect obtained with animate head nouns, but not with inanimate ones. Perhaps this indicates that whether or not the gap is processed actively depends on a delicate balance of cues. Suppose that the evidence usually compels parsers to navigate a filler/gap dependency cautiously, waiting for alignment cues before assigning the gap a grammatical role. Hence an ergative effect in most contexts. But, if the head noun is inanimate, that semantic cue might tip the scales just enough in favour of the active strategy. After all, an inanimate noun is very unlikely to be a transitive subject, in any language (Silverstein 1976, Comrie 1989, et seq.). This might lead Georgian comprehenders to actively process an object gap (cf. Mak et al. 2002, Gennari & MacDonald 2008). Crucially, an ergative coargument will not foil that prediction.

In any case, there are clear directions for follow-up work on Georgian: to directly compare the processing of ordinary main clauses and filler/gap dependencies; to investigate verb-medial and verb-final orders; to explore contributions of animacy and other cues besides case and word order. And while Georgian is in many ways typologically special, in ways that make it valuable for psycholinguistic research, it is not totally unique.[10] Comparative work, with similar experimental designs employed

[10] For instance, Hindi and its close relatives are also large, accessible languages with many of the same grammatical quirks as Georgian: flexible verb final word order, split ergative case marking, with both filler-before-gap and gap-before-filler constructions (Mahajan 1990, Bhatt 2003). There is already a growing

across languages, is therefore very promising. Such research will contribute both to the long tradition of crosslinguistic theorization in sentence processing (e.g., MacWhinney & Bates 1989, Bornkessel-Schlesewsky & Schlesewsky 2009), and to the more recent accelerating increase of linguistic diversity in experimental work (see Sauppe et al. 2023). As we consider how the comprehender adapts to ever more grammatical landscapes, the nature of the language processing system comes into focus.

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Declaration of generative AI use: The authors report that generative AI (ChatGPT-5.5/5.6) was used as a tool for statistical analyses, coding issues, identifying citations, and copyediting.

Data availability statement: The data that support the findings of this study are openly available in a Figshare repository at https://figshare.com/s/42ae13d06b9cb8459140 [anonymized link for peer review].

Participation consent statement: The authors confirm that all participants were given informed consent to participate in the research.

References

Aronson, Howard I. 1990. *Georgian: A Reading Grammar*. Columbus, Ohio: Slavica.

Barr, Dale J., Roger Levy, Christoph Scheepers, & Harry J. Tily. 2013. Random effects structure for confirmatory hypothesis testing: Keep it maximal. Journal of Memory and Language, 68(3), 255–278.

Bates, Douglas, Martin Mächler, Ben Bolker, and Steve Walker. 2015. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1): 1–48. DOI: https://doi.org/10.18637/jss.v067.i01

Bhatt, Rajesh. 2003. Locality in correlatives. Natural Language and Linguistic Theory, 210, 485–541.

Bhatt, Rajesh, and Léa Nash. 2022. The common core of relativization in Georgian. *Natural Language and Linguistic Theory*, 41. 501–546. DOI: https://doi.org/10.1007/s11049-022-09547-0

Bittner, Maria, and Kenneth Hale. 1996. The structural determination of case and agreement. *Linguistic Inquiry*, 27:1, 1–68.

Bornkessel-Schlesewsky, Ina and Matthias Schlesewsky. 2009. The role of prominence information in the real time comprehension of transitive constructions: A cross-linguistic approach. *Language and Linguistics Compass*, 3. 19–58.

Bornkessel-Schlesewsky, Ina and Matthias Schlesewsky. 2015. Scales in real-time language comprehension: A review. In Ina Bornkessel-Schlesewsky, Andrej Malchukov, and Marc Richards (eds.), *Scales and Hierarchies: A cross-disciplinary perspective*. Trends in Linguistics: Studies and Monographs, 277. De Gruyter Mouton. 321–352.

Carreiras, Manuel, Jon Andoni Duñabeitia, Marta Vergara, Irene de la Cruz-Pavía, and Itziar Laka. 2010. Subject relative clauses are not universally easier to process: Evidence from Basque. *Cognition*, 115, 79–92.

Clemens, Lauren Eby, Jessica Coon, Pedro Mateo Pedro, Adam Milton Morgan, Maria Polinsky, Gabrielle Tandet, and Matthew Wagers. 2015. Ergativity and the complexity of extraction: a view from Mayan. *Natural Language and Linguistic Theory*, 33, 417–467.

Comrie, Bernard. 1989. *Language universals and linguistic typology*, 2nd ed. Cambridge: Blackwell.

Dayal, Veneeta. 1996. Locality in Wh-Quantification: Questions and Relative Clauses in Hindi. Dordrecht: Kluwer.

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literature on sentence processing in Hindi (e.g., Vasishth & Lewis 2006, Dillon et al. 2012, Bhatia & Dillon 2022, Husain et al. 2025) on which comparative work with Georgian could build productively.

de Vincenzi, Marica. *Parsing Strategies in Italian*. Kluwer, Dordrecht.
Dillon, Brian, Andrew Nevins, Alison C. Austin, and Colin Phillips. 2012. Syntactic and semantic predictors of tense in Hindi: An ERP investigation. *Language and Cognitive Processes*, 27(3), 313–344.
Dixon, R. M. W. 1994. *Ergativity*. Cambridge: Cambridge University Press.
Drummond, Alex. 2007. Ibex (Internet-based experiments). Software. https://code.google.com/p/websprr/.
Ferreira, Fernanda. 2003. The misinterpretation of noncanonical sentences. *Cognitive Psychology*, 47. 164–203.
Frazier, Lyn. 1987. Syntactic processing: Evidence from Dutch. *Natural Language and Linguistic Theory*, 5, 519–559.
Frazier, Lyn and Janet Dean Fodor. 1978. The sausage machine: A new two-stage parsing model. *Cognition* 6, 291–326.
Fodor, Janet Dean. 1978. Parsing strategies and constraints on transformations. *Linguistic Inquiry*, 9(3), 427–473.
Foley, Steven. 2013. The syntax of Georgian relative clauses. Senior honors thesis, New York University.
Foley, Steven. 2020. Case, agreement, and sentence processing in Georgian. Doctoral thesis, University of California Santa Cruz.
Foley, Steven. 2021. Agreement in the languages of the Caucasus. In Maria Polinsky (ed.), *The Oxford Handbook of Languages of the Caucasus*. Oxford University Press. 845–872.
Foley, Steven. 2025. Processing Philippine and Reverse Philippine case alignment. In Alessa Farinella and Jed Pizarro-Guevara (eds.), *Proceedings of the Thirty-First Meeting of the Austronesian Formal Linguistics Association (AFLA)*. 83–95.
Gennari, Silvia P., and Maryellen C. MacDonald. 2008. Semantic indeterminacy in object relative clauses. *Journal of Memory and Language*, 58, 161–87.
Gennari, Silvia P., and MacDonald, Maryellen C. 2009. Linking production and comprehension processes: The case of relative clauses. *Cognition*, 111, 1–23.
Gibson, Edward. 1998. Linguistic complexity: Locality of syntactic dependencies. *Cognition*, 68, 1–76. DOI: https://doi.org/10.1016/S0010-0277(98)00034-1
Gibson, Edward, and Gregory Hickok. 1993. Sentence processing with empty categories. *Language and Cognitive Processes*, 8:2, 147–161. DOI:10.1080/01690969308406952
Hale, John. 2001. A probabilistic Earley Parser as a psycholinguistic model. Proceedings of the Second Meeting of the North American Chapter of the Association for Computational Linguistics, 159–166.
Hale, John. 2003. The information conveyed by words in sentences. *Journal of Psycholinguistic Research*, 32(2), 101–123.
Hale, John. 2006. Uncertainty about the rest of the sentence. *Cognitive Science*, 30(4), 643–672.
Harris, Alice C. 1981. *Georgian syntax: A study in relational grammar.* Cambridge Studies in Linguistics London, 33.
Husain, Samar, Apurva, Ishita Arun, and Himanshu Yadav. 2025. The effect of similarity-based interference on bottom-up and top-down processing in verb-final languages: Evidence from Hindi. *Journal of Memory and Language*, 143, 104627. DOI: https://doi.org/10.1016/j.jml.2025.104627
Keenan, Edward L., and Bernard Comrie. 1977. Noun phrase accessibility and universal grammar. *Linguistic Inquiry*, 8, 63–99.
King, Jonathan, and Marcel Adam Just. 1991. Individual differences in syntactic processing: The role of working memory. *Journal of Memory and Language* 30(5), 580–602. DOI: https://doi.org/10.1016/0749-596X(91)90027-H
Kwon, Nayoung, Yoonhyoung Lee, Peter C. Gordon, Robert Kluender, and Maria Polinsky. 2010. Cognitive and linguistic factors affecting subject/object asymmetry: An eye-tracking study of pre-nominal relative clauses in Korean. *Language*, 86, 546–582.
Kwon, Nayoung, Robert Kluender, Marta Kutas, and Maria Polinsky. 2013. Subject/object processing asymmetries in Korean relative clauses: Evidence from ERP data. *Language*, 89, 537–585.
Kuznetsova, Alexandra, Per B. Brockhoff, & Rune H. B. Christensen. 2017. lmerTest Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software*, 82(13), 1–26.
Lau, Elaine and Nozomi Tanaka. 2021. The subject advantage in relative clauses: A review. *Glossa: a journal of general linguistics*, 6(1): 34. 1–34. DOI: https://doi.org/10.5334/gjgl.1343

Lau, Ellen, Michaela Socolof, Nancy Clarke, Rusudan Asatiani, and Maria Polinsky. 2023. A subject relative clause preference in a split-ergative language: ERP evidence from Georgian. *Brain and Language*, 236: 105199. DOI: https://doi.org/10.1016/j.bandl.2022.105199

Lenth, Russell, Ben Bolker, Paul Buerkner, Iago Giné-Vázquez, Maxime Herve, Maarten Jung, Jonathan Love, Fernando Miguez, Hannes Riebl, and Henrik Signman. 2020. emmeans: estimated marginal means, aka least-squares mean. R package version 1.5.2-2.

Levy, Roger. 2008. Expectation-based syntactic comprehension. *Cognition*, 106(3), 1126–1177.

Lewis, Richard L., and Shravan Vasishth. 2005. An activation-based model of sentence processing as skilled memory retrieval. *Cognitive Science*, 29, 375–419.

Lin, Chien-Jer Charles, and Thomas G. Bever. 2006. In *West Coast Conference on Formal Linguistics (WCCFL)*, eds. Donald Baumer, David Montero, and Michael Scanlon, Vol. 25, 254–260. Somerville: Cascadilla Proceedings Project.

Lin, Yowyu, and Susan M. Garnsey. 2011. Animacy and the resolution of temporary ambiguity in relative clause comprehension in Mandarin. In Hiroko Yamashita, Jerome L. Packard & Yuki Hirose (eds.), *Processing and producing head-final structures*, 277–297. Dordrecht: Springer. DOI: https://doi.org/10.1007/978-90-481-9213-7_12

MacWhinney, Brian, and Elizabeth Bates. 1989. *The crosslinguistic study of sentence processing*. New York: Cambridge University Press.

Mahajan, Anoop. 1990. The A/A-bar distinction and movement theory. Ph.D. thesis, Massachusetts Institute of Technology.

Mak, Willem M., Wietske Vonk, and Herbert Schriefers. 2002. The influence of animacy on relative clause processing. *Journal of Memory and Language*, 47, 50–68.

McCloskey, Jim. 1997. Subjecthood and subject positions. In Liliane Haegeman (ed.), *Elements of Grammar: Handbook in Generative Syntax*. Springer Dordrecht. 197–235. DOI:10.1007/978-94-011-5420-8_5.

Montag, Jessica L. & Maryellen C. MacDonald. 2009. Word order doesn't matter: Relative clause production in English and Japanese. In Niels A. Taatgen & Hedderik van Rijn (eds.), *Proceedings of the Annual Meeting of the Cognitive Science Society 31*. 2594–2599. Austin, Texas: Cognitive Science Society.

Nash, Léa. 2017. The structural source of split ergativity and ergative case in Georgian. In *The Oxford Handbook of Ergativity*, eds. Jessica Coon, Diane Massam, and Lisa deMena Travis.

Nash, Léa. 2021. Nonunitary structure of unergative verbs in Georgian. *Natural Language and Linguistic Theory*, 40, 1201–1267.

Pickering, Martin, and Guy Barry. 1991. Sentence processing without empty categories. *Language and Cognitive Processes*, 6, 229–259.

Polinsky, Maria. 2016. Deconstructing Ergativity: Two types of ergative languages and their features. Oxford: Oxford University Press.

Polinsky, Maria, Carlos Gómez Gallo, Peter Graff, and Ekaterina Kravtchenko. 2012. Subject preference and ergativity. *Lingua*, 122, 267–277.

Roland, Douglas, Frederic Dick, and Jeffrey L. Elman. 2007. Frequency of basic English grammatical structures: A corpus analysis. *Journal of Memory and Language*, 57(3), 348–379. DOI: https://doi.org/10.1016/j.jml.2007.03.002

Royer, Justin, and Jessica Coon. 2025. Correlates of object raising in Mayan. *Language and Linguistic Compass*, 19: e70013. DOI: https://doi.org/10.1111/lnc3.70013

Sauppe, Sebastian, Caroline Andrews, and Elisabeth Norcliffe. 2023. Experimental research in cross-linguistic psycholinguistics. In Sandrine Zufferey and Pascal Gygax (eds.), *Routledge Handbook of Experimental Linguistics*. Routledge. 156–172. DOI: 10.4324/9781003392972-12

Shanidze, Akaki. 1980 [1953]. Kartuli enis gramat'ik'is sapudzvlebi [Fundamentals of Georgian grammar]. In *Txzulebani* [Collected Works], vol. 3. Scientific Academy, Tbilisi State University.

Silverstein, Michael. 1976. Hierarchy of features and ergativity. In R. M. W. Dixon (ed.), *Grammatical Categories in Australian Languages*, 112–171. Canberra: Australian Institute of Aboriginal Studies.

Skopeteas, Stavros, and Gisbert Fanselow. 2010. Focus in Georgian and the expression of contrast. *Lingua*, 120, 1370–1391.

Skopeteas, Stavros, Gisbert Fanselow, and Rusudan Asatiani. 2012. Case inversion in Georgian: Syntactic properties and sentence processing. In *Case, Word Order and Prominence*, 145–171. Springer Netherlands.

Skopeteas, Stavros, Caroline Féry, and Rusudan Asatiani. 2009. Word order and intonation in Georgian. *Lingua*, 119. 102–127.

Skopeteas, Stavros, Caroline Féry, and Rusudan Asatiani. 2018. Prosodic separation of postverbal material in Georgian: A corpus study on syntax-phonology interface. In Evangelia Adamou, Katharina Haude, and Martine Vanhove (eds.), *Information Structure in Lesser-described Languages: Studies in prosody and syntax*. John Benjamins. 17–50.

Tollan, Rebecca, Diane Massam, and Daphna Heller. 2019. Effects of case and transitivity on processing dependencies: Evidence from Niueam. *Cognitive Science*, 43(6), 1–14.

Ueno, Mieko, and Susan M. Garnsey. 2008. An ERP study of the processing of subject and object relative clauses in Japanese. *Language and Cognitive Processes*, 23, 646–688.

Vasishth, Shravan, Zhong Chen, Qiang Li, and Gueilan Guo. 2013. Processing Chinese relative clauses: evidence for the subject-relative advantage. *PLoS One*, 8(10), e77006.

Wagers, Matthew, Sandra Chung, and Manuel F. Borja. 2018. Grammatical licensing and relative clause parsing in a flexible word-order language. *Cognition*, 178, 207–211.