

Processing syntactic dependencies in Slovene heritage speakers

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ABSTRACT

This study investigates how Slovene heritage speakers comprehend syntactic dependencies. 30 heritage speakers were tested on (i) A'-movement, (ii) referential dependencies and (iii) the configurational dependency. Heritage speakers performed comparably to monolingual controls on canonical SVO and coordinated clauses but showed reduced accuracy on non-canonical OVS order, object relative clauses and cataphora while manifesting greater latencies on these types. Overall, the findings suggest that Slovene heritage speakers rely more on surface structure and default parsing strategies when morphosyntactic cues are in conflict with word order and that they operate under greater processing demands than monolingual speakers, supporting models of heritage grammar that frame it as a re-weighted yet resource-intensive system.

KEYWORDS heritage language · Slovene · sentence comprehension · relative clause · cataphora · word order

1 INTRODUCTION

Heritage speakers, bilingual individuals who acquire a minority home language in childhood but grow up in a dominant societal language, offer a unique window into how language systems change under conditions of reduced input. These speakers are often found to restructure or simplify various parts of the grammar (Polinsky 2018, Montrul & Polinsky 2021, Lohndal 2021, among others). The trajectory of such restructuring is far from uniform. A central puzzle is why some grammatical domains appear to be retained in heritage speakers, while others are consistently vulnerable. This raises important questions not only about the role of the quantity and quality of input available to the heritage speakers and its interaction with linguistic competence and processing routines in heritage speakers' minds, but also about the scope and design of experimental tools capable of capturing fine-grained distinctions between the relevant grammatical domains.

A central area of our interest in this context is the processing of syntactic dependencies by speakers of heritage Slovene in an English-dominant linguistic environment. In particular, we are interested in (i) A'-movement dependencies and non-canonical word orders, (ii) referential dependencies, specifically, cataphora, and (iii) the configurational dependency of Genitive of Negation. These dependencies place different demands on the parser and recruit different types of linguistic cues, such as word order, case morphology and lexical semantics, all of which can be affected by reduced quality and quantity of input. The salience and reliability of these cues play a crucial role in comprehension as well as production and may condition which features are retained and which are lost in a given heritage grammar.

Among Slavic languages, Slovene remains under-represented in heritage linguistic research. Although sociolinguistic and community-based studies document the presence of vibrant Slovene-speaking populations in North America and Australia (Government of Slovenia 2021, Čuš 2017, Šabec 1995, 2021, Kralj 2023), very little is known about how these speakers comprehend syntactic dependencies in their heritage language. In

addition, similarly to other Slavic languages, Slovene is well-suited to investigating the role of case morphology in various dependencies, being a morphologically rich and relatively free-word-order language in which case typically signals grammatical roles.

In this study, we examine how English-dominant heritage speakers of Slovene process the types of syntactic dependencies listed above. We explore these dependencies with special attention to the case morphology that interacts with dependency formation. Our results show that while speakers of heritage Slovene perform on a par with monolinguals in canonical SVO structures, they show marked difficulties with dependencies that involve greater morphosyntactic complexity. These findings contribute to a growing body of research on morphosyntactic restructuring and structural resilience in Slavic heritage languages and highlight the importance of salience of morphological and other types of cues in shaping comprehension under reduced input conditions.

2 SYNTACTIC DEPENDENCIES AND CASE MORPHOLOGY IN HERITAGE GRAMMAR

2.1 WORD ORDER AND CASE MORPHOLOGY

One dependency type in which heritage speakers face greater challenges is associated with non-canonical or marked word order. Evidence suggests that heritage speakers often have difficulty navigating word orders driven by information structure rather than syntax alone (Laleko & Polinsky 2016). Furthermore, they may lose sensitivity to case morphology in marked word orders such as OVS (Montrul 2016, Polinsky 2006, Polinsky & Scontras 2020, de Groot 2005) which, in Slavic languages, is often associated with syntactic or discourse-driven A'-movement (e.g., Bailyn 2012). These speakers tend to default to interpreting the first noun phrase as the subject, irrespective of case marking, based on the unmarked SVO order typical of the dominant societal language. This tendency has been observed in comprehension as well as production, in adult and child heritage speakers (Ionin et al. 2020, 2023, Isurin & Ivanova-Sullivan 2008, Laleko & Dubinina 2018, Meir et al. 2020, Polinsky 2006, Song et al. 1997, Zuban et al. 2021, among others).

On the other hand, Laleko (2024) noted that some heritage Russian speakers could successfully use certain marked word orders in appropriate contexts, albeit with some deviations from monolingual norms. Similarly, Hoot (2019), Hoot & Leal (2023) found resemblances among baseline and heritage speakers in processing non-canonical word orders in Hungarian and Spanish, respectively.

Heritage grammars thus display a likely case of cue re-weighting in the domain of word order, favoring the linear word order cue over the case morphology cue, particularly when case is not additionally anchored in a salient lexical item.

2.2 RELATIVE CLAUSES

Relative clauses, another construction type involving syntactic A'-movement (Chomsky 1977) have been subject to a long tradition of research on processing effects of locality and syntactic complexity. The general consensus is that object relatives are harder to process than subject relatives (Ford 1983, Just & Carpenter 1992, Gibson 2000, Grodner & Gibson 2005, Lewis & Vasishth 2005). The same asymmetry has been documented in heritage language processing (Albirini & Benmamoun 2012, Lohndal 2021, Polinsky 2018). These difficulties are frequently attributed to the reduced robustness of morphological case cues that are critical for disambiguating grammatical roles in languages with flexible word order. In a Russian study, Polinsky (2011) reports that, while children acquiring heritage Russian show performance comparable to their baseline monolingual peers on all types of relative clauses, adult heritage speakers tend to interpret object relative clauses as subject ones, associating the gap portion of the syntactic dependency with the subject, rather than object. The author suggests that this case of divergent acquisition

is a result of two factors: loss of case morphology that serves as a cue to distinguish the subject from object thematic role in Russian, and the universal preference for the subject interpretation in the absence of evidence to the contrary (again, in the form of morphological cues).

2.3 CATAPHORA

Cataphora or backwards anaphora is a referential dependency in which the referent linearly follows the pronominal (e.g., *when he entered, the king sat on the throne*). Previous works demonstrated that processing cataphoric pronouns involves a forward-looking search for an antecedent initiated by the pronoun cue, taxing working memory in ways similar to filler-gap dependencies (Cowart & Cairns 1987, van Gompel & Liversedge 2003, Kazanina et al. 2007). The same process is also operative in *pro*-drop languages, where the cataphoric pronoun is a silent *pro*. This has been shown for Italian (Carminati 2002, Fedele & Kaiser 2014) as well as Slovene (Pavlič & Stepanov 2023). The fact that covert and overt pronouns behave similarly processing-wise in cataphora is also in line with similar findings regarding processing strategies for establishing co-reference with null pronominals in anaphoric dependencies (Tsimpli et al. 2004, Sorace & Filiaci 2006).

In research on bilingual children, Serratrice (2007) found that bilingual English-Italian eight-year-old and Italian monolingual children preferred subject referents over object ones for null cataphoric pronouns, with bilinguals performing similarly to monolinguals. Both groups of children showed stronger subject preferences than adults.

With regard to heritage languages, prior studies on referential dependencies have focused on forward anaphora (Keating et al. 2011, Gračanin-Yuksek et al. 2020, Kim et al. 2009, Ivanova-Sullivan 2014), with cataphora being understudied (cf. Contemori et al. 2024). What is known, however, is that heritage speakers tend to overmark referents and to favor overt subjects in *pro*-drop heritage languages (Polinsky 2018: 254, Montrul 2008, 2016), which may potentially interact with resolution strategies for null/*pro* cataphora.

2.4 GENITIVE OF NEGATION

Genitive of Negation (GoN) is a phenomenon whereby an NP in structural positions such as object of a transitive verb or subject of existential clause receives Genitive in the context of sentential negation. GoN has been subject to a long-standing inquiry in formal Slavic linguistics, with numerous accounts of its syntactic underpinnings (Timberlake 1975, Babby 1980, Franks 1995, Biskup 2019, among others). Theoretically, GoN is neither fully structural nor fully lexical case, as both the lexical and syntactic components of grammar are involved (see the above works for further discussion). What makes GoN special for processing purposes, however, is its characteristic lexical ‘anchoring’ in the form of an overt negation marker, *ne* in Slovene.

When discussing incipient changes in the input, Polinsky (2018: 34-35) shows that GoN in Russian shows declining usage in heritage speakers, presumably influenced by its optional character in the baseline grammar, changes in linguistic input and general simplification in bilingual environments. A variationist study in Łyskawa & Nagy (2019), comparing heritage Polish (obligatory GoN), Russian and Ukrainian (optional GoN), found that GoN was largely retained among first-generation immigrants (95-99%) in all three languages but declined more in Ukrainian and Russian than in Polish, among second- and third-generation speakers. The obligatory nature of GoN thus appears to bolster its retention.

GoN in standard Slovene is obligatory as well, with few exceptions (Pavlič & Živanović 2013). This raises an interesting question as to whether this property translates into a greater resilience and consequently a greater degree of retainment of this construction also in the heritage grammar of this language.

The latter point also bears on the issue that not all morphological features are equally vulnerable. There is growing evidence that lexical anchoring and cue salience play an

important role in shaping heritage comprehension (cf. Albirini & Benmamoun 2014, Burmester et al. 2018, Parshina et al. 2022). Morphological features that are overtly marked, semantically transparent and, in addition, are tied to a lexical trigger may be more resilient than features dependent on abstract syntactic configurations only. This raises the possibility that GoN may be retained to a greater extent than, e.g. Accusative, because of its lexical anchoring in a particular morphosyntactic configuration. Both the obligatoriness and lexical anchoring aspects of GoN thus motivate an opportunity to experimentally explore the degree of its potential resilience in the heritage grammar.

3 RESEARCH QUESTIONS

In the present study, we focused on the following questions:

Q1: Which syntactic dependencies in the heritage grammar of Slovene remain stable, and which undergo restructuring and/or simplification under reduced input and cross-linguistic influence? This question is part of a larger inquiry regarding selective retention, loss and reanalysis in heritage grammars.

Q2: How do heritage speakers interpret grammatical dependencies when cues from word order, case morphology, and lexical context are in competition? This question relates to findings that heritage grammars often exhibit re-weighting of structural cues, favoring surface-linear or discourse-based interpretations over morphologically driven ones.

Q3: Are all morphological cases equally vulnerable to attrition, or are some (e.g., GoN) more robust due to lexical anchoring, obligatoriness, or perceptual salience?

4 METHOD

4.1 MATERIALS

We investigated comprehension of the syntactic dependencies in heritage speakers of Slovene using the JERA sentence comprehension battery previously standardized on 506 monolingual speakers of Slovene (Stepanov et al. 2023, 2024). The battery consists of 10 sentence types differing in syntactic complexity as a function of a particular type of syntactic dependency(ies) involved. Ten sentences represent each type, for a total of 100 sentences. Representative examples from each sentence type are shown in Table 1.

In all sentence types, clausal subjects and direct objects consist of single word items whose corpus frequency and length were balanced. The sentences involve reversible argument structures in the main clause. We assume, for present purposes, that sentences in T2, T8 and T10, where the object is fronted and the argument structure is signaled primarily by overt morphological case markers, reflect contrastive focus in Slovene (cf. Stopar 2017) and henceforth use the loose terms ‘focalization’ or ‘marked word order’ equally when referring to these types. Type T3 includes comparative sentences. Sentences in T4 involve coordination of two simple clauses with canonical (SVO) word order. Relative clause types T5 and T6 also include two full argument structures but involve additional structural embedding in comparison to T4. Types T7 and T8 test GoN, T8 also in conjunction with marked word order. Finally, T9 and T10 involve cataphoric dependencies, T10 in the marked word order context.

JERA is built around a cross-modal sentence-picture verification task whereby the participant listens to an audio recording of the target sentence and chooses the picture that best corresponds to its content. To that end, all test sentences were recorded by a native female speaker of standard Slovene with a Zoom H4n Pro audio recorder at the 48kHz sampling frequency and normalized for volume. Each sentence was paired with a visual array containing four pictures positioned in a 2 x 2 fashion on a computer screen whereby one picture represented the event described in the sentence and three other pictures were distractors. A key with graphical depictions of buttons with letters

No.	Sentence type	Example
T1	Basic SVO	Medved grize slona. bear.NOM bites elephant.ACC 'The bear is biting the elephant.'
T2	Focalization (OVS)	Slona grize medved. elephant.ACC bites bear.NOM 'The elephant is being bitten by the bear.'
T3	Comparatives	Medved nosi več korenčkov kot hrušk. bear.NOM carries more carrots.GEN than pears.GEN 'The bear is carrying more carrots than pears.'
T4	Coordinated SVO	Medved grize slona in konj lovi bear.NOM bites elephant.ACC and horse.NOM chases žirafa. giraffe.ACC 'The bear is biting an elephant and the horse is chasing a giraffe.'
T5	Subject relative clauses	Pes ki grize mačko brca konja. dog.NOM which bites cat.ACC kicks horse.ACC 'The dog which bites the cat kicks the horse.'
T6	Object relative clauses	Medved ki ga konj brca grize bear.NOM which him horse.NOM kicks bites slona. elephant.ACC 'The bear, whom the horse kicks, is biting an elephant.'
T7	Negated SVO	Medved ne grize slona. bear.NOM not bite elephant.GEN 'The bear is not biting an elephant.'
T8	Negated focalization	Slona ne grize medved. elephant.GEN not bite bear.NOM 'The elephant is not being bitten by the bear.'
T9	Cataphora	Medtem ko tepta rože medved meanwhile while trampling flowers.ACC bear.NOM grize slona. bites elephant.ACC 'While trampling the flowers, the bear bites the elephant.'
T10	Cataphora with focalization	Medtem ko tepta rože slona meanwhile while trampling flowers.ACC elephant.ACC grize medved. bites bear.NOM 'While trampling the flowers, the elephant is being bitten by the bear.'

Table 1: Sentence types tested in the JERA battery

corresponding to respective pictures was placed in the center of the screen to aid the participants in selecting the right button for response (see Procedure in §4.3). The goal of this design was to test participants' sensitivity to syntactic structure under controlled visual competition. An example of a visual stimulus corresponding to a T1 sentence *Medved grize slona* 'The bear is biting the elephant' is shown in Figure 1.

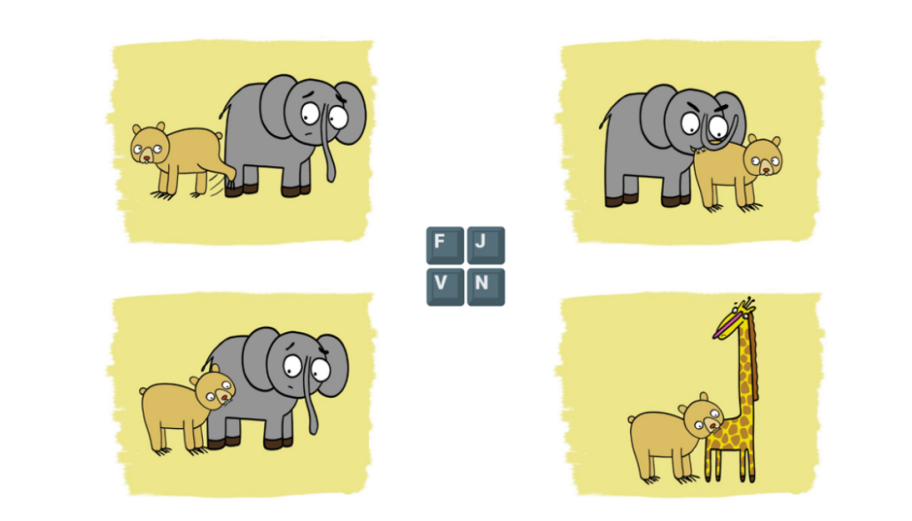


Figure 1: A visual stimulus array for a T1 sentence *Medved grize slona* 'The bear is biting the elephant'. Similar stimuli were used for T2 sentences.

A trial consisted of a sequence containing an audio recording of one target sentence and the corresponding visual array. There were 100 trials in a single experimental session.

4.2 PARTICIPANTS

We recruited thirty adult bilinguals of Slovene background who were dominant English speakers from the United States, Canada, and Australia (22 females, mean age = 55.9 years, $sd = 15.2$), of which there were 24 second-generation, 5 third-generation and 1 first-generation speakers. These countries host the largest Slovene emigrant communities vibrant in their activities aiming at preservation of their home language and cultural heritage (see references in §1). The participants in our study were exposed to Slovene from birth.

The group was demographically homogeneous: statistical analyses on accuracy and response times revealed no significant effects based on country of residence, age, generation, or education level (all $ps > 0.10$).

Control data were taken from 203 monolingual Slovene speakers in the existing JERA standardization corpus (127 women; M age = 58.3 years, $SD = 12.1$; cf. §4.1). This subset was chosen to match the heritage group as closely as possible in age, gender, and education.

In constructing the control baseline, we followed the common assumption that heritage speakers' grammatical competence is governed by the same principles and rules as that of native speakers of any language (Lohndal 2021: 645, Chomsky 1986), though not necessarily identical to the baseline grammar of monolinguals. The choice of an appropriate comparison baseline is debated in heritage linguistics. While many studies use monolinguals from the country of origin, others argue that first-generation immigrants offer a more accurate baseline, as they provide the actual input during heritage language acquisition (Polinsky 2018: 12). However, such data are often unavailable due to factors like age, health, attrition, limited community contact, or barriers to online

participation, as in our case where many older heritage speakers lacked computer access. We therefore used a monolingual control group of native speakers of Slovene residing in Slovenia, offering a stable native benchmark. These are often called homeland speakers, though ‘homeland’ and ‘baseline’ are not fully synonymous, as homeland grammar may differ from heritage input in register, dialect, or change trajectory.

The heritage speaker participants gave informed consent prior to participation. The study was approved by the Ethics committee of the University of Nova Gorica (protocol no. 11/2020).

4.3 PROCEDURE

Participants listened to a sentence and selected the picture they felt best matched its meaning. Each trial began with a blank screen showing a loudspeaker icon while the audio recording played. A four-picture display appeared 1000 ms after the recording ended. Participants responded using one of four keys (F, J, V, N), each mapped to a screen quadrant (top left/right, bottom left/right). This mapping was practiced beforehand and reinforced by an on-screen key (see Figure 1). Each sentence was played once without repetition. After the response, a blank screen with a prompt to press any key appeared, allowing for short breaks between trials. The order of sentence-picture blocks as well as the positions of target and distractor pictures were pseudo-randomized for each trial and participant by the software. Before the main phase, participants completed four practice trials with feedback; no feedback was given during the main task.

Response times were measured from the onset of the visual stimulus to the participant’s response. Heritage speakers were tested individually via remote access using standardized instructions. The task was programmed and administered on the Ibex Farm platform (Drummond et al. 2016). The average duration of the experiment was approximately 25 minutes.

4.4 PREDICTIONS

4.4.1 WORD ORDER VARIATION AND MORPHOLOGICAL CASE (T1, T2, T4, T8)

Basic SVO sentences (T1) and coordinated SVO structures (T4) serve as controls and were expected to be processed accurately by heritage speakers. In line with the literature reviewed in §2.1, focalized sentences (T2) were predicted to be significantly more challenging, reflecting speakers’ over-reliance on word order in determining the grammatical functions, namely subject and object, instead of the morphological case markers which signal these functions in standard Slovene. Negated focalized sentences (T8) were of particular interest insofar as they involve GoN and provide a contrast to T2: we hypothesized that T8 could show better performance than T2 due to the perceptual salience and lexical anchoring of Genitive in the presence of negation, compared to accusative.

4.4.2 RELATIVE CLAUSES (T5, T6)

Previous research has shown that subject relative clauses are easier to process than object relative clauses (see above), a pattern attributed to memory constraints and similarity-based interference (Gibson 2000, Lewis & Vasishth 2005). We expected a similar pattern in Slovene, with heritage speakers performing better on subject relatives (T5) than on object relatives (T6), possibly due to a combination of case morphology degradation and a universal preference for subject interpretation in the absence of clear morphological cues.

4.4.3 GENITIVE OF NEGATION (T7, T8)

Given the obligatory character of GoN in standard Slovene and its lexical grounding (§2.4), we expected that Genitive has a likely chance to be retained in heritage speakers, on the assumption that the interaction between overt lexical negation and morphological case contributes to selective resilience in the heritage grammar.

4.4.4 CATAPHORA (T9, T10)

As noted in §2.3, heritage speakers are known to overmark referents and to favor overt subjects, which may interact with resolution strategies for null cataphora. We expected heritage speakers to show good accuracy but increased response times in T9 (cataphora in SVO), and decreased accuracy in T10 (cataphora with marked word order), where the dependency is compounded by non-canonical word order and possible confusion over grammatical roles.

4.4.5 COMPARATIVE CONSTRUCTIONS (T3)

Comparative sentences are standardly considered syntactically similar to relative clause constructions in that both involve A'-operator movement (Bresnan 1973, Chomsky 1977). Studies of processing of comparative constructions have so far been limited, with the one important exception of Grant (2013) and no studies that we know of in the bilingual context. Because of that, inclusion of comparatives in our study was largely exploratory. Since these constructions do not rely heavily on interaction of case and word order cues for role assignment, we expected heritage speakers to perform relatively well from that perspective.

5 RESULTS

5.1 STATISTICAL ANALYSES

The results were modeled with logistic (accuracy) and linear (response times) mixed effects models using the *lme4* package in R (R Core Team 2023). Sentence type, population and the interaction term were coded as fixed factors, and participant and stimulus item as random factors. Main effects and interactions were determined on the basis of maximal likelihood estimation by comparing a model with a fixed factor or interaction term of interest and a respective null model. Pairwise comparisons among the population samples by sentence type were performed using the *emmeans* package yielding Tukey-adjusted p-values.

5.2 ACCURACY

All informants in our study were generally accurate in their responses, with most responses ranging between 85-100% accuracy per informant. There was a strong main effect of population ($\chi^2(1) = 28.47, p < 0.0001$), with an overall accuracy drop in the heritage population ($\beta_{\text{heritage}} = 2.60, SE = 0.58, z = 4.48, p < 0.0001$; $\beta_{\text{mainland}} = 1.35, SE = 0.24, z = 5.56, p < 0.0001$; reference=heritage), as well as sentence type ($\chi^2(9) = 92.42, p < 0.0001$) and there was a significant interaction among the two factors ($\chi^2(9) = 294.51, p < 0.0001$). The heritage speakers demonstrated comparable accuracy levels to the monolingual speakers of Slovene when processing basic SVO sentences (T1) and coordinated SVO sentences (T4), as well as the comparative constructions (T3). The heritage speakers' performance was marginally lower than the monolinguals' on subject relatives (T5) and cataphora sentences (T9). There was a dramatic drop in accuracy in sentences with focalization (T2) and focalization with cataphora (T10), both types with the marked (OVS) word order. Performance was also significantly lower on the object relatives (T6), negated (T7) and negated focalization (T8) sentences. Figure 2

plots model estimations of accuracy of responses between the heritage and monolingual groups.

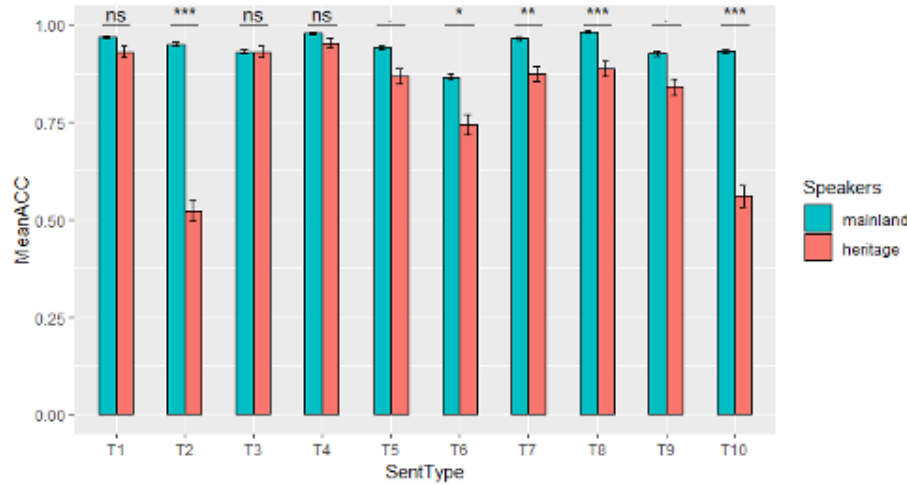


Figure 2: Comparison of accuracy in JERA between heritage speakers and age-matched baseline. Error bars represent standard error.

Table 2 summarizes pairwise comparisons of accuracy across selected sentence types in the heritage group (for similar comparisons in the monolingual group, see Stepanov et al. 2023). Understandably, accuracy was comparable in canonical SVO both in simple SVO (T1) and coordinated SVO (T4) sentences. Accuracy drops substantially in T2 (marked word order) compared to T1. This is mirrored in cataphora contexts where T10 (with marked word order in the main clause) shows worse performance than T9 (with canonical word order in the main clause). There was no difference in accuracy between T2 and T10 ($p > 0.10$). Performance on subject relative clauses T5 is (marginally) better than on object relatives T6, replicating the monolingual pattern. Accuracy was marginally lower for T5 (subject relatives) and significantly lower for T6 (object relatives) compared to T4 (clausal coordination). Both negative types with canonical and marked word order, T7 and T8, manifest similar accuracy rates. While there was no difference in accuracy between canonical SVO (T1) and negative (T7) sentences, in the marked word order heritage speakers performed significantly better on T8 than on T2.¹

5.3 RESPONSE TIMES

Again, there was a strong effect of population ($\chi^2(1) = 25.74, p < 0.0001$) with overall response time increasing by about 2.6 sec in heritage speakers ($\beta_{heritage} = 7954, SE = 1214, z = 6.55, p < 0.0001$; $\beta_{mainland} = -2663, SE = 510, z = 5.12, p < 0.0001$; reference=heritage) and sentence type ($\chi^2(9) = 64.34, p < 0.0001$) and there was a significant interaction among the two ($\chi^2(9) = 424.63, p < 0.0001$). For all tested sentence types with the exception of T1 and T4, the heritage speakers took significantly longer to select the picture. Performance on T1 and T4 was comparable to that of monolinguals ($p > 0.10$ for T1, $p = 0.08$ for T4). For T8 and T10, heritage speakers took almost twice as much time responding as the monolingual group. Figure 3 compares

¹These pairwise contrasts across sentence types should be interpreted with some caution: although lexical frequency and length were controlled across the test battery, specific lexical items varied across and within sentence types. This variability might have introduced minor confounds in pairwise comparisons such as differences in plausibility or semantic overlap between picture choices. However, these are unlikely to significantly affect the results, as the observed contrasts align with syntactic predictions and are replicated across related sentence types (e.g., T1–T2 and T9–T10; see also below).

Contrast	Estimate	SE	z-ratio	p-value
T1–T2	3.53	0.41	8.57	<.0001
T1–T4	-0.49	0.47	-1.03	0.99
T1–T7	0.87	0.42	2.03	0.57
T2–T8	-2.85	0.38	-7.43	<.0001
T2–T10	0.24	0.34	0.69	0.99
T4–T5	1.42	0.45	3.15	0.05
T4–T6	2.56	0.44	5.83	<.0001
T5–T6	1.14	0.37	3.02	0.07
T7–T8	-0.19	0.40	-0.47	1.0000
T9–T10	2.10	0.37	5.68	<.0001

Table 2: Selected pairwise comparisons of accuracy in the heritage group across sentence types.

response times between the heritage group and the native speakers in the homeland per sentence.

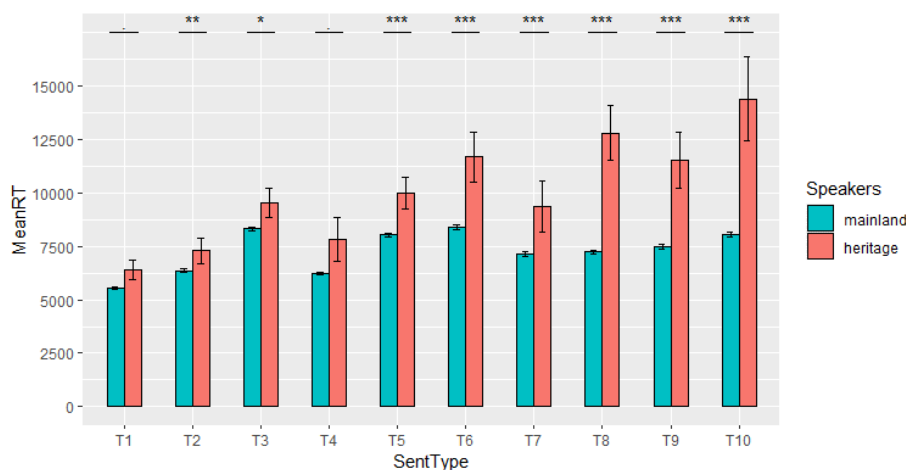


Figure 3: Comparison of response times between heritage speakers and age-matched baseline group (correct responses only). Error bars represent standard error.

Table 3 presents pairwise comparisons of response times in the heritage group across selected sentence types (see the caveat at the end of §6.2). Among the notable contrasts, negated sentences took longer than non-negated ones, both in canonical word order (T1 vs. T7) and in the marked one (T2 vs. T8). The same contrasts obtain among the cataphora vs. non-cataphora sentences (T1 vs. T9 and T2 vs. T10). Both types of cataphora sentence took comparable time to evaluate (T9 vs. T10). Among the sentences with two argument structures, both types of relative clauses (T5 and T6) took longer than clausal coordinations (T4), while subject and object relative clauses took similar time to evaluate (T5 and T6).

6 DISCUSSION

The goal of this study was to investigate the comprehension of syntactic dependencies in heritage speakers of Slovene growing up in an English-dominant environment.

Contrast	Estimate	SE	<i>t</i> -ratio	<i>p</i> -value
T1–T2	-1380	851	-1.62	0.83
T1–T4	-699	851	-0.82	0.99
T1–T7	-2847	851	-3.34	0.03
T1–T9	-4491	851	-5.27	<.0001
T2–T8	-4096	851	-4.81	0.0002
T2–T10	-5567	851	-6.54	<.0001
T4–T5	-3029	851	-3.56	0.02
T4–T6	-4303	851	-5.05	0.0001
T5–T6	-1274	851	-1.49	0.89
T7–T8	-2628	851	-3.08	0.07
T9–T10	-2456	851	-2.88	0.12

Table 3: Selected pairwise comparisons of response times in the heritage group across sentence types.

The results strengthen several previous findings in heritage linguistics while also pointing to some novel distinctions in the relative vulnerability of different morphosyntactic components.

6.1 WORD ORDER AND MORPHOLOGICAL CASE

Heritage speakers performed on a par with monolinguals on canonical structures such as monoclausal SVO sentences and coordinated clauses (T1, T4). These constructions require minimal syntactic processing beyond argument-role identification and impose no conflict between case morphology and word order. The accuracy rates on these structures serve as useful benchmarks for evaluating other sentence types. In contrast, heritage speakers showed significantly lower accuracy on focalized OVS sentences. In these sentences, grammatical roles must be assigned based on morphological case rather than linear position, placing higher demands on case processing.

In line with the accounts proposed in the literature (§2.1), the reduced performance on accuracy may be attributed to cue re-weighting, specifically, speakers' over-reliance on the word order cue in determining grammatical functions, namely subject and object, instead of the morphological case markers which signal these functions in standard Slovene.

6.2 RELATIVE CLAUSES AND COMPARATIVES

Performance on relative clauses followed a familiar asymmetry: subject relatives (T5) were processed (marginally) more accurately than object relatives (T6), replicating patterns attested in both monolinguals and heritage speakers across languages (§2.2). A further asymmetry is reflected in the contrast between subject (T5) and object (T6) relatives, on the one hand, and clausal coordinations (T4) on the other, all of which involve similar complexity in terms of number of argument structures (two) but are distinct in syntactic organization: the embedding structures (T5 and T6) demand more processing resources than the surface linear one (T4, see also Papagno & Cecchetto 2019).

The heritage speakers' weaker performance on object relative clauses (T6), relative to monolingual controls, plausibly stems from the combined demands of memory load and cue competition. Object relatives require listeners to maintain the head noun in working memory while integrating a sequence of intervening constituents, conditions that are known to tax the processing system even for monolinguals (see above). Furthermore, in

our materials, noun animacy did not assist parsing due to the reversible character of argument structures encoded in the stimuli (§4.1). Under these circumstances monolinguals fall back on morphological case to disambiguate the gap; heritage speakers, however, re-weight their cue hierarchy in favour of word order and therefore derive less benefit from case morphology. The resulting processing load on memory echoes the pattern reported for heritage Russian where adult speakers frequently reinterpret object relatives as subject relatives (Polinsky 2011), presumably for the same reason: when reliable morphological cues are down-weighted, the parser defaults to subject gap parsing. Our data thus reinforce the view that object relativization is a privileged diagnostic of how heritage grammars juggle memory constraints and diminished morphological support.

In addition, the finding that the accuracy contrast between the monolingual and heritage speakers is significant in T6 (object relatives) but only marginal in T5 (subject relatives), is noteworthy in light of the fact that Slovene relative clauses employ a resumptive strategy. In T6, a resumptive pronoun accompanies case marking (see Table 1), which does not impair performance in monolingual speakers, as has been shown in Pavlič & Stepanov (2020), but may hinder heritage speakers due to transfer effects from English which lacks resumptive pronouns in such constructions. This contrast does not arise in subject relatives (T5), where neither Slovene nor English uses resumptive pronouns.

Comparative constructions (T3) were processed relatively well, on a par with the monolinguals. This supports the view that (A'-)movement per se is not necessarily problematic for heritage speakers, especially when interpretation does not rely on case morphology. In other words, not all structurally complex constructions are equally fragile.

6.3 CATAPHORA

The accuracy data for T9 suggest that heritage speakers compute cataphoric coreference in heritage Slovene successfully, performing on par with monolinguals despite English being a non-*pro*-drop dominant language. However, this comes at a cost, as evidenced by markedly longer response times than those of monolinguals. In T10 (cataphora+OVS), accuracy drops sharply. The T9–T10 accuracy contrast also mirrors that between T1 and T2 (Table 2). If this drop reflects the influence of the marked word order, it suggests that heritage speakers process T10 as if it were T9. Response times for T9 and T10 are comparable (Table 3), which supports this conjecture.

6.4 GENITIVE OF NEGATION

The accuracy difference between T2 (marked word order, no GoN) and T8 (marked word order, GoN) presents an a priori puzzle. We reproduce a sample pair here for convenience:

- | | | |
|-----|--|------|
| (1) | Fanta lovi pes.
boy.ACC chases dog.NOM
'The boy is being chased by the dog.' | (T2) |
| (2) | Deklice ne lovi fant.
girl.GEN not chases boy.NOM
'The girl is not being chased by the boy.' | (T8) |

As noted above, there is good reason to believe that in (1) heritage Slovenes interpret the first NP as the subject based on the word order cue, rather than morphological case (in this case, Accusative). This invites a straightforward interpretation that the improved performance in T8 (cf. (2)) may be accounted for by postulating that Genitive in T8 is better retained in the speakers' grammar than accusative, due to its association with an overt lexical cue, the negative particle *ne*, in line with the prediction in §2.4. However,

there exists an alternative possibility that the improvement in T8 is due to a task-specific effect consistent with loss of Genitive.

In line with the overall JERA design, the visual layout for T8 included three distractor pictures depicting the positive version of the event described in the sentence (2) (the girl is being chased by the boy). If heritage speakers interpret the first NP as the subject, as is evident from their performance on T2, then, in T8, the participants could interpret (2) as *Deklica ne lovi fanta* 'The girl is not chasing the boy'. In that case, all four pictures in the T8 visual display can be interpreted to correspond to that meaning (Figure 4). Since the participants had no other clues at their disposal, they might have selected the only picture that stands out from the rest (where the boy is not chasing the girl) and happens to be the correct one. In other words, they could have developed a strategic response to T8 (in contrast, in T2, the visual setup includes exactly one distractor that corresponds to the 'first-NP-as-subject' possibility, cf. Figure 1).

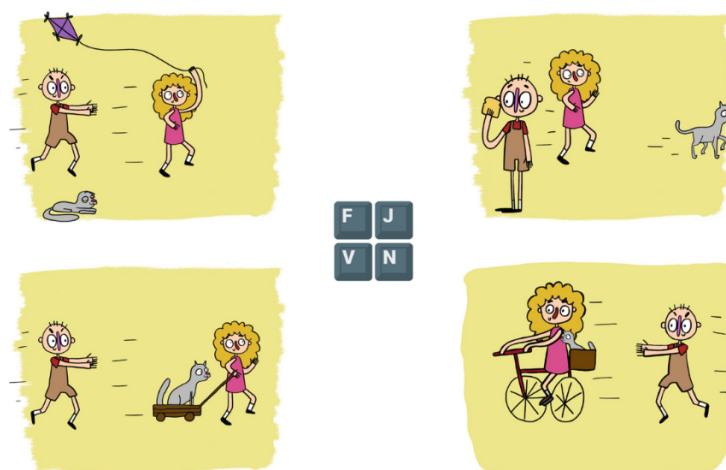


Figure 4: A visual array for the T8 sentence in (2)

In order to explore whether the improved performance on T8 was driven by the retained Genitive or by the strategic scenario compatible with the loss of Genitive, we conducted a post-hoc analysis breaking down participants' responses by the gender of the first noun. In Slovene, the GEN.SG. marker is homonymous with NOM.PL. for feminine nouns and morphologically distinct for masculine ones. If participants did not retain Genitive and interpret the first noun as the subject (as in T2), they may interpret sentence-initial feminine nouns as in (2) as nominative plural, creating an agreement mismatch with the following verb in singular. As shown in the left plot in Figure 5, heritage speakers were less accurate with clause-initial feminine than masculine nouns ($\beta = -1.158$, $SE = 0.506$, $z = -2.289$, $p = 0.02$) whereas no such gender effect was found in the baseline speakers ($\beta = 0.209$, $SE = 0.353$, $z = 0.591$, $p > 0.10$). Response times were longer for feminine compared to masculine nouns for the heritage speakers (the right plot in Figure 5), although the contrast did not reach significance ($\beta = 1209.6$, $SE = 1016$, $t = 1.190$, $p > 0.10$).

The observed gender contrast between heritage and monolingual speakers supports the hypothesis that feminine clause-initial nouns impose additional processing effort due to a subject-verb agreement mismatch, as described above. It also indicates that lexical anchoring via *ne* is insufficient to override the 'first-NP-as-subject' preference, at least for feminine nouns. As a reviewer notes, this pattern aligns with a version of the strategic scenario whereby the participants first attempt an (incorrect) SVO parse and, upon failing to find a suitable picture, turn to the strategic scenario. The evidence considered so far thus provisionally suggests the loss or re-weighting of GoN in the

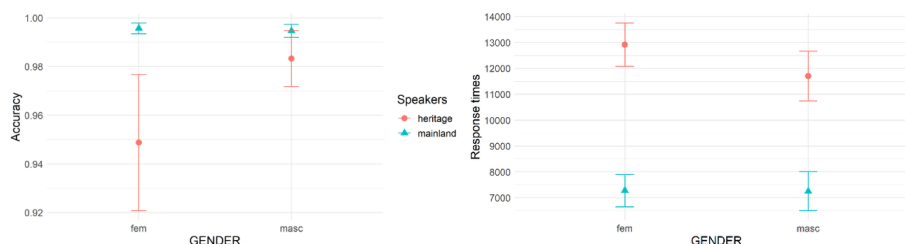


Figure 5: Impact of gender on accuracy and response times in T8: comparison of masculine and feminine nouns

heritage grammar, similarly to other morphological cases (e.g., accusative). Further research, potentially using a different experimental design, is needed to evaluate the strength of this interpretation.

Heritage speakers' overall lower accuracy in T8, despite its similarity to T7 in performance (Table 2), suggests a lower performance ceiling than monolinguals. One likely reason lies in the cognitive demands of processing negation, which requires first simulating an affirmative proposition and then revising it to reflect the negation (Kaup 2001, Kaup & Zwaan 2003). This two-step process adds inferential and memory load, particularly in metalinguistic tasks like sentence–picture verification (Tanenhaus et al. 1976, Just & Carpenter 1976). ERP studies also show increased N400 amplitudes for negated content, reflecting greater semantic integration costs (Lüdtke et al. 2008). Given heritage speakers' reliance on effortful processing in their weaker language (Polinsky 2018, Bice & Kroll 2021), these cumulative demands may limit their ability to apply task-specific heuristics as effectively as monolinguals. Further research is needed to test this.

Beyond the suggestive evidence regarding the loss of GoN, three key insights emerge. First, high accuracy in heritage comprehension tasks, especially with negation, may reflect strategic reasoning, not grammatical knowledge. Second, heritage speakers rely more on word order than on morphological case, especially in object-initial structures. Third, the cognitive demands of processing negation likely strain heritage speakers' resources, aligning with accounts of effortful and resource-demanding processing in heritage language use.

7 PROCESSING SYNTACTIC DEPENDENCIES: FINDINGS AND CONSEQUENCES

This study offers the first comprehensive assessment of how Slovene heritage speakers comprehend diverse (morpho)syntactic dependencies using a standardized test battery. First, the results reveal a consistent cue-reweighting in that heritage speakers prioritize SVO word order over morphological case. They perform comparably to monolinguals on canonical clauses but struggle when case must override linear order, as in OVS structures, object relatives, and cataphora. Both Accusative and likely Genitive fail as reliable cues, leading to surface-based parsing. Even when Genitive is lexically anchored via *ne*, improved performance likely reflects strategic reasoning, not grammatical retention.

Second, heritage speakers complete the same comprehension tasks under greater processing demands than monolinguals. Polinsky (2018: 36) argues that "...once the heritage language loses ground to another dominant language, resource-intensive phenomena [...] become more restricted." In our study, every structure requiring extra working memory or inference led to reduced accuracy and/or slower responses. For example, object relatives require maintaining the head noun across an embedded clause without strong cues like case or animacy. In cataphora (T10), speakers must identify the referent of cataphoric *pro* while also resolving marked word order. In negation, a likely two-stage

simulation process adds latency for all, but more so for heritage speakers, pointing to a higher cognitive load and a lower performance ceiling.

Not all dependencies are equally affected by processing limitations. Comparatives, which involve movement but minimal case demands, are processed accurately by heritage speakers. Subject relatives remain easier than object relatives, echoing monolingual patterns. Cataphora in canonical order is also resolved, albeit with longer latencies, suggesting that heritage speakers deploy forward-looking reference but need more time. These contrasts indicate that vulnerability depends not on abstract syntactic complexity, but on the specific constellation of cues each construction presents.

Our findings regarding cue re-weighting and increased processing demands align with established research on heritage language processing (§2). Our results further suggest that a standardized battery like JERA can also model how these two factors interact. By correlating indices of cue reliance (e.g., preference for word order over case) with latency costs on memory-intensive structures, future work could test whether greater re-weighting predicts higher cognitive load. Adding executive function measures could clarify whether cue choice is shaped by domain-general capacity. This approach is also broadly in line with the Interface Hypothesis, which links processing difficulty to cross-modular integration (Hopp 2007, Sorace 2011).

A reviewer suggests situating our findings within a usage-based perspective linking complex syntax to input frequency and literacy. Preliminary checks in the Gigafida (written)² and KRES (spoken)³ corpora confirm that unambiguous OVS clauses and object relatives are much rarer than canonical SVO or subject relatives in Slovene, meaning that heritage speakers receive minimal reinforcement for them once schooling shifts to English. However, frequency alone cannot account for the full pattern, as cataphora is similarly rare, yet heritage speakers performed well on canonical cataphoric sentences (T9), with accuracy dropping only when cue conflict was introduced (T10). This suggests that frequency may shape baseline familiarity but does not fully explain processing outcomes. Future work combining JERA with measures of literacy and language exposure (cf. Luchkina et al. 2021) could clarify how these factors interact with structure type.

Several factors limit our conclusions. One, mentioned above, has to do with lexical variability across sentence types, which is, however, mitigated by controlling lexical frequency and length across the entire test battery. Such lexical variability is a common feature of standardized batteries for testing sentence comprehension which deliberately vary vocabulary to reduce potential boredom or fatigue effects. Second, the sentence-picture verification format, though suited for large-scale testing, is vulnerable to task strategies and provides only endpoint measures. Finally, because first-generation immigrant data were unavailable for statistical sampling (§4.2), the homeland Slovene baseline may differ in subtle register or dialect features from the input that shaped our heritage speakers' grammar. However, we believe this concern is minimized by our choice of sentence types which target syntactic constructions not obviously prone to dialectal variation.

Taken together, the results of this study suggest that the heritage grammar of Slovene is subject to two main factors: morphological cue re-weighting and increased processing demands. Core clause comprehension is preserved, yet syntactic dependencies that depend on morphology or hierarchical embedding tend to be re-evaluated in favour of surface order or strategic reasoning. Further studies that combine the breadth of standardized tests with online measures such as eye-tracking or neuroimaging will be essential for identifying specific points of vulnerability on a more fine-grained scale, separating genuine grammatical knowledge from compensatory strategies and testing the extent to which these Slovene patterns generalize across the Slavic heritage spectrum.

²<https://www.cjvt.si/en/research/cjvt-projects/gigafida-corpus/>

³<http://www.korpus-kres.net/Support/About>

ABBREVIATIONS

ACC	accusative	NOM	nominative
GEN	genitive	PL	plural
GoN	genitive of negation	SD	standard deviation
M	Mean	SG	singular

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