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Interface challenges in online processing: the role of crosslinguistic influence in L2 sentence comprehension

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Abstract

The integration of multiple linguistic modules – syntax, semantics and pragmatics – poses a persistent challenge for adult second language (L2) learners, as posited by the interface hypothesis (IH). This study examines how crosslinguistic influence impacts L2 learners' acquisition and processing of Korean quotative constructions at the syntax–semantics– pragmatics interface. Using offline acceptability judgment and online self-paced reading tasks, we compared Japanese- and Chinese-speaking learners of Korean. The results revealed that Japanese-speaking learners outperformed Chinese-speaking learners in offline tasks, demonstrating native-like sensitivity to case-marking constraints, likely due to the structural similarities between Japanese and Korean. However, neither learner group exhibited sensitivity to case-marking violations during real-time processing, unlike native Korean speakers. These findings suggest a dissociation between explicit knowledge and online processing abilities, supporting the IH and emphasizing the persistent challenges of integrating multiple linguistic domains in L2 processing. This study underscores the role of crosslinguistic influence in facilitating explicit knowledge acquisition while revealing its limitations in fostering native-like automaticity in online processing.

1. Introduction

Integrating multiple sources of information constitutes one of the most vulnerable areas for adult second language (L2) learners (Hopp et al., 2020; Pérez-Leroux & Glass, 1999; Serratrice et al., 2009; Sorace & Filiaci, 2006; Sorace et al., 2009). This challenge has been extensively investigated within the theoretical framework of the interface hypothesis (IH, Sorace, 2011; Sorace & Filiaci, 2006). The IH proposes that

L2 learners encounter major difficulty when acquiring and processing linguistic phenomena requiring simultaneous coordination across different linguistic modules, including (morpho)syntax, semantics and pragmatics.

While interface-related difficulties have been widely documented (e.g., Belletti et al., 2007; Hopp, 2009; Hopp et al., 2020; Roberts et al., 2008; Serratrice et al., 2009; Slabakova, 2015; Sorace, 2011; Wilson, 2009), a contentious issue remains unresolved, raising a question about to what extent these challenges are modulated by various language-internal and external conditions. Some researchers maintain that certain interface phenomena, particularly those involving syntax–pragmatics mappings, pose insurmountable challenges for L2 learners, suggesting a fundamental constraint on ultimate attainment in these domains (Belletti et al., 2007; Liceras, 1988; Pérez-Leroux & Glass, 1999; Sorace, 2011; Sorace & Filiaci, 2006). In contrast, others contend that under certain circumstances, such as reduced cognitive load, advanced proficiency and crosslinguistic similarities between a learner's first language (L1) and L2, learners may overcome these integration difficulties and attain native-like performance (Herbay et al., 2018; Montrul & Rodríguez-Louro, 2006; Pan et al., 2015).

Against this background, the present study seeks to contribute to this ongoing debate by examining how learners' L1 influences their ability to manage interface-driven challenges. Our approach extends beyond the scope of previous research in three major ways. First, while many studies relied on offline measures, such as untimed grammaticality judgment tasks (e.g., Gondra, 2022; Leal et al., 2014; Özçelik, 2018; Slabakova, 2015; Slabakova et al., 2012) and verification tasks (e.g., Belletti et al., 2007; Rothman, 2009; Sorace & Filiaci, 2006), which allow participants ample time to process the stimuli and make conscious decisions (Ellis, 2005; Jiang, 2007), this study incorporates both offline judgment and online processing methodologies (e.g., Hopp, 2009). Untimed grammaticality judgments are widely understood to tap into learners' explicit grammatical knowledge (Ellis, 2005; Ellis & Loewen, 2007). Because participants are given unlimited time to reflect on sentence acceptability, their responses are typically guided by declarative knowledge that reflects conscious, metalinguistic representations of grammatical rules. In contrast, online self-paced reading tasks assess how efficiently learners apply their knowledge during incremental language processing. By measuring reading times across segmented sentences, these tasks assess the efficiency with which grammatical constraints are applied during incremental language processing, offering insight into the extent to which learners have internalized and proceduralized their knowledge (Ellis, 2005; Jiang, 2007). By employing this dual-task paradigm, we aim to disentangle whether difficulties at the syntax–semantics–pragmatics interface stem from representational deficits – that is, a failure to acquire the underlying linguistic constraints – or from processing limitations, such as difficulties in integrating multiple sources of information in real time (e.g., Herbay et al., 2018; Hopp, 2009).

Second, unlike much of the previous interface research, which has predominantly centered on Indo-European languages such as Dutch, English, German, Italian and Spanish (e.g., Hopp, 2009; Montrul & Rodríguez-Louro, 2006; Sorace & Filiaci, 2006), this study focuses on Korean, a typologically distinct and relatively understudied language in the interface literature. Morphological case marking in Korean presents substantial learning difficulties for L2 learners, especially when their L1 lacks a comparable case-marking system (e.g., Frenck-Mestre et al., 2019; Park & Kim, 2022). By placing L2 acquisition of Korean case marking at its analytic center, this study attempts to offer novel insights into how L2 learners with and without a case-

marking system in their L1 process Korean sentences at the interface of morphology, semantics and pragmatics.

Third, this study explores the role of crosslinguistic influence in modulating interface vulnerability by conducting a comparative analysis of L1 Mandarin Chinese (hereafter 'Chinese') and L1 Japanese learners of Korean. The typological contrast between these languages provides an ideal testing ground for this investigation. Japanese uses a case-marking system that closely parallels Korean in both morpho-syntactic marking and discourse-pragmatic operations. In contrast, Chinese, lacking a morphological case system, primarily relies on word order and contextual cues to disambiguate argument roles in clauses. As a result, Chinese-speaking learners must acquire the syntactic distribution of Korean case markers in given semantic and pragmatic contexts. By comparing these two learner groups, we investigate whether crosslinguistic similarities and differences between learners' L1 and L2 facilitate or impede the acquisition and processing of complex L2 structures involving the integration of syntactic, semantic and pragmatic information.

To address these issues, we examine learners' offline acceptability judgments and online reading patterns, focusing on Korean quotative constructions. We selected quotative constructions as target structures as they offer an ideal test case for our research goals. As will be discussed in detail, these constructions require the integration of syntactic, semantic and pragmatic information within a single grammatical domain (Ko, 2001), making them well suited for testing the IH. In addition, case-marking alternations, where grammaticality depends on verb semantics and pragmatic emphasis, create a clear diagnostic for whether L2 learners can coordinate multiple linguistic cues simultaneously. Crucially, the typological similarities between Korean and Japanese, contrasted with the differences between Korean and Chinese, allow us to assess how L1-L2 structural similarities modulate interface challenges. While other domains may also involve interface difficulty, quotative constructions provide a particularly controlled, multidimensional context in which interface vulnerability and crosslinguistic influence can be systematically examined.

2. The IH: Internal versus external interfaces

The central idea of the IH is that linguistic phenomena requiring integration across distinct modules, such as syntax, semantics and pragmatics, present unique challenges for L2 learners (Sorace, 2011; Sorace & Filiaci, 2006). A key distinction within the IH framework lies in the classification of interfaces as either internal or external. Internal interfaces involve interactions between core linguistic subsystems, such as syntax–semantics mappings, where both components operate within the linguistic system, whereas external interfaces require integration between linguistic knowledge and broader cognitive systems, such as discourse and pragmatics (Tsimpli & Sorace, 2006).

These interface types present varying degrees of difficulty, giving rise to competing perspectives within the IH, each offering different predictions. The strong version of the IH posits that external interfaces remain persistently challenging for L2 learners, even at high proficiency levels (Sorace, 2011; Slabakova et al., 2012; Tsimpli & Sorace, 2006). According to this perspective, the vulnerability of external interfaces stems from the cognitive demands imposed by simultaneously managing both linguistic and extralinguistic information. Unlike internal interface phenomena, which require integration within the linguistic system, external interfaces necessitate coordination

with broader cognitive resources such as discourse processing and pragmatic inference. The cognitive resources required for this integration – particularly under processing pressure – may exceed the computational resources available to even highly proficient L2 users, leading to systematic divergence from native-like patterns (Montrul & Polinsky, 2011; Sorace, 2011). Empirical studies supporting this strong position demonstrate that external interface phenomena, such as anaphora resolution and discourse-conditioned subject–verb inversion, consistently result in difficulties for L2 learners in both production and comprehension (e.g., Lozano, 2002; Sorace & Filiaci, 2006; Sorace et al., 2009).

In contrast, the weak version of the IH proposes that the challenges associated with interface phenomena may diminish significantly and, in some cases, even disappear under certain conditions. While this perspective acknowledges the inherent difficulty of interface integration, it suggests that various facilitating factors, such as advanced proficiency, reduced processing demands, explicit instruction and crosslinguistic similarities between the L1 and L2, can enable learners to overcome many of these difficulties, although some residual variability may persist in external interfaces (Rothman, 2009; Slabakova, 2009). A growing body of research supports this perspective, demonstrating that external interfaces do not inevitably lead to persistent deficits in L2 acquisition and processing, particularly among advanced learners (e.g., Gondra, 2022; Hopp, 2009; Hopp et al., 2020; Leal et al., 2019; Montrul & Rodíguez-Louro, 2006; Özçelik, 2018; Rothman, 2009).

While the debate between the strong and weak versions of the IH remains unresolved, recent research suggests that crosslinguistic influence plays a crucial role in determining whether L2 learners can successfully acquire interface-related structures. Studies have increasingly shown that structural similarities and differences between a learner's L1 and L2 can either facilitate or hinder the acquisition of interface phenomena, particularly at external interfaces where both linguistic and cognitive resources are involved (e.g., Carroll et al., 2000; Hopp, 2009; Kim & Park, 2024; Leal et al., 2019; Roberts et al., 2008; Slabakova, 2015; Wilson, 2009).

For example, Hopp (2009) investigated the acquisition of scrambling in German at the syntax–discourse interface among L1 English, L1 Dutch and L1 Russian learners of German with near-native and advanced proficiency levels. The study employed both offline and online measures to assess whether these learners could integrate syntactic and discourse-level constraints. It focused on the crosslinguistic differences among these languages in how scrambling is realized in relation to information structure, particularly with respect to object fronting across a subject. While Russian allows scrambling operations analogous to German, Dutch does not exhibit such scrambling. In contrast, English neither allows scrambling across subjects nor uses case marking to indicate information structure. The results indicated that both near-native L1 Russian and L1 English learners, but not the L1 Dutch group, demonstrated sensitivity to syntactic constraints on information structure, indicating their ability to integrate syntax and discourse-level information, even when their L1 differs from the target language in syntax–discourse mappings. Hopp (2009) attributed the absence of sensitivity among Dutch L1 learners to asymmetries in how information structure is mapped onto syntax in their L1 and L2. These findings support the weak version of the IH, indicating that, while advanced L2 learners can acquire interface-related phenomena, full convergence may be influenced by factors such as L1 background and processing demands.

Building on these findings, the current study extends the investigation to the integration of case marking, verb semantics and pragmatic information in Korean.

Specifically, we examine how the presence or absence of a case-marking system in learners' L1 influences their acceptability judgment and sentence processing patterns in L2 Korean sentence comprehension. To this end, we focus on Korean quotative constructions, which require the integration of multiple domains of information. In the following section, we provide an overview of these constructions and discuss how they involve the coordination of syntactic, semantic and pragmatic information.

3. Characteristics of Korean quotative constructions and comparative perspectives in Japanese and Chinese

Korean allows various case marking, depending on morphological, syntactic, semantic and discourse conditions (Hwang, 2023; Sohn, 1999). A case in point is Korean quotative constructions, which involve verbs of cognition and propositional attitude (e.g., *sayngkakhata* 'think', *mitta* 'believe', *alta* 'know') and typically exhibit complex multi-clausal structures. These constructions employ the quotative complementizer -*ko* to introduce embedded clauses that convey propositional content (Hong, 2005; Ko, 2001; Lee, 2006; Sohn, 1999; Yoon, 2007) and may include either volitional verbs (e.g., *ttwinta* 'run', 1a) or non-volitional predicates (e.g., *ipputa* 'pretty', 1b).

(1) a. Minho-nun   [Yuna-ka   ttwintako]-ko   sayngkakhayssta.
Minho-TOP[1] [Yuna-NOM   run]-COMP   thought
'Minho thought that Yuna ran.'
  b. Minho-nun   [Yuna-ka   ipputako]-ko   sayngkakhayssta.
Minho-TOP   [Yuna-NOM   pretty]-COMP thought
'Minho thought that Yuna was pretty.'

A critical feature of these quotative constructions is the case marking of the embedded subject, which alternates between nominative -*ka* and accusative -*ul* depending on the semantic properties of the subordinate predicate and the pragmatic focus of the sentence (Kim, 1994; Ko, 2004). As illustrated in (2), quotative constructions with volitional, unergative verbs in the embedded clause allow only nominative marking for the embedded subject, rendering the use of an accusative marker ungrammatical (2a). In contrast, when the embedded predicate is non-volitional, such as an unaccusative verb or an adjectival predicate, both nominative (1b) and accusative (2b) markings are acceptable for the embedded subject.

(2) a. *Minho-nun   [Yuna-lul   ttwintako]-ko   sayngkakhayssta.
Minho-TOP   [Yuna-ACC   run]-COMP   thought
'Minho thought that Yuna ran.'
  b. Minho-nun   [Yuna-lul   ipputako]-ko   sayngkakhayssta.
Minho-TOP   [Yuna-ACC   pretty]-COMP thought
'Minho thought that Yuna was pretty.'

This asymmetry in case marking is driven at least by two factors. First, the semantic properties of the embedded predicate determine whether its subject must

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[1]Abbreviations in the glosses are as follows: ACC = accusative marker; COMP = complementizer; NOM = nominative marker; TOP = topic marker

be licensed with the nominative case. Unergative verbs, which denote volitional actions, require an agentive subject that must be licensed by the nominative case as an external argument. In contrast, unaccusative verbs and adjectival predicates describe non-volitional states or conditions, allowing their subjects to be treated as internal arguments (Ko, 2001). As a result, while these subjects are typically marked with the nominative case, they may receive accusative marking under such conditions.

The second crucial factor is pragmatic emphasis, which significantly influences the grammaticalization of case marking, as observed across typologically diverse languages such as Estonian (Cann & Miljan, 2012), Hindi-Urdu (de Hoop & Malchukov, 2008) and Korean (Hwang, 2023). Korean quotative constructions, in particular, provide a compelling example of this effect. When the subject of an embedded clause receives special emphasis, it may be marked with accusative case marking, especially in constructions involving adjectival predicates (Kim, 1994). For example, the accusative-marked embedded subject in (2b) emphasizes Yuna's beauty, suggesting that the speaker is placing particular focus on Yuna as the subject of evaluation rather than merely describing her state. This nuance is best captured by contrastive translations such as 'Minho considers Yuna (not someone else) to be pretty' or focused readings such as 'It is Yuna that Minho considered to be pretty'. In contrast, an accusative-marked subject remains prohibited in constructions involving unergative verbs, even when the subject is discourse prominent, since these constructions require the embedded subject to be interpreted unambiguously as an agent engaged in volitional action and bearing external argumenthood.

In summary, the case alternation pattern in Korean quotative constructions arises from the interplay among syntax, semantics and pragmatics. The restriction on case marking for the embedded subject, which depends on the predicate's semantic properties (i.e., volitionality), reflects the interaction between syntax and semantics. At the same time, the differential case marking of the embedded subject in non-volitional predicates highlights the syntax–pragmatics interface, as accusative marking is permitted when pragmatic emphasis is placed on the embedded subject, such as for contrast, focus or increased salience in discourse.

For Japanese and Chinese speakers, the multidimensional features of Korean quotative constructions present varying degrees of crosslinguistic difference. Japanese exhibits nearly identical case marking patterns in quotative constructions due to shared morphological and syntactic properties (Kuno, 1976; Shibatani, 1990; Tanaka, 2002). Like their Korean counterparts, unergative embedded verbs in Japanese allow only nominative, but not accusative, marking for their subject (3a), whereas non-volitional predicates allow both nominative and accusative marking (3b), conditioned on specific discourse contexts.

(3) a. Shota-wa   Hanako-ga/*-o   hasiru-to   omot-ta.
         Shota-TOP   Hanako-NOM/*-ACC   run-COMP   thought
         'Shota thought that Hanako ran'.
     b. Shota-wa   Hanako-ga/−o   kireida-to   omot-ta.
         Shota-TOP   Hanako-NOM/-ACC   pretty-COMP   thought
         'Shota thought that Hanako was pretty.'

In contrast, Chinese lacks a case-marking system, and thus, argument roles are typically determined by their position within the sentence (Li & Thompson, 1989), as shown in (4). Therefore, the case-marking restriction on the embedded subject in Korean and Japanese is not applicable in Chinese.

(4) a. Wei   xiang   [Hua   pao   de]   zhihou
      Wei   think   Hua   run   COMP   after
      'Wei thought that Hua ran'

   b. Wei   xiang   [Hua   piaoliang   de]   zhihou
      Wei   think   Hua   pretty   COMP   after
      'Wei thought that Hua was pretty'

The crosslinguistic similarity between Korean and Japanese and the difference between Korean and Chinese in these constructions provide a critical test case for the effect of learners' L1. While Japanese learners may benefit from their L1 parallels in the case marking restriction, Chinese learners, whose L1 lacks case particles, must rely on cues unavailable in their native language.

4. Research questions

Taking advantage of the crosslinguistic similarities and differences in quotative constructions across Korean, Japanese and Chinese, this study investigates the acquisition and real-time processing of Korean quotative constructions at the syntax–semantics–discourse interfaces. By comparing L1 Japanese and L1 Chinese learners of Korean, we aim to address the following research questions.

1. Do L1 Japanese learners, whose L1 features a case-marking system, demonstrate superior performance compared to L1 Chinese learners, whose L1 lacks morphological case marking, in interpreting Korean case alternations in quotative constructions?
2. Do learners exhibit differences between offline acceptability judgments and online reading patterns, reflecting the distinctions between explicit knowledge and real-time processing?

5. Experiment 1: offline acceptability judgment task

5.1. Participants

The study involved two groups of L2 learners – 40 L1 Chinese learners of Korean (L1-Chinese group), 40 L1 Japanese learners of Korean (L1-Japanese group) – along with 40 native speakers of Korean as a control group. The L2 learners were recruited from undergraduate and graduate students enrolled at universities in South Korea. To ensure advanced proficiency, only learners who had attained at least a level of 5 on the test of proficiency in Korean (TOPIK) were included in the study. According to the test developers, levels 5 and 6 of TOPIK, the top two tiers in the test, correspond to Korean language users with professional-level proficiency, particularly in academic contexts.

To further assess the current levels of Korean proficiency, participants completed a modified version of TOPIK (Jeong, 2017). In this task, they read 30 sentences with blanks and selected the appropriate morpheme or word for each blank from four options. An independent samples t-test revealed no significant difference between the Chinese-L1 and Japanese-L1 groups in their proficiency scores, $t(78) = -1.248$, $p = .216$, Cohen's $d = -0.279$. Furthermore, the two groups did not differ significantly

Table 1. Background information for L2 learners

Group	L1-Chinese group (n = 40)		L1-Japanese group (n = 40)	
	M (SD)	Range	M (SD)	Range
Age	29 (3.6)	23–37	22 (2.3)	21–32
Years of learning Korean	4.6 (2.6)	0.8–12.0	4.0 (2.9)	1.0–14.0
Years of residence in Korea	3.5 (2.2)	0.2–10.0	1.9 (2.3)	0.1–14.0
Proficiency test score (max = 30)	14.7 (4.1)	8–24	15.7 (3.4)	6–23

in their length of learning Korean, $t(78) = 0.941$, $p = .350$, Cohen's $d = 0.210$. However, the Chinese-L1 group spent significantly more time residing in Korea than the Japanese-L1 group, $t(78) = 3.232$, $p = .002$, Cohen's $d = 0.723$. Participants' demographic information is provided in Table 1.

All participants provided written consent before participating in the experiment and received monetary compensation for participation.

5.2. Materials

The acceptability judgment task included 12 experimental sentences featuring Korean quotative constructions, as illustrated in (5). To examine participants' knowledge of case-marking constraints on embedded subjects, we manipulated two factors: the case marker type on the embedded subject (nominative versus accusative) and the type of embedded predicate (adjectival predicate versus unergative verb).

(5) a. Adjectival predicate conditions
    Hamin-i Sehuy-ka/−lul   acwu   chakhata-ko sayngkakhaysseyo.
    Hamin- Sehuy-NOM/-ACC very   kind-COMP   thought
    NOM
    'Hamin thought that Sehuy was very kind'
   b. Unergative verb conditions
    Hamin-i Sehuy-ka/−lul   manhi ketnunta-ko sayngkakhaysseyo.
    Hamin- Sehuy-NOM/-ACC much   walk-COMP   thought
    NOM
    'Hamin thought that Sehuy walked a lot'

Each participant was assigned to one of the four counterbalanced lists, ensuring an even distribution of case-marking and predicate-type conditions across participants. In addition to the experimental items, we included 40 fillers, consisting of 20 grammatical and 20 ungrammatical sentences. The ungrammatical fillers included a variety of structures with violations specifically targeting case-marker selection.

5.3. Procedure

All participants completed both the acceptability judgment and self-paced reading experiments during a single testing session. The experimental sequence was as

follows: (1) language background questionnaire, (2) Korean proficiency test (modified TOPIK), (3) self-paced reading task (Experiment 2) and (4) acceptability judgment task (Experiment 1). This order ensured that participants' performance on the online processing task remained unaffected by prior exposure to test items in the offline judgment task.

The acceptability judgment experiment was administered through an online platform using Google Forms. Participants rated sentence naturalness using a 4-point Likert scale, ranging from 1 ('Highly unacceptable') to 4 ('Highly acceptable'). To discourage random responses to items that they were unsure of, an additional 'I don't know' option was provided. Sentences were presented individually, with the next trial appearing immediately after the response. Participants were not allowed to revisit or change their previous ratings. The experiment began with two practice trials to familiarize participants with the rating procedure. Instructions emphasized evaluating the overall acceptability or naturalness of each sentence, rather than focusing solely on grammatical correctness. The entire task took approximately 20–25 minutes to complete.

5.4. Data trimming and analysis method

We first checked 'I don't know' responses, which accounted for 0.3% of the total data (0.8% in the L1-Chinese group, 0.1% in the Japanese group and 0.05% in the L1-Korean group). These responses were excluded from further analysis.

Participants' acceptability ratings were analyzed using a cumulative link model with the *clmm* function (Christensen, 2015; Christensen & Brockhof, 2013), a statistical method suitable for handling ordinal data. The model included three fixed effects: *Group* (L1-Chinese, L1-Japanese, L1-Korean), *Case marking* on the subject (nominative, accusative) and *Predicate type* (adjectival predicate, unergative verb). The *Group* variable was Helmert coded, allowing for two comparisons: one between the L2 groups with the L1-Korean group and another between the L1-Chinese group with the L1-Japanese group. The fixed effects of *Case marking* and *Predicate type* were contrast coded (−0.5 assigned to accusative and adjectival predicate conditions, 0.5 assigned to nominative and unergative verb conditions) and centered around the mean. The model also incorporated random effects for participants and items. Initially, we constructed the maximal random-effects structure permitted by the design, including by-participant random slopes for *Case marking* and *Predicate type*, a by-item random slope for *Group*, and random intercepts for participants and items. To address issues with model convergence, we progressively simplified this structure by removing the least influential random slopes, insofar as model simplifications did not significantly reduce model fit, as determined by likelihood ratio tests (Bates et al., 2015). As a result, the final model retained a by-participant random slope for *Case marking*, a by-item random slope for *Group* and random intercepts for participants and items. All modeling was conducted in R version 4.3.3 (R Core Team, 2024).

5.5. Predictions

Among the four conditions, only the accusative-marked subject in the unergative verb condition is ungrammatical. Accordingly, native speakers of Korean are expected to judge sentences in this condition as less acceptable than those in the other conditions. If L2 learners have successfully acquired the case-marking constraints at the syntax–semantics–pragmatics interface, they should demonstrate a similar pattern: lower

acceptability ratings for accusative-marked subjects only in the unergative verb condition, while showing no distinction between the two case-marking conditions in the adjectival predicate condition. Furthermore, if the presence of case marking in learners' L1 facilitates this acquisition, the Japanese-L1 group is expected to exhibit more native-like performance compared to the Chinese-L1 group.

5.6. Results

Figure 1 presents the acceptability ratings across the four conditions for each group. The graph shows distinct patterns among the three groups. Both the L1-Korean and L1-Japanese groups rated sentences with accusative-marked subjects in the unergative condition as less acceptable than those in the other conditions. In contrast, the L1-Chinese group consistently rated accusative-marked subjects as less acceptable than nominative-marked subjects, regardless of the predicate type.

To analyze these results in detail, we fitted a cumulative link model. The model outcomes are summarized in Table 2.

The model revealed significant effects of *Group*, *Case marking* and *Predicate type*, along with several significant interactions. To further inspect these interactions, we constructed separate cumulative link models for each group, including the fixed effects of *Case marking* and *Predicate type*, along with random effects of participants and items.

For the L1-Korean group, the model showed a significant effect of *Case marking* ($b = 3.96$, $SE = 0.77$, $p < .001$), a significant effect of *Predicate type* ($b = -2.16$,
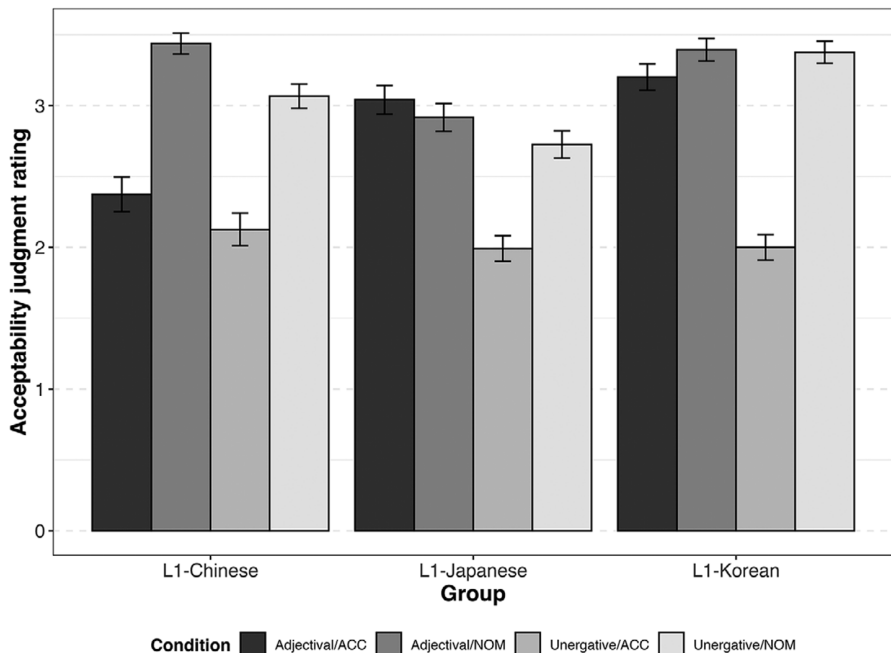

Figure 1. Acceptability judgment ratings for experimental items.

Table 2. Model outputs from the acceptability judgment task

	ß	SE	p
Group (L1-Chinese versus L1-Japanese)	−0.26	0.56	.643
Group (L1-Korean versus L2 groups)	1.24	0.50	.013*
Case marking	2.46	0.32	<.001***
Predicate type	−1.60	0.14	<.001***
Group (L1-Chinese versus L1-Japanese) × case marking	−2.28	0.74	.002**
Group (L1-Korean versus L2 groups) × case marking	0.86	0.66	.194
Group (L1-Chinese versus L1-Japanese) × predicate type	−0.90	0.30	.003**
Group (L1-Korean versus L2 groups) × predicate type	−0.39	0.30	.193
Case marking × predicate type	1.87	0.25	<.001***
Group (L1-Chinese versus L1-Japanese) × case marking × predicate type	3.04	0.60	<.001***
Group (L1-Korean versus L2 groups) × case marking × predicate type	2.50	0.53	<.001***

* $p < .05$; ** $p < .01$; *** $p < .001$.

$SE = 0.35$, $p < .001$) and a significant interaction between the two ($b = 4.13$, $SE = 0.53$, $p < .001$). Post-hoc tests using the *emmeans* function with Tukey adjustments confirmed that sentences with accusative-marked subjects received significantly lower ratings than sentences with nominative-marked subjects in the unergative verb condition ($b = -6.02$, $SE = 0.85$, $p < .001$), whereas ratings between the two case-marking conditions did not significantly differ in the adjectival predicate condition ($b = -1.89$, $SE = 0.78$, $p = .076$).

A similar pattern emerged in the L1-Japanese group, where we found a significant effect of *Case marking* ($b = 0.98$, $SE = 0.43$, $p = .024$), a significant effect of predicate type ($b = -1.80$, $SE = 0.21$, $p < .001$) and a significant interaction between the two ($b = 2.39$, $SE = 0.41$, $p < .001$). Post-hoc tests with Tukey adjustments confirmed that sentences with accusative-marked subjects received significantly lower ratings compared to those with nominative-marked subjects in the unergative condition ($b = -2.17$, $SE = 0.48$, $p < .001$), whereas no significant difference emerged between the two case-marking conditions in the adjectival predicate condition ($b = 0.22$, $SE = 0.48$, $p = .969$).

In contrast, the model for the L1-Chinese group revealed a significant effect of *Case marking* ($b = 3.03$, $SE = 0.63$, $p < .001$) and a significant effect of *Predicate Type* ($b = -0.94$, $SE = 0.22$, $p < .001$) but no significant interaction between the two ($b = -0.36$, $SE = 0.43$, $p = .406$). These results indicate that participants in this group found sentences in the adjectival predicate condition more acceptable than those in the unergative verb condition. Also, they consistently rated sentences with accusative-marked subjects as less acceptable than those with nominative-marked subjects. However, their judgments did not differ between the adjectival predicate and unergative verb conditions when the subject was accusative marked.

In summary, the analysis of participants' acceptability judgments indicated that both the L1-Korean and L1-Japanese groups were sensitive to the interaction between case marking and predicate type, whereas the L1-Chinese group was not. The judgment patterns of the Japanese-L1 group suggest that these participants were able to integrate morphosyntactic, semantic and pragmatic cues in a native-like manner. In contrast, the L1-Chinese group demonstrated a more general sensitivity to case marking but did not exhibit the same interaction effect observed in the L1-Korean and L1-Japanese groups. These results suggest that learners' L1

significantly influenced their judgments of case-marking constraints at the syntax–semantics–pragmatics interface.

6. Experiment 2: online self-paced reading task

6.1. Participants

The same participants from Experiment 1 completed the self-paced reading task.

6.2. Material

The items for the self-paced reading task were based on those used in the acceptability judgment task, with some modifications. As shown in (6), an adverbial phrase (e.g., *ecey* 'yesterday') was consistently added at the beginning of each sentence to provide temporal context. Additionally, an extra clause (*nanun kipwuni cohasseyo* 'I felt good') was appended to accommodate a spillover region, allowing for the detection of any delayed processing effects. Each sentence was presented in nine regions (Rs). Among them, we focused on R6 (*sayngkakhay-se*) as the critical region, as it represents the earliest point at which comprehenders could integrate case marking and predicate information. We also analyzed R7 (*na-nun*) as a spillover region.

(6) a. Adjectival predicate conditions

$Ecey_{R1}$	$Hamin-i_{R2}$	$Sehuy-ka/-lul_{R3}$	$acwu_{R4}$	$chakhata-ko_{R5}$
yesterday	Hamin-NOM	Sehuy-NON/-ACC	very	kind-COMP
$sayngkakhay-se_{R6}$	$na-nun_{R7}$	$kipwun-i_{R8}$	$cohasseyo._{R9}$	
thought-and	I-TOP	feeling-NOM	good	

'Hamin thought that Sehuy was very kind, and so I felt good.'

   b. Unergative verb conditions

$Ecey_{R1}$	$Hamin-i_{R2}$	$Sehuy-ka/-lul_{R3}$	$manhi_{R4}$	$ketnunta-ko_{R5}$
yesterday	Hamin-NOM	Sehuy-NON/-ACC	much	walk-COMP
$sayngkakhay-se_{R6}$	$na-nun_{R7}$	$kipwun-i_{R8}$	$cohasseyo._{R9}$	
thought-and	I-TOP	feeling-NOM	good	

'Hamin thought that Sehuy walked a lot, and so I felt good.'

Each participant was assigned to one of four lists counterbalanced for case-marking (accusative, nominative) and predicate-type (unergative, adjectival) conditions. The experimental items were intertwined with 40 fillers with a variety of structures.

6.3. Procedure

The task was administered via a web-based interface supported by PCIbex Farm (https://farm.pcibex.net/). Prior to the task, participants read instructions and

completed five practice trials to become familiar with the procedure. Sentences were displayed incrementally in a noncumulative moving-window manner (Just et al., 1982). At the start of each trial, placeholders in the form of dashes appeared on the screen, representing each segment of the sentence. Pressing the spacebar revealed the first segment, which was then replaced by dashes once the next segment appeared. This process continued until the entire sentence had been revealed, allowing participants to read each sentence at their own pace.

After each sentence, a true-or-false comprehension question assessed the participants' understanding. Participants selected their response by clicking on one of the two options displayed on the screen. The task proceeded without any feedback, and the reading times for each segment, along with participants' accuracy on the comprehension questions, were recorded automatically by the software. The task lasted approximately 20 minutes.

6.4. Data trimming and analysis method

First, we removed trials for which participants provided incorrect responses in comprehension questions.[2] This process results in a loss of 6.2% of the data (3.7% in the L1-Korean group, 7.7% in the L1-Chinese group and 6.9% in the Japanese-L1 group). We also identified and removed extreme reading times (RTs) that exceeded 3 standard deviations from the mean across participants, resulting in a loss of 1.8% of the data (0.6% in the L1-Korean group, 2.3% in the L1-Chinese group and 2.2% in the Japanese-L1 group). For the normality of data distribution, the RTs after trimming were log transformed. To further minimize variations in individuals' reading speed and differences in word length across items, the log-transformed RTs were converted to residual RTs, which were calculated by subtracting the predicted RTs from the log-transformed RTs (Ferreira & Clifton, 1986).

Log-transformed residual RTs from the critical region (R6) and the spillover region (R7) were analyzed using linear mixed-effects models, implemented with the *lmer* function (Bates et al. 2015) in R. We conducted separate analyses for the adjectival-predicate and unergative-verb conditions, as their embedded clauses differed not only in predicate type but also in overall clause structure and lexical content, which can influence self-paced reading times. For example, as illustrated in example (6), variations in the pre-critical regions (R3, R4 and R5) introduce differing lexical and structural characteristics across conditions, potentially imposing distinct processing demands that influence RTs in the critical region (R6) and leading to divergent reading-time patterns unrelated to our manipulation of case marking. Analyzing each predicate type separately thus reduces the risk of conflating condition-specific surface features with the effects of interest. To control for multiple comparisons, we applied a Bonferroni correction by dividing the conventional alpha level of .05 by the number of tests, resulting in an adjusted alpha level of .025 for each test.

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[2]The mean accuracy scores were 90.3% ($SD = 6.2$) for the L1-Korean group, 86.5% for the L1-Chinese group ($SD = 6.7$) and 84.7% ($SD = 7.4$) for the Japanese L1-group. A one-way ANOVA revealed a significant effect of group, $F(2, 117) = 7.237$, $p = .001$. Post-hoc comparisons showed that the Korean-L1 group had significantly higher accuracy than both L2 groups (all $ps < .05$), while the difference between the two L2 groups was not statistically significant ($p = .447$). Despite these differences, all three groups demonstrated high accuracy, indicating that they paid close attention to the meaning of the task items.

For each predicate type condition at each region, the model included the fixed effects of *Group* (L1-Chinese, L1-Japanese, L1-Korean), *Case marking* on the subject (nominative, accusative) and *Predicate type* (unergative verb, adjectival predicate). The *Group* variable was Helmert coded, comparing (a) the L2 groups with the L1-Korean group and (2) the L1-Chinese and L1-Japanese groups. *Case marking* and *Predicate type* were contrast-coded (-0.5 for accusative and adjectival conditions, 0.5 for nominative and unergative conditions) and centered around the mean. Due to model convergence issues, we progressively simplified the maximal random-effects structure, following the same procedure used in Experiment 1. As a result, the final, most parsimonious model retained a by-participant random slope for *Case marking*, along with random intercepts for participants and items.

6.5. Predictions

In self-paced reading tasks, grammatical violations typically lead to increased reading times. Accordingly, we expect native speakers of Korean to show slowdowns when processing an accusative-marked embedded subject compared to a nominative-marked subject in the unergative verb condition. In contrast, no significant reading time differences are predicted between the two case marking conditions in the adjectival predicate condition.

If L2 learners can successfully integrate multiple sources of information including syntactic, semantic and pragmatic cues, they should exhibit native-like processing patterns, spending more time for accusative-marked subjects only in the unergative verb condition, while demonstrating no reading time difference between the two case-marking conditions in the adjectival predicate condition. Additionally, if the learners' L1 influences their processing, the Japanese-L1 group is expected to exhibit more native-like processing patterns than the Chinese-L1 group.

6.6. Results

6.6.1. Adjectival predicate condition

Figure 2 presents participants' reading time profiles for the two case-marking conditions in the adjectival verb context. Inspection of the graphs suggests that all three groups spent almost the same time between the two case-marking conditions in the critical and spillover regions.

To examine these patterns in detail, we conducted mixed-effects regression. The summary of the mixed-effects models is presented in Table 3.

In the critical region (R6), the model only revealed a significant effect of *Group*, driven by generally longer reading times in the L1-Korean group compared to the two L2 groups. Similarly, in the spillover region (R7), *Group* remained the only significant effect, again reflecting longer reading times for the L1-Korean group. These results suggest that all three groups exhibited comparable reading times across the two case-marking conditions when the embedded clause contained an adjectival predicate.

6.6.2. Unergative verb condition

Participants' reading time patterns in the unergative verb condition are illustrated in Figure 3. The graphs suggest that the L1-Korean group spent a longer time in the
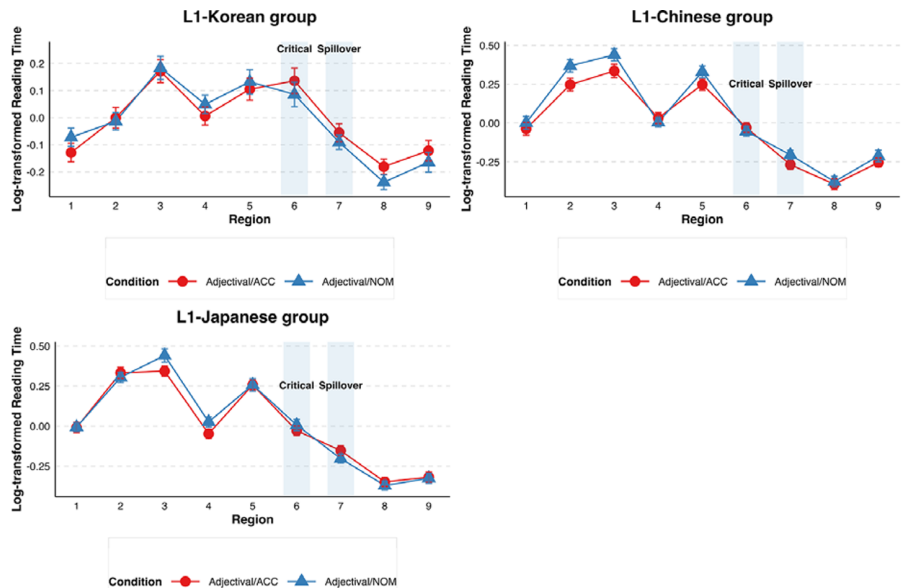
Figure 2. Reading time profiles in the adjectival predicate condition.

Table 3. Model outputs from the self-paced reading task: adjectival predicate condition

Region	Factor	ß	SE	p
Critical (R6)	(Intercept)	0.02	0.02	.153
	Group (L1-Chinese versus L1-Japanese)	0.02	0.04	.579
	Group (L1-Korean versus L2 groups)	0.13	0.03	<.001***
	Case marking	−0.01	0.03	.650
	Group (L1-Chinese versus L1-Japanese) × case marking	0.06	0.07	.384
	Group (L1-Korean versus L2 groups) × case marking	−0.06	0.06	.384
Spillover (R7)	(Intercept)	−0.16	0.01	<.001***
	Group (L1-Chinese versus L1-Japanese)	0.06	0.04	.112
	Group (L1-Korean versus L2 groups)	0.13	0.03	<.001***
	Case marking	−0.01	0.02	.715
	Group (L1-Chinese versus L1-Japanese) × case marking	−0.11	0.06	.042
	Group (L1-Korean versus L2 groups) × case marking	−0.04	0.05	.435

*** $p < .001$.

accusative-marked subject condition than in the nominative-marked verb condition, particularly in the spillover region (R7). In contrast, the two L2 groups did not show noticeable differences in reading times between the two case-marking conditions.

We scrutinized these patterns using mixed-effects regression. The model summary is presented in Table 4.

In the critical region (R6), there were no significant effects or interactions, indicating that all three groups showed similar reading times across the case-marking conditions. In the spillover region (R7), the model revealed a main effect of *Group*, induced by longer reading times in the L1-Korean group compared to the L2 groups. Crucially, there was a significant interaction between *Group* and *Case marking*,
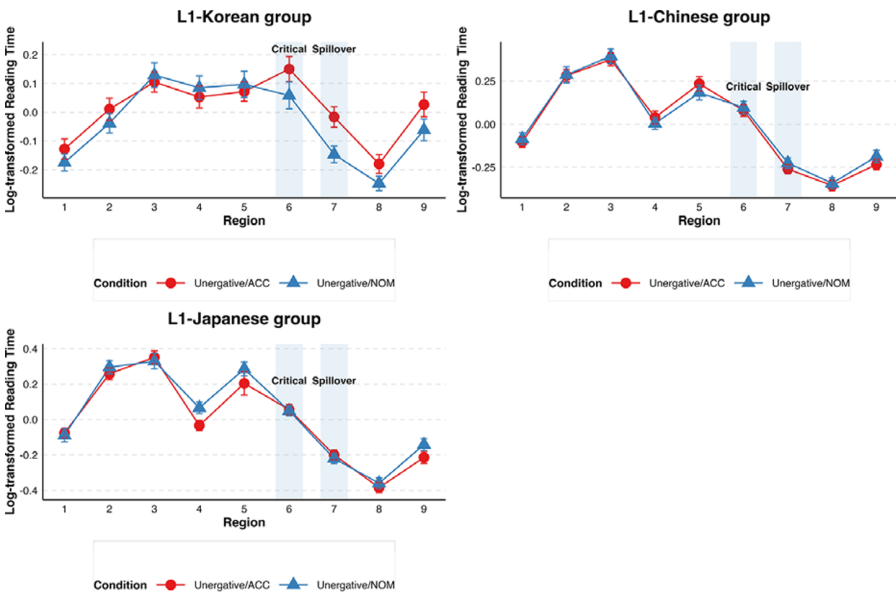
Figure 3. Reading time profiles in the unergative verb condition.

Table 4. Model outputs from the self-paced reading task: unergative verb condition

Region	Factor	ß	SE	p
Critical (R6)	(Intercept)	0.08	0.02	.003**
	Group (L1-Chinese versus L1-Japanese)	−0.04	0.04	.275
	Group (L1-Korean versus L2 groups)	0.03	0.04	.394
	Case marking	−0.03	0.03	.333
	Group (L1-Chinese versus L1-Japanese) × case marking	−0.02	0.07	.758
	group (L1-Korean versus L2 groups) × case marking	−0.09	0.06	.138
Spillover (R7)	(Intercept)	−0.18	0.01	<.001***
	Group (L1-Chinese versus L1-Japanese)	0.03	0.03	.225
	Group (L1-Korean versus L2 groups)	0.15	0.03	<.001***
	Case marking	−0.04	0.03	.167
	Group (L1-Chinese versus L1-Japanese) × case marking	−0.06	0.06	.295
	group (L1-Korean versus L2 groups) × case marking	−0.14	0.06	.013*

* $p < .025$; ** $p < .01$; *** $p < .001$.

suggesting that the L1-Korean group processed the two case-marking conditions differently from the L2 groups. Follow-up analyses for each group confirmed that the effect of *Case marking* was significant only in the L1-Korean group ($b = -0.13$, $SE = 0.05$, $p = .005$), but not in the L1-Chinese group ($b = 0.04$, $SE = 0.04$, $p = .379$) and the L1-Japanese group ($b = -0.02$, $SE = 0.04$, $p = .642$).

In summary, these results indicate that only the L1-Korean group was sensitive to the case-marking violation associated with an accusative-marked embedded subject in the unergative verb condition.

7. Discussion

The primary objective of this study was to examine L2 learners' acquisition and real-time processing of Korean quotative constructions. These constructions involve complex interactions where learners must integrate morphosyntactic case-marking constraints with verb semantics and pragmatic cues. To investigate how learners manage these challenges and whether L1 knowledge affects this process, we conducted both acceptability judgment and self-paced reading tasks, which yielded distinct findings.

The acceptability judgment task revealed a clear advantage for L1 Japanese learners (L1-Japanese group) over L1 Chinese learners (L1-Chinese group) in their explicit knowledge of case-marking constraints in the target constructions. Specifically, only the L1-Japanese group demonstrated native-like performance by consistently rejecting sentences including an accusative-marked subject in unergative verb constructions, whereas the L1-Chinese group did not show such sensitivity. Notably, the two learner groups were closely matched in Korean proficiency, and the L1-Chinese group had even spent a longer period residing in Korea than the L1-Japanese group. The discrepancy thus suggests that the structural similarities between Japanese and Korean enabled the acquisition of case-marking constraints for the L1-Japanese group.

The results of the acceptability judgment task provide compelling evidence for the role of crosslinguistic similarity in L2 acquisition at the syntax–semantics–pragmatics interface. These findings resonate with previous studies showing that L2 learners acquire interface-sensitive phenomena more successfully when there is structural alignment between their L1 and L2 (e.g., Hopp, 2009; Leal et al., 2019; Roberts et al., 2008; Slabakova, 2015; Wilson, 2009). The current study adds to this growing body of evidence by demonstrating that positive transfer from a structurally similar L1 can enhance learners' explicit knowledge of complex morphosyntactic constraints in L2 Korean.

These results also lend support to both the strong and weak versions of the IH. For the L1-Chinese group, the difficulty in rejecting ungrammatical accusative-marked subjects in the unergative verb condition suggests that these interface-level constraints remain challenging despite their high proficiency and extended exposure to Korean. This persistent vulnerability at the syntax–semantics–pragmatics interface is consistent with the strong version of the IH, which argues that interface structures remain persistently problematic for L2 learners (Tsimpli & Sorace, 2006).

In contrast, the L1-Japanese group's native-like performance suggests that structures involving the interaction across multiple domains are acquirable by L2 learners under favorable conditions, such as crosslinguistic similarities. Unlike the strong version of the IH, the weak IH allows for the possibility that the L2 acquisition of interface phenomena is modulated by factors such as L2 proficiency, L1 transfer and processing resources (e.g., Herbay et al., 2018; Hopp et al., 2020; Montrul & Rodríguez-Louro, 2006; Özçelik, 2018; Pan et al., 2015). The facilitative effect observed for the L1-Japanese group emphasizes the significant role of positive crosslinguistic influence in overcoming the inherent complexity of interface-related phenomena in L2 acquisition. Specifically, these learners' reliance on their L1 knowledge in retrieving relevant case-marking constraints may have reduced cognitive demands, freeing up resources for the efficient integration of multiple cues during the task.

However, the results from the self-paced reading task revealed a crucial disparity between learners' explicit knowledge and their ability to process case-marking violations in real time. Despite the L1-Japanese group's native-like performance in

the acceptability judgment task, neither L2 group showed significant sensitivity to the ungrammaticality of accusative-marked subjects in the unergative verb condition during online sentence processing. This divergence suggests that even when L2 learners develop accurate grammatical representations of the target phenomenon, they may not necessarily apply this knowledge in an automatic, incremental fashion during real-time comprehension (e.g., Jiang, 2007). These findings align with prior research indicating that linguistic features acquired explicitly may not immediately transfer to implicit processing mechanisms, particularly at the syntax–pragmatics interface (e.g., Hopp, 2009).

The persistent difficulty in processing the Korean quotative constructions among L2 learners offers support for the vulnerability of external interfaces (Sorace, 2011; Sorace & Filiaci, 2006), at least in real-time sentence processing. Our findings suggest that real-time integration of multiple information sources may remain problematic even for learners with advanced proficiency or those with similar L1 structures. One possible explanation for this difficulty lies in the cognitive demands associated with L2 processing (Jiang, 2004, 2007). Unlike native speakers, L2 learners may rely more heavily on controlled processing mechanisms, making it more difficult to detect grammatical violations under time constraints. This challenge can be especially pronounced for interface phenomena, where multiple sources of information must be coordinated simultaneously. Even when L2 learners acquire structural representations that align with their L1, as observed in the L1-Japanese group, their online processing may remain less automatic due to the increased burden of managing multi-domain dependencies.

The dissociation between the results of the acceptability judgment task and the self-paced reading task aligns with previous research distinguishing explicit and implicit knowledge in L2 acquisition (Ellis, 2005; Jiang, 2007; Suzuki & Dekeyser, 2017). Expanding on this distinction, Jiang (2004, 2007) proposed that L2 learners may develop accurate metalinguistic representations without fully incorporating this knowledge into their automatic processing routines. Our results reinforce this perspective, demonstrating that while learners, particularly those whose L1 shares structural similarities with Korean, can explicitly recognize case-marking constraints, they struggle to apply this knowledge in real-time comprehension. These results suggest that achieving native-like processing at the syntax–semantics–pragmatics interface may require more than just explicit learning. Rather, multiple factors, such as near-native proficiency, extensive L2 exposure, crosslinguistic similarities and enhanced cognitive capabilities, likely work in concert to facilitate the automatized, native-like processing of interface-related phenomena (e.g., Hopp, 2020; López-Beltrán et al., 2022).

The present study's focus on Korean quotative constructions provides valuable insights into interface phenomena in L2 acquisition more broadly. Our findings that crosslinguistic similarity facilitates explicit knowledge but not automatic processing not only reinforce the persistent vulnerability of external interfaces (Sorace, 2011; Sorace & Filiaci, 2006) but also contribute to a growing body of evidence highlighting the dissociation between explicit and implicit knowledge in the interface literature. By demonstrating these patterns in the context of Korean, a relatively understudied language in L2 interface research, this study advances the field forward through the consideration of multiple factors, including structural similarity between L1 and L2, high proficiency, extended exposure, cognitive resources and targeted instruction.

Moreover, this study illustrates the methodological and theoretical challenges of studying interface phenomena. As noted by Hopp et al. (2020), interface effects can be highly variable across domains and populations, and not all interfaces are equally

problematic for L2 learners. Our dual-method approach (offline and online tasks) thus highlights the need for diverse methodologies to capture the full extent of interface vulnerability, as reliance on a single measure may obscure important dissociations between knowledge and processing. In this regard, findings from quotative constructions contribute to our understanding of interface phenomena, supporting the view that interface challenges are both domain and task dependent (Hopp, 2009) and that crosslinguistic influence, while facilitative in some respects, has clear limitations in fostering native-like automaticity.

Last, we acknowledge some limitations that need to be addressed in future research. First, our experimental design did not include measures of potentially influential factors such as working memory capacity. These factors have been shown to influence L2 processing, particularly for complex structures (Hopp, 2014; Linck et al., 2014). Therefore, further studies should include such measures to determine whether increased cognitive abilities can help overcome processing limitations at the interface level, leading to native-like processing.

In addition, despite our efforts to recruit advanced learners, the L2 participants in our study were far from near natives, as in previous studies (e.g., Belletti et al., 2007; Carroll et al., 2000; Hopp, 2009; Sorace & Filiaci, 2006). This raises the question of whether the observed dissociation between explicit knowledge and online processing is a consequence of L2 proficiency or whether it reflects a more persistent challenge at the syntax–semantics–pragmatics interface. Future research should examine whether learners with near-native proficiency exhibit more native-like processing patterns.

Another limitation concerns the use of the temporal adverb *ecey* 'yesterday' preceding the stative mental verb *sayngkakhata* 'think' in the self-paced reading task. As one reviewer noted, such combinations may pose aspectual mismatches that could have contributed to the longer reading times observed in the L1-Korean group. While our main focus was on case-marking effects, future studies may benefit from using more compatible temporal expressions (e.g., *olaytongan*, 'for a long time') to minimize potential processing confounds.

8. Conclusion

This study demonstrates a clear dissociation between L2 learners' explicit knowledge and real-time processing abilities at the syntax–semantics–pragmatics interface, as well as highlighting the task-dependent nature of crosslinguistic influence. While crosslinguistic similarity facilitated the acquisition of explicit knowledge, this advantage did not extend to automatic, real-time processing. The findings suggest that even when L2 learners develop accurate grammatical representations, they may struggle to effectively use this knowledge during real-time comprehension, particularly when multiple cues must be integrated. Future research should examine whether near-native proficiency, enhanced cognitive abilities or extensive L2 exposure can minimize this gap between explicit knowledge and automatic processing.

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