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Effects of topicality in the interpretation of implicit consequentiality: evidence from offline and online referential processing in Korean

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Abstract: There is little consensus as to whether the use of implicit causal biases is driven exclusively by verb semantics or mediated by an interaction of verb semantics and other information sources. We tested whether the topic status of a subject modulates Korean speakers' referential choices and processing in the interpretation of implicit consequentiality information. Results from two sentence-completion tasks (Experiment 1) showed more subject reference in participants' continuations when the preceding subject was marked by the topic rather than the nominative marker, regardless of the directionality of the implicit consequentiality bias. In a self-paced reading task (Experiment 2), Korean speakers spent shorter reading times when the referent in the consequence clause was resolved as referring to the previous subject than when it referred to the previous object, although only in the topic-marked condition and not in the nominative-marked condition. Our results suggest that the implicit consequentiality effect remains consistent regardless of the subject's topic status in the offline tasks, but the effect interacts with the topicality effect in real-time sentence processing. We discuss the implications of our findings for assumptions concerning the underlying mechanisms of referential resolution in discourse including causal bias verbs.

Keywords: implicit consequentiality; Korean; self-paced reading; sentence completion; topicality

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1 Introduction

In discourse processing, comprehenders are required to compute the coherent relationships among a sequence of events being described (Graesser et al. 1994). One common type of relationship in a discourse context is the causal coherence between two clauses, where each event is construed as a *cause* and a *result*, respectively (Kehler 2002). Comprehenders use a multitude of cues to establish specific causal event structures in their mental models. In the interpretations of a cause–result event (1), for example, several cues can be employed, including verb semantics, discourse markers, and contextual information, to construct the causal relationships between the clauses and establish a coreference between a referring expression (e.g., *he*) and its antecedent (e.g., *Paul*, *Mathew*).

(1) *Because Paul frightened/feared Mathew, he …*

Several interrelated factors may influence the process of coreference establishment during the construction of mental models of the causal structure, such as the subjecthood of the antecedent of a pronoun (Arnold 2010; Hobbs 1979), the order of mention (e.g., Arnold 1998; Crawley et al. 1990; Gernsbacher et al. 1989), and grammatical roles (Sheldon 1974). Importantly, anaphora resolution in causal discourse contexts can also be driven by biases induced by semantic aspects of a verb. In (1), the verb *frighten* implicates *Mathew* as the more suitable character that undergoes the event's consequence whereas the verb *fear* is more likely to focus on *Paul* as the potential undergoer of the event and thus the more suitable antecedent of the pronoun. In the (psycho)linguistics literature, the phenomena where the verb and a conjunction guide coreference biases toward one of the characters as the focal point of the event cause or consequence have been referred to as *implicit causality* (Au 1986; Brown and Fish 1983; Garvey and Caramazza 1974) and *implicit consequentiality* (Crinean and Garnham 2006; Stewart et al. 1998). Sentence (1) is an instance of implicit consequentiality as the verb creates biases toward one of the characters as the focal point of the event consequence. This paper will use *implicit causal biases* as a cover term for both implicit causality and consequentiality biases.

Verb-induced implicit causal biases, in conjunction with discourse coherence delivered by specific connectors (e.g., *because, and so*), guide speakers in making probabilistic inferences about causal relationships across events (Cozijn et al. 2011; Garnham et al. 2020; Itzhak and Baum 2015). A substantial body of research has provided compelling evidence that speakers across different language backgrounds actively use the implicit causality and consequentiality information when

they are prompted to continue sentence fragments like (1) (e.g., Crinean and Garnham 2006; Ferstl et al. 2011; Hartshorne and Snedeker 2013; Stevenson et al. 1994) or to resolve anaphora during online sentence comprehension (e.g., Cozijn et al. 2011; Garnham et al. 2020; Itzhak and Baum 2015; Pyykkönen and Järvikivi 2010; Stewart et al. 2000).

Despite the well-documented effects of causally implicated verbs and conjunctions, the mechanisms underlying the biases are at the center of the ongoing debate. Although there is broad consensus that verb semantics is a crucial determinant of the bias effects, there is less agreement on whether the bias effects can also be affected by other factors. The essential question addressed in the present study is whether Korean speakers' implicit consequentiality biases are affected by case-marking information beyond verbs and conjunctions in sentence comprehension. More specifically, we tested whether the strength of implicit consequentiality biases is modulated by the presence of a topic- versus nominative-marked subject during Korean speakers' anaphora resolution. Implicit consequentiality in Korean lends itself well to investigating interactions between effects of case marking and implicit causal biases. Having a rich case-marking system, Korean allows either a topic or nominative marker to modify an entity occupying the subject position, giving rise to different degrees of discourse prominence (Sohn 1999). In addition, implicit consequentiality in Korean is delivered through a subordinate clause followed by the main clause, allowing for the topic-marked entity to exert its influence across the whole sentence (e.g., Nariyama 2002). Although some research has examined the roles of topic makers in anaphora resolution in Japanese and Korean (Shoji et al. 2017; Ueno and Kehler 2010, 2016), few studies have investigated the effect of topic on the strength of implicit consequentiality biases. Therefore, exploring the effect of subjecthood on implicit consequentiality biases in Korean offers unique insight into how speakers from a case-marking language establish coherence relations in the discourse using various linguistic devices.

2 Previous studies on implicit causal biases

Implicit causal bias is a well-known phenomenon whereby some interpersonal verbs attract biases in re-mentioning either their subject or object in causal dependent clauses (Garvey and Caramazza 1974). These biases are known to arise in different discourse contexts depending on the specific coherence relationship between clauses (Garvey and Caramazza 1974; Hartshorne and Snedeker 2013; Stevenson et al. 1994). Implicit causality biases are created when certain interpersonal verbs induce biases to mention one of their arguments as an underlying

cause in an explanation clause (often followed by *because*). In contrast, implicit consequentiality biases bring one of the verb's arguments into focus as the consequence of an event in a result clause (often followed by *and so*). In addition to the discourse's causal relationships, a verb's thematic roles play an important role in determining implicit causality and consequentiality. For example, among the four types of interpersonal verbs identified by Au (1986) – namely, experiencer-stimulus (ES), stimulus-experiencer (SE), agent–patient (AP), and agent-evocator (AE) – ES and SE verbs focus on different entities (stimulus or experiencer) as an implicit cause or consequence depending on the coherence relationship (*because* vs. *and so*), whereas AE verbs impute the cause or consequence of an event to the same entity (i.e., evocator; Crinean and Garnham 2006; Stevenson et al. 1994).

Although discourse contexts and verbs' semantic roles are considered crucial factors in identifying properties of implicit causal biases, researchers have put forward different accounts of the mechanisms underlying these biases. Some scholars assume that implicit causal biases emerge as the function of a verb's semantic structure (Bott and Solstad 2014; Crinean and Garnham 2006; Hartshorne et al. 2015; Hartshorne and Snedeker 2013). This *lexical semantic account* posits that the verb's semantic structure – more specifically, the thematic relations of the verb's arguments – directly contributes to causal biases. This account also maintains that other cues derived beyond a verb's lexico-semantic information, such as morphological, discourse, and pragmatic cues, can only minimally affect the bias effects. Several studies have provided supporting evidence of the lexical-semantic account by demonstrating consistent effects of implicit causality and consequentiality from the verbs that share the same semantic classes across different languages (e.g., Bott and Solstad 2014; Hartshorne et al. 2013) while showing only a small effect of pragmatic information on the biases (e.g., Hartshorne and Snedeker 2013).

In contrast, other researchers have suggested that a verb's semantic structure essentially interacts with other cues to create biases. In line with this account, some studies have shown that the effect of implicit causal biases is strengthened or attenuated depending on local and nonlocal contextual cues beyond the verb's semantic structure (e.g., van den Hoven and Ferstl 2018; Kehler et al. 2008; Koornneef et al. 2016). For instance, van den Hoven and Ferstl (2018) showed that inferences of implicit causality could shift when a preceding context does not validate the assumption underlying the causality event. In their written story completion experiment, German speakers did not attribute the cause of an event to the referent biased by the implicit causality verb when a preceding discourse context did not support the assumption of sincerity for the action denoted by the verb. For example, although the verb *criticize* creates an implicit causality bias toward an object referent (e.g., *Tom criticized John$_i$ because he$_i$*), the German

speakers were less likely to mention the object referent as the underlying cause in the explanation clause when the preceding context implied that the action of criticizing was not sincere (e.g., out of jealousy on the part of the subject referent). Similarly, several studies have found an effect of local contextual information, such as the social status or gender of event participants, on causal biases, although the magnitude of the effect was small (e.g., Ferstl et al. 2011).

As such, it remains inconclusive whether implicit causal biases can be solely characterized by a verb's lexico-semantic aspects or modulated by other information; thus far most studies testing the role of various cues have focused on semantic and pragmatic factors (e.g., discourse information and the status of the event participants). These studies have focused primarily on Indo-European languages, such as English, German, and Dutch, which allow few options for clause-internal linguistic devices to interact with causal biases. To the best of our knowledge, only one study has investigated how implicit causal biases can interact with case-marking information within a clause. Extending an earlier study (Ueno and Kehler 2010), Ueno and Kehler (2016) tested how the interaction of referential type, verb aspect, and case-marking information influences Japanese speakers' referential resolution in the context of Japanese implicit causality. In their second experiment, Japanese speakers provided written continuations for an implicit causality sentence, using different types of referential forms (null, overt, free), in which the case marking for the subject and the verb aspect were manipulated, as shown in (2).

(2) *Taro-wa/ga* *Jiro-o* *odorokashita/odorokashi-te-iru* *tokoro-datta.*
Taro-TOP/NOM Jiro-ACC surprised/surprise-INF-ASP scene-was
'Taro surprised/was surprising Jiro.'
shugo-shoryaku/kare-wa/jiyu _____
subject-omission(Null)/he-TOP(Overt)/free(Free)
(Ueno and Kehler 2016: 1192)

Analyses of participants' responses in terms of subject or object mentioning showed a significant effect of implicit causality, as participants provided more subject reference when the subject-biasing verb was presented. However, the implicit causality effect did not robustly interact with the case-marking condition. For subject-biasing verbs, there was more subject reference, regardless of the case-marking conditions. For object-biasing verbs, participants provided more subject reference in the topic than the nominative-marked condition, yet this tendency was only marginal. From these results, Ueno and Kehler concluded that the implicit causality effect is hardly influenced by the topic status of the subject for subject-biasing verbs, and there is only a minimal effect of the topic marker in the object-biased condition.

The lack of evidence of the interplay between implicit causality and case marking in Ueno and Kehler (2016) may indicate a strong effect of causality verbs, providing support for the lexical semantic account. However, the result may also have been driven by the specific context of the Japanese implicit causality sentences in their study, which dissociated the cause and effect events using separate sentences and no conjunction. Although the subject's topical status can affect the choice of referential forms in the following discourse in Japanese and Korean (Christianson and Cho 2009; Ueno and Kehler 2010, 2016), the effect may not strongly influence the casual bias effects when the cause and effect events are presented as separate sentences without any subordinate conjunction. Therefore, in the current study, we employed Korean implicit consequentiality sentences, where the cause and effect events are presented as a subordinate and the main clause, conjoined by a subordinate connector within a single sentence.

3 Interaction of case marking and implicit consequentiality in Korean

Korean has a rich case-marking system, signaling an entity's semantic role through a designated case marker, as in (3).

(3) a. *Paul-i* *Tom-ul* *mwusepkeyha-yss-ki* *ttaymwuney,* *ku-ka…*
Paul-Nom Tom-Acc frighten-Past-Conn because he-Nom[1]
'Because Paul frightened Tom, he…'

b. *Paul-i* *Tom-ul* *mwuseweha-yss-ki* *ttaymwuney,* *ku-ka…*
Paul-Nom Tom-Acc fear-Past-Conn because he-Nom
'Because Paul feared Tom, he…'

In Korean, the nominative marker *-i*/*-ka* signals a subject status while the accusative marker *-ul*/*-lul* marks an entity's object status. Notably, Korean allows a subject referent to receive topichood when accompanied by the topic marker *-un*/*-nun* (Sohn 1999). The distinction between the subject and topic status lies in the relative prominence imposed on the referent in the event being described: Compared to the nominative-marked counterpart, the entity qualifying as the topic receives increased salience and accessibility in discourse (Arnold 2010). The prominence of a topic-marked entity can affect coherence establishment in the

1 Abbreviations in the glosses throughout this paper are as follows: Acc = Accusative marker; Conn = Connective; Dat = Dative marker; Decl = Declarative marker; Nom = Nominative marker; Past = Past tense marker; Top = Topic marker.

following event (Kehler 2002), constraining syntactic operations of null referents that are bound by the topic (Huang 1984).

An issue particularly relevant to this study is whether a subject's different status depending on case marking interacts with implicit consequentiality biases in Korean. This idea is motivated by a hypothesis proposed by Nariyama (2002), who maintained that a null referent in complex sentences in Japanese has different interpretive readings depending on the specific markers attached to the subject in the preceding clause. As an illustration, the null referent in the main clause in (4a) refers to the topic-marked referent in the previous clause whereas the null referent in (4b) may be associated with the previous subject or with someone else.[2]

(4) a. *Hanako-wa haitte kuru nari, to-o sime-ta.*
Hanako-Top enter come as soon as door-Acc shut-Past
'As soon as Hanako came in, (Hanako) shut the door.'

b. *Hanako-ga haitte kuru nari, to-o sime-ta.*
Hanako-Nom enter come as soon as door-Acc shut-Past
'As soon as Hanako came in, (Hanako or someone else) shut the door.'

Nariyama (2002) explained these interpretive differences of the null referent in terms of the interaction between switch-reference systems and the scope of case markers. Switch-reference systems function as the reference-tracking devices that help comprehenders determine whether or not entities across clauses share the same reference in discourse (Stirling 1993). According to this account, complex clauses in head-final languages like Korean and Japanese, where the subordinate clause precedes the main clause, allow for switch-reference marking across clauses, involving either the same or a different reference in clause chaining. In particular, Nariyama claimed that the different ranges of scope encoded in the nominative and topic markers can have a significant consequence on the switch-reference interpretations: The Japanese nominative marker *-ga* (the Korean equivalent of *-i/-ka*) has a restrictive scope that exerts influence only within a clause, allowing either the same or different reference interpretations for the null subject in (4b), whereas the Japanese topic marker *-wa* (the Korean equivalent of *-un/-nun*) has a scope extending over to the following main clause, leading to the same reference interpretation as in (4a).

2 According to Nariyama's (2002) account, in order for the null referent in (4b) to be unambiguously interpreted as the previous subject, a pause should be inserted following the nominative-marked subject. As the current study investigates the effect of case marking in written sentence comprehension, we assume the possibility that sentence (4b) receives either a same-reference or different-reference reading.

The interpretative restrictions on the null referent as a function of scope variability between the nominative and topic markers in Japanese complex clauses provide important implications for our understanding of how topicality modulates the effect of implicit consequentiality in Korean. Like the Japanese complex clauses in (4), the Korean sentences including an implicit consequentiality verb are subject to the switch-reference operation and the scope range associated with the nominative and topic markers. Consider (5), for example.

(5) *Paul-i/Paul-un* *Tom-ul* *mwusepkeyha-yss-ki* *ttaymwuney*, …
Paul-Nom/Paul-Top Tom-Acc frightened-Past-Conn because
'Because Paul frightened Tom, …'

The verb *mwusepkeyha* 'frighten' in (5) selects the subject referent *Paul* as the causer and the object referent *Tom* as the undergoer of the event, thereby giving rise to an implicit consequentiality bias to mentioning *Tom* as the potential subject in the ensuing consequence event. However, this object bias conflicts with the switch-reference marking when the subject *Paul* is modified by the topic maker *-un*, which favors the repeated mentioning of the topic-marked entity in the subsequent clause.

Investigating comprehenders' referential interpretations in this context, where the switch-reference operation and the implicit consequentiality biases arise as conflicting cues, allows us to address the question of whether implicit consequentiality biases are affected by intra-clausal cues induced by the case-marking manipulation for the subject referent. To this end, we conducted offline sentence-completion tasks (Experiments 1a and 1b) and an online self-paced reading task (Experiment 2) to examine Korean speakers' referential interpretation and processing in Korean complex clauses, which involved an implicit consequentiality verb and the subject referent modified by different types of markers (nominative vs. topic markers). Based on the scopal properties of a topic-marked entity in complex sentences (Nariyama 2002), we predict that topicality will influence Korean speakers' referential choices and resolution in implicit consequentiality sentences. Specifically, if topicality, as conveyed via topic marking in the subject, modulates the effect of implicit consequentiality, speakers will provide more subject reference following a topic-marked than a nominative-marked subject, regardless of the direction of implicit consequentiality biases in the sentence-completion task. In the self-paced reading task, the modulating effect of topicality will be indicated by reduced reading times when the reference associated with an event consequence is resolved toward a topic-marked subject in the preceding clause, regardless of the direction of implicit consequentiality biases.

4 Experiment 1: Sentence completion

The primary objective of the current experiment is to investigate whether the topic status of the subject referent in Korean complex clauses influences the effect of implicit consequentiality biases in Korean speakers' referential choices. In two sentence-completion tasks, we tested (1) whether the implicit consequentiality effect is manifest when the subject referent is marked by the nominative marker and (2) whether the topic-marked subject referent modulates the bias effect.

4.1 Experiment 1a

4.1.1 Participants

Experiment 1a involved 21 adult Korean speakers (17 women, 4 men), ranging in age from 18 to 43. They reported having spoken Korean since childhood as their only native language. Participants received monetary compensation for their participation in the experiment.

4.1.2 Materials

Materials for the Korean sentence-completion task included 24 experimental items with implicit consequentiality verbs. For the target verbs, we initially selected 44 English implicit consequentiality verbs found to create a bias to either the subject (NP1 verb) or object (NP2 verb; e.g., Cheng and Almor 2017; Crinean and Garnham 2006; Stewart et al. 1998). Among these verbs, we chose a subset of verbs that met the following criteria. First, given that a verb's thematic structure significantly impacts implicit causal biases (Bott and Solstad 2014; Brown and Fish 1983), we controlled for the verb's semantic classes within each bias type based on Levin's (1993) classification. As a result, the NP1 verbs consisted of experiencer–stimulus verbs (e.g., *like*, *despise*) while the NP2 verbs consisted of stimulus–experiencer verbs (e.g., *amuse*, *annoy*). We also restricted our selection of verbs to include those showing a bias toward the subject or the object more than 70% of the time, based on the implicit consequentiality bias strength reported by Crinean and Garnham (2006). Finally, we excluded two NP2 verbs (i.e., *agitate*, *dumbfound*) that have low frequency. Using these procedures, we obtained 12 NP1 and 12 NP2 verbs.

Two Korean–English bilinguals translated the English verbs into Korean using the NAVER English–Korean dictionary (https://dict.naver.com/). Disagreements between the translators were resolved through discussion. The translated verbs

appeared in a subordinate clause fragment with two human event participants, as illustrated in (6).

(6) *Yuna-ka/Yuna-nun Minjee-lul kyengmyelha-yss-ki ttaymwuney*, ____
Yuna-Nom/Yuna-Top Minjee-Acc despise-Past-Conn because
'Because Yuna despised Minjee, _____'

To investigate the interaction between topicality and implicit consequentiality bias, we systematically manipulated the case marker for the subject referent within each bias type. Half of the items included a nominative-marked subject (e.g., *Yuna-ka*); the other half included a topic-marked subject (e.g., *Yuna-nun*). Given the potential influence of genders on referential choices in sentences with implicit causal biases (e.g., Stewart et al. 2000), we used the same gender for both the subject and object referents (i.e., either both male or both female). Names for the referents were adopted from a previous Korean sentence-completion study (Kim and Grüter 2019).

The experimental items were counterbalanced across two lists, and each participant saw an item in only one case-marking condition. We also added 36 fillers constructed analogously with the experimental sentences (subordinate clause containing a subject, an object, a verb, and a connector) except for the verb and the conjunction. Fillers included non-causal-bias verbs with various types of thematic structures (agent–patient, stimulus–experiencer, experiencer–stimulus) and contained conjunctions other than *ttaymwuney* 'because', such as *tongan* 'while', *ttay* 'when', and *camaca* 'as soon as'.

4.1.3 Procedure

The task items were presented on a web-based interface. Participants individually completed the task on a computer. During the task, participants were asked to type a completion for each fragment as naturally as possible while avoiding humor. Each item was presented on a single page on the screen, and participants were not allowed to return to previous items to correct their responses. The entire task took approximately 40 min.

4.1.4 Coding and analysis

Two native speakers of Korean annotated participants' responses in terms of intended reference of the subject. Each coder annotated reference type as corresponding to one of the following categories: subject, object, other, or unclear. A response was coded as subject or object when the main subject of the event consequence referred to either the previous subject or object. These referent types

constituted 86% of all responses. The reference type of other included cases when neither the previous subject nor object was mentioned as the subject of the result event (9% of all data). Responses coded as unclear indicated cases when one of the coders could not determine the reference in response either because the subject of the event could refer to either of the previous referents (1% of all data) or because a continuation was incomplete or semantically incoherent with the previous clause (2% of all data). For data analyses, we only included responses coded as subject or object. We also eliminated inter-coder disagreements, which constituted 1% of all data.

To assess whether the different case-marking conditions (nominative vs. topic markers) influence the bias of mentioning the subject or object in the previous clause, we fit a mixed-effects logistic regression model (Baayen 2008) to the likelihood of mentioning the subject of the previous clause in the participants' responses. The model included the fixed effects of verb bias (NP1, NP2), case marking (nominative, topic), and their interaction as well as the random effects of participant and item. All fixed effects were centered using deviation coding (NP1 and nominative conditions coded as −0.5). We initially constructed the maximal random effects structure permitted by the design (Barr et al. 2013) by adding by-participant random slopes for the fixed factors. We then simplified the structure by removing the slope for verb bias to avoid a convergence error and minimize the loss of statistical power (Matuschek et al. 2017). The modeling was conducted using the lme4 package in R (R Core Team 2009).

4.1.5 Prediction

In light of the well-established effects of implicit consequentiality biases reported in previous studies (e.g., Crinean and Garnham 2006; Stewart et al. 1998), we expected to find a significantly stronger subject bias in the NP1 than in the NP2 condition. Importantly, if the topic-marked entity influences the interpretation of implicit consequentiality, we would find significantly more subject reference following the subject marked by the topic marker than the nominative marker. The crucial question we asked is whether the topicality effect overturns the implicit consequentiality effect. If the effect of topicality emerges more strongly than the implicit consequentiality effect, a strong subject bias will be found in the NP2 as well as the NP1 condition. Otherwise, if participants rely more on implicit consequentiality than on topicality, there will be a strong subject bias in the NP1 condition and a strong object bias in the NP2 condition, regardless of the case-marking conditions.

4.1.6 Results and discussion

Figure 1 shows the percentage of subject reference in the two case-marking conditions (nominative-marked, topic-marked) for NP1 and NP2 items. Participants showed a stronger subject bias for NP1 than for NP2 items; this tendency remained consistent for both case-marking conditions.

We analyzed the results in detail by conducting the mixed-effects logistic model (glmer). The model revealed a main effect of verb bias ($b = -3.19$, $SE = 0.49$, $p < 0.001$), induced by significantly more subject reference in the NP1 than the NP2 condition. There was also a main effect of case marking ($b = 2.11$, $SE = 0.33$, $p < 0.001$), with more subject reference in the topic-marked than the nominative-marked condition. The effect of case marking did not interact with verb bias ($b = -0.66$, $SE = 0.66$, $p = 0.312$). The main effect of verb bias was further supported by separate analyses for each case-marking condition (with the corrected alpha level of 0.025), which showed a main effect of verb bias in both the nominative-marked ($b = -3.15$, $SE = 0.73$, $p < 0.001$) and topic-marked condition ($b = -3.50$, $SE = 0.92$, $p < 0.001$).

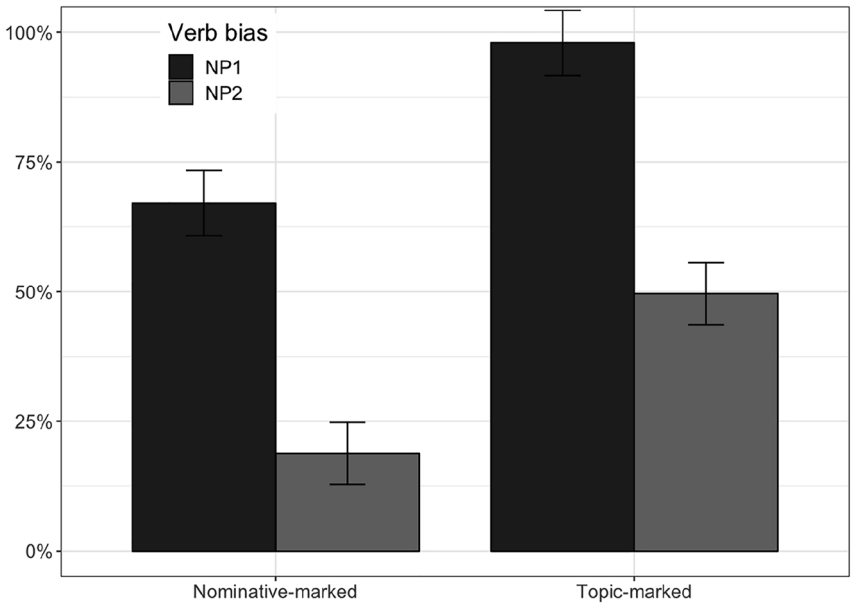

Figure 1: Mean percentage of subject reference in Experiment 1a; error bars denote 95% confidence intervals.

The reliable effect of verb bias in the nominative- and topic-marked conditions indicates that the speakers made referential choices guided by the verb's bias, reaffirming the well-established effect of implicit consequentiality bias in Korean sentence completion. It should also be noted that the topic-marked condition boosted the subject bias in both NP1 and NP2 conditions, reflected by the main effect of case marking. These results indicate that both implicit causality and topicality independently affected reference biases. Importantly, we did not find a robust interaction between these two factors, suggesting that the topicality effect did not reverse the implicit consequentiality effect. In the topic-marked condition, participants provided significantly more subject reference in the NP1 than the NP2 condition. These results suggest that both implicit consequentiality and topicality effects remained consistent, without one effect winning out against the other.

However, an important caveat needs to be raised before drawing any conclusions. We presented the experimental items with the topic-marked and nominative-marked conditions intermixed in a single session during the task. Although the items with different case marking were separated by at least one filler item, participants may have experienced some interference across the different case-marking conditions. It is conceivable that such interference could potentially impinge on the interaction of the topicality effect with verb bias because a topic-marked entity does not sometimes receive high salience when the morphological marking remains less well-noticed without additional contextual information (e.g., Ueno and Kehler 2016). To address this concern, we conducted another sentence-completion task with the topic-marked and nominative-marked items presented in separate blocks.

4.2 Experiment 1b

4.2.1 Participants

Another group of 26 Korean speakers (19 women, 7 men; mean age = 26, SD = 6.4) who did not participate in Experiment 1a took part in Experiment 1b. All participants identified themselves as native speakers of Korean. Participants received monetary compensation for their participation in the experiment.

4.2.2 Materials

The materials for the experiment were identical to those used in Experiment 1a, although the order of presentation differed. Each list included two blocks, and the items in each case-marking condition were assigned to one of the blocks (i.e., one

block containing the items in the nominative-marked condition and the other containing the items in the topic-marked condition). The order of the two blocks was counterbalanced across participants. The fillers retrieved from Experiment 1a were intermixed with the experimental items in each block.

4.2.3 Procedure

The sentence-completion task was conducted in the same manner as in Experiment 1a, except that participants had a short break between the blocks. After completing the first block, a message appeared indicating the end of the first half of the task. Participants proceeded to the next block when they were ready.

4.2.4 Coding and analysis

As in Experiment 1a, we only included responses coded as subject or object (91% of the entire dataset). Statistical analyses were conducted in the same manner as in Experiment 1a.

4.2.5 Results and discussion

Figure 2 shows the percentage of subject reference in each case-marking condition for NP1 and NP2 items. Participants provided more subject bias for NP1 than for NP2 items; this imbalance appears similar in both case-marking conditions.

We examined the results in detail using the mixed-effects logistic model (glmer). The model showed a reliable effect of verb bias (b = −3.77, SE = 0.50, $p < 0.001$), with more subject reference in the NP1 than in the NP2 condition. In addition, there was a main effect of case marking (b = 2.05, SE = 0.48, $p < 0.001$), indicating more subject reference in the topic-marked than in the nominative-marked condition. There was no interaction between verb bias and case marking (b = 0.22, SE = 0.68, p = 0.749). These results were reminiscent of the response patterns in Experiment 1a, in which participants provided more subject reference in the NP1 than in the NP2 condition for both the topic-marked and the nominative-marked condition.

In order to more directly compare these results with those from Experiments 1a, we combined responses from both experiments, creating an additional model with verb bias, case marking, and experiment (1a coded as −0.5, 1b coded as 0.5) as fixed factors. The model showed a main effect of verb bias (b = −3.65, SE = 0.51, $p < 0.001$) and a main effect of case marking (b = 2.03, SE = 0.36, $p < 0.001$) in the same direction as in the models from each experiment. There was also a main effect of experiment (b = 0.67, SE = 0.27, p = 0.014), with more subject reference occurring

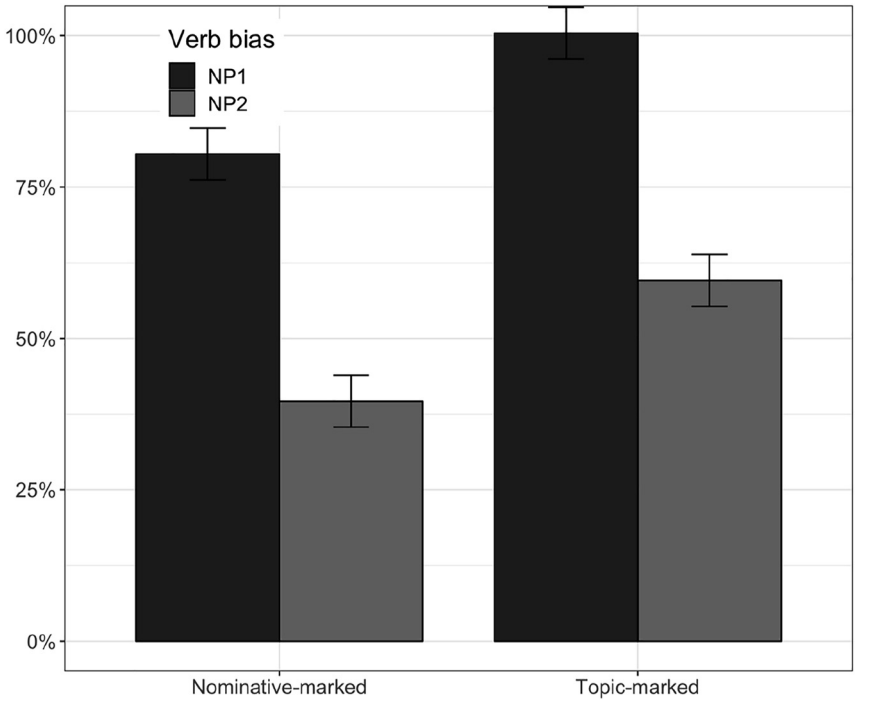

Figure 2: Mean percentage of subject reference in Experiment 1b; error bars denote 95% confidence intervals.

in Experiment 1b than in Experiment 1a. However, the effect of experiment did not interact with any of the factors, indicating that the results from the two experiments were comparable except for the increased subject reference in Experiment 1b compared to Experiment 1a. These findings dismiss our speculation that the presentation of both case-marking conditions within a single block might have affected topicality in Experiment 1a.

Overall, the results across the two experiments provide evidence for the independent effects of implicit consequentiality and topicality on Korean speakers' referential choices in sentence continuations, yet no interaction between the two effects. The effect of implicit consequentiality was indicated by the overall stronger subject bias in the NP1 than in the NP2 items. The topicality effect was shown by more subject reference in the topic-marked than in the nominative-marked condition. However, we found no evidence that the topicality effect overturned the implicit consequentiality effect. In the NP2 condition, where the effects of implicit consequentiality and topicality emerged as conflicting cues, participants provided

subject reference only about 50% of the time in the topic-marked condition in both experiments. These findings appear consistent with the lexical semantic account positing that the verb's semantic cues mainly drive implicit causal biases, and other contextual information is unlikely to overturn the bias effect. Aligning with this account, we found that the implicit consequentiality effect remained intact regardless of the discourse status of the subject referent (i.e., topic vs. non-topic). These results do not support the prediction that the topicality effect will reverse the direction of implicit consequentiality. Contrary to Nariyama's (2002) hypothesis regarding the role of a topic-marked NP in Japanese complex clauses, the topic status of the subject in the main clause did not lead to a strong bias to subject reference in the ensuing clause in the presence of the NP2-bias verbs.

However, these outcomes fall short of providing a complete picture of how topicality interacts with implicit consequentiality to influence Korean speakers' referential processing because the sentence-completion tasks only tapped into participants' preferences in referential choices or their ultimate choice of referents in offline comprehension. Providing a specific type of continuation does not necessarily entail that speakers completely reject the other possible ways of completing a sentence or that their ongoing process of referential resolution is aligned with their final choice. Therefore, it is necessary to scrutinize how readers establish referential relationships between clauses during incremental processing to fully test the interplay between implicit consequentiality and topicality. To address this issue, we conducted a self-paced reading task (Experiment 2) that focused on NP2 items to examine whether a topic-marked subject in the preceding clause would interact with the implicit consequentiality bias and change the interpretation of a null referent in the following clause.

5 Experiment 2: Self-paced reading

Experiment 2 investigated whether the sentence-completion patterns from Experiment 1 would persist during real-time referential processing. To this end, we presented participants with Korean sentences containing NP2 implicit consequentiality verbs in the *because*-clause followed by a disambiguating clause beginning with a null referent potentially referring to either the previous subject or object. To test the modulating role of topicality, we manipulated case marking for the subject in the *because*-clause. For the nominative-marked condition, we expected participants to show faster reading times in the disambiguating clause when the null subject indicated the previous object (object-referring condition) relative to when it referred to the previous subject (subject-referring condition) due to an implicit consequentiality effect from the NP2 verbs. For the topic-marked condition, if topicality exerted

a strong influence on referential processing to such an extent that its effect overturned the implicit consequentiality effect, speakers would show faster reading times in the subject-referring than in the object-referring condition. These reading time patterns would lead to an interaction between case marking and reference. Otherwise, if implicit consequentiality constrained speakers' referential processing more strongly than topicality, participants would show faster reading times in the object-referring than in the subject-referring condition.

5.1 Participants

Experiment 2 involved 32 native Korean speakers (24 women, 8 men; mean age = 24, SD = 4.9). They were all born and raised in South Korea. None of them participated in Experiment 1a or 1b. Participants received course credit for their participation.

5.2 Materials

A total of 24 sentences were distributed in a 2 × 2 Latin square design manipulating the case marking for the subject in the first clause (nominative-marked, topic-marked) and the reference of the null subject in the second clause (subject-referring, object-referring). Examples of experimental items are illustrated in (7).

(7) a. subject-referring conditions

Region (R) 1		R2	R3
Youngsoo-ka / Youngsoo-nun		*Jiho-lul*	*hwanakeyha-yss-ki*
Youngsoo-Nom / Youngsoo-Top		Jiho-Acc	anger-Past-Conn
R4	R5	R6	R7
ttaymwuney (∅)	*Jiho-eykey*	*kotpalo*	*sakwaha-yss-ta.*
because	Jiho-Dat	immediately	apologize-Past-Decl

'Because Youngsoo angered Jiho, (he) immediately apologized to Jiho.'

b. object-referring conditions

Region (R) 1		R2	R3
Youngsoo-ka/ Youngsoo-nun		*Jiho-lul*	*hwanakeyha-yss-ki*
Youngsoo-Nom / Youngsoo-Top		Jiho-Acc	anger-Past-Conn
R4	R5	R6	R7
ttaymwuney (∅)	*Youngsoo-eykey*	*kotpalo*	*ttacy-ess-ta.*
because	Youngsoo-Dat	immediately	complain-Past-Decl

'Because Youngsoo angered Jiho, (he) immediately complained to Youngsoo.'

Each experimental item consisted of a *because*-clause followed by a disambiguating clause denoting a consequence of the event. The *because*-clause included a subject referent modified by either the nominative marker *-i*/*-ka* or the topic marker *-un*/*-nun*, an object referent with the accusative marker *-ul*/*-lul*, and an NP2 implicit consequentiality verb. The verbs were retrieved from the sentence-completion tasks in Experiments 1a and 1b, and each verb appeared twice with different sentence items. The ensuing clause provided information that helped disambiguate the subject referent to either an NP1 or NP2 reading. Crucially, the disambiguating clause did not contain an overt subject; instead, it began with a referent marked by the dative marker *-ekey*. This referential choice was based on the null-subject property of Korean, which prefers a null referent in the complex clause context, such as (7) (Roh and Lee 2003). Instead of an overt referent, the reference of the null subject was resolved by the dative-marked entity. When the previous object with the dative marker appeared in the disambiguating clause (7a), the null subject was interpreted as indicating the previous subject (subject-referring condition). Conversely, the previous subject appearing with the dative marker, as in (7b), indicated the null referent was resolved as referring to the previous object (object-referring condition). Because of the null subject's disambiguating role, the dative-marked referent was analyzed as the critical region (R5) in our analyses. We also assessed participants' reading times for the following region (R6) to capture any effects spilling over from the previous region.

The experimental items were intermixed with 48 fillers with diverse structure patterns, such as subject and object relatives, sentences with scrambled word order, sentences involving a nonlocal subject–predicate honorific agreement, and sentences involving numeral quantifiers.

5.3 Procedure

The self-paced reading task was run on the Ibex Farm 0.3.9 program (Drummond 2013). Participants individually completed the task on a computer. Sentences were presented in a non-cumulative moving window display (Just and Carpenter 1992). During the task, participants saw a series of dashes on the screen, which indicated target words' position within a sentence. Participants revealed the first word by pressing the spacebar. With the next press, the first word was replaced with the dashes, revealing the next word. After each sentence was processed, a true–false verification question appeared with two options, prompting participants to respond by clicking one of them. The verification questions for the experimental items queried the reference of the null subject in the disambiguating clause. For

example, after reading the sentence "[in English translation] Because Youngsoo angered Jiho, (he) immediately apologized to Jiho," participants saw the question "[in English translation] Did Youngsoo apologize to Jiho?" Examining participants' interpretations of the null referent was necessary to assess the effects of implicit consequentiality and topicality precisely. For this reason, we excluded trials from further analyses for which participants failed to provide the intended reference for the null subject. The task was preceded by written instructions and five practice items. The overall procedure took approximately 10–15 min.

5.4 Data trimming and analysis

Prior to the data analysis, we trimmed participants' reading time (RT) data for the experimental items in the following steps. First, trials with incorrect answers in the yes–no verification questions were removed, which affected 13.4% of the data. Next, we removed outliers defined as RTs below 100 ms and above 4,000 ms (0.9%) as well as RTs that fell beyond three standard deviations from the mean (2.4%).

The remaining data were statistically analyzed using a linear mixed-effects model (Baayen 2008; Baayen et al. 2008). To meet the normal distribution requirement of the data, all RTs were log-transformed (Ratcliff 1993). To further factor out the variability in individuals' reading speed and the word-length difference in the critical region across the conditions, the log-transformed RTs were residualized by calculating the difference between the expected RTs and the raw RTs (Trueswell et al. 1994). The expected RTs were obtained from an analysis regressing the word length onto the raw RTs. To test the effects of implicit consequentiality and topicality on participants' reading times, we fit linear mixed-effects models to the residual RTs for the critical (R5) and the spill-over region (R6), respectively. Each model included case marking (nominative, topic), reference of the null subject (subject-referring, object-referring), and their interaction as fixed effects, along with the random effects of participant and item. The fixed effects were centered using deviation coding (nominative and object-referring conditions coded as –0.5). The maximal random effects structure was constructed and then simplified in a stepwise fashion based on likelihood ratio tests. As the two separate models were analyzed simultaneously, each analysis's alpha level was corrected for 0.025 (0.05 divided by 2). In the case of a significant interaction between case marking and reference, we split the data into two subgroups by case marking and investigated any reading time difference between the two reference types in each case-marking condition. These post-hoc analyses were conducted using a linear mixed-effects regression containing reference as a single fixed effect (centered

using deviation coding), along with the random effects of participant and item. In these models, the alpha level was further adjusted to 0.012 (0.025 divided by 2).

5.5 Results and discussion

Figure 3 displays participants' reading time profiles across the four conditions. Participants' reading patterns appear to diverge across the conditions starting from the critical region (R5). They had shorter RTs in the topic-/subject-referring condition than the other conditions in the critical region, which was more prominent in the following spill-over region.

In order to assess whether the divergent reading time patterns across conditions were statistically different, linear mixed-effects regression (lmer) was conducted on participants' RTs for the critical and spill-over regions.[3] Table 1 summarizes the model output.

In the critical region (R5), we found no main effect of case marking, reference, or their interaction. Exploratory analyses for each case-marking condition did not show a main effect of reference for the nominative ($b = -0.01$, $SE = 0.05$, $p = 0.873$)

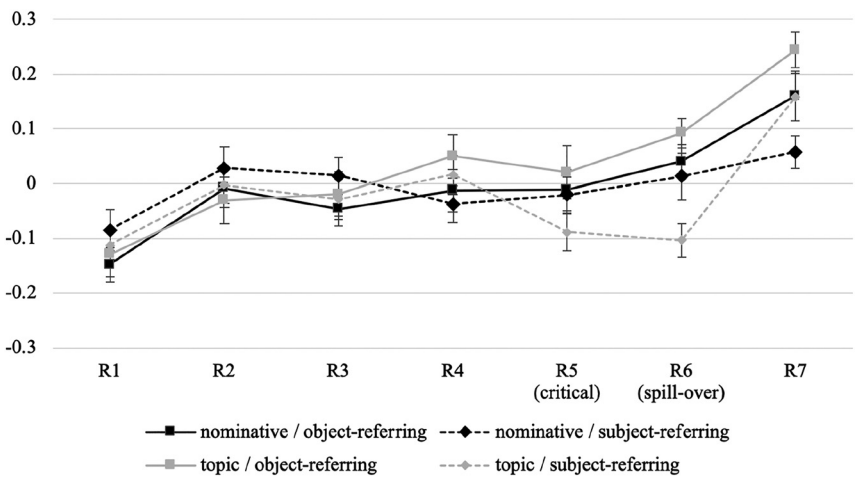

Figure 3: Residual reading time profile in the self-paced reading task; error bars indicate 95% CIs.

3 Linear mixed-effects models conducted on the other regions did not show any significant effects of case marking, reference, or their interaction.

Table 1: Model outputs for regions 5 and 6 from the self-paced reading task.

		b	SE	*p*
Region 5 (critical)	Intercept	−0.02	0.03	0.455
	Case marking	−0.01	0.04	0.722
	Reference	−0.06	0.04	0.084
	Case marking × reference	−0.11	0.07	0.127
Region 6 (spill-over)	Intercept	0.01	0.03	0.613
	Case marking	−0.03	0.03	0.411
	Reference	−0.11	0.03	<0.001
	Case marking × reference	−0.15	0.07	0.021

condition, yet there was only a weak effect of reference for the topic condition (b = −0.11, SE = 0.05, p = 0.040) at the adjusted alpha level. Overall, the results in the critical region suggest that the participants spent almost the same time in this region, although they showed a weak tendency toward shorter RTs in the topic-/subject-referring condition than in the other conditions.

In the spill-over region (R6), there was no main effect of case marking. Importantly, however, we found a reliable effect of reference qualified by its significant interaction with case marking, suggesting that participants' reading time gap between the two reference type conditions was different across the two case-marking conditions. Post-hoc analyses examining this interaction were performed for each case-marking condition, with the linear mixed-effects model including reference as a fixed effect. The model for the nominative condition did not show any effect of reference (b = −0.03, SE = 0.04, p = 0.499), whereas the model for the topic condition revealed the main effect of reference (b = −0.18, SE = 0.05, p < 0.001). As is evident in Figure 3, participants had significantly shorter RTs for the subject-referring condition than for the object-referring condition in the topic condition, but not in the nominative condition. These results suggest that participants experienced less processing difficulty when the null subject was disambiguated as the topic-marked subject in the previous clause, whereas they spent the same time on both reference conditions when the subject in the preceding clause was marked by the nominative case.

The results of the self-paced reading task suggest that topicality affected referential processing during the online comprehension of the Korean implicit consequentiality sentences. Recall that the implicit consequentiality verbs created a bias toward an object as the main undergoer of an event in the task, making it a more likely referent in the following consequence clause. Despite this object bias, our participants showed significantly shorter RTs in the subject-referring than the

object-referring condition for the topic-marked subject in the spill-over region. These findings support the claim that a topic-marked subject leads to a same-reference interpretation in complex clauses (Nariyama 2002). Crucially, our results further indicate that this effect emerges during real-time sentence comprehension. In contrast, we did not find an effect of implicit consequentiality as participants spent the same reading time between the two reference conditions in the nominative condition, which contrasts with the consistent effect of implicit consequentiality observed in the offline sentence-completion tasks in Experiments 1a and 1b. In the next section, we discuss these findings in detail.

6 General discussion and conclusion

The goal of the present study was to test whether the topic status of a subject modulates Korean speakers' referential processing during offline and online interpretations of implicit consequentiality sentences. The analyses of sentence-completion and self-paced reading tasks yielded different outcomes for the interaction of topicality and implicit consequentiality. In the sentence-completion tasks, participants provided a referent consistent with the verb's bias in their continuations, regardless of the case markers for the subject. Although there was more subject reference in the topic- than the nominative-marking condition in general, the topic-marked subject did not lead to a strong subject bias in the NP2 condition, indicating no modulating effect of topicality. In the self-paced reading task, the predicted NP2 interpretation biased by the verb was influenced by the presence of the topic-marked subject in the preceding clause, which led to significantly shorter reading times when the reference in the next clause referred to the previous subject than the previous object. However, we found no evidence for an effect of implicit consequentiality. Specifically, the RTs in the nominative condition remained the same, regardless of whether the null reference was disambiguated to the previous subject or object.

The divergent findings observed between the offline and online tasks suggest that speakers' real-time reference resolution may not always converge on their final decision about a referential choice. First, the topicality effect modulated implicit consequentiality biases in the online task, but not the offline task. Although topicality affected participants' referential choices in their offline continuations, its effect was not strong enough to overturn the implicit consequentiality effect. In contrast, in the online task, it became clear that the topic-marked subject led to a stronger bias toward a subject interpretation of the null referent despite the presence of the implicit consequentiality verbs that favored object interpretations. The contrasting findings between the offline and online tasks

regarding the interaction of contextual information and implicit causal biases are not new. Several studies adopting the offline sentence-completion paradigm showed a robust effect of implicit causal biases hardly modulated by contextual information (e.g., Bott and Solstad 2014; Hartshorne et al. 2015; Hartshorne and Snedeker 2013; Ueno and Kehler 2016). In contrast, evidence showing significant effects of contextual cues on comprehenders' construal of causal events has mostly come from studies employing reaction-time-based measures of referential processing (e.g., van den Hoven and Ferstl 2018; Koornneef et al. 2016). In fact, these findings have been obtained with different populations under varying experimental settings, rendering it difficult to make direct comparisons across the outcomes between offline and online experiments. In this regard, the current study provided confirming evidence that the interpretation of causal structures may depend on different sources of cues in offline and online comprehension by involving a homogenous speaker group using the same experimental stimuli.

Although no explicit models or accounts provide clear explanations of the different degrees of topicality effect depending on the task type, we speculate that the divergent findings may be related to the different integration timings of case marking and implicit consequentiality information in offline and online comprehension. In our self-paced reading experiment, participants encountered topicality information before the verb's bias cue, suggesting that the topicality information must be retained in participants' memory until it is integrated with the causal bias information for reference resolution in the second clause. Our reading-time measures successfully captured the interaction between the two cues, revealing the effect of topicality over the verb's bias information in the spill-over region. However, this interaction may have been difficult to capture during the offline task because the topicality effect may have decayed in participants' memory to a greater extent and, thus, may have been less accessible than the late-arriving implicit consequentiality information when the participants had sufficient time for reading the sentence fragment and planning their continuations.

Another major difference between the outcomes from the offline and online tasks is the implicit consequentiality bias under the nominative condition. Although the offline task clearly showed the bias effect, there was little evidence of this effect in the self-paced reading task. One reason may be associated with the different processes underlying offline referential choices and online referential processing. The construal of causal relationships in a discourse context is driven by several factors, such as verb semantics, thematic roles, and world knowledge (Arnold 1998). In particular, online referential resolution is strongly influenced by the form of referring expressions and speakers' coreference expectations in the upcoming material (e.g., Grüter et al. 2018). Recall that, in the self-paced reading task, we did not provide an overt subject in the second clause to allow for the

natural reading of the sentence given Korean's null subject property (Roh and Lee 2003). The absence of an overt referent may be responsible for the lack of any implicit consequentiality effect. Previous research has suggested that pronouns play a crucial role in guiding comprehenders in tracking references across clauses (Arnold 2010; Kehler 2002). Although some studies have found an early effect of a verb's bias immediately following the causal bias verb (e.g., Pyykkönen and Järvikivi 2010), most studies have provided converging evidence that the causality effect emerges after a pronoun is encountered, either immediately following the pronoun (e.g., Cozijn et al. 2011; Featherstone and Sturt 2010; Itzhak and Baum 2015) or near the end of the clause (e.g., Garnham et al. 1996; Stewart et al. 2000). During the self-paced reading task, our participants read target sentences in an incremental fashion. Accordingly, they might have deferred referential processing until they detected an overt referent – that is, the use of a null subject might have delayed their referential processing, which might have prevented them from making full use of the implicit consequentiality information in a rapid fashion. In contrast, the participants freely chose a referential form, including a null and an overt referent, in the sentence-completion tasks. During this process, participants were expected to select a specific type of referent in their mental models. As they had already established referents in their minds, their referential choices could have been more strongly affected by the information of implicit consequentiality in the offline tasks.

To test this speculation regarding the role of referential forms in the effect of implicit consequentiality, we conducted an additional analysis limited to a subset of participants' responses in Experiments 1a and 1b that contained a null subject (61.3% of all data). We then compared the effect of implicit consequentiality in these subset data with the entire dataset to scrutinize how the null referent contributed to a reduced effect of implicit consequentiality compared to the effect observed in our main analyses. A logistic mixed-effects regression model including verb bias (NP1, NP2) and data type (subset, entire) showed a main effect of verb bias ($b = -3.73$, $SE = 0.42$, $p < 0.001$), with more subject reference in the NP1 than in the NP2 condition, as well as a main effect of data type ($b = 2.07$, $SE = 0.31$, $p < 0.001$) with more subject reference in the subset data than in the entire dataset. Importantly, a significant interaction emerged between verb bias and data type ($b = -1.46$, $SE = 0.57$, $p = 0.011$), induced by the reduced effect of verb bias in the subset data compared to the bias effect in the entire data. These findings suggest that null reference is part of the factors that drove the absence of the implicit consequentiality effect in the self-paced reading task. Despite these possible accounts for the different results across the tasks, it remains speculative as to what exactly drove the stronger effect of implicit consequentiality in the offline

compared to the online tasks. It could be a result of the retrieval difficulty of the verb's bias information, a result of missing effects of implicit consequentiality arising from the null subject in the online task, or an interaction of both causes. The question is left open, and further studies need to test each of these speculations to advance our understanding of how referential forms affect speakers' interpretations of implicit causal biases.

The significant effect of topicality in the self-paced reading task indicates that the topic status of the subject exerts a strong influence on Korean speakers' interpretation of implicit consequentiality, at least during online referential processing. These findings are consistent with Nariyama's (2002) hypothesis about the scope of a topic-marked entity in complex clauses. They also provide supporting evidence that case-marking information can affect the interpretation of causal events in languages like Korean. The topicality effect found in this study is in line with previous findings that morphological cues affect speakers' construction of a mental model of the event structure in discourse (Grüter et al. 2017; Hwang 2018; Kim et al. 2013; Kim and Grüter 2019). Like these studies, we also found the modulation of explicit marking (i.e., topic marker) in Korean speakers' processing of implicit consequentiality information. Perhaps explicit devices such as a topic marker draw comprehenders' attention, achieving a high degree of salience and thereby helping comprehenders better capitalize on these cues to resolve reference during online processing.

Like our findings, Ueno and Kehler (2016) also found a small effect of topic marking in Japanese speakers' referential choices in implicit causality sentences, but only when the verb created a bias toward an object. In their IC2 condition, the topic-marked subject induced more subject reference in participants' sentence completion than the nominative-marked subject, although this effect was only marginal. Based on these findings, Ueno and Kehler (2016) hypothesized that the topicality effect is manifest when the biases induced by the topic and the verb constitute conflicting cues as "only here does the explicit indicator of what is being talked about contradict the direction of the discourse set up by the lexical semantics of the verb" (p. 1212). In contrast, we found a robust topicality effect in the self-paced reading task. As previously discussed, the stimuli in Ueno and Kehler (2016) involved two separate sentences without a conjunction, which may have reduced the topicality effect. In contrast, our study examined the effect of a topic-marked subject in the context of implicit consequentiality, where the cause and consequence events were presented as a chain of subordinate and main clauses. In light of Nariyama's (2002) account, we attribute the pronounced effect of topicality in our study to the function of the topic marker whose scope extends to the following clause when the subordinate clause is followed by the main clause. We

thus conclude that the conjoined effects of increased salience of the explicit topic marker and its scopal property led to the current results (Arnold 1998, 2010; Au 1986; Baayen 2008). Future research is needed to investigate whether the topicality effect would also emerge in other complex clause contexts beyond implicit consequentiality sentences.

In conclusion, our study has demonstrated the modulatory role of topicality in the Korean speakers' construal of a causal event in the online self-paced reading task. The present results imply that topicality serves as a highly accessible cue during referential processing for Korean speakers. These findings are consistent with previous findings that have identified several factors influencing a speaker's referential resolution in implicit causality and consequentiality sentences, such as verb-mediated bias information, contextual cues, and discourse coherence (e.g., van den Hoven and Ferstl 2018; Kehler et al. 2008; Koornneef et al. 2016). In addition to these factors, the present data show that the explicit topic marker mediates comprehenders' construction of the mental model of the events described by the causal structures – at least during online processing. This result is in line with the account that coreferential biases are guided by a multitude of factors (Ferstl et al. 2011), rather than the perspective that implicit causal biases are determined primarily by verb semantics (Bott and Solstad 2014; Crinean and Garnham 2006; Hartshorne et al. 2015; Hartshorne and Snedeker 2013). The role of topicality, as demonstrated in this study, is expected to advance our understanding of how readers establish mental models of discourse events using various sources of information during online sentence comprehension. Concurrently, the contrasting findings between the sentence-completion and self-paced reading tasks point to the need for investigating the specific mechanisms underlying these tasks that may have affected the amplified or reduced effect of topicality on the speakers' interpretation of implicit consequentiality.

Supplementary Material

Supplementary material accompanying this article can be found at https://doi.org/10.5281/zenodo.6951043.

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