Incremental processing of negation:
Evidence from Korean*

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Lee, Miseon. 2017. Incremental processing of negation: Evidence from Korean. Linguistic Research 34(2), 205-224. The present study seeks to investigate whether negation is incrementally comprehended in Korean. Many of previous behavioral and neurological studies have found delays and errors in the comprehension of English negation. However, more recent studies have reported that negative sentences are incrementally processed as fast and accurately as affirmative sentences, given a pragmatically felicitous context. This discrepancy suggests that the poor comprehension of negation is mainly due to the absence of a felicitous context. In line with this, our hypothesis was that pragmatic felicity could help negation processing by establishing expectancies for using negation. In an eye-tracking task, we found that twenty-four Korean-speaking participants were equally fast and accurate in comprehending both affirmatives and negatives within a discourse context. Fixation analyses further showed that shortly after hearing the verb in a scrambled sentence, participants distinguished between negative and affirmative interpretations. These findings support the hypothesis that given a felicitous context, negation is incrementally processed by rapidly using the polarity information of the verb. (Hanyang University)

Keywords negation in Korean, incremental processing, pragmatic context, a two-step theory, eye-tracking

1. Introduction

Negation is essential in natural language to express various semantic categories including nonexistence, rejection, denial, prohibitions, and factual descriptions (e.g., The cat doesn't like it when you pull her tail). It emerges fairly early in child

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language development and negation words such as *no* and *not* are one of the most frequently used expressions in adults’ speech to children (e.g., Bloom 1970; Cameron-Faulkner *et al.* 2007; Klima and Bellugi 1966; Pea 1980; Wode 1977). Ubiquitous and common though they are, previous studies have shown that negation provides unique challenges for language comprehension, even for adult native speakers. Evidence comes from a variety of experimental studies using behavioral and neurological tasks (Carpenter and Just 1975; Clark and Chase 1972; Fischler *et al.* 1983; Just and Carpenter 1971, 1976; Kaup *et al.* 2006, 2007; Kounios and Holcomb 1992; Lüdtke *et al.* 2008; Mayo *et al.* 2004). A consistent finding from these studies is that English speakers are overall slower and make more errors in their responses to a negative sentence such as “A robin is not a bird” than to its affirmative counterpart.

This general finding on the delayed interpretation of negation has been explained by a *two-step theory* of negation processing. This theory proposes that a negative sentence initially facilitates the representation of a situation described by its affirmative counterpart and then shifts to the representation of a negated state (Cuccio 2012; Hasson and Glucksberg 2006; Giora *et al.* 2004, 2007; Kaup *et al.* 2006, 2007; Kaup and Zwaan 2003; MacDonald and Just 1989). Many behavioral studies have provided supporting evidence for the two-step processing. For example, in Kaup *et al.*’s (2007) speeded picture-recognition task, participants read a sentence (e.g., *The eagle was not in the sky* or *The eagle was in the sky*), and afterwards responded by selecting a picture of the described entity (e.g., an eagle with its wings folded or an eagle with its wings outstretched). The participants made more picture-selection errors for negative sentences, which was claimed to be due to the competition from its affirmative simulation. In addition, their response times to negative sentences were significantly shorter when the picture matched the affirmative situation (i.e., the picture of an eagle with its wings outstretched) than when it mismatched the factual situation. These results were interpreted as showing that understanding negation first requires constructing of the affirmative interpretation, and subsequently forming of a representation of a negated state of the situation (Kaup *et al.* 2006, 2007).

Several ERP studies support this two-step comprehension of negation, showing that the N400 is insensitive to negation (Fischler *et al.* 1983; Kounios and Holcomb 1992; Lüdtke *et al.* 2008). For example, Fischler and colleagues (1983) found greater
N400 effects for true negatives (e.g., *A robin is not a truck*) than false negatives (e.g., *A robin is not a bird*). This result is in accord with the two-step theory of negation processing. A true negative sentence (e.g., *A robin is not a truck*) elicits N400 responses because listeners first construct the semantically implausible affirmative representation (e.g., *a robin is a truck*) before applying the negative meaning (for a review, see Kaup et al. 2007; Singer 2006).

However, more recent research has presented a different picture. It has been found that with an appropriate context, listeners do not process negation in two steps but immediately obtain the negative interpretation (Anderson et al. 2010; Autry and Levine 2012; Dale and Duran 2011; Glenberg et al. 1999; Huette 2016; Lüdtke and Kaup 2006; Khemlani et al. 2012; Nieuwland and Kuperberg 2008; Nieuwland and Martin 2012; Orenes et al. 2014, 2016; Reuter et al. 2017; Snedeker et al. 2012; Tian et al. 2010; Wason 1965). For example, using a similar paradigm as in Kaup et al. (2007), Tian and colleagues (2010) examined how people comprehended simple negative sentences (e.g., *Mike didn’t iron his shirt*) as compared to cleft sentences with a negative clause (e.g., *It was Mike who didn’t iron his shirt*). Clefts are known to have a presupposition (e.g., someone didn’t iron his shirt), so they could create a pragmatic context for negative meaning (Levinson 1983; Roberts 1996). In Tian et al.’s study, after reading a simple negative sentence, participants responded faster to a picture of an affirmative situation (e.g., an ironed shirt) than to an image of a negative situation (e.g., a crumpled shirt), as found in previous studies without contexts. However, after reading a cleft negative sentence, they responded faster to a picture matching a negative situation. Snedeker and colleagues (2012) also found that given a felicitous context, participants were equally fast and accurate in comprehending simple affirmatives and negatives. In their eye-tracking task, participants looked more towards the objects corresponding to the polarity of the verb shortly after hearing the verb. For example, when hearing an affirmative verb (e.g., *broke*), they looked more at affirmative objects (e.g., broken objects). Crucially, upon hearing a negative verb (e.g., *didn’t break*), they looked more at negative objects (e.g., unbroken objects).

A similar result was reported in an ERP study (Nieuwland and Kuperberg 2008). Nieuwland and Kuperberg found larger N400 effects for false statements than for true statements, both for affirmative sentences (e.g., *With proper equipment, scuba-diving is very dangerous*) and for pragmatically felicitous negatives (e.g., *With
proper equipment, scuba-diving isn’t very safe). Crucially, this result is inconsistent with the two-step theory, which predicts larger N400 effects for true negatives (e.g., *With proper equipment, scuba-diving isn’t very dangerous*) than for false negatives (e.g., *With proper equipment, scuba-diving isn’t very safe*). Instead it indicates that negation can be immediately interpreted as long as it appears in a pragmatically felicitous context.

Taken together, these results suggest that earlier findings of delayed processing of negation reflect the infelicitous use of negation rather than delays in the processing of negation. This is because, as Wason (1965, 1972) argued, the negation requires a felicitous context that triggers the listener’s anticipation of its use. For example, with the presence of an apple in a naturalistic situation, there is no pragmatic reason to say “This is not a pear,” even if it is true. In contrast, in a situation where several pears and an apple are present, it is more plausible to say “This is not a pear.” Thus, when the context is felicitous and provides pragmatically proper expectancies for the use of negation, it is expected that listeners would process negative elements fast and incrementally in sentence interpretation. It is partly because listeners are not only interpreting a sentence itself but also inferring how the content of the sentence might be related to the real world in incremental processing (e.g., Brown-Schmidt et al. 2008; Grice 1989; Hobbs et al. 1993).

The present study aimed to explore how adult native speakers of Korean interpret negative sentences within a pragmatically supportive context. This study used eye-tracking in the visual world paradigm to measure moment-to-moment eye gaze data during critical sentences. On Kaup’s (Kaup et al. 2006, 2007) two-step theory of negation processing, in which negative sentences give rise to affirmative simulations that are then shifted out of attention, participants are expected to be slower and less accurate in their responses to negative sentences and to look at the affirmative target first. In contrast, in line with the incremental processing account, we hypothesized that if participants can integrate the information from a supportive context and rapidly process negation to guide interpretation, they should show equally fast and accurate performance on both affirmative and negative sentences, as found in English negation (Snedeker et al. 2012). Before moving onto the method section, we present a brief review of negation in Korean in the next section.
2. Negation in Korean

As is well known, there are two distinct forms of syntactic negation in Korean—the short form negation (SFN) and the long form negation (LFN), as illustrated in (1). In SFN, the negative marker *an* immediately precedes the predicate. In LFN, on the other hand, *an* and an auxiliary verb *ha*- ‘to do’ follow the predicate which appears with the nominalizer suffix -ci (*an* + *ha* is usually contracted into *anh*).

(1) a. Affirmative:
Eddy-ka sangca-lul yel-ess-ta
Eddy-Nom box-Acc open-Past-Se
‘Eddy opened the box.’
b. Short form negation (SFN):
Eddy-ka sangca-lul an yel-ess-ta
Eddy-Nom box-Acc not open-Past-Se
‘Eddy didn’t open the box.’
c. Long form negation (LFN):
Eddy-ka sangca-lul yel-ci anh-ass-ta
Eddy-Nom box-Acc open-Nmn not.do-Past-Se
‘Eddy didn’t open the box.’

In general, the two negation forms are synonymous with slight stylistic differences—SFN being slightly less formal, more direct and more colloquial than LFN (Choo and Kwak 2008; Sohn 1999). However, some researchers have reported that the two forms of negation are in fact different in their meaning and pragmatic implications (Kim 1996; Lee 1993; McClanahan 1998). For instance, McClanahan (1998) claims that unlike LFN, SFN *an* expresses the speaker’s strong volition not to do the denoted action. The two forms of negation also differ in their distributional property, with more restrictions on the use of SFN (Sohn 1999). Action verbs and descriptive verbs allow both forms of negation, but SFN does not sound natural with adjectives (in particular, those of three or more syllables) and compound verbs (e.g., *kongpwu-hata* ‘study’, *yath-pota* ‘look down upon’). While LFN is relatively free to

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1 Korean examples are presented using Yale Romanization. We use the following abbreviations: Nom = nominative case, Past = past tense, Se = sentence ender, Qtf = quantifier, Gen = genitive case, Acc = accusative case, Nmn = nominalizer
occur with any verbs, it is generally not allowed with a copular verb *i-ta when it has a noun complement (e.g., *haksayng i-ci anh-ta ‘(He) is not a student’).

Previous studies have consistently reported that SFN appears in production earlier than LFN. In child Korean, LFN starts to be produced around age 3;5, much later than SFN (Choi and Zubin 1985; Hahn 1981; Han and Park 1995; Kim 1997). LFN is more difficult to learn than SFN in L2 Korean as well. Jeon (2001) reported that learners of Korean made more errors with LFN (55% correct) than with SFN (92.5% correct) in an elicited imitation task. The same pattern was also noticed in Broca’s aphasia (Lee 2007). In an elicited production task, Korean speakers with Broca’s aphasia showed a dissociation between the preserved SFN and the impaired LFN (90% vs. 3 % correct). In contrast, these studies found no significant differences between the two negation forms in comprehension.

Little has been reported in literature on how negation is processed in Korean in real time. The very few online studies to date have examined the processing of LFN without context (Kim 2007; Nam 2016) and found no evidence for immediate processing of negation in Korean. For example, Nam (2016) found greater P600 effects for false LFN (e.g., chimtay-nun kakwu-ey sokha-ci anh-nun-ta ‘A bed doesn’t belong to the furniture category’) than true LFN (e.g., sikyey-nun kakwu-ey sokha-ci anh-nun-ta ‘A clock doesn’t belong to the furniture category’). Meanwhile, for lexical negatives, greater N400 was observed for true negatives (e.g., napi-nun kkoli-ka eps-ta ‘A butterfly doesn’t have a tail’) than for false negatives (e.g., holangi-nun kkoli-ka eps-ta ‘A tiger doesn’t have a tail’). These results are in line with the findings from English, supporting the two-step account. A true negative sentence elicits N400 (for lexical negatives) or P600 responses (for syntactic negatives) because participants first construct the semantically implausible affirmative counterpart (e.g., A butterfly has a tail, A clock belongs to the furniture), and then shift to the negative representation when encountering the negative marker.

However, none of these studies used any context in their tasks while negation can be incrementally processed given a felicitous context (e.g., Nieuwland and Kuperberg 2008). Hence, it is possible that their findings of two-step processing were due to the absence of a context, as clearly shown in previous studies of English negation. With this possibility, our eye-tracking experiment set out to address whether Korean negation is comprehended incrementally given a context, and thereby to assess the two contrasting accounts of negation processing (i.e., two-step
processing vs. incremental processing). To examine this issue, we tested real-time processing of LFN within a context.

3. Methods

3.1 Participants

Twenty-four undergraduate students at a university in Seoul participated in this study (mean age = 23.8 years, 12 males). All were native speakers of Korean and had less than a year of living experience abroad. The participants had normal or corrected-to-normal hearing and vision, with no history of neurological, psychological or linguistic disorders. They received monetary compensation for their participation.

3.2 Stimuli

The experimental design and stimuli of this study was adopted from Snedeker et al. (2012). There were four experimental lists. Each list consisted of sixteen trials, half affirmatives and half negatives. Each trial included a set of pre-recorded auditory stimuli: a context story, an interjection, a critical sentence, and response prompt (see Figure 1 for an example). Each context story described an event with a cartoon character (e.g., Eddy) and two pairs of objects (e.g., two boxes and two envelopes). The character performed an action (e.g., opening) on one object from each pair before being interrupted. This created a neutral discourse context.

Each critical sentence included a sentential subject, a past tense verb or a past tense verb negated by a long form negation -cianh- ‘not’ (e.g., yel-ess-ta ‘opened’ or yel-cianh-ass-ta ‘didn’t open’), and a direct object which was composed of han-kay-ui ‘one of’ followed by a target noun (e.g., pongthwu-lul ‘the envelope’). We used LFN as stimuli for two reasons. First, in addition to the restrictions regarding the use of SFN as described above in section 2, there is a controversy that SFN is not a syntactic negation but a lexical negation where an is an affix or an adverb (Ahn 1991; Kim 1996; Park 1990). These properties of SFN may have an effect on processing that is not comparable to
English negation processing. Second, previous studies of Korean negation mostly investigated LFN without context and demonstrated that LFN is comprehended in two steps. Given these findings, we attempted to examine whether the results can be replicated in an online task within a context and thereby to test the two contrasting hypotheses. While Korean is a head-final language with a canonical SOV order, we used the scrambled order, where the negated verb precedes its direct object. In the canonical structure as in (1), the polarity information is available at the sentence-final position. Thus, it is not clear whether LFN is really processed in two steps (shifting from the affirmative to the negative representation), or the observed two-step processing simply reflects the processing of incoming words one by one in order (i.e., preverbal NPs first, and the negation last). In contrast, the scrambled order allows us to test whether the polarity information of the verb, rather than the lexical semantics of the target noun, can guide real-time comprehension of the unfolding sentence. In other words, by placing the negated verb at a non-final position, it is possible to see if the polarity information is immediately processed at the verb or is processed via its affirmative interpretation at the end of a sentence.2

We used sixteen transitive verbs as stimuli. For each verb, we crossed two objects (e.g., box and envelope) with two polarities (e.g., open and didn’t open), to construct four possible critical sentences, as in (2).

(2) An example of four critical sentences for *yel-ta* ‘to open’

   Eddy-Nom open-Past-Se one-Qtf-Gen box-Acc
   ‘Eddy opened one box.’

   Eddy-Nom open-Nmn not.do-Past-Se one-Qtf-Gen box-Acc
   ‘Eddy didn’t open one box.’

   Eddy-Nom open-Past-Se one-Qtf-Gen envelope-Acc
   ‘Eddy opened one envelope.’

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2 As a reviewer pointed out, it should be noted that the scrambled structure may involve a different processing and/or cognitive mechanism from that of the canonical structure. While this issue is beyond the scope of this work, it should be examined in future research.
   Eddy-Nom open-Nmn not.do-Past-Se one-Qtf-Gen envelope-Acc
   ‘Eddy didn’t open one envelope.’

The auditory stimuli were accompanied by visual displays. Each display consisted of four objects, which were different in kind (e.g., boxes or envelopes) and in color or state (e.g., red or blue). As shown in Figure 1, for each trial, three visual displays were presented in sequence reflecting events of the context story. When an action (e.g., opening) happened to one of the four objects (e.g., an envelope), the display changed to show the result of that action (Figure 1 (b)). When the same action happened to the second object (e.g., a box), the display changed again (Figure 1 (c)), depicting the final state of the four objects.

(a) Display 1: Context: It was Eddy’s birthday. Eddy got gift boxes and cards from his family. He wanted to see what was inside the gift boxes and the cards.
(b) Display 2: Context: Eddy opened the blue envelope and found a message from his mother.
(c) Display 3: Context: He opened the red box and found a wonderful robot. Next, he was going to open the red envelope and the blue box. But it was time for him to blow the candles out on his birthday cake. So he decided to open them later. Interjection: Oh, that’s what happened! Critical sentence: Eddy didn’t open one envelope. Response prompt: Choose which one it was.

Figure 1. An example of visual and auditory stimuli
(presented in Korean: see Appendix)

Four experimental lists counterbalanced the order of trial presentations and the target noun. The location of the target image was also counterbalanced across trials. With this balanced design, each noun and each image served as its own control across experimental lists.
3.3 Procedure

Participants’ eye movements were recorded using an SR Research EyeLink II head-mounted eye-tracker with sampling rate of 500 Hz on a 17” screen (1280 x 1024 pixel resolution). Calibration and validation were conducted at the beginning of the practice and the experiment sessions and, if necessary, were repeated several times per session. Participants were instructed to listen to the auditory stimuli as they were viewing the visual displays on the screen. We measured participants’ eye-fixations to the four images during the critical sentence and accuracy of responses.

During testing, participants first completed three practice trials to ensure that they understood the task. The practice trials had the same design as the test trials, but the context and critical sentences were all simple affirmative statements (e.g., *Ai-ka phwungsen-ul tul-ko-iss-eyo.* ‘A child was holding a balloon’). After the practice trials, participants completed sixteen test trials. In each test trial, they heard pre-recorded auditory stimuli while viewing corresponding visual displays (Figure 1). A male voice told a context story about the four objects on a display. After each story, a female voice said the interjection (i.e., “Oh, that’s what happened!”), a critical sentence (e.g., “Eddy didn’t open one envelope”), and response prompt (e.g., “Choose which one it was”). Participants then selected one of the four images on the final visual display by pressing a button on a button box.

3.4 Results

3.4.1 Response data

Participants provided a behavioral response at the end of each trial. They made no errors in choosing the target image corresponding to the critical sentence.

3.4.2 Eye-tracking data

We measured participants’ eye-fixations to the visual images during each critical
sentence. If participants can incrementally process negatives as well as affirmatives, we expect more looks based on the polarity of the images (i.e., *polarity effect*).

To assess the processing of the polarity information of the verb, we first analyzed looks to the affirmative images (e.g., the opened box or the opened envelope) during five big time regions of critical sentences (Table 1). In this analysis, we offset each time region by 200 ms from the onset of the relevant word to account for the time that a participant needs to program and execute a saccade (Matin et al. 1993).

**Table 1. Mean duration (ms) of time regions for fixation analyses**

<table>
<thead>
<tr>
<th>Time Region</th>
<th>Subject</th>
<th>Verb</th>
<th>Pre-Noun</th>
<th>Noun</th>
<th>Prompt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>Eddy-ka ‘Eddy-nom’</td>
<td>yellesseyo ‘opened’/ yeclianhassseyo ‘didn’t open’</td>
<td>hankayui ‘one’</td>
<td>pongthwu-lul ‘envelope-acc’</td>
<td>‘Choose which one it was.’</td>
</tr>
<tr>
<td>Affirmative</td>
<td>458</td>
<td>740</td>
<td>494</td>
<td>525</td>
<td>1472</td>
</tr>
<tr>
<td>Negative</td>
<td>482</td>
<td>1010</td>
<td>491</td>
<td>496</td>
<td>1489</td>
</tr>
</tbody>
</table>

ANOVAs indicate a main effect of polarity ($F(1,23) = 138.586, p = .000$) and an interaction of time region and polarity ($F(1,23) = 43.989, p = .000$). To determine when the polarity effect began, we completed additional ANOVAs within each time region. The results showed that the polarity effect began during the verb region ($F(1,23) = 9.269, p = .006$) and remained significant until the response prompt ($p = .000$). That is, participants started to look more towards the affirmative objects (e.g., opened objects) when hearing the affirmative verb (e.g., yel-ess-eyo ‘opened’) and more towards the negative objects (e.g., closed objects) when hearing the negative verbs (e.g., yel-cianh-ass-eyo ‘didn’t open’). This result suggests that the participants were able to rapidly process polarity information during the verb window and use the information to anticipate the incoming word. Next we completed a fine-grained analysis to further examine the starting point of the polarity effect. This analysis of 100 ms time windows was not offset by 200ms to illustrate real-time processing of sentences. The results showed that the polarity effect began 400ms after the verb onset ($F(1,23) = 5.335, p = .03$), and remained significant until after the end of a critical sentence, as shown in Figure 2.
4. Discussion

Based on previous findings (Anderson et al. 2010; Autry and Levine 2012; Huette 2016; Khemlani et al. 2012; Nieuwland and Kuperberg 2008; Nieuwland and Martin 2012; Orenes et al. 2014, 2016; Snedeker et al. 2012; Tian et al. 2010), we hypothesized that negation is processed incrementally when presented in a pragmatically supportive context. To evaluate this hypothesis, we examined the moment-to-moment eye movements during a scrambled negative sentence in Korean. If participants looked to the affirmative images upon hearing the negative verb, this would support a two-step theory of negation processing. Alternatively, if participants directly looked to the negative images when hearing the negative verb, this would support the hypothesis of incremental processing of negation.

Our results are fully consistent with the incremental hypothesis. Given a discourse context, participants made rapid use of the polarity information to predict

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3 The vertical lines represent the average onset of the verb (at 0ms) and the average onset of the final noun. The dashed lien represents the average onset of the verbal affixes.
the likely object upon hearing the verb, as found in English negation (Snedeker et al. 2012). Fixation analyses revealed a symmetric looking pattern, with eye movements to the images consistent with the verb polarity occurring during the same time window for both trial types. In other words, participants looked more towards the affirmative objects (e.g., opened objects) upon hearing the affirmative verb (e.g., yel-ess-eyo ‘opened’). Crucially, when hearing the negative verb (e.g., yel-cianh-ass-eyo ‘didn’t open’), they looked more towards the negative objects (e.g., closed objects). Their eye movements revealed no processing advantage for affirmative sentences or shifts in fixation from affirmative objects to negative objects, contrary to the two-step theory (Kaup et al. 2006, 2007). The polarity effect began during the verb window, 400 ms after the verb onset when the polarity information was available. These results indicate that participants were able to rapidly use the polarity information available from the verb to predict an upcoming object given a discourse context.

It should be noted that the anticipatory looks to a likely object at the verb are not attributed to the lexical association between the verb and an upcoming object. In many cases, listeners can interpret sentences in real time by integrating multiple constraints (Snedeker and Trueswell 2004). For instance, listeners predict an upcoming object (e.g., a cake or a bike) on hearing a verb eat or ride, using the lexical information of the verb together with their world knowledge. However, in the present design, a visual display contains two kinds of objects, both of which are semantically related to the verb (e.g., opening boxes and opening envelopes are both possible). Given this unbiased semantic relatedness between the verb and the objects, if a simple lexical association between the verb and its expected object drives the predictive processing (Jackendoff 1997, 2002), participants should look to any object in the visual display without any preference. Instead, the successful anticipatory fixation to negative objects upon hearing the negative verb (e.g., unopened objects for didn’t open) should be the result of rapid use of the verb polarity.

Considering the poor comprehension of negation observed in prior studies without contexts, the success on the present task strongly hints at the importance of discourse context in negation processing. Along with the discourse context, the visual display accompanying a critical sentence may also provide strong clues to the interpretation of a negative sentence. In fact, visual contexts have been found to have a continuous and incremental effect on the interpretation of syntactic ambiguity
In particular, as the two pairs of objects on display are contrasted to each other in terms of either polarity or lexical meaning, they could provide a felicitous context to establish listeners’ expectancies regarding the use of negation, as illustrated in prior findings (e.g., Hurewitz et al. 2001).

The high response accuracy illustrates that participants were able to eventually identify the target. The successful target identification supports the idea that online sentence processing draws on a complex integration of combinatorial and lexical semantics (Borovsky et al. 2012; Kamide et al. 2003). For instance, upon hearing *yel-cianh-ass-eyo* ‘didn’t open,’ participants first identified two potential objects (e.g., the closed box and the closed envelope), using the polarity information of the verb. Then, shortly after hearing the final noun *pongthwu-lul* ‘an envelope,’ they activated the lexical meaning of the named object and looked to the named objects (e.g., closed and opened envelopes). Yet the lexical semantics of the noun alone is insufficient to identify the target because two objects correspond to the meaning. The target (e.g., the closed envelope) is only identified by combining the polarity information of the verb (i.e., not open) and the lexical information of the noun (i.e., envelope).

5. Conclusion

Recent studies of negation comprehension have found that negation can be incrementally processed in English given a pragmatically supportive context (e.g., Nieuwland and Kuperberg 2008). Consistent with these findings, the present study showed that Korean-speaking adults can incrementally process negation within a discourse context and comprehend both affirmative and negative sentences equally fast and accurately. These results contradict a two-step theory of negation comprehension (Kaup et al. 2006, 2007). Rather, they are consistent with the long-standing view that felicitous context can aid negation processing by establishing expectancies for using negation (Wason 1965, 1972). Yet, to better understand the role of context in the negation processing, it remains to be seen how different types of context (e.g., discourse context, visual context, lexical associations) interact with the comprehension of negation. While the discourse context used in the present study...
is neutral in that it provides no clues about polarity distinction or target identification, we could use more informative context where the discourse or visual scenes provide a stronger clue to trigger the listener’s expectation of the use of negation. We could also investigate how the same critical sentences are comprehended in the absence of discourse or visual context.

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Appendix

An example of context stories in Korean

오늘은 에디의 생일이에요. 에디는 가족들에게 선물을 많이 받았어요. 에디는 그 안에 뭐가 있는지 너무 궁금했어요. 그래서 에디는 먼저 파란 봉투를 열었어요. 그 안에 엄마의 생일카드가 있었어요. 다음에 빨간 상자를 열었어요. 그 안에는 멋진 로봇이 있었어요. 그리고 에디는 나중에 열어보기로 해요.

'It was Eddy’s birthday. Eddy got gift boxes and cards from his family. He wanted to see what was inside the gift boxes and the cards. Eddy opened the blue envelope and found a message from his mother. He opened the red box and found a wonderful robot. Next, he was going to open the red envelope and the blue box. But it was time for him to blow the candles out on his birthday cake. So he decided to open them later.'