Inferences During Discourse Comprehension In Korean

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To appear in:

Jungmin Lee, Youngjin Kim, & Greg Simpson (eds), ***Handbook of Korean Psycholinguistics,*** Cambridge: Cambridge University Press

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Introduction

In the field of discourse comprehension, it is assumed that the goal of reading is to build a coherent representation. To do that, readers need to recognize the relations between the parts of the discourse and piece them together. Readers may have to fill in the information implied in the text and even elaborate on what is mentioned. All these processes "go beyond" the information given in the text and these processes are called inference (Graesser, Singer, & Trabasso, 1994; Schank & Abelson, 1977). For the last several decades, numerous studies in the field of discourse comprehension have been conducted around the problem of inference. Which inferences occur, when they occur and how they affect the memory of the discourse have been the main issues in this field.

In this chapter, the studies that were conducted in Korean language on inferences during reading and their effects on memory are reviewed. While many interesting findings have been reported from the studies conducted in Korean. A large proportion of them are consistent with the findings from the studies in the English language. Inference in discourse comprehension seems to be a process which is less affected by the structure and characteristics of a specific language as compared to such earlier processes as speech perception, word recognition, or sentence parsing. More abstract and higher level of cognition, universal to humans, appears to be involved in inference. Still, there were many novel finding that were not observed in the studies in English. Whether these finding are specific to the Korean language or not would have to be explored further.

In the rest of the chapter, the studies on inferences in the Korean language are reviewed under three themes: Anaphoric, Causal, and Elaborative inference.

1. Anaphoric Inference

While there are many kinds of anaphora such as pronoun, noun phrase, proper name and zero anaphora, the studies on anaphoric inference in the Korean language has been focused mainly on pronoun resolution. Other forms of anaphora have been studied only sporadically(Lee & Lee, 1993; Yoo & Lee, 1989)

As for the pronoun resolution, what factors contribute to the process and how they interact on-line are the main issues in the Korean as well as in the English language. There are two competing views. The modular view is that the resolution of a pronoun is mainly determined by the syntactic cues of the pronoun in a rather bottom-up fashion (see Fredriksen, 1981; Swinney, 1991). According to this approach, syntactic constraints

of a pronoun are usually sufficient enough to assign a correct antecedent. Upon encountering a pronoun, the antecedent is reactivated based on the syntactic cues provided by the pronoun. A second view, the interactive approach, claims that the syntactic cues interact with other contextual cues to assign an antecedent even when the syntactic cues are unambiguous. Contextual cues guide the assignment of the antecedent in a top-down fashion especially when the syntactic cues are ambiguous(see Garrod & Sanford, 1990; Gernsbacher, 1989).

A series of studies have explored this issue using the Korean text. Among the syntactic cues of Korean pronoun like number, person, gender, and register, the effects of the gender cue have been the most frequently studied. For example, Bang(1990) and Lee & Lee(1990) conducted a reading time and a probe recognition experiments to find out how the constraint of the gender cue affects the pronoun resolution. The participants read such passages as shown in (1)-(3) in Korean. They either read the sentences (1)-(2)-(3) where the pronoun 'He' is unambiguous because there is only one male antecedent, or (1')-(2)-(3) where the pronoun is ambiguous. Right after the participants finished reading the target sentence, they performed a recognition task to a probe word.

(1)	A policeman found a drunken actress in a car.	(Unambiguous Condition)
(1')	A policeman found a drunken actor in a car.	(Ambiguous Condition)
(2)	The car was covered with mud.	
(3)	He asked for a driver's license.	(Target Sentence)
Probe:	POLICEMAN	

The two studies found that the reading time of the target sentence was faster in the unambiguous condition than in the ambiguous condition. The response time to the probe was also faster in the unambiguous condition. These studies show that when there are more than one antecedent constrained by the gender cue, processing of the sentence is more difficult. (Corbett & Chang, 1983; MacDonald & MacWhinney, 1990)

Having confirmed the effects of the gender cue, later studies explored the interaction between the gender cue and a contextual factor after the pronoun was presented. Lee(1993) investigated how the gender cue and the case of an antecedent(whether the antecedent is a subject or an object in the sentence it belong to) interact with each other in the time course of pronoun resolution. It has been found that a subject, or an agent mentioned first in a sentence, usually becomes the focus in the given context (Gernsbacher, 1989). Thus, Lee assumed that the case of the antecedent provides a differential pragmatic context at the time the pronoun is being read (Kim,

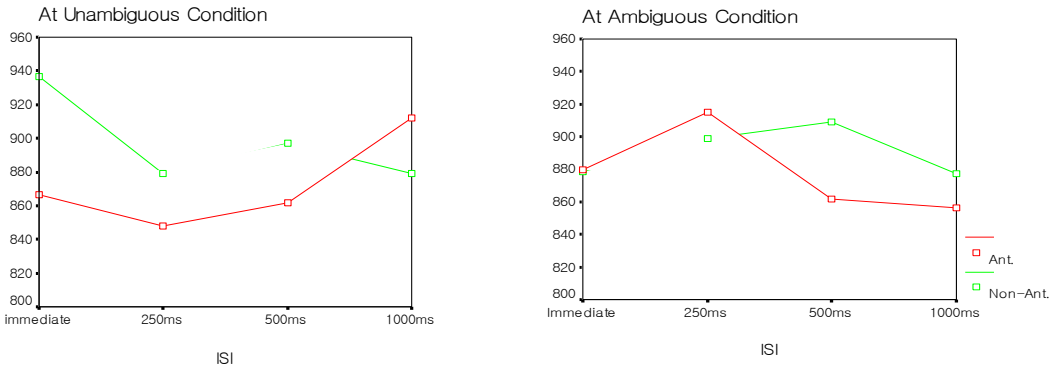
Lee, & Gernsbacher, In press).

In this study, two kinds of passages were used where the antecedent of the pronoun was either a subject as in the above passage (1)-(3), or an object as in (5)-(7).

(5)	A policeman found a drunken actress in a car.	(Unambiguous Condition)
(5')	A policeman found a drunken actor in a car.	(Ambiguous Condition)
(6)	The car was covered with mud.	
(7)	She/He stepped out of the car.	(Target Sentence)
Probe:	ACTRESS/ACTOR	

The participants read the sentences one phrase(a word followed by a particle indicating the case) at a time in a RSVP(rapid serial visual presentation) mode. Right after the participants read the pronoun 'He', or "She', they were presented with a recognition probe at ISI 0, 250, 500, and 1000ms.

As a result, at ISI 0msec, there was a differential activation depending on the ambiguity of the gender cue, but there was no effect of the case. The effect of the gender cue was the largest at 0 msec ISI, gradually decreasing in later ISIs as shown in Fig 1. The effect of the context manipulated as the case of the antecedent started to show up only after 250msec. At 250 and 500 msec ISI, the probe was recognized faster when the antecedent was a subject than it was an object.



[Figure 1] Time course of gender cue effect in probe recognition time (from Lee, 1993, Exp 4a).

This study shows that only the syntactic cues are used to determine the antecedent in the early stage of the Korean pronoun resolution and the case starts to have effect after the antecedent has been assigned. Based on these results, the modular view is supported, suggesting that unambiguous syntactic cues are sufficient to reactivate the antecedent.

However, the interactive view may not be rejected just based on these findings. In the sentences used in the above studies, the second sentence was neutral in the sense that it did not provide any focus on either antecedent, reducing the possible effect of the case in the first sentence. The interactive view of Sanford & Garrod(1994) assumes that a focus is usually provided and established by previous sentences before a pronoun is presented and the role of the pronoun is mainly to confirm the focus of the previous context. Since the focus may not have been clearly given in the sentences used in the above studies, the effect of the context should still be explored further.

Recently, Lee & Lee(2004) found an interesting interaction between the case and the gender difference. The response time was faster when the pronoun was a female than when it was a male regardless of the case. The case had effect only on a male pronoun, with the faster response if the antecedent was a subject than it was an object. This can be interpreted as a marking effect in the sense that female role names in Korean are more conspicuous. It may be because Korean readers regard a male antecedent as a default. In fact, the pronoun referring to the third person male in Korean (corresponding to ‘he’ in English) used to refer both male and female up to several decades ago. Studies in Social cognition in Korea also have provided consistent findings in terms of the marking effect of female (Lee and Bang, 2003). Several studies in English have explored the issue of the gender stereotyping in pronoun resolution and reported that the resolution was faster when the gender of the pronoun and the stereotyped role name are congruent, but the differences between female and male were not observed in their studies (Banaji & Hardin, 1996; Garnham, Oakhill, & Reynolds, 2002).

2. Causal Inference

Many studies on causal inference in Korean reported findings that are consistent with those of the English language. They both confirmed the importance of causal inferences in a coherent representation of a discourse (Lee, 1984; Lee & Choi, 1986; Do, 1994). Several studies are worth mentioning because they provide novel findings that have not been observed in the English language. These studies are about the effects of causal inferences on understanding and memory of a discourse rather than the issue of on-line occurrence of causal inferences during reading.

2.1 Effects of Causal Inference and Predictability on Memory

Kim(1998; 2000) and Park, Lee, & Kim(2003) explored the nature of causal inference and its effect on memory of a discourse. Keenan, Brown, & Baillet(1984) and Myers, Shinjo, & Duffy(1987) reported a U-shaped relationship between the degree of causal relationships and the amount of cued recall. That is, the probability of recall of one of the sentences given the other sentence as a recall cue increased up to a certain point but decreased when the causal relation was the strongest. They interpreted the results as reflecting the effects of elaboration, claiming that the intermediate level of causal relationship requires elaboration to integrate the sentences, which led to higher level of recall. Kim and her colleagues suspected that there could be something other than elaboration in the characterization of causal relationship. They guessed it might be 'predictability'. While the sentence pair (8) and (9) are different in terms of the amount of elaboration required for integration, the sentence pair (9) and (10) are different not in terms of elaboration but in terms of how frequent or predictable the event of the second sentence is as a response to the event of the first sentence.

(8) Susan felt her baby's forehead with her palm.
She took her baby to a hospital right away.

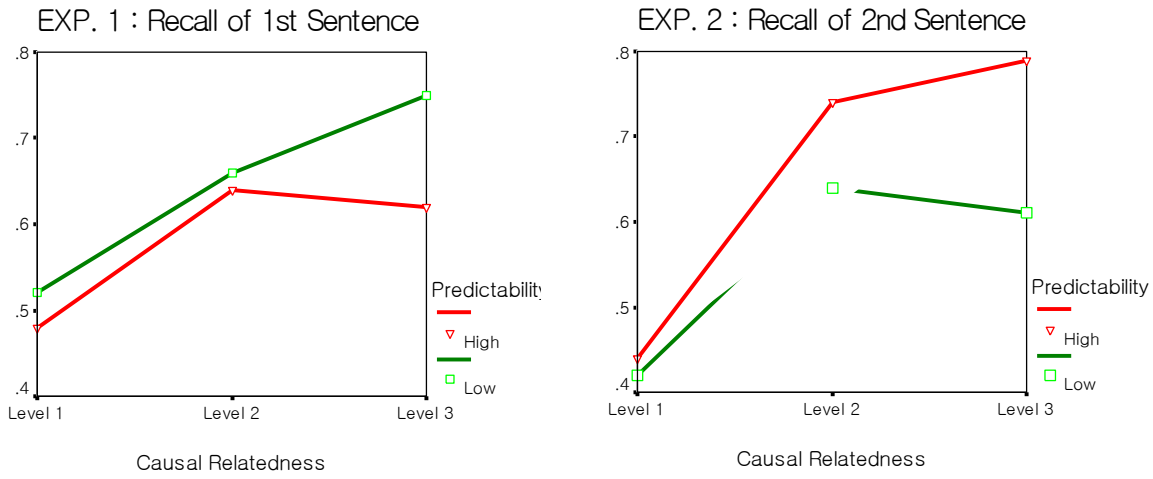
(9) Susan's baby was violently ill with fever.
She took her baby to a hospital right away.

(10) Susan's baby was violently ill with fever.
Susan wiped her baby's body with a wet towel.

Participants rated the sentence pairs (8) and (9) as different in the degree of causal relationship but not the pairs (9) and (10). But in a predictability rating, the pair (9) was rated as more predictable than (10).

In order to investigate the effects of predictability along with the elaboration on recall, she made antecedent events to vary the degree of elaboration (as Keenan et. al., 1984 and Myers et. al., 1987), and two resulting events to vary the predictability, creating 6 pairs of sentences for one theme. While Keenan et. al.(1984) and Myers. et. al.(1987) found the same U-shaped pattern in recall of either sentence, Kim(1998; 2000) found that the pattern of recall was different depending on which sentence was recalled. As shown in Fig. 2, recall of the first sentence was greater for low predictability but recall of the second sentence was greater for high predictability. When the probability of

recall was collapsed over two levels of predictability, the results matched with those of Keenan et. al.(1984) and Myers et. al.(1987)



[Figure 2] Effects of causal relatedness and probability on cued recall (from Kim, 2000)

Why predictability leads to such recall patterns is not known as of now. Kim(2000) once hypothised that the participants integrated the high predictability sentences in a forward direction but reversed the direction in the low predictability sentences. According to her, when the recall cue is the second sentence, the recall of the first sentence should be easier because the direction of retrieval is the same as the direction of encoding. This hypothesis was not confirmed in a probe recognition study but partially supported in response errors (Park, Lee, & Kim, 2003).

2.2 Processing of Contrast Information

Most researches on causal inferences have been about the integration of causally consistent information. That is, the information presented in a discourse can be easily integrated based on our world knowledge. Sometimes, however, a reader is presented with a contrast information in a discourse. A contrast information is present in a text when two parts of the text "spans which present an opposition (Ford, 2000)" or "the assertion rendered by the second clause is" in opposition "to an assumption that either may be read off, or must be inferred from, previous information (Brausse, 1998)." Comparing the processing and memory of ADDITIVE, CAUSATIVE, and ADVERSATIVE (Halliday & Hassan, 1976) information in texts, Lee(1979) proposed that the presence of contrast information in a text entails a representation of higher

abstraction level coherence.

In a series of research, Lee and his colleagues (a review; Lee, Choi, Lee, & Cho, 2000) conducted experiments on the nature of processing contrast information in text comprehension and its effect on recall. They proposed a three-step processing model of contrast information processing: 1) the process of finding the nature or levels of mismatch between the current input information and the mental model or the situation model already formed based on the previous information given in the text, 2) the process of resolving the mismatch through activating new additional relevant knowledge structures and generating a series of elaborative inferences, and 3) the process of integrating all the relevant information into a coherent and higher abstraction level representation of the discourse. They predicted that these additional processing stages could entail longer processing time at the time of encoding, and that in the final representation, the contrast itself could be stored as a higher abstraction level (macro-) proposition that will serve as an effective higher-level retrieval cue and shorten the retrieval time for the contrast information as well as the text itself.

From experiments, presenting short texts as shown in (11)-(14) in Korean, sentence by sentence, Lee and Choi(1986) showed that the target sentence was better cued-recalled (cued by a theme word or by the immediately preceding sentence) if the target sentence carried information that is somewhat contrast to the meaning given in the previous sentences (Contrast conjunctives were not given explicitly. Participants had to infer the conjunctives implicitly. This excludes the problem of lexical semantic interpretation (Lang, 2000 of contrast effect.). This confirms the similar results obtained from the previous research employing English speaking participants and English text materials (Lee, 1979).

(11) A stiff harness was fastened to a horse.
(12) The horse didn't like the harness.
(13) The horse bit the harness into pieces.
(14) The rancher put a new harness on the horse.
(Non-Contrast Target Sentence)
(14') The rancher put a stiffer harness on the horse.
(Contrast Target Sentence)

Using 15-sentence long script texts in Korean and employing a sentence-by-sentence reading task, Lee et al. further investigated the processing time of contrast information in texts, manipulating the following variables: whether the contrast information is at the

macro-proposition or micro-proposition level, whether the mismatch of the contrast information with the information given in the previous sentence gets resolved (explained) or not by the immediately following sentence (Lee & Lee, 1989), and whether the story structure of the text is of a linear or hierarchical one (Cho & Lee, 1992).

A clear and consistent finding obtained across the studies was that it took significantly longer to encode the contrast target sentences than the noncontrast ones, and yet contrast sentences were recalled in greater amounts and recognized faster (Lee & Choi, 1986; Cho & Lee, 1992; Lee & Lee, 1989). In non-contrast texts, macro- and micro-sentences were encoded in almost the same amount of time and yet the (primed) recognition latency for macro-sentences was longer than for micro-ones, while in contrast texts macro-sentences took longer to be encoded but were recognized in almost the same amount of time as micro-ones. And macro-contrast sentences were recognized faster than macro-noncontrast sentences. When the sentence (S+1) immediately following the target sentence did (RESOLUTION: RS) or did not (NONRESOLUTION: NR) carry the information that explained, elaborated, or resolved the contrast, the contrast target sentences were recalled in greater amount (more than twice) and recognized faster in RS condition than in NR condition (Lee & Lee, 1989), while the reading time for the (S+1) sentences was not significantly different between the two conditions. Cho & Lee (1992) further found that the presence of contrast information has a greater effect on reading and recognition time in texts with hierarchical story structure than in ones with linear structure.

The general results of the series of research can be summarized as that contrast in a text entails longer encoding time but shorter recognition latency and that this effect was stronger with the macro-level contrast. The results can be interpreted as indicating that contrast information in a text can be represented as a macro-proposition, and that it makes the text representation more coherent at a higher abstraction level. It seems we need a more comprehensive concept of coherence in discourse comprehension that encompasses the contrast information processing as an upper-level-coherence construction device.

2.3 Effect of Causal Connectives

Whether and how the causal connectives affect the integration of sentences were investigated by Jun, Lee, & Lee(2001). It is well known that the reading time of the second sentence is faster in a pair of causally related sentences than in a pair of unrelated sentences. Jun et. al.(2001) also found faster reading time for the second

sentence with a causal connective than without one. However, when the reading time for each phrase was analyzed, an interesting pattern emerged. The reading time of the last phrase of the second sentence was longer in the connective condition. This finding was interpreted as due to the characteristics of Korean where the verb comes last in a sentence. The readers are likely to postpone the final integration until the verb appears.

The results from the recognition experiments showed a more complicated pattern. The response time to the recognition probe from the first sentence was faster in connective condition than in no-connective condition at the end of the second sentence. The response time, on the other hand, was faster in no-connective condition right after the first phrase of the second sentence. These results suggest that the presence of a connective leads the readers to employ different integration processes. When there is a connective, they already know that the logical relationship between the first and second sentence and wait until the whole sentence is provided before they integrate the two sentences. When there is no connective, however, the readers try to integrate the two sentences from the beginning of the second sentence, keeping the content of the first sentence activated.

3. Elaborative Inference

Inference is called elaborative if it is not required for coherence of a discourse. Inference on instrument, instantiation, emotion, and predicting likely events are regarded as elaborative inferences.

The studies in the English language often reported contradictory claims on whether on-line elaborative inference occurs or not depending on which material or tasks are used. Several studies in Korean also reported different findings depending on the tasks they used (Lee, Lee, Kim, & Lee, 1997; Yoo & Lee, 1989). In an experiment where the participants read one of the four sentences as shown in (15) – (18) and responded to the target word referring the instrument, Lee, Lee, Kim, & Lee(1997) observed the evidence for on-line inference for instrument in a lexical decision task but not in a naming task.

(15) The fashion model wiped herself with a towel after taking a shower.
(16) The fashion model wiped herself after taking a shower.
(17) The fashion model wiped herself with a shirt after taking a shower.
(18) The fashion model wiped the bathtub after taking a shower.
Target word: TOWEL

As Lucas, Tenenhaus, & Carlson(1990) suggested, they interpreted the positive evidence in lexical decision task as indicating that instrument inference is more likely to be represented in a level of situation model rather than lexical level. Their interpretation was supported in Kim, Lee, Lee, & Lee(1998) where naming task was performed with a picture instead of a target word. Unlike in the previous naming task with letters, positive evidence for on-line inference was found.

Similar results were found in the studies on predicting inference. Lee & Lee(1999) found positive evidence for on-line predicting inference in a lexical decision task and reading time task but not in a naming task. Again, they claimed that the naming task is not sensitive to inferences represented in a situation model.

The clear contrasts between the findings from the naming task and those from other priming tasks such as recognition or lexical decision in Korean may stem from the orthographical characteristics of the Korean alphabet. The Korean alphabet has a systematic and regular correspondence with the pronunciation, which may reduce the necessity for the participants to access the lexicon when presented with a target word. That is, naming the target word based on the orthographical regularities without referring to the lexicon is more likely in the Korean participants.

Conclusion

A very brief survey of Korean research on inference in discourse comprehension was described. Experimental results on pronoun resolution process showed that the effects of first mentioning, gender cues and its interaction with contextual factors are somewhat different from those in English language. And features that have not been explicitly investigated in English language, such as predictability of discourse and processing of contrast information revealed some results that have new implications on inference in discourse comprehension. Research on Korean causal connectives produced results that support the general findings in English language, and yet suggest an additional feature specific to Korean language where verb comes to the last in a sentence.

Korean research on inference in discourse comprehension was influenced by M. A. Gernsbacher., W. Kintsch., and T. Trabasso. Research on anaphoric inference was done in line with Gernsbach's studies, some research on causal inference (section 2.1) was done mainly by Kim (formerly S. Y. Suh) in line with Trabasso's studies, and other research was influenced by Kintsch's line of investigation.

In addition, there is another framework that has been the starting point of many of the Korean research. It is Jung-Mo Lee's(Lee, 1979; Lee, 1981) "Elaborative Coherence Framework." Based on experiments employing referential ties and different types of sentential connections (additive, causal, and contrastive), Lee proposed a framework of coherence of spreading and integrative elaboration. The framework says comprehending a discourse is a process of coherence building that entails representations of increasingly higher abstraction. Two important processes guide the coherence building inference; Automatic spreading process and strategic integrative process. Lee's framework could be compared to other discourse processing models: For example, the Focus Model (Sanford & Garrod, 1981), the Construction-Integration Model (Kintsch, 1998), the Structure Building Framework (Gernsbacher 1990), the Constructionist Theory (Graesser, Singer, & Trabasso, 1994), the Resonance Model (Myers, O'Brien, Albrecht, & Mason, 1994), and the Event Indexing Model (Zwaan, Langston, & Graesser, 1995).

Many of results of Korean studies on inference processing could be interpreted in this framework of elaborative coherence of two interactive and parallel processes; In pronoun inference, gender cues guide a strong automatic spreading processes between pronoun and antecedent in early stage, followed by the process of employing contextual information, such as the focus, to facilitate antecedent assignment. In causal and contrast inference, causal inference occurs automatically when if the strength of cause-result connection is strong enough. When the connection strength is weak or the connection is of contrastive relation, the inference occurs strategically, resulting in integrative processing of higher abstraction. Finally, in elaborative inference, inferences employ both of massive spreading processing and integrative processing. One of the future tasks of Korean researchers could be elaborating and integrating this framework with the models proposed by Western counterparts.

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