Sentence processing and memory representation in Korean

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Introduction

When readers comprehend a sentence, they construct coherent mental models in memory. The mental models of sentences include various components: semantic roles, syntactic positions, pragmatic order, and so on. These components influence each other in order to construct a mental model of a sentence. One of the most important questions in the field of the psychology of language is how these components contribute to the representation and processing of a sentence.

Gernsbacher (1990) proposed a general cognitive framework to explain the process and representation of skilled language comprehension, called the ‘Structure Building Framework’ (hereafter SBF). The SBF has three component processes: laying the foundation, mapping, and shifting. These processes operate with the incoming language information to build a mental model of a sentence. Gernsbacher claimed that these processing mechanisms could be applied to any information beyond language. The most important principle of laying the foundation is the advantage of ‘first mention’. This effect was obtained consistently in English using several variations of sentences. Based on the laying of the foundation, the activation of incoming information transmits a processing signal to enhance or suppress previous information. The processes develop a mental model by mapping and shifting for coherence between new and old information. The SBF has been supported by many empirical findings (see Gernsbacher, 1997).

The important question is whether the advantage of first mention is a universal phenomenon across languages or is unique to specific languages. S. Kim and J.-H. Lee (1995, 1997, 2004) have conducted a series of studies to investigate the linguistic differences in the effect of first mention between Korean and English. Korean has two characteristics that are distinctive from English. First,

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Korean has a case-marker syntax. The case marker (particle) at the end of a noun indicates the case of that noun. In Korean, case markers play a critical role in determining the syntactic and semantic role of each constituent of a sentence, regardless of word order. Second, Korean has an SOV canonical order unlike English which has an SVO order. Because Korean has case markers, each word can be relatively freely positioned in a sentence without changing the meaning of the sentence. In English, however, since the SVO word order is strict, changing the order will critically influence the meaning of the sentence. This paper focuses on the question of whether or not language structure influences the cognitive processing and representation of a sentence.

The constraints of sentence representation

The coherent mental representation of sentences comprises different components, and these different components vary in their memory accessibility. By measuring and comparing the accessibility of each component in a sentence, how a sentence is processed and represented can be understood. What factors affect the accessibility of the different components of a mental representation of a sentence?

McKoon, Ratcliff, Ward, and Sproat (1993) have demonstrated that syntactic position affects the accessibility of components in an English sentence.

(1) His demanding boss is critical.
(2) His critical boss is demanding.

When participants were asked whether the word demanding occurred in the set of sentences they read, they responded considerably faster if they read sentence (2) than if they read sentence (1). The lexical item, demanding, plays a different syntactic role in the two sentences: In sentence (1), demanding is a modifier; in sentence (2), it is a predicate. Thus, the syntactic position appears to affect the accessibility of the sentence components.

Semantic factors, such as the semantic role (e.g. whether the entity is the semantic agent who causes the action or the semantic patient who receives the action) might also affect the accessibility of the sentence components. Agents are more likely to be animate than inanimate (Clark, 1965). They are also likely to be more active and attract more attention than semantic patients (Zubin, 1979). Agents tend to match the speaker or listener’s perspective (MacWhinney, 1977).

Many pragmatic factors might also affect the accessibility of the components in a sentence (see also Green, 1989). What has been most widely investigated is the order of mention. First-mentioned entities appear to have a privileged status in many aspects of sentence and text representation. For example, initial sentences take longer to read than subsequent sentences (e.g. Haberlandt & Graesser, 1990).
and initial words take longer to read than later-occurring words (e.g. Aaronson & Ferres, 1983; Chang, 1980; Givón, 1986; von Eckardt & Potter, 1985). In the case of spoken English, speakers usually put the important constituent like the focus, topic, or theme of the sentence first, and listeners are assumed to construct a representation of the sentence based on the shared pragmatic knowledge of language use (Birch & Garnsey, 1995; Green, 1989).

The advantage of first mention

Gernsbacher and Hargreaves (1988) presented the following sentences to participants and then measured recognition latencies for the probe word, Tina.

(3) Tina beat Lisa in the state tennis match.
(4) Lisa beat Tina in the state tennis match.

The participants’ probe recognition latencies to Tina were faster after reading sentence (3) than after reading sentence (4). These data suggest that different components of a sentence are represented with different degrees of accessibility.

Gernsbacher’s (1990) SBF attempts to account for this privilege of primacy. According to the SBF, the first-mentioned information is more accessible because it forms the foundation for the representation and serves as a cornerstone to enable the integration (mapping) of further information. The phenomenon of the greater accessibility of first-mention information has been termed as the advantage of first mention, and has been empirically tested by Gernsbacher and her colleagues (see Gernsbacher, 1997).

However, the advantage of first mention is typically confounded with syntactic position and semantic role in English. For example, in sentence (3) Tina is not only the first-mentioned character, but she is also the subject of the sentence (syntactic position), as well as the agent of the action (semantic role). In contrast, in sentence (4) Tina is now the second-mentioned character, and she is also the object of the sentence, as well as the patient of the action (semantic role). The faster probe recognition time for Tina after the participants had read sentence (3) versus sentence (4) might be due to the order of mention, syntactic position (subject versus object position), semantic role (agent versus patient role) or an interaction among these three factors.

In order to dissociate the effect of syntactic position from that of semantic role, Gernsbacher and Hargreaves (1988) manipulated the voice of a sentence to be either active or passive. They found the effect of first mention in the passive voice sentence, which suggests that the order of mention is a critical factor for determining the relative accessibility of components in a sentence. However, in their study, the order of mention was confounded with the syntactic position; the first mention characters were always the syntactic subject.
To separate the advantage of first mention from the advantage of syntactic subject, Gernsbacher and Hargreaves (1988) removed one of the characters from its main clause and placed it as the object of a prepositional phrase. These prepositional phrases were presented as in sentences (5) and (6).

(5) Because of Tina, Lisa was evicted from the apartment.
(6) Because of Lisa, Tina was evicted from the apartment.

Recognition latencies for the probe name Tina were faster after the participants read sentence (5) than after having read sentence (6); thus, no advantage was found for the syntactic subject.

Carreiras, Gernsbacher, and Villa (1995) replicated one of Gernsbacher and Hargreaves’ (1988) experiments using Spanish. Spanish differs from English in its flexibility of word order. The results demonstrated that the advantage of first mention was present in Spanish as well. Thus, the advantage of first mention occurred even when the first-mentioned character was a syntactic object and there was indeed no reliable effect of syntactic position on relative accessibility.

Temporal contributions of syntactic, semantic and pragmatic factors

In Korean, the case markers (particles) at the end of a noun indicate the case of the noun; therefore, word order is relatively flexible. Because the object of a sentence can be placed before the subject in Korean, it is possible to dissociate the syntactic position from the order of mention through the use of inversion, which is impossible in English.

To further investigate the advantage of first mention crosslinguistically, S. Kim and Lee (1995) conducted two experiments using Korean. At a short interval between the offset of the sentence-final word and the probe word (Inter-stimulus interval [ISI] 255 ms), they found effects of both syntactic position and the order of mention. The subject of a sentence was accessed more easily than the object (28 ms), and the first-mentioned character was accessed more easily than the second-mentioned character (28 ms). This data suggest that syntactic and pragmatic factors affect the relative accessibility of the components of a sentence representation immediately. However, when the interval between the offset of the sentence-final word and the probe word was extended to 1540 ms, the effect of syntactic position was no longer observed, whereas the effect of the order of mention was found to be stronger (47 ms). Unfortunately, in Kim and Lee’s (1995) study, the syntactic position was confounded with the semantic role; the syntactic subjects were always semantic agents, and the syntactic objects were always the semantic patients.

Kim, Lee, and Gernsbacher (2004) solved the confounding problem of syntactic position with the semantic role by manipulating the voice of a
In Korean, it is possible to make the voice of a sentence passive by using the passive form of the verb without changing the word order or the sentence meaning. Therefore, Korean is an ideal language for factorial manipulation of the three factors: syntactic position, semantic role, and order of mention. In addition, Kim et al. (2004) controlled RSVP (rapid serial visual presentation) rate (250 ms and 500 ms) and ISI (immediate, 500 ms, 1000 ms) in order to examine the relative contributions of the syntactic, the semantic, and the pragmatic factors, and as well as to chart the time course of these influences. These variables informed the locus of the mention-order effect in Korean (see Table 35.1). In six experiments, participants performed a probe recognition task after reading each of a series of sentences.

The results showed that the order of mention strongly influenced the accessibility between ISI 500 ms and 1000 ms regardless of the RSVP rate. But the

<table>
<thead>
<tr>
<th>Table 35.1. Examples of experimental materials (Kim et al., 2004)</th>
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<tr>
<td><strong>Subject Agent First:</strong> Kukjang-eseo <strong>Hansu-nun</strong> Junho-lul kkojipe-ss-ta.</td>
</tr>
<tr>
<td>‘theater-loc’ ‘Hansu-subj’ ‘Junho-dir obj’ ‘pinched’</td>
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<tr>
<td>(At the theater Hansu pinched Junho.)</td>
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<td><strong>Object Agent First:</strong> Kukjang-eseo <strong>Hansu-eykey</strong> Junho-nun kkojiphye-ss-ta.</td>
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<td><strong>Probe word:</strong> ‘<strong>Hansu</strong>’</td>
</tr>
</tbody>
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-eseo: locative particle (postposition) kukjang: theater |
-nun: subjective case particle kkojipta: pinch |
-lul: direct objective case particle -hye: passive morpheme |
-eykey: indirect objective case particle -ss-ta: past tense-declarative suffixes
advantage of first mention was not observed at ISI 0 ms and the interaction effects between the syntactic position and semantic role were observed only in the subject analysis. The interaction between syntactic position and semantic role was as follows: the reaction time to the probe word was faster in the condition of either ‘semantic agent and syntactic subject’ or ‘semantic patient and syntactic object’ than either ‘semantic agent and syntactic object’ or ‘semantic patient and syntactic subject’ (see Figure 35.1).

The interaction effects between syntactic position and semantic role

J.-H. Lee, Lee, Kim, and Park (2002) conducted experiments at shorter ISI (i.e. 150 ms) and RSVP rates of 250 and 500 ms using the materials presented in Table 35.1. The advantage of first mention was observed at ISI 150 ms, regardless of the RSVP rate and an interaction effect between syntactic position and semantic role was found as well (see Figure 35.2). A series of studies provided the locus and duration of the mention-order effects in Korean. The first-mention effect was observed at an ISI of 150 ms (Lee et al., 2002), 255 ms (Kim & Lee, 1995), 500–1000 ms (Kim & Lee, 1997; Kim et al., 2004), and
These results confirmed Gernsbacher’s (1990) suggestion that the advantage of first mention was a relatively long-lived characteristic in the representation of a sentence.

In addition to the effects of the order of mention, they also observed effects of syntactic position and semantic role. Although this interaction was observed in other experiments as well, the pattern was different. For example, Kim and Lee (1995) observed the main effects of syntactic position and order of mention simultaneously at ISI of 255 ms. Kim and Lee (1997) found an interaction between syntactic position and semantic role at ISI 500 ms, and Lee et al. (2002) also found a three-way interaction among syntactic position, semantic role, and order of mention at an ISI of 150 ms (see Figure 35.1). Although these results seem to be in contrast to the advantage of first mention, the effects were observed in relatively short ISI conditions.

The interaction between the syntactic position and the semantic role can be explained by a relationship among the sentence components (Kim & Lee, 1995, Kim & Lee, 1997; Kim et al., 2004). There is a possibility that this interaction occurred because of the sentence voice. Although the sentence components can be positioned flexibly in Korean, the typical order is SOV. When the sentence is an active voice, sentence subject and object (syntactic position) are compatible...
with each other as an agent and patient (semantic role). This relationship between the syntactic and semantic constraints might contribute to the verb’s causal direction between NP1 and NP2 (see McDonald & MacWhinney, 1995). For example, in the active voice, the direction of the cause and the consequence was from NP1 to NP2, but in a passive voice, it was from NP2 to NP1. The different ways of satisfying those constraints may influence the memory accessibility of sentence components. But it should be noted that this difference did not influence the advantage of first mention in a single sentence (see Lee et al., 2002).

**The effect of clause recency**

According to the SBF, the advantage of first mention could be extended into inter-clause and inter-sentence representations (Gernsbacher, 1990). Gernsbacher et al. (1989) measured the accessibility of the sentence in two-clause sentences, such as sentences (7) and (8) below.

(7) Tina gathered the kindling, and Lisa set up the tent.
(8) Lisa gathered the kindling, and Tina set up the tent.

At an immediate test interval (ISI 0 ms), where the probe word was presented with the last word of the sentence in sequence, Gernsbacher et al. (1989) observed an advantage of clause recency: the second character was more accessible than the first-mentioned character. At a very brief test interval (ISI 150 ms), the two characters were equally accessible. However, at longer test intervals (ISI 1400 ms and 2000 ms), the first-mentioned characters were considerably more accessible than the second-mentioned characters.

Gernsbacher et al. (1989) explained the clause recency effect by suggesting that comprehenders had greatest access to the information that was represented in the substructure that they were currently developing. After comprehenders had finished building their mental sub-structures, the information from the first component began to become more accessible. The diminished accessibility of the most recent component was coupled with the increased accessibility of the first component.

Lee et al. (2002) compared the first-mention effect with the recency effect at various ISIs. They presented (9) or (10) and tested probe recognition at ISIs of 150 ms and 1500 ms.

(At the theater Hansu-\textit{subj} a popcorn-\textit{obj} ate, at the market Junho-\textit{subj} a cola-\textit{obj} bought.)

(At the market Junho-\textit{subj} a cola-\textit{obj} bought, at the theater Hansu-\textit{subj} a popcorn-\textit{obj} ate.)
Participants read the sentence with the RSVP procedure and were asked to recognize the probe word. The results indicated that recency effects were observed at both ISIs. A recency effect was found with the priming effect of 155 ms at ISI of 150 ms and 94 ms at ISI of 1500 ms (see Figure 35.3). These findings were inconsistent with Gernsbacher’s SBF, and instead are consistent with the results of Chang (1980) and von Eckardt and Potter (1985).

**Semantic-bias effect**

Lee et al. (2002) investigated the recency effect further. They argued that the recency effect was not just due to the order of mention, but was related to inter-clause coherence as well. They constructed two types of materials: in one condition, each of the clauses had its own subjecthood, in the other condition, relative clauses had a semantic bias to recent clauses (see Table 35.2). These manipulations were made to compare the recency effect with the semantic bias effect in the inter-clause sentences. According to the SBF (Gernsbacher, 1990, 1997), interactions between clause recency and mention order were expected across the time course. The results showed that the response to the first information was slower than to the second information in the complex sentence,
but that the semantic bias effect was more robust than the first-mention effect (see Figure 35.4). These findings suggested that the more complex the clause was, the more the semantic bias or focus was important in constructing coherent mental models in Korean.

When sentences are constructed, a complex event can be expressed using different connectives which signal the relation between the clauses. These connectives include causal, temporal, additive, and adversative relations. The use of connectives, except the causal connectives, are identical in both Korean and English. For the causal connectives, however, there is a difference in the order of the cause and the effect. In English, the effect usually precedes the cause, but this is not the case in Korean. These differences in clause order imply that important pragmatic information does not always appear in the first clause in Korean.

The verb in a sentence is the most important component in representing sentence meaning. In Korean, the canonical word order of SOV implies that the final meaning of a sentence can be constructed in the verb. This principle is applied to mental models of inter-clause or inter-sentence relations. The case marker signals only the syntactic and the semantic cues. Although nouns with a case marker are influenced by the advantage of the mention order, the integrated meaning of a sentence is constructed by the verb in the final order in the sentence. In SVO languages, the important information can be positioned in a
sentence final component. This order is a pragmatic principle in Korean that differs from SVO languages like English or Spanish.

**Summary and conclusions**

The summary of previous findings on the advantage of first mention in Korean is as follows:
1. The advantage of first mention clearly occurred in simple sentences.
2. The interaction between syntactic position and semantic role was found in simple sentences.
3. As the clause and sentence became more complex, a clause recency effect was found.
4. As the clause and sentence became more complex, semantic bias had more powerful effects on sentence representation.

According to the SBF, the advantage of first mention should be observed in single sentences, between sentences, in multi clauses, and discourse. However, evidence against the SBF prediction was found in Korean. The most prominent features of Korean were the case marker, the order of the relative clause, free word order, canonical SOV, and the ellipsis of the sentence component. These
Korean linguistic constraints result in differential cognitive processing and memory representation of the sentence (Lee, 1993; Suh, Lee & Jang, 1997). Although the advantage of first mention was found in a single sentence, the effect could not override the recency effect in a complex sentence. Rather the recency effect and the semantic bias effect were more dominant in processing the complex sentences in Korean.