

The Resolution of Wh-Scope Ambiguity in Korean and Locality Bias

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The interpretation of a wh-phrase in Korean is structurally dependent on the position of a question particle in the sentence. In order to investigate how native speakers of Korean resolve the dependency between a wh-phrase and a question particle, this study administered a sentence fragment completion test to 76 adult native speakers of Korean. The participants were presented with sentence fragments containing a wh-phrase in three conditions, which varied by the position of the wh-phrase, and then were asked to provide their own words to complete the sentences. The analysis of the responses revealed that the participants strongly preferred to fix the scope for a wh-phrase as early as possible, after the argument position of a wh-phrase. The findings confirm previous findings on a locality bias in the processing of in-situ wh-constructions, and further provide evidence for the bias in the processing of scrambled-wh constructions.

Keywords: wh-scope, dependency resolution, locality bias, scrambling, Korean

1. Introduction

In sentence processing, the interpretation of one element in a sentence frequently depends on other element(s) of the sentence. This dependency often involves movement as in (1).

(1) What did you ask me to do __ before I leave?

In order for this sentence to be interpreted, the displaced wh-phrase *what* must be associated with its argument position (the “gap” position) and

receive a thematic role from the verb *do* in the embedded clause. One of the main issues in sentence processing is thus how the parser resolves dependencies between a displaced wh-element (the “wh-filler”) and its gap.

On the other hand, in East Asian languages with scrambling, such as Korean and Japanese, wh-phrases can remain “in situ” (i.e., in their canonical/thematic position), in which case, the interpretation does not involve the resolution of dependency between the wh-filler and its gap. Instead, these languages require different types of dependency resolution. Unlike in English, where the interrogative scope is determined by the surface position of a fronted wh-phrase, the wh-position in Korean or Japanese does not provide any clue to the scope within which the wh-phrase must be interpreted. Interestingly, what determines the interrogative scope in these languages is a tiny question particle attached to the verb. Therefore, the processing of wh-constructions in these languages requires the parser to resolve the dependency between a wh-phrase and a scope marking question particle.

The present study attempts to explore the mechanisms for resolving this special type of dependency. While there has been a substantial amount of research on how people engage in dependency resolution while processing wh-constructions in head-initial languages, especially English, research on the processing of wh-constructions in East Asian languages with scrambling is only in its initial stages. Recently, researchers have proposed that the strategies for processing and generating wh-questions in head-final languages like Japanese are essentially identical to those for head-initial languages, although they display various typological and syntactic differences (Aoshima, Phillips, & Weinberg, 2004; Lieberman, Aoshima, & Phillips, 2006; Miyamoto & Takahashi, 2002).

Meanwhile, research on how the parser resolves dependencies concerning wh-constructions in head-final languages with scrambling has centered on Japanese wh-constructions. Studies on the processing of Korean wh-constructions, especially on dependency resolution with respect to wh-scope marking, have been sparse. Moreover, the studies on wh-scope fixing in the Japanese context so far have been limited to how people predict or generate a question particle upon encountering a wh-phrase

in situ. The question of how the parser resolves the dependency when the wh-phrase is scrambled from its canonical position remains unexplored. This study approaches the question of wh-scope fixing by investigating how the scope of wh-phrases – whether in-situ or scrambled – is fixed by native speakers of Korean from a sentence generation perspective. By doing so, the study aims to learn whether the processing bias that has been reported to be at work in the Japanese context is also observed in wh-scope marking in Korean. Further, the study explores whether previous findings on the mechanism for processing wh-in-situ constructions can be extended to all wh-constructions, including questions with a scrambled wh-phrase.

2. Theoretical Background

2.1. Processing Wh-Constructions in English and Locality Bias

In English, wh-movement is an obligatory syntactic operation. Sentences with a wh-element situated in its thematic position are unacceptable, except in echo questions (e.g., *Excuse me, you danced with whom?*) or multiple-wh constructions (e.g., *John told Bill who danced with whom*). In terms of the feature-driven movement approach to syntax, the movement of a wh-phrase is driven by a feature-checking motivation (Chomsky, 1995). The fronted wh-phrase has its wh-features checked in the surface position to which it has been moved. At the same time, the surface position of the wh-phrase determines the interrogative scope. For example, (2) is a direct question as *who* has been fronted to the sentence-initial position, whereas (3) is an indirect question as *who* has been raised to the initial position of the embedded clause.

(2) Who did John say [Bill saw ___ at the party]? (direct question)

(3) John told me [who Bill saw ___ at the party]. (indirect question)

As the wh-element has been displaced from its original position that re-

ceives a thematic role from the predicate, the *wh*-phrase must be linked with its original thematic position (a gap or a trace) in order to be fully interpreted. This link between a moved element and its gap is called a “filler-gap dependency.” In processing a sentence, a human parser must determine the gap position of a displaced *wh*-phrase in order to resolve the filler-gap dependency. Thus, when a *wh*-phrase is identified, the parser engages in a search for the gap.

Researchers in psycholinguistics have long been interested in how a human parser resolves filler-gap dependencies on line. Although there remains controversy over the exact nature of the processing mechanisms, there is a general consensus that sentence processing is a left-to-right, and incremental process (O’Grady, 2013; Phillips, 2003; Sturt & Lombardo, 2005). The parser incorporates upcoming elements as they are encountered in real time. Based on the immediately available input string, it actively predicts and imposes a tentative structure on the sentence, even before the actual lexical materials are encountered. Thus upon hearing or reading a *wh*-phrase, the parser actively predicts a gap position without waiting until it reaches the actual gap position. And this pro-active gap creation is known to sometimes misguide the parser into wrong analyses (Crain & Fodor, 1985; Stowe, 1986). For example, while processing sentences like (4), the parser will opt to posit a gap for “who” as early as grammatically possible, which in this case, is right after the embedded verb “introduce.”

(4) John wondered who the president is going to introduce ...

So when it turns out later that this initial analysis is incorrect and that the object position of *introduce* is in fact filled as in (5), the parser is forced to initiate a reanalysis.

(5) John wondered who the president is going to introduce him to ___ at the meeting.

This kind of misanalysis and reanalysis is known to cause a slowdown in reading time. The slowdown, also known as the Filled Gap Effect,

has been repeatedly confirmed in various experiments (Crain & Fodor, 1985; Fodor, 1978; Frazier & Clifton, 1989; Pablos, 2008; Stowe, 1986). Researchers have attributed the phenomenon to people's preference for local resolution of filler-gap dependencies. Due to limited working memory capacity, the parser seeks to reduce the burden of holding the wh-phrase in memory. As a result, the parser is biased to resolve the dependency locally, positing a gap at the earliest grammatically permissible position.

2.2. Processing Wh-Constructions in Korean and Locality Bias

So far, we have discussed the locality bias observed in the interpretation of wh-phrases extracted from their thematic position. However, East Asian languages such as Korean and Japanese do not necessarily require a wh-phrase to be fronted. Although a wh-phrase can be moved via scrambling, it can also remain in its canonical position and be assigned its argument role by a local verb in the same clause. Therefore, in such wh-in-situ constructions, the parser does not need to resolve a filler-gap dependency.

On the other hand, the scope of a wh-question in Korean or Japanese is not automatically determined by where the wh-phrase is situated because the surface wh-position is not the scope position. In these languages, wh-scope is determined by the location of the Q, which is lexically realized as a question marker – or a question particle – affixed to the verb (QM, hereafter). In Korean, for example, the suffix *-ni* marks a direct question, and *-ci* marks an indirect question, as in examples in (6) and (7) below (Japanese equivalents are juxtaposed).

(6) Direct Question

John-un [Bill-i mwues-ul sassta-ko] malhayss-ni? (Korean)

John-wa [Bill-ga nani-o katta-to] itta-no? (Japanese)

John-TOP [Bill-NOM what-ACC bought-Decl] said-Q

(7) Indirect Question

John-un [Bill-i mwues-ul sassnun-ci] malhayss-ta. (Korean)

John-wa [Bill-ga nani-o katta-ka] itta. (Japanese)

John-TOP [Bill-NOM what-ACC bought-Q] said-Decl

As the placement of the QM determines the scope within which a wh-question is to be interpreted, a dependency is established between the wh-phrase and the QM. Miyamoto and Takahashi (2002) proposed that this dependency drives the parser to initiate a search for a QM upon encountering an in-situ wh-phrase in a sentence (see also Aoshima et al., 2004; Lieberman et al., 2006). They further claimed that as in other dependency resolutions, the parser in the course of left-to-right sentence processing actively predicts the position of a QM rather than waiting until it reaches the actual QM.

Suppose that a sentence has been parsed only up to the following input string.

- (8) John-un [Bill-i supermarket-eyse mwues-ul ...
 John-TOP [Bill-NOM supermarket-LOC what-ACC ...

In the unfinished bi-clausal sentence fragment in (8), the interpretation of the in-situ wh-phrase is ambiguous with regard to its scope, as the parser has not yet encountered a QM. Up to the moment the parser encounters the accusative wh-phrase *mwues-ul*, it is not yet fixed whether the QM will appear on the matrix verb, as in (6) above, or on the embedded verb, as in (7). While both are permissible structural candidates, according to Miyamoto and Takahashi (2002), Japanese native speakers strongly prefer to posit a QM in the embedded clause. In other words, the parser opts for a local resolution at the embedded verb rather than at the main verb, because in head-final languages, the embedded verb precedes the main verb and thus is the earlier grammatical position for dependency resolution (Aoshima et al., 2004; Miyamoto & Takahashi, 2002).

The underlying processing bias for local resolution in Japanese, according to Miyamoto and Takahashi (2002), is parallel to the mechanism that English native speakers employ in resolving the dependency existing between a wh-filler and its gap. Just as a fronted wh-phrase in English triggers a search for its gap position, a wh-phrase in Japanese triggers a search for a QM that will license its wh-feature and fix the scope of its interpretation. And in both cases, the parser opts for a local dependency resolution.

Miyamoto and Takahashi's (2002) claim on the locality bias concerning a QM is based on their study of Japanese speakers' processing of bi-clausal constructions containing in situ wh-phrases in the embedded clauses. The examples in (9) and (10) are taken from Miyamoto and Takahashi's study.

- (9) [senmu-ga donna-pasokon-o takatteiru-to] kakarichoo-ga itta-no?
[director-NOM what-kind-computer-ACC using-is-Decl] supervisor-NOM said-Q
'What kind of computer did the supervisor say the director is using?'
- (10) [senmu-ga donna-pasokon-o takatteiru-ka] kakarichoo-ga kiita-no?
[director-NOM what-kind-computer-ACC using-is-Q] supervisor-NOM
asked-Decl
'Did the supervisor ask what kind of computer the director is using?'

In Miyamoto and Takahashi's (2002) self-paced reading experiment, native speakers of Japanese were asked to read in-situ-wh constructions with or without a QM in the embedded clause, such as (9) and (10), on a computer screen. Each sentence was segmented into multiple regions and presented region-by-region, and the processing time at each region was recorded for individual trials (for details on self-paced reading, see Just, Carpenter & Wooley (1982)). While there was no difference in reading times between the two sentence types up to the wh-phrase, the researchers found that Japanese native speakers read the embedded verbs affixed with a declarative marker significantly slower than those affixed by a QM. They argued that the latency at the embedded verb with a declarative complementizer occurred because Japanese speakers expected a QM on the embedded verb. Miyamoto and Takahashi called the slowdown due to the mismatch between the expectation for a QM and the unexpected encounter with a declarative marker the "Typing Mismatch Effect" (TME, henceforth). They further claimed that the TME is another manifestation of the human parser's universal parsing strategy of local resolution, motivated by the need to minimize the burden of capacity-limited working memory.

The slowdown effect also has been attested in other self-paced reading experiments. Aoshima et al. (2004) asked Japanese native speakers to

read bi-clausal sentences containing an in-situ wh-phrase in the embedded clause. The sentences were presented both as direct questions, where a QM was affixed to the main verb, and indirect questions, where a QM was affixed to the embedded verb.¹⁾ In the Korean context, H-r Hahn and S Hong (2014) conducted a near-replication of Aoshima et al.'s study, with native speakers of Korean as participants. As in Aoshima et al.'s experiment, the participants read two types of wh-in-situ constructions, with a QM either on the embedded verb as in (11) or on the main verb as in (12).

- (11) halmeni-nun halapeci-ka nwukwu-eykey apatu-rul cwuessnun-ci apuci-ey-key allyecwuess-ta.
 grandma-TOP [grandpa-NOM who-DAT apartment-ACC gave-Q]
 dad-DAT informed-Decl
 'Grandma told Dad whom Grandpa gave an apartment house to.'

- (12) halmeni-nun [halapeci-ka nwukwu-eykey apatu-rul cwuessta-ko] apuci-ey-key allyecwuess-ni?
 grandma-TOP [grandpa-NOM who-DAT apartment-ACC gave-Decl]
 dad-DAT informed-Q
 'To whom did Grandma tell Dad that Grandpa gave an apartment house?'

The reading time analyses of both studies revealed that there was a slow-down around the embedded verb affixed by a declarative complementizer, suggesting that native speakers of Korean as well as native speakers of Japanese expect a QM on the embedded verb, building evidence for the TME in head-final languages.

The TME also has been supported by sentence production studies in the Japanese language context. Using a sentence fragment completion task, Lieberman et al. (2006) investigated whether the TME as a universal locality preference is at work in sentence processing by both native speakers and L2 learners. In their experiment, the participants were asked to read incomplete sentence fragments and then to complete the sentences by supplying their own words. Each sentence fragment consisted of four

1) Aoshima et al. (2004) included two other conditions where the wh-phrase was scrambled to the sentence initial position, which are discussed later in this section.

consecutive arguments, one of which was an in-situ wh-phrase in the embedded clause as illustrated below:

- (13) sensei-wa/ga [seito-ga tosyositu-de dare-ni ... (Lieberman et al., 2006: 434)
teacher-TOP/NOM student-NOM library-at who-DAT...

As the second NP with a nominative case marker (e.g., *seito-ga* ‘student-NOM’), immediately following the sentence-initial topic/nominative marker, signals the onset of an embedded clause, it was necessary for the participants to provide at least two verbs – an embedded verb first and then a matrix verb. In addition, the wh-phrase in the embedded clause (e.g., *dare-ni* ‘to whom’) required them to affix a QM either to the embedded verb or to the main verb (or both) in order to make the sentences grammatical. The analysis of their fragment completions revealed that not only the native speakers but also the L2 learners of Japanese showed a clear preference for providing a QM at the embedded verb – the earliest possible grammatical position.

2.3. Scrambled Wh-Phrases and the TME

So far, we have discussed Korean/Japanese native speakers’ locality bias in resolving dependency between a wh-phrase in situ and a QM, which has been observed in slowdown in self-paced reading experiments as well as in the local provision of QMs in sentence completion tasks. Miyamoto and Takahashi’s (2002) original proposal was restricted to wh-constructions where the wh-phrase remains in situ in the embedded clause. But what happens if the wh-phrase is scrambled out of the embedded clause? Does the same locality bias hold in scrambled-wh conditions? If so, is the locality based on the distance between the surface position of the scrambled wh-phrase and the QM, or is it based on the distance between the gap position and the QM?

Aoshima et al. (2004) extended the proposal made by Miyamoto and Takahashi (2002) to scrambled-wh constructions. They assumed that the TME is at work in the processing of scrambled-wh constructions as well as in the processing of in-situ wh-constructions in Japanese. Considering

the TME as an effect that operates in the parsing of any wh-construction whose wh-phrase is base-generated in the embedded clause, they reasoned that the TME is sensitive not only to the position of an in-situ wh-phrase but to a gap position (that is, the thematic position) of a scrambled wh-phrase. Thus, they adopted the TME as “a diagnostic of where a fronted wh-phrase receives its thematic interpretation” (p. 29). In the self-paced reading experiment with native speakers of Japanese, mentioned above, the researchers included two more conditions with a scrambled-wh phrase: direct questions with a declarative complementizer marked on the main verb and indirect questions with a QM on the embedded verb. In the reading time analysis, they found that the region around the embedded verb with a declarative complementizer was read slower than the region with a QM. The slowdown at the embedded verb with a declarative affix was then attributed to the TME: the initial expectation for a QM at the local predicate, followed by an unexpected encounter with a declarative affix.

However, the claim that the TME was responsible for the slowdown in the scrambled-wh condition is unwarranted. First of all, if the slowdown is to be ascribed to the TME, there should first be independent evidence that Japanese readers posit a gap in the embedded clause: unless the readers posited a gap in the embedded clause, no local relation can be established between the gap and the embedded verb, and TME might be irrelevant to the slowdown at the embedded verb. Therefore, it is a prerequisite to first show whether the readers actually posited a gap in the embedded clause and assigned a thematic role in relation to the embedded verb. Secondly, even if the Japanese readers indeed created a gap in the embedded clause, it is still an open question whether the gap induces the same effect as an in-situ wh-phrase so as to lead to a slowdown at the embedded verb with a declarative complementizer. In other words, we still need to examine whether the TME is an effect only for a lexically realized wh-phrase in-situ or if it can be extended to a gap position. It is also unclear whether the TME would be sensitive to the fronted wh-phrase or to its gap.²⁾ Finally, if scope marking is sensitive to the

2. A reviewer commented that the gap associated with a scrambled wh-phrase is funda-

position of a scrambled wh-phrase, the distance between the wh-word and the gap can also matter, because some distance effects on dependency resolution have been documented in other languages (Gibson, 1991; Grodner & Gibson, 2005).

The inconclusiveness of Aoshima et al.'s findings is largely attributable to the nature of comprehension-based tasks such as self-paced reading. In a comprehension test such as Aoshima et al.'s, we cannot ensure that the Japanese speakers actually posited a gap in the embedded clause and that this in turn triggered a search for a QM at the earliest possible position.

By contrast, production tasks such as the sentence fragment completion task employed by Lieberman et al. (2006) make it possible to observe where in the sentence the gap for a scrambled wh-phrase is created, as participants provide both the embedded and main verbs, and their argument structures reveal which verb is in a predicate-argument relationship with the displaced wh-phrase. Once we identify the position of the gap, we can examine whether a locality bias exists between the gap and the QM. For this reason, the present study employed a sentence fragment completion test that required the participants themselves to provide the verbs as well as the QM. Through the experiment, we attempted to seek answers for the following three questions:

1. Do native speakers of Korean prefer to mark wh-scope based on a locality condition when processing sentences with a wh-phrase in situ?
2. Do native speakers of Korean prefer to mark wh-scope in reference to the gap position when processing sentences with a scrambled wh-phrase?

mentally different from an English wh-gap, in that English gaps for wh-phrases are wh-gaps whereas those in Korean are NP-gaps, and further suggested that scope-fixing in Korean may therefore involve the dependency between the gap and the QM rather than between the scrambled wh-phrase and the QM. The distinction between a wh-gap and an NP-gap might be relevant in interpreting the results of our experiment. While we did not take a particular syntactic position regarding the status of scrambled wh-phrases and their gaps, we assumed, following Aoshima, Weinberg, and Phillips (2002, 2004), that a wh-phrase has a wh-feature and a theta feature to be checked, whether it is scrambled or placed in situ. In the in-situ condition, Miyamoto and Takahashi (2002) claimed that processing a wh-in-situ initiates a search for its licenser (that is, a QM). In this paper, we questioned whether processing a scrambled wh-phrase also initiates a search for a QM, and whether a local resolution is preferred in the process.

3. Do native speakers of Korean display different scope-marking patterns depending on how far a wh-phrase has been moved from its argument position?

3. Method

3.1. Participants

Seventy-six adult native speakers of Korean participated in the experiment. They were either college graduates or undergraduate students residing in Korea. The experiment lasted 20-25 minutes, and the participants received either gift or monetary compensation for their participation.

3.2. Materials and Design

Experimental items consisted of nine sets of sentence fragments composed of four arguments, one of which was a wh-phrase (for example, *kyoswu-nun cokyo-ka silhemsil-eyse mwues-ul*). Each set of an item had three conditions, which varied according to (i) whether the wh-phrase was placed in its thematic position in the embedded clause or was scrambled, and (ii) how far the wh-phrase was scrambled from its thematic position. A sample set of conditions is illustrated below (wh-phrases are italicized):

[Condition 1: Wh-in-situ condition]

kyoswu-nun cokyo-ka silhemsil-eyse mwues-ul _____
 professor-TOP assistant-NOM laboratory-LOC what-ACC

[Condition 2: Medial-wh condition]

kyoswu-nun mwues-ul cokyo-ka silhemsil-eyse _____
 professor-TOP what-ACC assistant-NOM laboratory-LOC

[Condition 3: Initial-wh condition]

mwues-ul *kyoswu-nun cokyo-ka silhemsil-eyse* _____
 what-ACC professor-TOP assistant-NOM laboratory-LOC

We included accusative, dative, and locative arguments as the wh-phrases in the sentence fragments, so that our results would be generalizable to the entire class of wh-phrases generated in the embedded clause.³⁾ Each argument type occurred both in the form of a wh-pronoun (that is, *mwues* ‘what’, *mwukwu* ‘who’, *eti* ‘where’) and in the form of *which N* (e.g., *mwusun noray* ‘which song’, *etten saram* ‘which one/person’, *mwusun siktang* ‘which restaurant’).⁴⁾

In the first condition (the wh-in-situ condition), the wh-phrase was placed in its canonical position. The sentence fragment began with a matrix subject, which was immediately followed by an embedded subject.

(14) *kyoswu-nun* [cokyo-ka silhemsil-eyse *mwues-ul*...

The second condition, which was the medial-wh condition, began with a matrix subject immediately followed by a wh-phrase. Note that an accusative wh-phrase in this condition cannot be interpreted as the main-clause object because the object of the main verb is not compatible with a clausal complement of the main verb (see (15) below). Thus the accusative NP in this condition must be interpreted as having been scrambled from the embedded clause object position, whether it is within or outside the embedded clause ((16a) and (16b), respectively).

3) It is known that embedded wh-nominatives in Japanese cannot be fronted to the sentence-initial position (Aoshima et al., 2004). To avoid a possible confound, nominative wh-phrases were excluded from the design. Questions can be raised as to whether the item design really needed to include different argument types. According to statistically-driven, usage-based view of language use and learning, however, less frequent word combinations tend to be harder to comprehend, produce, or learn (MacDonald, Pearlmuter, & Seidenberg, 1994; MacWhinney, 1998; Race and MacDonald, 2003). In our sentence completion context, it was considered that the scramblings of wh-datives from embedded interrogative clauses, for example, may be less frequent than the scramblings of the other types of wh-phrases, which can, in turn, affect the QM marking patterns.

4) While previous studies on Japanese typing mismatch used *which N* (as in *dono sensei* ‘which student’), it has been reported that a phrase like *etten saram* ‘which person’ in Korean is ambiguous between ‘which person (interrogative)’ and ‘a certain person (existential)’, and strongly biases Korean readers toward the existential interpretation (H-r Hahn & S Hong, 2014; H-K Park, 2010). On the other hand, one word wh-pronouns such as *mwukwu* ‘who’ were found to induce the readers more to an interrogative interpretation (H-r Hahn & S Hong, 2014). Therefore, in order to elicit as many interrogative interpretation as possible (and to secure a sufficient amount of data concerning QMs), we included more prompts with wh-pronouns.

- (15) *kyoswu-nun mwues-ul [cokyo-ka silhemsil-eyse coffee-rul masyessnun-ci]
morun-ta.
professor-TOP what-ACC assistant-NOM laboratory-LOC coffee-ACC
drank-Q not-know-Decl
'ungrammatical'
- (16a) kyoswu-nun [mwues-ul cokyo-ka silhemsil-eyse ___ masyessnun-ci] mor-
un-ta.
- (16b) kyoswu-nun mwues-ul [cokyo-ka silhemsil-eyse ___ masyessnun-ci] mor-
un-ta.
professor-TOP what-ACC assistant-NOM laboratory-LOC ___ drank-Q
not-know-Decl.
'The professor does not know what the assistant drank at the library.'

On the other hand, the other two argument types (datives and locatives) are compatible with a clausal complement, and the sentence-medial *wh*-phrase is thus structurally ambiguous: the *wh*-phrase can originate either from the matrix clause as in (17) or from the embedded clause as in (18a) or (18b). We will return to this issue later, when we report our findings.

- (17) cemwen-un nwukwu-eykey [sonnim-i kakyek-ul salpheoassta-ko] poko-
hayss-ni?
salesclerk-TOP whom-DAT customer-NOM price-ACC examined-Decl re-
ported-Q
'To whom did the salesclerk report ___ that the customer examined the
price?'
- (18a) cemwen-un [nwukwu-eykey sonnim-i ___ kakyek-ul mwulepoassnun-ci]
kwungkumhayss-ta.
- (18b) cemwen-un nwukwu-eykey [sonnim-i ___ kakyek-ul mwulepoassnun-ci]
kwungkumhayss-ta.
salesclerk-TOP whom-DAT customer-NOM ___ price-ACC asked-Q
wondered-Decl
'The salesclerk wondered whom the customer asked about the price'

The third condition, with the scrambled-wh in the initial position, began with a wh-phrase, followed by a matrix subject and an embedded subject. Again, the fronted wh-phrase in the sentence fragment was ambiguous between a main clause argument as in (19) and an embedded clause argument as in (20).

- (19) nwukwu-eykey cemwen-un ___ [sonnim-i kakyek-ul salpheoassta-ko] po-
kohayss-ni?
whom-DAT salesclerk-TOP ___ customer-NOM price-ACC examined-Decl
reported-Q
'To whom did the salesclerk report that the customer examined the price?'

- (20) nwukwu-eykey cemwen-un [sonnim-i ___ kakyek-ul mwulepoassnun-ci]
kwungkumhayss-ta.
whom-DAT salesclerk-TOP customer-NOM ___ price-ACC ask-Q won-
dered-Decl
'The salesclerk wondered whom the customer asked about the price.'

The nine sets of experimental items in the three conditions were distributed among three lists, using a Latin square design, so that the participants encountered individual experimental items in only one of the three conditions. The experimental items were interspersed with 16 filler items, so that a full test consisted of 25 items (see Appendix for the experimental items).

3.3. Procedure

The participants were asked to read the sentence fragments and to complete the sentence by providing their own words in a paper-and-pencil based task. They were informed that they were free to complete the sentences as either declaratives or interrogatives.

3.4. Data Analysis

The sentences completed by the participants were classified according to the argument position of the wh-phrase and the position of the QM.

Ungrammatical sentence completions were excluded from the analysis. Completions with two QMs (one on the embedded verb and the other on the main verb) and sentences where the *wh*-phrase was given an existential interpretation instead of an interrogative interpretation were also excluded from the analysis.

With the remaining trials, we first analyzed the sentence completions in terms of the thematic position of a *wh*-phrase, and then in terms of the position of a QM. As mentioned above, it was necessary to first identify the thematic position of a *wh*-phrase before we could determine whether the participants marked a QM on the earliest verb after the thematic position. In the *wh*-in-situ condition, the surface *wh*-position was counted as the thematic position. For the two scrambled-*wh* conditions, we identified the gap posited by the participants, based on whether the participants associated the *wh*-phrase with the embedded verb or the main verb. Sentences whose *wh*-phrase was interpretable as an argument of either verb were excluded from the analysis.

After the thematic positions of the *wh*-phrases had been identified, we examined the affixes of the embedded verbs and the main verbs to see if the QM was affixed to the earliest possible position. The QM marking patterns were compared across the three conditions: the *wh*-in-situ condition, the medial-*wh* condition, and the initial-*wh* condition. The distribution of QMs was also compared across the three different argument roles of the *wh*-phrases: accusatives, locatives and datives. Chi-square and Fisher Exact tests were used in order to compare scope-marking patterns across conditions.

4. Results and Discussion

The test yielded a total of 684 sentence fragment completions with a *wh*-phrase. Among them, 37 trials were ungrammatical as in (21). In 119 completions, the *wh*-phrase was given an existential interpretation as in (22). Fourteen sentences were ambiguous because the *wh*-phrase could be interpreted as an argument of either the embedded verb or the main verb, or because the completions had two QMs, as in (23). These

completions were excluded from the analysis.

- (21) *eti-eyse Kim sensayng-un ku haksayng-i chamkose-rul chaycemhayss-ni?
Where-LOC Mr. Kim-TOP the student-NOM reference-book-ACC grad-
ed-Q
(This response has only one verb and is thus ungrammatical/uninterpretable.)
- (22) Kim sensayng-un eti-eyse ku haksayng-i chamkose-rul hwumchyesstanun
sasil-ul alkeytoyess-ta.
Mr. Kim-TOP somewhere the student-NOM reference-book-ACC stole-that
fact-ACC came-to-know-Decl
'Mr. Kim came to know the fact that the student stole the reference book
somewhere'
- (23) eti-eyse Kim sensayng-un ku haksayng-i chamkose-rul kwuiphayssnun-ci
mwulepoass-ni?
Where-LOC Mr. Kim-TOP the student-NOM reference-book-ACC pur-
chased-Q asked-Q?
'Did Mr. Kim ask where the student purchased the reference book?'
OR 'Where did Mr. Kim ask if the student purchased the reference book?'

Our analysis of scope marking is based on the remaining 514 sentences. We will first report the participants' scope marking pattern in the wh-in-situ condition (Condition 1). Then we will discuss the scope fixing patterns in the trials where the wh-phrase in the stimulus fragment was placed outside the embedded clause (Conditions 2 & 3).

4.1. Scope Marking in the Wh-In-Situ Condition

A wh-phrase in situ, by definition, is in a predicate-argument relation with a local verb in the same clause. As such, it is not surprising that all the embedded in-situ wh-phrases in our experiment (N = 203) were associated with an embedded verb, as illustrated in (24).

- (24) kyoswu-nun cokyo-ka silhemsil-eyse mwues-ul hanun-ci ala-yahanta. (P #8)
professor-TOP assistant-NOM laboratory-at what do-Q know-must-Decl
'A professor must know what an assistant does at the laboratory'

The analysis of QM placement revealed that the participants attached a QM on the embedded verb in most cases. Indirect questions, with both a wh-phrase and a QM placed in the embedded clause, amounted to 92.6% of trials (N = 188). Only 7.4% of fragments (N = 15) were completed as direct questions, as exemplified in (25).

- (25) Kim sensayng-un ku haksayng-i eti-eyse chamkose-rul sassta-ko sayngka-khay-yo? (P #63)
 Mr. Kim-TOP the student-NOM where-LOC reference-book-ACC
 bought-Decl think-Q
 ‘Where does Mr. Kim think the student bought the reference book?’

Table 1 presents the counts and percentages of the embedded QMs and matrix QMs.

Table 1. Thematic Positions of Wh-Phrases vs. QM Placement: Wh-In-Situ Condition

	Thematic position of wh			QM placement		
	Embedded clause	Main clause	Total	Embedded clause	Main clause	Total
N	203	0	203	188	15	203
%	(100)	(0)	(100)	(92.6)	(7.4)	(100)

The proportions of the embedded QM completions and the matrix QM completions were significantly different according to both the Chi-square test ($X^2 = 168.491$, $df = 1$, $p < .0001$) and the Fisher Exact test ($p < .0001$). While we measured the differences in QM distributions in terms of both Chi-square tests and Fisher Exact tests in all of the analyses, we found that the two measures converged, showing no differences in significance levels. Therefore, we will hereafter report only the Chi-square statistics.

When the scope marking patterns were compared across the three different argument roles (accusatives, datives, and locatives), it was found that the argument types of the wh-phrases did not affect the scope-marking

pattern. As shown in Table 2, the predominance of local QM attachment was consistently observed irrespective of the thematic roles of the wh-phrases, and the difference across the three argument types was not significant ($X^2 = 2.761$, $df = 2$, $p = .251$).

Table 2. Scope Marking Pattern by Wh-Phrase Type: Wh-In-Situ Condition

Wh-argument	Verb with a QM					
	Embedded V		Main V		Total	
	N	(%)	N	(%)	N	(%)
Accusative	69	(92.0)	6	(8.0)	75	(100)
Dative	61	(96.8)	2	(3.2)	63	(100)
Locative	58	(89.2)	7	(10.8)	65	(100)
Total	188	(96.6)	15	(7.4)	203	(100)

The locality bias was also maintained when we compared scope-marking patterns for the two different versions of wh-phrases (i.e., wh-pronouns vs. *which N*). The difference in QM marking patterns between the two versions was not significant ($X^2 = .144$, $df = 1$, $p = .704$).

All these findings demonstrate the predominance of local scope marking in the embedded clause in the wh-in-situ condition, confirming the findings in the production studies by Lieberman et al. (2006), and lending support to Miyamoto and Takahashi's (2002) original findings in terms of the TME. Further, the preference for local QM placement across different types of wh-phrases suggests that the locality bias holds for the entire class of in-situ wh-phrases.

4.2. Scope Marking in the Medial-Wh Condition

Unlike in the wh-in-situ condition, where the thematic positions of wh-phrases are directly observable, the surface wh-position in the medial-wh condition or the initial-wh condition does not tell us where the wh-phrase has been base-generated. Therefore, we first examined whether the wh-phrase in each trial was thematically associated with the embedded verb or the

main verb. The analysis revealed that the participants associated most of the wh-phrases with the embedded verb, as in (26), creating an embedded gap in 92.9% of the trials (N = 159). Only in 12 out of 171 completions was the gap posited in the main clause, as exemplified in (27).

- (26) manager-nun mwusun noray-rul kaswu-ka mwuday-eyse hal-ci miri poko-hayss-ta. (P #26)
 manager-TOP which-song-ACC singer-NOM stage-LOC sing-FUT-Q beforehand reported-Decl
 ‘The manager reported beforehand as to which song the singer will sing on the stage.’

- (27) sungmwwuon-un nwukwu-eykey kicang-i kinay-eyse hupyenhanta-ko yayki-hayssul-kka? (P #56)
 steward-TOP whom-DAT captain-NOM cabin-LOC smoke-Decl said-Q
 ‘To whom did the steward possibly say that the captain smokes in the cabin?’

Turning to scope marking, we examined whether the QM was marked on the embedded verb or the main verb of the completions. We excluded the trials where the wh-phrase was associated with the main verb in this analysis. The scope marker must be positioned higher in the structural hierarchy than the thematic position (Aoshima et al., 2004; Miyamoto & Takahashi, 2002; Nishigauchi, 1990). So, when they placed a gap in the main clause, they had no option but to place the QM in the same main clause, as in (28) below, guaranteeing 100% local attachment.

- (28) enu paywu-eykey cakka-nun PD-ga cwuinkong yekhal-ul pyenkyenghayssta-ko allyechwuess-ni?
 which actor-DAT writer-TOP director-NOM title-role-ACC changed-Decl informed-Q? (P #22)
 ‘Which actor did the writer inform that the director changed the title role?’

Therefore, the real test case for the locality bias or the TME is when the gap is created in the embedded clause, so that the participants are given the choice of marking a QM on the embedded verb or the main verb. A QM in the embedded clause containing a gap will constitute true evidence for the locality bias in scope fixing and the TME. On the

other hand, a QM on the matrix verb when the wh-phrase is associated with the embedded verb will constitute counterevidence against the locality bias and the TME.

When we analyzed only the cases where the gaps associated with the scrambled wh-phrase were posited in the embedded clause, we again found a strong preference for marking a QM on the embedded verb. Embedded clause QMs were provided in 96.9% of trials (N = 154), with only five QMs affixed on the main verb (3.1%). The difference between the embedded clause scope marking and the main clause scope marking was highly significant ($X^2 = 149.629$, $df = 1$, $p < .0001$), indicating a strong bias for embedded clause resolution in the medial-wh condition.

Table 3. Thematic Positions of Wh-Phrases vs. QM Placement: Medial-Wh Condition

	Thematic position of wh			QM placement		
	Embedded clause	Main clause	Total	Embedded clause	Main clause	Total
N	159	12	171	154	5	159
(%)	(92.9)	(7.1)	(100)	(96.9)	(3.1)	(100)

In the comparison of scope-fixing patterns across the three different wh-phrase types, we found consistently high proportions of embedded clause QMs, irrespective of the argument types, as can be seen in Table 4.

Table 4. Scope Marking Pattern by Wh-Phrase Type: Medial-Wh Condition

Wh-argument	Verb with a QM					
	Embedded V		Main V		Total	
	N	(%)	N	(%)	N	(%)
Accusative	70	(97.2)	2	(2.8)	72	(100)
Dative ⁵⁾	24	(100.0)	0	(0.0)	24	(100)
Locative	60	(95.2)	3	(4.8)	63	(100)
Total	154	(96.9)	5	(3.1)	159	(100)

The difference in the scope-fixing patterns was not significant among the three argument types ($X^2 = 1.352$, $df = 3$, $p = .509$), suggesting that the thematic roles of the wh-phrases did not affect the distribution pattern of the QM in the medial-wh condition. In addition, as in the wh-in-situ condition, the scope fixing patterns did not differ depending on the different kinds of wh-phrases ($X^2 = 2.166$, $df = 1$, $p = .141$).

4.3. Scope Marking in the Initial-Wh Condition

The analysis of verb-argument associations in the initial-wh condition revealed that the participants associated the sentence-initial wh-phrase with the embedded clause in most of the trials (138 out of 165 trials), just as in the wh-in-situ and medial-wh conditions. The distribution of the gaps for wh-phrases was significantly different between the embedded clause gaps and main clause gaps ($X^2 = 78.377$, $df = 1$, $p < .0001$).

As in the medial-wh conditions, we excluded completions with a main-clause gap in our analysis of scope-marking patterns. Among the completions with an embedded-clause gap, 86.3% of trials ($N = 107$) were completed with a QM affixed on the embedded clause as in (29), whereas 13.7% of trials were completed as direct questions with a QM on the matrix verb as in (30).

(29) eti-eyse senswu-nun coach-ka hwunryen-ul sikhil-ci kwungkumhayss-ta. (P #30)

where-LOC player-TOP coach-NOM train-ACC make-do-FUT-Q wondered-Decl

'The player wondered where the coach will train him'

(30) mwusun noray-rul manager-nun kaswu-ka mwuday-eyse pullessta-ko mal-hayessul-kka? (P #51)

which song-ACC manager-TOP singer-NOM stage-LOC sang-Decl said-Q?

'Which song did the manager probably say that the singer sang on the stage?'

5) Most of the sentence-medial and sentence-initial dative wh-words were given an existential interpretation by the participants, which reduced the size of the analyzable wh-dative constructions.

Table 5. Thematic Positions of Wh-Phrases vs. QM Placement: Initial-Wh Condition

	Thematic position of wh			QM placement		
	Embedded clause	Main clause	Total	Embedded clause	Main clause	Total
N	124	16	140	107	17	124
(%)	(88.6)	(11.4)	(100)	(86.3)	(13.7)	(100)

For all argument types, the participants were found to prefer to attach a QM at the embedded verb, as shown in Table 6. The scope-marking pattern was not found to have been affected by argument types ($X^2 = .412$, $df = 2$, $p = .814$). Nor was it affected by whether the wh-phrase was a wh-pronoun or a *which N* ($X^2 = .150$, $df = 1$, $p = .699$).

Table 6. Scope Marking Pattern by Wh-Phrase Type: Initial-Wh Condition

Wh-argument	Verb with a QM					
	Embedded V		Main V		Total	
	N	(%)	N	(%)	N	(%)
Accusative	52	(88.1)	7	(11.9)	59	(100)
Dative	9	(81.8)	2	(18.2)	11	(100)
Locative	46	(85.2)	8	(14.8)	54	(100)
Total	107	(86.3)	17	(13.7)	124	(100)

4.4. Distance Effect

So far, we have shown that Korean native speakers are sensitive to the gap position of a scrambled wh-phrase: the participants affixed a QM to the earliest possible verb after the gap. The final question we ask is if the same native speakers were also sensitive to the surface wh-position. To be specific, we looked for any distance effect, examining whether the locality bias increases or decreases in strength as the wh-phrase is scrambled farther away from its original thematic position. Figure 1 presents

the proportions of embedded-clause scope marking and main-clause scope marking in the three conditions. As can be seen in Figure 1, the overall pattern of QM distribution is very similar across conditions.

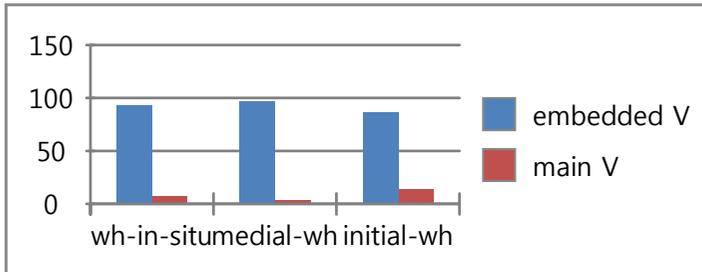


Figure 1. Scope Marking Positions by Condition.

Statistically, however, the scope-fixing pattern was found to differ significantly depending on the placement of the *wh*-phrase ($X^2 = 11.081$, $df = 2$, $p < .01$). Pair-wise comparisons of the three conditions showed that the difference was highly significant between the medial-*wh* condition and the initial-*wh* condition ($X^2 = 10.846$, $df = 1$, $p = .001$), while the difference was only marginal between the *wh*-in-situ condition and the medial-*wh* condition ($X^2 = 3.080$, $df = 1$, $p = .079$) and between the *wh*-in-situ condition and the initial-*wh* condition ($X^2 = 3.483$, $df = 1$, $p = .062$).

Therefore, while there do seem to be some differences in the strength of the bias depending on conditions, the result is not straightforward. Although the proportion of local QM marking is lower in the initial-*wh* condition than in the other two conditions, the difference is not simply attributable to a distance factor, as a higher proportion of embedded QMs was found in the medial-*wh* condition with local scrambling than in the *wh*-in-situ condition with no scrambling.⁶⁾ If distance is a factor, we would expect the locality bias to be the strongest in the *wh*-in-situ condition and the weakest in the initial-*wh* condition (or the other way around)

6) One reviewer suggested that while the physical distance between the *wh*-phrase and the main verb is the longest in the initial-*wh* condition, its structural distance is the closest, which might partly explain the higher rate of matrix verb scope-marking in the initial-*wh* condition.

increasing or decreasing in strength as the wh-phrase moves farther away from the canonical position. As we found no such directionality, our tentative conclusion is that the sentence processing mechanism is sensitive to the gap position rather than the actual site of a scrambled wh-phrase, when it comes to the resolution of scope ambiguity.

Note that all the sentence-initial wh-phrases that were included in the analysis above were wh-phrases scrambled from the embedded clauses. Therefore, it is evident that the participants did not generate more main clause QMs in the initial-wh condition because they interpreted a sentence-initial wh-phrase as an argument of the matrix verb. Also interesting to note is the fact that the participants frequently generated sentences with a “wh-island” by fixing the wh-scope at the embedded clause.⁷⁾ In other words, the participants allowed wh-phrases to be interpreted as having been extracted from the island, which resonates with recent findings by J-M Yoon (2013). While there exists some evidence that Korean/Japanese wh-constructions may not be subject to wh-island constraints (H-r Hahn, 2015; Saito, 1989), the proliferation of sentences with wh-phrases scrambled from the so-called wh-island by our participants strongly suggests that long-distance scrambling from an embedded wh-clause is not rejected by native speakers of Korean.

5. Summary and Conclusion

The present study explored how native speakers of Korean, a head-final language with scrambling, resolve the dependency between a wh-phrase and a QM, in order to see if they use the same processing strategy as that used by speakers of head-initial languages such as English. Along the lines of the studies conducted by Miyamoto and Takahashi (2002)

7) Another reviewer commented that the embedded clause with a QM may not be a wh-island. While there is controversy over what constitutes a wh-island in Korean or Japanese (Miyagawa, 2005; Saito, 1989; Yoon, 2013), I adopted Saito (1989)'s view of Japanese wh-island (where sentences such as *John-ga [Taroo-ga nani-o katta ka] sir-itagatteiru* ('John wants to know what Taroo bought') have been analyzed as containing an embedded clause) in stating that the participants proliferated constructions with wh-island violation by extracting a wh-element out of the island.

and Lieberman et al. (2004), we approached this question by asking whether Korean speakers also show a locality bias in determining the scope of a *wh*-phrase. The results of our sentence fragment completion test have demonstrated that native-speakers of Korean show a strong preference for local scope marking by generating a QM as early as possible after the argument position of a *wh*-phrase is identified. Our findings thus confirm in the Korean context previous findings on the comprehension and production of Japanese *wh*-constructions with in-situ *wh*-phrases (Aoshima et al., 2004; Lieberman et al., 2006; Miyamoto & Takahashi, 2002). As Korean is typologically and structurally close to Japanese, and as both languages are head-final languages that allow *wh*-phrases in-situ, our findings on the generation of QMs for Korean *wh*-in-situ constructions lend robust support to the locality bias as a parser's general propensity that operates in the processing of head-final languages.

Our findings, however, go beyond confirming previous findings. First, we have provided evidence that the human parser prefers local scope marking even when a *wh*-phrase is displaced out of its canonical position. We further suggested that the locality in scope fixing for scrambled-*wh* constructions is defined in terms of the distance of a QM from the gap rather than from the scrambled *wh*-phrase. Finally, we extended these findings on *wh*-scope marking to the entire class of *wh*-phrases by demonstrating that the locality bias holds for the processing of various types of *wh*-phrases. We believe that these new findings might contribute to a better understanding of underlying human processing mechanisms.

This study has some limitations. First, our findings are based on sentence fragment completions, which require the participant to generate some portion of the sentence, while the majority of sentence processing studies are comprehension-based. However, as Lieberman et al. (2006) argue, the sentence completion task “probes the syntactic and semantic expectations that are generated” based on the processing of pre-specified material, similar to other real-time comprehension tasks such as self-paced reading (p. 442). Further, the sentence fragment completion task enabled us to observe the actual gap position so that we could work out the dependency between the gap and the QM, giving us a vantage point that a compre-

hension-based experiment could not provide. In this regard, sentence completion was more suited to our purpose. One concern regarding this technique is that the sentence fragment completion task might have biased participants toward completing sentences as declaratives and thus producing more indirect questions than direct questions. This possible bias, if it exists, could be a confounding factor if it exaggerates the preference for local scope marking. Although this concern has never surfaced elsewhere in the literature, a careful examination of a sentence completion task's possible weaknesses seems to be required to make the best use of the technique.

As the scope of our investigation is limited to the dependency between a wh-phrase and a QM, we did not discuss another interesting dependency observed in our data—the dependency between a scrambled wh-phrase (i.e., the filler) and its gap. For its full interpretation, a scrambled wh-phrase must be associated with its argument position as well as with its scope position. While we touched on this matter only briefly, our future analyses of the sentence fragment completion data may provide crucial clues as to the underlying mechanism for resolving filler-gap dependency in Korean wh-constructions.

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Appendix

Experimental Items: The Wh-in-situ Condition

1. kyoswu-nun cokyo-ga silhemsil-eyse mwues-ul _____
professor-TOP assistant-NOM laboratory-LOC what-ACC
2. kyosa-nun haksayng-i tosekwan-eyse mwues-ul _____
teacher-TOP student-NOM library-LOC what-ACC
3. manager-nun kaswu-ka mwuday-eyse mwusun noray-rul _____
manager-TOP singer-NOM stage-LOC which song-ACC
4. cemwen-un sonnim-i nwukwu-eykey kakyek-ul _____
salesclerk-TOP customer-NOM whom-DAT price-ACC
5. sungmwwuon-un kicang-i kinay-eyse nwukwu-eykey _____
steward-TOP captain-NOM cabin-LOC whom-DAT
6. cakka-nun PD-ga enu paywu-eykey cwuinkong yekhal-ul _____
writer-TOP director-NOM which actor-DAT title-role-ACC
7. senswu-nun coach-ka eti-eyse hwunryen-ul _____
player-TOP coach-NOM where-LOC train-ACC
8. Kim sensayng-un ku haksayng-i eti-eyse chamkose-rul _____
Mr. Kim-TOP the student-NOM where-LOC reference-book-ACC
9. cinkwutul-un sinhonpwupwu-ka mwusen siktang-eyse noray-rul _____
friends-TOP honeymoon couple-NOM which restaurant-LOC song-ACC