The Role of Frequency in the Processing of *giving* and *receiving* Events in Korean

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ABSTRACT

This study aimed to examine the processing benefits of frequency information associated with the case marker *-eykey* in comprehending Korean declarative sentences. By using a picture description task in which pictures ambiguously illustrated either a giving event (*-eykey*$_{REC}$ ⋯ *cwuta* '*give* ⋯ *to*') or a receiving event (*-eykey*$_{SOURCE}$ ⋯ *patta* 'receive ⋯ from'), we found that giving events were predominantly preferred to receiving events. The results of the online sentence comprehension study revealed that 1) give-type verbs were integrated into sentences faster than receive-type verbs overall and 2) the reading-time differences between the verb types were significant when role NPs were canonically ordered (NP-*eykey* ⋯ NP-*(l)ul*) but not when they were noncanonically presented (NP-*(l)ul* ⋯ NP-*eykey*). We claim that structural and semantic frequency bias associated with *-eykey* facilitates readers' anticipatory processing in the integration of upcoming information. We further discuss how the processing differences in giving and receiving events might attribute to the argument-adjunct distinction between recipients and sources.

Keywords: frequency, ambiguity in thematic role assignment, case marker, Korean sentence comprehension

1. Introduction

For a given sentence fragment (1), there exists temporal ambiguity associated with the marker, *-eykey*, that allows several options for the upcoming position: An intransitive verb (e.g., *ka-ss-ta* 'went') is one of the options if *-eykey* plays a role as a simple locative marker. If the marker plays a recipient thematic role, a theme with a giving verb (e.g., *cwu-ess-ta* 'gave') will occur next. Additionally, if *-eykey* plays a source role, a theme with a receiving verb (e.g., *pat-ass-ta* 'received') will follow. Considering such an uncertain context, it is an important question to ask how rapidly readers exploit their expectation of which option is most likely to occur

next in the integration of thematic roles assigned to -*eykey* into sentences. The goal of this study is to examine the function of frequency in estimating readers' likelihood of each option for -*eykey* during the Korean giving-receiving sentence comprehension.

(1) Ku-ka   kunye-eykey ....
    He   *her-AMB ....*

Humans are sensitive to the frequencies of events that they have directly or indirectly experienced in their life time. Given such a human nature, no wonder is that the positive correlation between frequency and information process has been observed in the studies of various fields like visual and auditory perception (Bingham, Zaal, Shull & Collins 2002; Justus & List 2007), learning (Diessel 2007; Rott 2007), language comprehension (Mitchell 1987; MacDonald 1994; Roland & Jurafsky 2002; Chater & Manning 2006), and many other fields (Ellis 2002). In particular, used-based approaches in linguistics and psycholinguistics have claimed that language users acquire statistical information through their linguistic experience with input which constitutes distributional properties at all levels of language units such as lexicon, syntactic structures, and discourse comprehension. For example, bi-gram letter frequency plays an important role in visual word identification (Muncer & Knight 2012) and so does phonotactic probability in speech segmentation (Zamune 2009; Mersad & Nazzi 2011). The acquisition of grammar is to learn many frequency-based abstraction of linguistic constructions (Goldberg 1995, 2006) and structural regularities (MacDonald, Pearlmutter, & Seidenberg 1994; Trueswell 1996).

Using statistical information is also crucial in sentence processing (Mitchell 1987; MacDonald 1994; Roland & Jurafsky 2002; Chater & Manning 2006). Studies have demonstrated that readers use their statistical information in comprehension; by exploiting lexical and structural regularities for given sentence fragments, readers are highly likely to select the most probable[1] syntactic and semantic candidate among all possible candidates for their comprehension (Hale 2001; Jurafsky 2003; Chater & Manning 2006; Levy 2008). Such probabilistic behaviors of language users are also observed in language production such that speakers tend to produce the most

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1) Frequency does not always refer to probability. However, this paper takes the view of frequentist probability that relatively high frequency of events eventually leads to the high probability of the events (Hale 2001; Jurafsky 2003; Griffiths 2011).

probable utterance on the basis of frequency of utterance representations (Janssen & Barber 2012). It is important to note that not all types of frequency information are equally significant in language processing. The statistical information associated with some elements is considered more effective than the information associated with others.

In head-initial languages like English, verbs provide strong semantic and syntactic constraints on sentence structures, leading to the hypothesis that verbs' statistical information associated with these constraints should be informative in processing remaining parts of sentences. For example, given the fragment like (2a) in which a main verb can be either *confirmed* or *insisted*, readers temporarily find it ambiguous at the verb about whether the fragment will continue as a direct-object(DO) construction (2b) or a sentential complement(SC) construction (2c). Verbs like *confirm* and *hear*, so-called DO-biased verbs, co-occur with DOs much more frequently than SCs, indicating that DO continuation (2b) is more probable than SC continuation (2c). On the contrary, the frequency distribution of verbs like *insist* and *believe* is opposite in a way that these verbs appear more frequently in SC constructions than DO constructions. Thus, for this type of SC-biased verbs, SC continuation (2c) is more probable than DO construction (2b). Previous findings indicate that readers are able to rapidly exploit the statistical information of verbs' subcategorization preference (Trueswell, Tanenhaus, & Kello 1993; Garnsey, Perlmutter, Meyer, & Lotocky 1997; Wilson & Garnsey 2009) and verbs' senses (Roland & Jurafsky 2002; Hare, McRae, & Elman 2003) in the resolution of syntactic ambiguity in the downstream of sentences.

(2) a. The waiter confirmed/insisted ....
    b. The waiter confirmed/insisted the reservation yesterday.
    c. The waiter confirmed/insisted the reservation was made yesterday.

Another example demonstrating the role of verb's statistical information is that the processing difficulty of prepositional phrase (PP) attachment is modulated by verb semantic class (Spivey-Knowlton & Sedivy 1995). For action verbs like *smash*, PPs were read faster when they were attached to verbs (VP-attachment) as in (3b) than when they were attached to noun phrases (NP-attachment) as in (3a). In contrast, for psychological verbs like *glance*, NP attachments as in (3c) were easier than VP attachments as in (3d). The corpus results were consistent to readers' comprehension behaviors such that PPs of (3b) were more frequent than those of

(3a) whereas PPs of (3c) occurred more than those of (3d).

(3) a. The fireman <u>smashed down</u> the door <u>with a rusty lock </u>but smoke overcame him.
   b. The fireman <u>smashed down</u> the door <u>with a heavy axe</u> but smoke overcame him.
   c. The salesman <u>glanced at</u> the customer <u>with ripped jeans </u>and then walked away.
   d. The salesman <u>glanced at</u> the customer <u>with suspicion</u> and then walked away.

Unlike English, languages like Korean and Japanese are classified to head-final languages of which verbs are placed sentence finally. This typological difference between head-initial and head-final languages suggests that the anticipatory processing driven by verbs' statistical information in comprehending English sentences may appear in a different manner in the processing of Korean or Japanese sentences. Kamide, Altmann, and Haywood (2003) provided interesting results for this manner. Using a visual-world paradigm, Japanese listeners were instructed to look at a picture, describing a waitress walking to a male customer who was sitting next to a table on which a plate of hamburger was placed. Simultaneously, they listened to dative sentences like (4a) or simple declarative sentences like (4b). The researchers observed that the listeners anticipatorily looked at depicted objects (e.g., *hamburger*) corresponding to patient roles at the auditory input of adverbs (e.g., *merrily*) of (4a) more than those of (4b). According to Kamide and her colleagues, the existence of recipients attached with *-ni* case marker might have facilitated to listeners' expectation of hearing a theme, with the claim that case markers in head-final languages contributed to eliciting the expectation of upcoming arguments as similarly as verbs in head-initial languages did.

(4) a. *Weitoresu-ga*   *kyaku-ni*   *tanosigeni*   *hanbaagaa-o*   *ha-kobu.*
     waitress-nom   customer-DAT   merrily   hamburger-acc   bring
     The waitress merrily brings the hamburger to the customer.
   b. *Weitoresu-ga*   *kyaku-o*   *tanosigeni*   *karakau.*
     waitress-nom   customer-ACC   merrily   tease
     The waitress merrily tease the customer.

In Korean, Yun and Hong (2014) conducted a cloze task in which participants were asked to complete sentence fragments like (5a-b). Theme NPs were produced at 73% in (5a), whereas VPs were mentioned at 81% in (5b). They also observed that theme NPs were read faster when they occurred after (5a) (i.e., canonical order)

than recipient NPs when they occurred after (5b) (i.e., noncanonical order) while length and lexical frequency of target words were controlled for. They argued that the presence of *-eykey* triggered readers' structural expectation for an upcoming thematic role, comparing to the case that the presence of *-(l)ul* led to readers' structural expectation for an upcoming recipient role. Their claim was consistent with the corpus results by Choi (2007). Using Sejong spoken corpus, she showed that dative sentences where recipients with dative markers precede themes (i.e., 86% - 598 out of 712 tokens) occurred more frequently than dative sentences where recipients with dative markers follow themes (i.e., 16% - 114 out of 712 tokens).

(5) a. *Chelswu-ka*   *kyengchal-eykey* _____
      Chelswu-NOM   policeman-DAT
   b. *Chelswu-ka*   *sinpwunchun-lul* _____
      Chelswu-NOM   ID card-ACC

In addition to testing the structural bias associated with *-eykey,* the current study attempts to investigate whether the statistical bias associated with *-eykey* senses would modulate processing difficulty, in particular, in the resolution of *-eykey* ambiguity. As mentioned in the beginning of this paper, the marker, *-eykey*, has multiple senses; 1) a locative role as in *He her-eykey went*, 2) a recipient role as in *He her-eykey apple-ul gave*, and 3) a source role as in *She him-eykey apple-ul received*. According to the results from Yun and Hong's (2014) cloze task, *-eykey* takes a recipient role most frequently (at 63%) followed by a locative role (at 10%) and a source role (at less than 5%). That is to say, *-eykey* as a recipient role marker is the most probable, whereas *-eykey* as a source role marker is the least probable. The low probability of *-eykey* as a source role is also supported by Kim's (2009) corpus study. She extracted all instances of *-eykey* from Sejong corpus and found that *-eykey* taking a source role occurred only 76 instances out of 3,063 instances in total. Taking into account the results above, for the ambiguous fragment (6), the most likely event that will be unfolding in the downstream of the sentence is a giving event where the *-eykey* NP takes a recipient role but the least likely event might be a receiving event where the *-eykey* NP takes a source role.

(6) *Ku-ka*   *kunye-eykey* ....
   He   *her-eykey* ....

In this study, we aim to extend the statistical issues associated with the case marker *-eykey* into the processing of giving and receiving events, while we are qualitatively elaborating the results from Yun and Hong (2014). Our research questions are as follows;

Question 1: With no linguistic precursor (i.e., when *-eykey* is not explicitly mentioned), which event should be perceived more dominantly; a giving event or a receiving event? Previous studies using linguistic precursors have revealed that a giving event, rather than a source event, should be counted as a default. We question whether this is also true when there is no any linguistic cue available.

Question 2: Yun and Hong (2014) used a self-paced moving window reading with a secondary judgment task which has been considered a strongly-constraining task to test subtle semantic effects. This task has often been criticized because it does not precisely reflect readers' natural comprehension behaviors. In the current study, we use a simple self-paced reading comprehension without a secondary judgment task with a different set of experimental stimuli. We question whether Yun and Hong's (2014) results are replicated even when a less-constraining task is employed.

Question 3: Will the structural function of *-eykey* as a theme-role indicator interact with the semantic function of *-eykey* as a facilitator in the resolution of event ambiguity? We hypothesize that given the statistical bias for *-eykey* as a recipient marker, *-eykey* taking a recipient role will be processed more easily than *-eykey* taking a source role. However, given Yun and Hong (2014)'s finding that the presence of a recipient facilitates the anticipation of occurring a theme in a canonical word order but not in a noncanonical word order, the ambiguity resolution of *-eykey* might be much easier in the canonical condition in which a recipient with *-eykey* appears before a theme than in the noncanonical condition in which a recipient with *-eykey* appears after a theme.

To answer these questions, we conducted two studies: a picture-description task in Experiment 1 for Question 1 and an online self-paced moving window reading comprehension in Experiment 2 for Questions 2 and 3.

2. Experiment 1

2.1. Participants

Forty university students attended in the experiment. They were all native Korean speakers and did not have any significant influences from other languages.

2.2. Materials and procedure

Twenty-two experimental pictures, as displaced in Figure 1a-b, were used in this picture description study. The pictures had to satisfy a couple of requirements. First, in each picture, there should be three participants (i.e., agent, recipient or source, theme) which are obligatorily required for a giving or receiving event. Second, each picture had to be so ambiguous that it could be perceived as either a giving or receiving event. To avoid participants being strategic in interpreting the pictures, there were two versions of each picture in which the position of characters was switched each other. For example, in Figure 1a, a boy with a hood tee was sitting in the left but he was sitting in the right in Figure 1b. As a result, the position of a character would not lead to a systematic bias on who is doing a giving or receiving action. Participants did not see the same picture twice, and they were asked to describe an event drawn in the picture in one sentence. During the instruction, we implicitly encouraged them to make their description in a format matching for the who-did-what-to/from-whom information. With Figure 1a-b, participants were encouraged to generate "A boy is passing the salt to the girl", although there were other possible sentences like "They are friends" or "They are having dinner together." The experimental pictures were counterbalanced across the two presentation lists and intermixed together with 28 filler pictures. The filler pictures were designed not to use similar linguistic constructions that are likely to be used to describe the experimental stimuli. For the pictures in which only one character appeared, intransitive constructions might be used. Each participant saw 50 different pictures. It took about 30-40 min to complete the task on average.
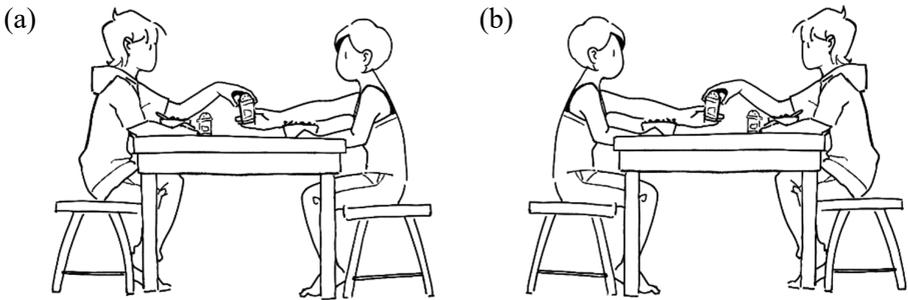
Figure 1. A sample picture stimuli used for the picture-description task.

2.3. Coding

The descriptions obtained from three participants had to be discarded due to their illegitimate content. Thus, we coded the data from the remaining 37 participants. The event descriptions that participants produced were coded in two ways. First, we categorized participants' descriptions into event types: giving event, receiving event, giving-and-receiving event, and others. Table 1 displays several example tokens that were actually produced by participants when they described Figure 1a(b). Second, we also coded the order of how event participants were arranged in terms of canonicality; that is, whether recipients attached with *-eykey* preceded themes attached with *-ul/lul* (i.e., canonical order) or whether recipients with *-eykey* followed themes with *-ul/lul* (i.e., non-canonical order). For the second coding, it was necessary that recipients and themes were explicitly mentioned. We found that 58% of the data (i.e., 475 out of 812) did not spell out participant roles with *-eykey* (or *-hantey*) and only 42% of the data (i.e., 337 out of 812) explicitly expressed the two obligatory participant roles. Thus, the 42% data were only entered for our second coding.

Table 1. Example sentences describing Figure 1a(b) that were obtained from Experiment 1

Event type	Examples
Giving event	1. 남자가 여자에게 후추를 주고 있다. Namca-ka yeca-eykey hwuchwu-lul cwu-ko iss-ta (A man is passing pepper to a woman.) 2. 남자가 여성에게 후추를 건네 주고 있다. Namca-ka yeseng-eykey hwuchwu-lul kenneycwu-ko iss-ta (A man is handing over pepper to a woman.)
Receiving event	1. 여자가 남자에게 후추를 건네 받고 있다. Yeca-ka namca-eykey hwuchwu-lul kenneyp-at-ko iss-ta (A woman is receiving pepper from a man.)
Giving-receiving events	2. 수업 중 쪽지를 주고 받는다. Swuep-cwung ccokci-lul cwukopat-nun-ta (Null are exchanging a memo during the class.) 2. 서로의 음식을 건네고 있다. Selo-uy umsik-ul kenney-ko iss-ta (Null are passing their own food each other.)
Others	1. 두 명이 밥을 먹는다. Twu myeng-i pap-ul meknun-ta (Two people are having meal.) 2. 음식이 싱겁다. Umsik-i singkep-ta (The food is low in salt.)

2.4. Results

Our coding results are displayed in Figure 2a-b. First, as shown in Figure 2a, giving events took the largest portions at 52%, followed by receiving events at 25%. These two events together took 77%, more than three fourths of the total data, suggesting that our pictures successfully expressed events associated with dative/ source constructions. Crucially, as we hypothesized, our results revealed that even though both giving and receiving events were available for each ambiguous situation, giving events were perceived to be more typical, dominant, and frequent than receiving events. Among 77%, giving events took 68% but receiving event took only 32%. Of interest, because roles associated with -*eykey* were temporarily ambiguous, the other source marker like -*buteo* (*from*) could have been preferred to reduce the related role ambiguity. Nonetheless, the use of -*eykey* marker was still predominant, regardless of whether events would be giving or receiving. The production ratio of

-eykey to *-buteo* was 10 to 1; *-buteo* was elicited only 3 times out of 30 source roles and the 27 times of source roles were attached with *-eykey* marker. Second, the sentences of a canonical order (i.e., *-eykey* + *-(l)ul*) were overwhelmingly frequent in comparison to those of a non-canonical order (i.e., *-(l)ul* + *-eykey*). As shown in Figure 2b, the former took 95%, while the latter did only 5%.
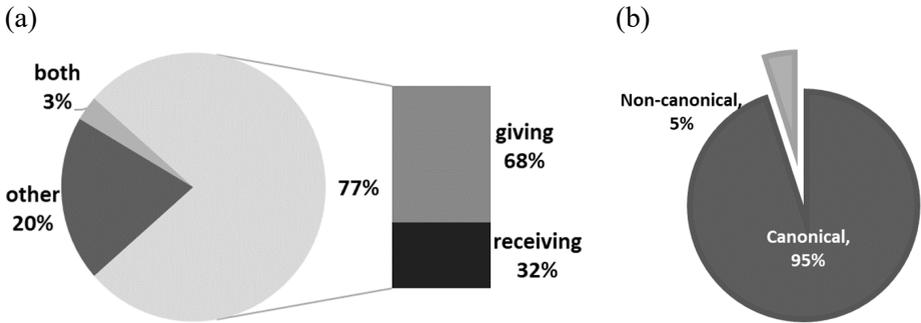
(a)   (b)

Figure 2. a) distribution of event types by proportions, b) distribution of the order of thematic roles.

In sum, the results from Experiment 1 revealed three findings: 1) When three participants roles were available in an event (i.e. who-did-what-to/from-whom event), giving events were much more likely, typical and frequent than receiving events. Note that such a preference was observed without any linguistic cues being accessible. Psychologically speaking, the threshold of giving events seemed to be relatively lower than that of receiving events, and thus giving events were activated more strongly than receiving events. 2) The structural preference for the canonical order (i.e., *-eykey* preceding *-(l)ul*) was repeatedly observed. 3) In order to express a source role, the ambiguous linguistic marker, *-eykey*, was predominantly produced, although another unambiguous source-role marker, *-buteo*, was available.

3. Experiment 2

3.1. Participants

One-hundred-seven university students attended in the online reading experiment. All were native Korean speakers and did not have any difficulty in reading.

3.2. Materials

Twenty sets of experimental stimuli, as indicated in (7a-d), were used. The stimuli differed by two factors (structural frequency and semantic frequency associated with *-eykey*). First, the structural frequency associated with *-eykey* marker was manipulated by keeping the order of internal arguments to be canonical (i.e., order of high structural frequency), as found in (7a-c), or non-canonical (i.e., order of low structural frequency), as found in (7b-d). Second, the semantic frequency associated with the ambiguous *-eykey* was realized by manipulating verb types. The main verbs of sentences were from either give-type verbs, as shown in (7a-b), or receive-type verbs, as shown in (7c-d). On encountering the verbs occurring later on, thematic roles corresponding to the NPs with *-eykey* marker were resolved as recipients in (7a-b) (i.e., role of high semantic frequency) and as sources in (7c-d) (i.e., role of low semantic frequency). All experimental sentences consisted of six regions, marked by '|': subjects, NP1, NP2, adverbs, verbs, and verb conjugations. Except the order of arguments (NP1-NP2 or NP2-NP1) and verbs, the other parts of the sentences are exactly the same across all conditions. Because processing difficulty by word order might not emerge immediately at the second NP position, adverbs were inserted between second NPs and verbs to separate the canonicality effect from the effect due to the resolution of role ambiguity. If verbs appear sentence finally, the effect in the resolution of role ambiguity might be confounded with the wrap-up effect that "..a special computational episode occurs when a reader reaches the end of a sentence." (Just & Carpenter 1980). To avoid the potential concern, verb conjugations are additionally added at the sentence-final position.

(7) a. Canonical order, Give-type verbs: high structural and high semantic frequency
정원이가 보경에게 수학을 열심히 가르치는 중이다.
Cengwen-ika | Pokyeng-eykey | swuhak-ul | yelsimhi | kaluchi-nun | cwungi-ta
Cengwen-NOM Pokyeng-DAT mathematics-ACC hard teach -ing
Cengwen is teaching Pokyeng mathematics hard

b. Non-canonical order, Give-type verbs: low structural and high semantic frequency
정원이가 수학을 보경에게 열심히 가르치는 중이다.
Cengwen-ika | swuhak-ul | Pokyeng-eykey | yelsimhi | kaluchi-nun | cwungi-ta
Cengwen-NOM mathematics-ACC Pokyeng-DAT hard teach -ing
Cengwen is teaching Pokyeng mathematics hard

c. Canonical order, Receive-type verbs: high structural and low semantic frequency

정원이가 보경에게 수학을 열심히 배우는 중이다.

Cengwen-ika | Pokyeng-eykey | swuhak-ul | yelsimhi | paywu-nun | cwungi-ta

Cengwen-NOM Pokyeng-DAT mathematics-ACC hard learn -ing

Cengwen is learning mathematics from Pokyeng hard.

d. Non-canonical order, Receive-type verbs: low structural and low semantic frequency

정원이가 수학을 보경에게 수학을 열심히 배우는 중이다.

Cengwen-ika | swuhak-ul | Pokyeng-eykey | yelsimhi | paywu-nun | cwungi-ta

Cengwen-NOM mathematics-ACC Pokyeng-DAT hard learn -ing

Cengwen is learning mathematics from Pokyeng hard.

Twenty sets of experimental materials were counterbalanced by using a Latin-squared method and they were pseudo-randomly intermixed with 102 filler sentences. A participant read 122 sentences in total. The syntactic structures of these fillers were various (e.g., complex sentences like relative clauses or sentences with subordinate clauses). In order to keep readers' attention, comprehension questions were inserted every three or four sentences. 42 filler sentences (i.e., 30% of the total trials) were followed by comprehension questions. The accuracy of the questions was used to filter out poorly-reading participants during the analysis of reading times.

3.3. Procedure

A participant-paced moving-window reading procedure without a secondary judgment task was used. A row of white dashes was presented on a computer monitor. The dashes corresponded to all the characters of each stimulus sentence. Stimulus sentences were presented on one line. To begin reading the first region of sentences, participants pressed a spacebar. This caused the dashes corresponding to this region to be replaced by words. To read the next region, participants hit the spacebar again. This hit made the first region to return to dashes and the second region to appear. Participants kept pressing the spacebar to read each subsequent region until the end of a sentence. The reading times of each region were recorded automatically. In every three or four sentences, they encountered a comprehension question. To answer the question, they pressed "Yes" or "No" key marked on a keyboard. Before the experiment began, participants were asked to read the instructions carefully.

After reading the instructions, they completed 15 practice trials (6 out of 15 had comprehension questions) to familiarize themselves with the task and the response keys. On average, it took about 15-20 mins to complete reading all sentences.

3.4. Analysis

The reading times of second NPs at Region 3, adverbs at Region 4, and verbs at Region 5 were entered for statistical analyses. Prior to the analyses, outliers were filtered. Reading times greater than 3,000 milliseconds were omitted, resulting in the removal of only 19 scores out of the total number of scores. It affected only 2% of the data. The extremely long reading times were removed because including them might have led to inflated estimation of the data. One of the problems was that the lengths of target words were not equally controlled across all conditions at Region 3. Especially, the lengths of target words at Region 3 were longer when their roles corresponded to recipients than themes. This was basically because the case marker for recipients (i.e., *-eykey*) had one syllable longer than the case marker for themes (i.e., *-ul*). The potential confounding effect due to the length difference were controlled for during the process of statistical analysis.

A series of linear mixed-effect regression models was conducted while controlling for the variances of subjects and items simultaneously and the additional effects of length at Region 3. For our analyses, we used the R statistics program (version 3.5.1, R Development Core Team 2018) and lme4 (version 1.1-17, Bates, Maechler, Bolker, & Walker 2015). In all quantitative analyses below on RTs by regions, fixed factors were entered as categorical variables: Order ('0' for Canonical order, '1' for Non-canonical order), Role ('0' for Recipient, '1' for Source). Length corresponded to the number of letters of target words. This factor was included to control for the effect associated with readers' perceptual efforts on length in sentence processing (Juhasz & Rayner 2003). Order and Length were used as fixed factors for the analysis of the RTs of Region 3, whereas Order was only used to predict the variances of the RTs of Region 4. Finally, for the analysis of the RTs of Region 5, Role, Order, and the interactions were entered as fixed factors in predicting the variances of the RTs of Region 5. In all analyses, all fixed factors were centered and participants and items (stimuli) were included as random variables (random intercepts and random slopes for the effect of the designated fixed factors) to control for unwanted participant and item variability. An initial fit for the random intercept and slopes model performed, and each model fit was

optimized based on 100,000 iterations. We simplified the initial fully crossed and fully specified random effect structure to yield the maximally justified random structure, as discussed by Baayen, Davison, and Bates (2008). When models failed to converge, we removed random slopes for the effect of fixed factors of items while keeping random intercepts for participants and items and random slopes for participants. Approximately 3% out of the overall data were removed from the final model by Baayen's (2008) outlier removal procedure. Specifically, RTs with a standardized residual at a distance greater than 2.5 standard deviations from zero were removed. The p-values of fixed factors in each model were obtained by running the lmerTest package (Kuznetsova, Brockhoff, & Christensen 2017).

3.5. Results

The results from the best-fitting models for the RTs of Region 3, 4, and 5 are displayed in Table 2a-c, respectively.

Table 2. Results from linear mixed effect regression models which tested the RTs of target constituents at Region 3, 4, and 5

a. Results at Region 3 (second NPs)				
	Coefficient	S.E.	t-value	df	p-value
Intercept	523.49	24.65	21.24	59.81	.00
Order	−4.57	22.42	−.20	64.61	.83
Length	28.91	23.57	1.23	35.62	.23
b. Results at Region 4 (adverbs)				
	Coefficient	S.E.	t-value	df	p-value
Intercept	488.58	19.57	24.97	69.63	.00
Order	77.32	23.33	3.32	33.64	.00
c. Results at Region 5 (verbs)				
	Coefficient	S.E.	t-value	df	p-value
Intercept	473.43	19.96	23.71	63.64	.00
Role	41.12	19.91	2.07	20.38	.05
Order	10.65	21.44	.50	25.55	.62
Role × Order	54.42	28.74	1.89	87.74	.06

3.6. Order effect

Recall the result of Yun and Hong (2014) that role prediction for upcoming roles occurred at the position of the second internal arguments; that is, the second arguments of a canonical order were read faster than those of a noncanonical order. The effect of role predictability driven by canonicality supports the facilitating role of structural frequency information associated with *-eykey*. We questioned whether this result would be replicated but we did not predict exactly where the effect of role prediction would emerge. One possibility is that readers may slow down immediately at the position of second arguments (i.e., Region 3) in the same way that Yun and Hong (2014) have observed. Alternatively, if the task constraint is not strong enough, the effect might be spilled over to the next position, and thus, the significant effect corresponding to role prediction may elicit one position later. This alternative story suggests that the effect would appear at the adverbial position.

The effect of Order was not observed at the second argument position, Region 3 (Table 2a) but the significant effect of Order emerged at one position later, Region 4 (Table 2b). That is, at the adverbial position, the change of Order from being canonical to being noncanonical led to the significant increase of reading times by 77.32ms. For example, *Pokyeng-eykey* (Pokyeng-DAT) following the context of *Cengwen-ika swuhak-ul* (Cengwen-NOM mathematics-ACC) did not take longer to read than *swuhak-ul* (mathematics-ACC) following the context of *Cengwen-ika Pokyeng-eykey* (Cengwen-NOM Pokyeng-DAT). At one position later, however, the adverb, *yelsimhi* (*hard*) was read significantly longer when it followed the noncanonical context of *Cengwen-ka swuhak-ul Pokyeng-eykey* (Cengwen-NOM mathematics-ACC Pokyeng-DAT than when it followed the canonical context of *Cengwen-ika Pokyeng-eykey swuhak-ul* (Cengwen-NOM Pokyeng-DAT mathematics-ACC).[2] The results from Yun and Hong (2014) were replicated. However, the time course for the effect was not immediate but delayed, probably due to the looseness of a task constraint.

3.7. Role effect

Our question was to test whether the semantic frequency bias associated with *-eykey* would be actively used during online sentence comprehension. If the roles

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2) One of the anonymous reviewers pointed out whether the effect of Order by canonicality refers to the faster integration of canonically-ordered thematic roles or the slower integration of noncanonically-ordered thematic roles. It is an important question to untangle processing mechanism such as whether the processing benefit due to canonicality is driven by facilitating probable choice or inhibiting less probable choice. However, the design used for the current study cannot distinguish the two mechanism and should leave it to the issue of a follow-up study.

attached with -*eykey* are assigned as recipients rather than sources, potentially due to the statistical bias for recipient -*eykey* over source -*eykey*, readers would be surprised when they later encounter receive-type verbs indicating that the roles with -*eykey* should be revised from recipients to sources. In this case, the processing of the verbs should be slow down in comparison to that of give-type verbs that do not require such a revision to -*eykey*. We expect to observe the reading-time differences between the two verb types. The significant effect of Role would support the facilitating role of semantic frequency information associated with -*eykey*.

At the verb position (Region 5), the main effect of Role was significant, meaning that receive-type verbs took longer to read than give-type verbs at 41.12ms (Table 2c). For example, the reading times of *paywu-nun* (learning) were longer than those of *kaluchi-nun* (teaching), regardless of whether the internal arguments were ordered canonically or noncanonically. Interestingly, the interaction between Role and Order was marginally significant (Table 2c). When we unpacked the interaction terms to understand the nature of the relationship between the factors, we found that the difference of reading times between give-type verbs and receive-type verbs were much larger in the non-canonical condition than in the canonical condition (Figure 3). This interaction suggested that the processing of receive-type verbs was more difficult than that of give-type verbs overall and the difficulty increased when internal arguments were noncanonically ordered more than when they were canonically ordered. In other words, the resolution of role ambiguity associated with -*eykey* was more difficult in the receiving events than in the giving events overall and its difficulty increased much more when the explicit occurrence of the second arguments was unlikely.
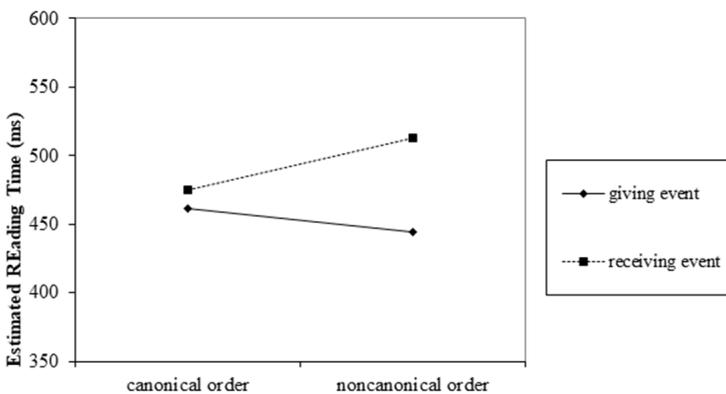

Figure 3. Interaction between Order and Role, plotted by using the method of Aiken and West(1991).

To sum up, the effect of Order occurred at the adverbial position, Region 4, indicating that the adverbs were read faster in the canonical condition than in the non-canonical condition. The effect of Role emerged at the verb position, Region 5. Give-type verbs were read faster than receive-type verbs and the difference of the reading times between the verb types was larger in the non-canonical condition than in the canonical condition. These results support our hypotheses: 1) the structural frequency information associated with *-eykey* replicated the effect of role prediction, as Yun and Hong (2014) has already claimed, and 2) the semantic statistical preferences of *-eykey* for giving events over receiving events led to considerable difficulty in the integration of verbs into sentences.

4. General Discussion

We discuss our results by answering the questions that we raised above in Introduction.

4.1. Question 1: For a given who-did-what-to/from-whom event without a linguistic precursor, which event is more dominantly perceived, a giving event or a receiving event?

The results from Experiment 1 revealed that the who-did-what-to/from-whom depicted events were expressed as giving events much more than receiving events, suggesting that giving events were more dominantly perceived than receiving events. Of interest, the stronger preference for giving events over receiving events was observed nonlinguistically as well as linguistically (Kim 2009; Yun & Hong 2014).

Why is that giving events are preferred to receiving events even when depicted events are ambiguous? We think that our results could reflect features of humanness such as subjectivity. In psychology, subjectivity is a concept expressing that humans do not simply take their internal mechanisms triggered by external events, but they actively internalize their experiences in agents' perspectives. Thus, when they conduct tasks, humans tend to experience events associated with tasks subjectively by making use of their sensory, motor, and neural systems (Bandura 1993; Harre & Gillet 1994). In the same line with this claim, psycholinguistic studies of embodied cognition have shown that if a perspective is adopted for action language, it is highly likely to match to an agent's perspective (e.g., Glenberg & Kaschak 2002; Zwaan & Taylor 2006;

Wu & Barsalou 2009). For example, studies using functional magnetic resonance imaging (Hauketal 2004; Aziz-Zadehetal 2006) found that listening to an arm-related word (e.g., *touch*) induced increased activation in the areas of premotor and primary motor cortex. These areas were also associated with arm movements. Also, listening to a face-related word (e.g., *speak*) increased brain activation of the areas which were supposed to be activated when face was actually moved. Similarly, areas associated with feet were activated in readers' listening to a foot-related word (e.g., *kick*). These patterns of brain activation hint that participants tend to take the perspectives from agents (e.g., kicker) rather than patients (e.g., person who is kicked). Furthermore, adopting an embodied agent's perspective begins automatically from the early stages of semantic processing (Pulvermüller, Shtyrov, & Ilmoniemi 2005; Pulvermüller, Fadiga 2010). That being said, taking agent's perspective represents human nature of subjectivity which in turn reveals as repeated patterns of nonlinguistic and linguistic event experiences. In our study, the stronger preference for giving events than receiving events is consistent with the claim by the studies discussed above in that our participants might take an agent' point of view (i.e., giver) in the processing of the who-did-what-to/from-whom ambiguous events rather than a patient's point of view (i.e., receiver).

4.2. Question 2: Using a different set of experimental stimuli and less constraining reading task, will the role predictability effect that Yun and Hong (2014) observed be replicated?

Recall that in Experiment 2, the significant effect of canonicality emerged at the adverbial position (Region 4), meaning that the adverbs were read faster in the canonical order condition (i.e., recipient + theme order) than in the noncanonical order condition (theme + recipient order). Yun and Hong's (2014) finding was replicated in our Experiment 2 but, unlike the previous study, the effect was delayed. As we speculated earlier, using different tasks between the studies might have resulted in the differences across the studies. The task that Yun and Hong (2014) have required readers to pay intensive attention in exploiting semantic information at each region of a sentence. Thus, when the semantic role information associated with *-eykey* was exploited at Region 2, the effect for role anticipation could emerge immediately at Region 3 in which the satisfaction of readers' expectation was confirmed. For such a strongly-constraining case, the effect were likely to appear

immediately. However, when the constraint of the task itself was not strong enough, as we did in Experiment 2 in which readers were not required to make semantic judgment during reading, readers' attention on semantic information might not be that intensive, and thus the chances that the effect might be spilled over the next region was high. The time course showing how rapidly semantic information could be used was modulated by a type of a comprehension task.

Our study is not the only one that observed different results by using different tasks. Schotter, Bicknell, Howard, Levy, and Rayner (2014) investigated readers' cognitive flexibility in reading for comprehension and proofreading by manipulating lexical frequency and predictability. They, especially in their Experiment 2, aimed to investigate whether the effects of lexical frequency and predictability would differ as a function of a task. The researchers reasoned that in order to detect wrong words (e.g., *trail* for *trial*) in the proofreading task, proofreaders were required to perform deep processing with respect to the fact that proofreaders should apply their orthographic, lexical, syntactic, semantic, and contextual knowledge into the decision on whether an incoming word would be incorrect for a given context. Thus, what is crucial is that proofreading for wrong word errors requires not only checking the word but also assessing the degree to which the word's meaning and their grammatical properties are appropriate for the context. This processing burden would be less for readers who are just required to comprehend sentences without being involved in a sensicality judgement.

Schotter et al. (2014) found that reading times in proofreading were slower than in comprehension. The effect sizes of lexical frequency and predictability increased in proofreading relative to reading for comprehension. These difference across the tasks indicated that the way in which readers perform a task was modulated by the extent to which readers were sensitive to specific linguistic properties of the words they read. When readers were more involved in readjusting semantic processing, the effect associated with word (frequency and predictability) was strengthened. The researchers claimed that word and sentence processing during reading was highly responsive to task demands.

Schotter et al.'s (2014) claim could be applied to account for the differences between our current results and Yun and Hong's (2014) results. Readers in Yun and Hong's (2014) study might have been involved much more deeply in the processing of semantic information than readers in the current study. The deeper processing of semantic information could attribute to elicit immediate predictability effect based on the frequency of word order, whereas the relatively shallower

processing of semantic information could lead to the delayed predictability effect.

4.3. Question 3: Will the function of -eykey as an upcoming role indicator interact with that of *-eykey* as a facilitator in the resolution of event ambiguity?

We hypothesized that taking into account the statistical bias for *-eykey* as a recipient marker, give-type verbs would be processed more easily than receive-type verbs. Also, considering that the presence of a recipient facilitates the anticipation of the occurrence of a theme, the difficulty in the resolution of role ambiguity at the verb position might be much severer in the noncanonical condition in which a recipient with *-eykey* appears after a theme than in the canonical condition in which a recipient with *-eykey* appears before a theme. Our hypotheses were supported as we predicted: We observed the main effect of Role and the marginal interaction between Role and Order. The nature of the interaction was exactly the same as we expected.

In a crosslinguistic point of view, the statistical information of a case marker in Korean is functionally similar to that of verbs in English during sentence comprehension. Both case markers in Korean and verbs in English contribute to increasing the prediction of an upcoming constituent and facilitating the resolution of semantic and structural ambiguity (c.f., Trueswell et al. 1993; Garnsey et al. 1997; Wilson & Garnsey 2009). At a fine-grained level, the frequency of verb-specific senses has significant effect on predicting which constituent would be upcoming in English (Roland & Jurafsky 2002; Hare, McRae, & Elman 2003). Likewise, the sense frequency of case markers also matters in the resolution of role ambiguity in Korean. In short, our results provide additional evidence supporting the claim such that case markers in head-final languages do have a similar function with verbs in head-initial languages (Kamide et al. 2003 and other studies).

4.4. The distinction between arguments and adjuncts: recipients vs. sources

Our last but important question to discuss is what underlies the statistical and processing preference for recipients over sources. Many linguistics have agreed that recipients are considered as arguments while sources are rather counted as adjuncts under the criteria that recipients are obligatorily required by verbs (events encoded by verbs) but sources are optional (Somers 1984; van Valin 2001; Koenig, Mauner, & Bienvenue 2003) and that recipients are co-occurred with particular class of verbs

but sources are free to occur with any verbs (Matthew 1981; Radford 1988; Croft 2001; Koenig et al. 2003). Under the psycholinguistic approach, the psychological reality of such a linguistic distinction between arguments and adjuncts is often tested as processing differences during sentence comprehension. In fact, the argument-vs-adjunct distinction has been a hot topic among a large number of psycholinguistic studies (c.f., Tutinjian & Boland 2008). First, studies of the Construal hypothesis (Frazier & Clifton 1996) have argued that arguments are parsed and attached by structural information, whereas adjuncts are tentatively attached by non-structural information (Frazier & Clifton 1996). In this view, argumenthood drives the parsing mechanism by which a phrase is attached to the developing syntactic representation of a sentence (Frazier & Clifton 1996; Boland & Boehm-Jernigan 1998). Second, by manipulating prepositional phrase-attachment ambiguity (VP-attachment in (8a) vs. NP-attachment in (8b)), a group of studies demonstrated that argument status is crucial in accounting for why argument attachment (8a) is favored and easier to process than adjunct attachment (8b) (Abney 1989; Liversedge, Pickering, Branigan, & van Gompel 1998; Schütze & Gibson 1999; Kennison 2002).

(8) a. The saleswoman tried to interest the man [in a wallet].
    b. The saleswoman tried to interest the man [in his fifties] during the storewide sale.

Third, studies of constraint-based approach (Boland, Tanenhaus, Garnsey, & Carlson 1995) have posited that the semantic information cued by thematic roles and argument structure knowledge could also provide a processing mechanism to facilitate the integration of syntactic, semantic, and pragmatic information (e.g., Carlson & Tanenhaus 1988; Taraban & McClelland 1988; Koenig et al. 2003; Boland 2005). For example, Koenig et al. (2003) observed the faster reading times of *the old king with* when an instrument is semantically obligatory as an argument in the beheading event (9a) than when an instrument is not necessarily required in the killing event (9b). The argument status associated with an instrument at the wh-filler position (i.e., *which sword*) facilitated the integration of direct object plus with preposition (i.e., *the old king with*) faster in the argument condition (9a) than in the adjunct condition (9b).

(9) a. Which sword did the rebels behead [the old king with] during the rebellion?
    b. Which sword did the rebels kill [the old king with] during the rebellion?

Our results from the current studies could extend the existing findings that have been developed predominantly based on English into Korean. In Korean like other languages, arguments are destined to be favored over adjuncts even in processing. The statistical and processing preferences for recipients over sources, triggered by case markers in Korean, is a sort of universal phenomena that exist across languages.

One final note, though, is that the processing benefit for arguments over adjuncts is not always visible. The significant differences between recipients and sources occurred only in the noncanonical condition (i.e., syntactically infrequent structure) but not in canonical condition (i.e., syntactically frequent structure). In Korean, this semantic constraint, argumenthood, might not be powerful enough in itself but it may play an auxiliary role in concert with other syntactic constraints like canonicality. Thus, when the syntactic constraint is satisfied by observing canonicality, the violation of semantic constraint does not elicit severe processing difficulty of adjuncts in comparison to arguments. However, when the syntactic constraint is not satisfied by violating canonicality, the violation of semantic constraint might accelerate the difficulty in processing adjuncts that might result in making the processing benefit of argumenthood visible. It is an interesting question but a new set of researches are required for further discussion.

5. Conclusion

This study aims to examine the processing benefits of frequency information associated with the case marker -*eykey* during the comprehension of Korean declarative sentences. By employing pictures that can be interpreted as either a giving event (-*eykey*$_{REC}$ ⋯ *cwuta* '*give* ⋯ *to*' or a receiving event (-*eykey*$_{SOURCE}$ ⋯ *patta* '*receive* ⋯ *from*'), we found that giving events were preferred to receiving events. Regardless of explicit linguistic cue, giving events are prototypical over receiving events. Moreover, the results from online sentence comprehension revealed that 1) give-type verbs were integrated into sentences faster than receive-type verbs and 2) the differences were much more accelerated when thematic roles are canonically ordered than when they are noncanonical ordered. These results showed that the frequency information associated with -*eykey* facilitated readers' anticipatory processing in the integration of upcoming arguments (as found in Yun and Hong 2014) and weighed readers' preference for giving events in the resolution of role ambiguity. We have discussed the processing difference in giving and receiving event might represent the

argument-adjunct distinction between recipients and sources. However, in order to be clear the issue of the argumenthood between recipients and sources in Korean, additional studies are further required. Observing the processing difficulty in conducting filler-gap studies might be the one to try next.

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