The Effect of Role Predictability and Word Predictability on Sentence Comprehension*

Hongoak Yun and Upyong Hong

Konkuk University
oaktreepark@gmail.com, uphong@konkuk.ac.kr

The purpose of this study was to investigate whether the degree of difficulty in the integration of a word into a sentence could be determined by not only how likely the word would be for a given context but also how likely the thematic role associated with the word would be to occur. For our aim, we used dative sentences in Korean in which three arguments (i.e., agent, recipient, and patient/theme) appeared prior to a sentence-final verb. We manipulated 1) the degree of role predictability corresponding to the third argument by scrambling the internal arguments that occurred after an agent and 2) the predictability of words corresponding to the third arguments that was either highly likely or unlikely for a given context. A self-paced moving window reading with a secondary judgment task was conducted. A linear mixed-effect regressions on the reading times of the words corresponding to the third arguments was run while controlling for the effects of lexical frequencies and lengths on the processing of target words. The results from the model revealed that the words were read faster when they were highly likely for given contexts than when they were unlikely, and importantly, that the words were read faster when the roles associated with the words were strongly expected than when they were weakly expected. Our results showed that both role predictability and word predictability had independent effects on the processing of a word in a sentence. We claim that a processing model should be loaded with at least two components that take into account role predictability as well as word predictability.

Key words: *role predictability, word predictability, expectation-based sentence processing, Korean dative sentences, head-final language*

*This work was supported by the Korea Research Foundation Grant funded by the Korean Government (NRF-2013S1A5A2A03044144). Corresponding author: oaktreepark@gmaill.com (Hongoak Yun). We appreciate anonymous reviewers for their previous comments.

Journal of Cognitive Science 15: 349-390, 2014

1. Introduction

One of characteristics of human sentence comprehension is that readers integrate incoming information into sentences incrementally and immediately without waiting for the moment that they become completely clear where to integrate incoming information into. The maximum case of incrementality and immediate processing is often discussed under the aspects of expectation (Altmann & Mirković, 2009; Elman, 1990; 2009). Namely, sentences are processed even anticipatorily in a way that more expected information is easier to be integrated than less expected information (Ashby, Rayner, & Clifton, 2005; Bicknell, Elman, Hare, McRae, & Kutas, 2010; Ehrlich & Rayner, 1981; Frisson, Rayner, & Pickering, 2005; Staub, 2011; DeLong, Urbach, & Kutas, 2005; Federmeier, Wlotko, De Ochoa-Dewald, & Kutas, 2007; Otten & Van Berkum, 2008; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005).[1] The easier processing of more expected words or phrases is possible, presumably, because more expected words or phrases are more strongly activated than less expected ones which in turn more activated information requires less amount of processing effort in processing (c.f., Hale, 2001; Levy, 2008).

The expectation-based comprehension could take place at multiple levels. For example, given the sentence fragments like (1), readers might have syntactic expectation that they would encounter a direct object in the form of a noun phrase. Or, they might exploit the participant role information encoded by the verb, *eat*, (i.e., who-did-what-to-whom information). Thus, readers might expect to encounter a noun phrase associated with a patient role that refers to what *Jack ate at Burger King*. Readers' expectation might be specific enough to restrict a range of possible role fillers. For instance, role fillers associated with the patient role for the event of Jack's eating

[1] For clarification, we use the terminology 'expectation' or 'predictability' broadly without making specific distinctions. Thus, the effect of expectation refers to the situations on either when particular information is anticipated, prior to its presence, leading to easy processing or when particular information might not be anticipated but easy to integrate into a sentence at the moment of its presence.

should have semantic features like being edible. Finally, given the prior context, the situational knowledge in readers' minds might cue particular words like *hamburgers* or *French fries* as appropriate role filler for the patient role rather than words like *spaghetti* or *sushi rolls.*

(1) At the newly opened Burger King, Jack ate _____.

As illustrated above, although it is not intuitively difficult to follow that readers' expectation could develop at multiple levels, it is not empirically evident yet whether the expectation taking place at each level would actually have its independent effect on sentence comprehension. In this paper, our goal was to explore this issue. In particular, we pinned our primary focus on whether the effect associated with thematic role expectation would be independent from or might be mediated through the effect associated with word expectation on sentence comprehension.

By doing so, we attempt to test two existing claims. First, one of the predominant views in computational modeling has posited that the effect due to the simultaneous activation occurring at multiple domains during online comprehension can be fully mediated by the predictability of word for a given context (i.e., word expectation). Thus, how likely a word would be in a given context could play a role as a perfect mediator in predicting the degree of processing difficulty, as illustrated in Equation (1), (Boston, Hale, Patil, Kliegl, & Vasishth, 2008; Hale, 2001; Levy 2008; Pado, Crocker, & Keller, 2009). Second, there have been controversial discussions on whether or not the use of the argument information has necessarily independent effects on the processing of arguments in sentence comprehension above and beyond the use of the situational knowledge in contexts. One of the views has stressed on the role of the situational knowledge while taking little consideration of the role of the verb's argument information (Bicknell et al., 2010; Elman, 2009; 2012; Matsuki, Chow, Hare, Elman, Scheepers, & McRae, 2011). Note that many previous findings have relied on the sentence processing in head-initial languages like English.

$$\text{Processing difficulty} \propto -\log P(w_i \mid w_{1\ldots i-1}, \text{CONTEXT}) \qquad \text{Equation (1)}$$

In this study, we argued that head-final languages, not head-initial languages, provide appropriate condition to test the effects of role expectation and word expectation during online sentence comprehension. Unlike the predominant claims by previous studies, we proposed to test a hypothesis that both thematic role predictability and word predictability have effects on proc in the integration of words into sentences.

1.1 Issues on Role Predictability vs. Word Predictability

In the psycholinguistic literature, there have been arguments on what exactly facilitates the processing of words or phrases associated with arguments encoded by verbs. On the one hand, studies have showed that the verb's argument information is anticipatorily used to facilitate the processing of words or phrases corresponding to the roles encoded by verbs. Using a visual world paradigm in which participants saw a depicted picture on the computer screen while they were listening to a sentence, Altmann and Kamide (1999) demonstrated that the verb's argument information led to participants' anticipatory looks to the objects that were not auditorily expressed yet. For example, participants looked at a picture depicting a boy sitting on the floor surrounded by objects like a cake, a toy train, a toy ball, and a toy helicopter while they were listening to a sentence. They launched their eyes to the depicted *cake*, prior to the auditory input of *cake,* when they heard *the boy will eat* but not when they heard *the boy will move.* The early looks to *cake* in the eating condition was possible in the sense that *cake* was the only object that the boy could eat among the other objects, while there was no early looks to *cake* in the moving condition because the boy could move all of the other depicted objects. Altmann and Kamide (1999) explained their results in term of participants' immediate use of the verb's argument information, in particular, verb's selectional constraints.

The anticipatory use of the verb's argument information was found in wh-filler gap studies (Boland, Tanenhaus, Garnsey, & Carlson, 1995). Using nonsensical and sensible wh-filler gap sentences, Boland et al. (1995) observed immediate anomaly effects in gap filling before the occurrence of explicit evidence for a gap that fronted wh-fillers were to be filled in. For instance, in sentences like *which prize**|*client does the salesman visit while in the city?,* readers rejected nonsensical sentences, marked with *,

immediately at the verbs. Such an early rejection indicated that the fronted wh-fillers were assigned to be a patient upon the recognition of verbs (for similar results, see also, Garnsey, Tanenhaus, & Chapman, 1989). Note that *which prize* was an inappropriate role filler for the patient role at the verb, *visit*, because *prize* was not the place that people could visit. However, this interpretation is only possible with an assumption that there would be no potential gap occurring for *prize* later on in the downstream of a sentence. Boland et al.'s data showed that readers did not wait for explicit evidence to confirm their assumptions. Instead, readers used the verb's argument information immediately as early as they could. In order to make it clear that the early rejection did not simply indicate active filler-gap phenomenon but the early use of the verb argument information, the authors also demonstrated that an early anomaly effect occurred at one position later (i.e., after verbs but before the explicit evidence for a gap) in dative sentences like *Bob wondered which bachelor*|secretary Ann granted a maternity leave to this month.* Altogether, Boland al. (1995)'s results provided evidence supporting that readers used the verb's argument information anticipatorily and applied it immediately in the integration of arguments into sentences.

The anticipatory use of the verb's argument information was found in the processing of active declarative sentences (Yun, Mauner, & Koenig, 2006; Warren, McConnell & Rayner, 2008). Using sentences like *The aboriginal man jabbed/attacked the angry lion with a spear near its prey,* Yun et al. (2006) demonstrated that the processing of instrument noun phrases (i.e., *a spear*) was more facilitated when the phrases followed the verbs (i.e., *jab*) which obligatorily required an instrument to be used in the events that the verbs encoded than when the instrument phrases followed the verbs (i.e., *attack*) which optionally permitted the use of an instrument in the event that the verbs imposed (Koenig, Mauner, & Bienvenue, 2003). The authors reasoned that the recognition of verbs like *jab* activated strongly the instrument role that might or might not be explicitly expressed in the downstream of the sentences, in contrast to that of verbs like *attack*. The anticipatorily activated instrument information led to the facilitation of the processing of instrument noun phrases when the phrases actually appeared. Simply put, the verb's argument information elicited the expectation of thematic roles and led to the facilitation of the processing of role fillers that

were associated with the already-activated thematic roles.

On the other hand, in contrast to the view emphasizing on the effect of the verb's argument information, there is another view claiming that the situational (world) knowledge embedded in the prior context, not the verb *per se*, is anticipatorily used to facilitate the processing of the upcoming information (Bicknell et al., 2010; Elman, 2009; 2012; Matsuki et al, 2011). In this view, what is important is readers' rapid computation completely based on the situation and events imposed by the context. Thus, in most cases, what is often triggered as a result of readers' computation by using the contextual information is the expectation of a particular word, rather than thematic roles by verbs, that would provide the most appropriate thematic fit to the context. For example, in Bicknell et al. (2010)'s ERP study, the electronic amplitudes corresponding to *the spelling* in *The engineer checked the spelling of his latest report to the editor* went more negatively at the time course of the 400 ms from the onset of the target word than the amplitudes corresponding to *the spelling* in *The journalist checked the spelling of his latest report to the editor*. The N400 indicated that more predictable and good-fitting word *the spelling* following *the journalist checked* was easier (or less surprising) to process than less predictable and poor-fitting word *the spelling* following *the engineer checked* (for similar ERP results, DeLong et al., 2005; Federmeier et al., 2007; Otten & Van Berkum, 2008; Van Berkum et al., 2005; Van Petten & Luca, 2012). Simply said, readers dynamically computed yet-to-be-encountered information based on the contextual information, resulting in the easier integration of predictable words to the representations being constructed during online sentence comprehension.

In the situational knowledge-based view, the effect elicited by the verb's argument information during comprehension might not be necessarily independent beyond the effect elicited by the use of the situational knowledge in context (Hare, Jones, Thomson, Kelly, & McRae, 2009). For example, the results of Altmann and Kamide (1999) could be re-explained without putting an emphasis on the effect of the verb's argument information. In their study, listeners might actively use the situational information from the context; *cake* than any other choices was the most likely role filler to fit best to the situation that *the boy will eat*. In contrast,

cake was no better than the other choices as role filler for the situation that *the boy will move*. That being said, the active use of the situational knowledge might have led to anticipatory looks to *cake* in the eating situation but not in the moving situation. Similarly, the immediate rejections that Boland et al. (1995) observed could also be the function of the active use of the situational knowledge in context. In their example sentence, *which prize*/client did the salesman visit while in the city?*, readers made early rejections at the verb because *prize* was not a good patient role filler for salesman's visiting, whereas *client* was a good role filler for the event. The early rejections could have emerged because of the early use of the contextual information rather than by the use of the verb's argument information, *per se*, (see also Elman, 2009; 2012).

Although the situational knowledge-based approach has attempted to explain many previous findings in its view, the approach has not actually provided convincing evidence that the verb's argument information does not play an independent role in sentence comprehension. Moreover, the claim by the situational-based approach could be challenged by the findings of Boland (2005) in which in her Experiment 1, visual objects corresponding to arguments received more anticipatory looks than visual objects corresponding to adjuncts, regardless of how likely auditory words referring to visual objects were for given contexts. Even unlikely argument objects received anticipatory looks.[2] That is to say, it is not properly investigated yet whether the anticipatory effect by the verb's argument information has additional contribution to sentence comprehension or might be entirely mediated through the anticipatory effect driven by the situational knowledge. For clear understanding, a fair test should be able to examine the effect of word expectation on the integration of words into sentences as a function of whether the expectation of roles corresponding to words is strong or weak.

Having a fully factored design of role and word expectation is not easy, especially, if head-initial languages like English are used. In part, this is related to the fact that when verbs are processed before arguments encoded

[2] We appreciate an anonymous reviewer's comment to point out Boland (2005)'s results for this matter.

by the verbs appear, the recognition of the verbs automatically leads to assigning thematic roles to to-be-encountered words (i.e., role fillers). As a result, thematic roles associated with those words are expected to encounter in any way, regardless of how likely word (i.e., role filler) would appear. For example, in Bicknell et al. (2010)'s study, the thematic role for *the spelling* was assigned by the verb *check* upon the recognition of the verb in both journalist and engineer situations. Thus, at the verb, *check*, the degree of role expectation that a theme would be coming up was equally high in both situations. In contrast, the degree of word expectation became different in a way that *the spelling* was more predictable with the event, *the journalist checked,* but less predictable with the event, *the engineer checked*. Simply put, the effect of word expectation was tested without manipulating the degree of role expectation.

A similar difficulty was found in Boland (2005). She observed the typicality effect that visual objects received more anticipatory looks when they were likely than when they were unlikely during the temporal window of 500-1000ms from the verb onset. Crucially, the effect appeared only when likely and unlikely objects were depicted together in the same visual scenes and the typicality effect occurred regardless of whether auditory words corresponding to those visual objects were arguments or adjuncts (Experiment 2). However, the same typicality effect did not emerge when likely and unlikely objects were presented separately and the anticipatory looks to either likely or unlikely objects always occurred more when auditory words corresponding to visual objects were arguments than when auditory words corresponding to visual objects were adjuncts (Experiment 1). Boland (2005)'s results also suggested that testing word expectation and role expectation independently was not easy in head-initial language, English.

In a nutshell, using head-initial languages, it was feasible to manipulate and test the effect of word expectation in sentence comprehension without considering the issue of role expectation. Or, vice-versa, it was fair to test the effect of role expectation during sentence comprehension without considering the degree of how likely a word would be as a role filler for a given context. However, when the two types of expectation have to be considered, it was not clear and easy to test the effect of each type of

expectation independently. As a solution, we propose to use head-final languages like Korean as a target language to examine our issue. The following section serves to explain how using Korean could be a way to investigate our question.

1.2 Head-final Language as a Target Language

In Korean like many other head-final languages, verbs appear sentence-finally and scrambling constituents is allowed. Notice that verbs in Korean cannot assign thematic roles anticipatorily to the arguments that the verbs encode in a similar way that thematic roles are assigned anticipatorily upon the recognition of verbs in head-initial languages. In what follows, we introduced two studies demonstrating that the anticipatory role assignments in head-final languages could take place by other grammatical constraint such as case markers, although the integration of arguments should be completed later on at verbs.

First, Kamide, Altmann, and Haywood (2003) have showed that the case-marker information in Japanese resulted in eliciting the expectation of upcoming thematic roles. In their visual-world study, listeners looked at a picture describing a waitress was approaching to a customer sitting next to a dining table where a plate of hamburger was put on, while they were listening to sentences like (2a) or (2b). The researchers observed anticipatory looks to depicted objects (e.g., hamburger) referring to patient roles at adverbial positions (e.g., merrily), prior to the explicit mention of the objects, when listeners heard recipients (e.g., customer-DAT) attached with dative case markers (i.e., -*ni*), as in (2a), relative to when listeners heard patients (e.g., customer-ACC) attached with accusative case markers (i.e., -*o*), as in (2b). These results indicated that the expectation of patient roles emerged as a function of the presence of recipients with dative case markers, even prior to the auditory input corresponding to actual patient objects. The authors claimed that in head-final languages, the grammatical function carried by case markers played an important role in generating the expectation of upcoming roles.

(2a) *weitoresu-ga* *kyaku-ni* *tanosigeni* *hanbaagaa-o* *ha- kobu.*
waitress-nom **customer-DAT** ***merrily*** hamburger-acc bring
The waitress will merrily bring the hamburger to the customer.
(2b) *weitoresu-ga* *kyaku-o* *tanosigeni* *karakau.*
waitress-nom **customer-ACC** ***merrily*** tease
The waitress will merrily tease the customer.

Second, similar results were also observed in the processing of Korean dative sentences. Hong, Nam, and Kim (2012) conducted an eye-tracking reading study using sentences like (3a-b). They observed that readers took longer to read the phrases of patients and recipients, in order, such as sentences like (3b) than the phrases of recipients and patients, in order, such as sentences like (3a), in the measurements of second-pass reading times, total gaze durations, and regressions. The results of Hong et al. (2012) and Kamide et al. (2003) have revealed that in the processing of dative sentences, Korean and Japanese language processors seemed to develop the expectation of upcoming patient roles when recipient roles were provided, but not *vice versa*. Thus, owing to the developed expectation, they felt easier to process more expected patient roles occurring after recipient roles than less expected recipient roles occurring after patient roles.

(3a) *Chelswu-nun* *chinkwu-eykey meymo-lul* *cuksi* *namky-ess-ta*
Chelswu-TOP **friend-DAT** **memo-ACC** immediately leave-PAST-DECL
Chelswu left (his) friend a memo.
(3b) *Chelswu-nun* *meymo-lul* *chinkwu-eykey* *cuksi* *namky-ess-ta*
Chelswu-TOP **memo-ACC** **friend-DAT** immediately leave-PAST-DECL
Chelswu left a memo to (his) friend.

In order to make it sure that the degree of role expectation as a function of the presentation order of thematic roles was a significant factor to predict the degree of processing difficulty, Yun, Nam, and Hong (2013) built a probability-based statistical model on Hong et al.'s eye-tracking data. First, using the Hong et al.'s experimental materials in a cloze task, the researchers estimated the degree of role expectation per item by computing the conditional probability of an upcoming role for a given context. The

results of the cloze task revealed that the mean conditional probability that patient/theme roles would occur after the presence of recipients was a way high at .84, whereas the mean conditional probability that recipient roles would occur after patients/themes was extremely low at .04. Yun et al.'s cloze results were consistent to the corpus results by Choi (2007). Using Sejong corpus, she showed that dative sentences where recipients with dative markers appeared before patients with accusative markers (i.e., 86% - 598 out of 712 tokens) occurred more frequently than dative sentences where patients with accusative markers appeared before recipients with dative markers (i.e., 16% - 114 out of 712 tokens). Both Yun et al.'s cloze results and Choi's corpus results confirmed that the order of recipients and patients was canonical in Korean dative sentences.

Second, Yun et al. (2013) built a statistical model by submitting the conditional probability of roles as a predictor on the eye-tracking measurements of Hong et al. (2012) while controlling for the effect of the lengths and lexical frequencies of target words. The results of the model yielded that the conditional probability of thematic roles significantly predicted the processing difficulty that Hong et al.'s participants had in their measurements of second pass reading times, total gaze duration, and regression. That is, the reading times of the phrases (recipient + theme, or theme + recipient) took longer as the degree of the conditional probability of thematic roles increased. Yun et al. (2013) demonstrated that the canonicality effect in the processing of Korean dative sentences could be accounted for under the notion of expectation-based sentence comprehension.

Taken together, studies using head-final languages like Korean and Japanese suggested that the expectation of thematic roles could occur in the sequences of arguments attached with case markers. Importantly, the degree of role expectation by the canonical order had significant effects on sentence comprehension. Phrases of canonically ordered arguments were of strong role expectation and easy to process, whereas, phrases of non-canonically ordered arguments were of weak role expectation and difficult to process. However, there was one lacking point in these studies. They examined the expectation-based sentence processing at the level of thematic roles but have not investigated how the degree of processing difficulty could

be influenced by the expectation of words aside from or in addition to the expectation of roles. This lacking part is what we attempted to investigate in our study. In particular, our goal was to test whether the expectation of thematic roles could play an independent role in predicting the degree of difficulty in the integration of words into sentences, in addition to the expectation of words.

1.3 Research Hypotheses

We hypothesized that role expectation and word expectation, respectively, would have independent effects on sentence comprehension. If our hypothesis were correct, we predicted that it would be the easiest to integrate words into sentences when the words were highly likely for given contexts and the thematic roles associated with the words were strongly expected. However, if words were unlikely and the roles associated with the word were weakly expected, the integration of the words into sentences would be the most difficult. More precisely saying, we proposed to test three hypotheses. First, the words whose roles are strongly expected would be easier to process than the words whose roles are weakly expected. Second, the words that are highly likely for a given context would be easier to process than the words that are unlikely for a given context. Consequently, third, the highly-likely words whose roles are strongly expected would be the easiest to process, whereas the least-likely words whose roles are weakly expected would be the most difficulty to process.

2. Study

We planned to test our hypotheses by examining the processing of Korean dative sentences in which three arguments appeared before sentence-finally occurring verbs. Our study was conducted in an order that is illustrated in Figure 1. First, a cloze task (Taylor, 1953) was run to measure the degree of role expectation. In this measure, we computed the likelihood of the third argument occurring given the consecutive presentation of the two previous arguments. Second, a listing task was run to build the probability distribution of possible words that would fit to the role corresponding to the third argument as role fillers. The results of the listing study were also used

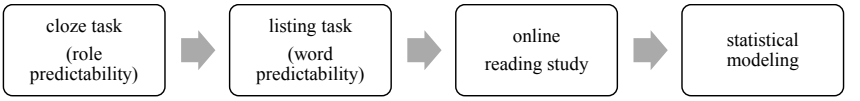

Figure 1. The procedural orders that we stepped through for our study

in order to select experimental items for our online reading study. Third, an online reading study was conducted in order to obtain readers' behavioral responses (i.e., reading times per a presentation unit). Finally, with the probability measures on roles and words being submitted as predictors, a linear mixed-effect regression model was built on the reading times of target words.

2.1 Measuring Role Predictability

The role predictability refers to the likelihood of the third argument occurring given the consecutive presentation of two arguments; that is, how likely patients/themes would occur after the presentation of recipients given sentence fragments like (4a) or how likely recipients might appear following the presentation of patients/themes given sentence fragments like (4b). With respect to the Yun et al. (2014)'s results, we expected that the occurrence of patients/themes after recipients would be highly likely whereas the occurrence of recipients after patients/themes would be unlikely.

69 students attending at Konkuk University took part in the cloze task as a part of class activities. They were asked to complete sentence fragments like (4a-b) with whatever came up into their minds at first. We collected 2578 numbers of completions after removing 24 ungrammatical or irrelevant responses (e.g., vulgar expression). Then, we coded the completions by their semantic categories. The key part in coding was whether the completions produced in sentence fragments like (4a) were noun phrases associated with recipients and whether the sentence completions produced in sentence fragments like (4b) were noun phrases associated with patients or themes.

(4a) *Chelswu-ka* *kyengchal-eykey* _____
Chelswu-NOM policeman-DAT
(4b) *Chelswu-ka* *sinpwunchun-lul* _____
Chelswu-NOM ID card-ACC

As found in Yun et al. (2013), the proportions that patients/themes were produced when agents and recipients were presented like (4a) (M = .73, $S.D.$ = .10) were a way higher than the proportions that recipients were produced when agents and patients/themes were presented like (4b) (M = .03, $S.D.$ = .05). The differences were statistically significant (t (47) = 52.60, p < .000).

2.2 Measuring Word Predictability

The word predictability indicates how likely a specific word associated with relevant roles would be as a role filler for a given context. That is, in sentence fragments like (4a), we were interested in figuring out the probability distribution of possible words as appropriate role fillers corresponding to patient/theme roles. For example, we would like to know which word would be the most or least likely role fillers for the prior contexts like *Chelswu-ga kyengchal-eykey* (Chelswu-NOM policeman-DAT). Likewise, as for the examples like (4b), we would like to know which word would be the most or least likely as a recipient for the given contexts like *Chelswy-ga sinpwuncung-lul* (Chelswu-NOM ID card-ACC).

74 students from Konkuk University took part in this listing task as a part of class activities. Because the goal of this task was to know which word would be possible at how much likelihood under the assumption that a particular role would occur, we specifically asked the participants to produce five possible role fillers in the order that they came up in their minds. Before we measured the conditional probability of each role filler for each context, we first had to make some changes of some completions. First, if the completions were the form of noun phrases, we removed the modifiers of the noun phrases. For example, for the context (4a), if there was a completion like *pilli-n ton-ul* (meaning 'borrowed money' in English), we removed *pillin* (meaning 'borrowed' in English) and kept only *ton-ul* (meaning 'money' in English). Second, we had to change some words into another word that shared similar meaning at most. For example, we changed

ayin (meaning 'lover' in English) or *yenin* (meaning 'love' in English) into *ayin* (meaning 'lover' in English). Altogether, 3.2% completions were changed in total.

We only took into account the first three completions out of the five completions, not only because many participants did not fill up five possible completions but also because many completions listed in the fourth and fifth ranks were not appropriate. In addition, we weighted the completions by the ranks that they were listed. The completion listed in the first rank was weighted most by multiplying its frequency by three and the frequency of the completion listed in the second rank was multiplied by two. Finally, the completion in the third rank was weighted by being multiplied by one. The conditional probability of each completion in each item was estimated based on the weighted frequency that was held by collapsing the weighted frequencies of the top three completions across all participants. The weighted frequency of a particular word, W*k*, in a particular item, I*j*, was divided by the total sum of weighted frequencies across all possible word choices produced in that particular item, as illustrated in Equation (2).

$$\text{Conditional probability of W}k\text{ in Item }j = \frac{\textit{weighted frequency of Wk in Ij}}{\Sigma_{i=1}^{n}\ \textit{weighted frequency of Wk in Ij}} \qquad \text{Equation (2)}$$

Based on the results that we estimated, we selected words that were either highly likely or unlikely in each sentence fragments like either (4a) or (4b). These words were used for our online reading time study. We prepared 24 sets of experimental materials. The conditional probability of target words differed between highly likely (M = .15, SD = .07) and unlikely role fillers (M = .003, SD = .0008) when roles were strongly expected (t (23) = 9.90, p < .001). Similarly, the conditional probability of target words differed between highly likely (M = .17, SD = .08) and unlikely role fillers (M = .001, SD = .0004) when roles were weakly expected (t (23) = 9.18, p < .001). However, the conditional probabilities of highly likely words were equally controlled between when roles were strongly expected and when roles were weakly expected (t (23) = - 1.06, p > .05). Also, the conditional probabilities of unlikely words were equated between when roles were strongly expected

and when roles were weakly expected (t (23) = 1.30, p > .05).

2.3 Obtaining Behavioral Responses

The purpose of the online study was to obtain readers' processing behaviors in the integration of words into sentences. We hypothesized that the processing difficulty of particular words would be affected not only by how likely they were in given contexts but also by how strongly roles associated with the words were expected. In particular, we predicted that the processing of words would be the easiest when they were highly likely and when the roles corresponding to the words were strongly expected. In contrast, the processing of unlikely words would be more difficult when the expectation for the roles associated with them were weak than when it was strong. In order to test our hypotheses, we conducted a 2 Role Predictability (Strong, Weak) x 2 Word Predictability (Highly Likely, Unlikely) experiment.

Participants. 74 Konkuk University students took part in the online reading study. They received 5,000 won to compensate for their participation.

Materials. We used dative sentences like (5a-d). Each sentence consisted of five regions, marked by "|". 24 sets of experimental materials were counterbalanced across four presentation lists, by using a Latin-squared method. The experimental materials differed in two factors. One factor was whether an upcoming thematic role was strongly or weakly expected for given contexts in sentences. The results of our cloze task, reported in the section of measuring role predictability, revealed that the expectation of upcoming roles was strong for the sentences where recipients following agents were presented in sentences like (5a) and (5b), whereas the expectation of upcoming roles was weak for the sentences where patients/themes following agents were presented in sentences like (5c) and (5d). The other factor was whether an upcoming word was highly likely or unlikely role filler for a given context in each role condition. For example, *sinpwuncung-ul* was a highly likely role filler for the event of Example (5a) but an unlikely role filler for the event of Example (5b). Similarly, *kyengchal-eykey* was highly likely as a recipient for the event of Example (5c) than *moteyl-eykey* for the event of Example (5d).

(5a) High Role Expectation, High Word Expectation:
Chelwu-ka | *kyengchal-eykey* | *sinpwuncung-ul* | *tangtanghakey* | *ceysi-hayss-ta*
Chelwu-NOM policeman-DAT ID card-ACC proudly showed
Chelwu showed a policeman (his) ID card proudly.

(5b) High Role Expectation, Low Word Expectation:
Minhoka | *moteyl-eykey* | *sinpwuncung-ul* | *tangtanghakey* | *ceysi-hayss-ta*
Minho-NOM model-DAT ID card-ACC proudly showed
Minho showed a model (his) ID card proudly.

(5c) Low Role Expectation, High Word Expectation:
Hochel-ika | *sinpwuncung-ul* | *kyengchal-eykey* | *tangtanghakey* | *ceysihayssta*
Hochel-NOM ID card-ACC policeman-DAT proudly showed
Hochel showed (his) ID card to a policeman proudly.

(5d) Low Role Expectation, Low Word Expectation:
Wuseng-ika | *sinpwuncung-ul* | *moteyl-eykey* | *tangtanghakey* | *ceysihayssta*
Wuseng-NOM ID card-ACC model-DAT proudly showed
Wuseng showed (his) ID card to a model proudly.

The underlined words that were the third word of each sentence were crucial for our study. While we were making experimental materials, we had to have the same words for the patient position in (5a-b) but different words for the recipient position in (5c-d). Thus, it was extremely important to control other lexical properties associated with target words across conditions. By doing so, we were sure that any differences of processing times could be only due to the differences of predictability degrees but not due to the differences of other properties like lexical frequencies, word lengths, or plausibility ratings.

First, we computed the lexical frequencies of target words using Sejong corpus and log-transformed them. The lexical frequencies of highly likely words did not differ between when roles were strongly expected and when roles were weakly expected (t (23) = - 0.07, p >.05). This was the same when target words were unlikely (t (23) = .41, p >.05). Also, the lexical frequencies of target words did not differ between highly likely and unlikely role fillers when roles were weakly expected (t (23) = 0.5, p >.05).

Second, we also measured the degree of plausibility for target words. Here, we asked participants to rate how plausible it would be for target

words to occur given context from 1 corresponding to being implausible to 7 corresponding to being highly plausible. The means of the plausibility ratings for all target words were above 3 out of 7, suggesting that all items were relatively sensible. Not surprisingly, the differences of the plausibility ratings between highly likely words and unlikely words were significant in both when roles were strongly expected (t (23) = 14.27, p <.001) and when roles were weakly expected (t (23) = 9.95, p <.001). Importantly, however, the plausibility ratings of highly likely words did not differ across the conditions of role expectation (t (23) = .22, p >.05). Neither did the plausibility ratings of unlikely words between when roles were strongly expected and when roles were weakly expected (t (23) = .57, p >.05).

Third, the lengths of target words were equated between highly likely and unlikely words in the condition of weak role expectation (t (23) = .37, p >.05). However, the target words associated with recipients were longer than words associated with patients/themes in both when roles were highly likely (t (23) = - 8.0, p >.001) and weakly expected (t (23) = - 6.97, p >.001). All of the lexical properties of target words are displayed in Table 1. All sets of experimental items are attached in Appendix.

The experimental sentences were pseudo-randomly intermixed with 77 filler sentences. The syntactic structures of these fillers were various. Some filler sentences had the forms of relative clauses, complex sentences, and simple declarative sentences. Because we asked participants to reject sentences at the point that they thought the sentences did not make sense while they were reading sentences, we included non-sensible sentences. Most experimental sentences were likely to be judged sensible. However,

Table 1. The means (standard deviations) of lexical properties associated with target words

	word predictabiltity	Log lexical frequency	Length	Plausibility
Strong Role Predictability	highly likely (e.g., 5a)	2.88 (.58)	3.33 (.48)	6.09 (.51)
	unlikely (e.g., 5b)	2.88 (.58)	3.33 (.48)	3.66 (.88)
Weak Role Predictability	highly likely (e.g., 5c)	2.89 (.91)	4.63 (.58)	6.03 (.74)
	unlikely (e.g., 5d)	2.76 (1.08)	4.63 (.71)	3.49 (1.0)

given the fact that some sentences, especially when target words were unlikely, the low plausibility of those sentences may have elicited some rejections. The fillers were either sensible or nonsensical. 30% of the distractor sentences, which were 25% of the total number of trials, were designed not to make sense. Nonsensical filler sentences were rejected due to diverse reasons. That is, some sentences did not make sense due to semantic reasons. Some sentences had to be rejected due to the violations of grammar, tense, or agreements.

Procedure. A participant-paced moving-window procedure with an incremental judgment task was used. This secondary task was used to increase the sensitivity of the methodology to subtle semantic anticipation effects that might not be observed in a straight reading paradigm (Mauner, Tanenhaus, & Carlson, 1995).[3] Participants first saw a row of dashes and white spaces on a computer monitor. The dashes corresponded to all of the black characters of each stimulus sentence. Stimulus sentences were presented on one line. Participants pressed a "Yes" key marked on a computer keyboard to reveal the first region. This caused the dashes corresponding to this region to be replaced by words. To reveal the next region, participants again pressed the "Yes" key. This second press caused the first region to revert to dashes while revealing the second region. Participants kept pressing the "Yes" key to read each subsequent region as long as the sentence they were reading made sense to them syntactically, semantically, and pragmatically. If at any time a sentence did not make sense, participants pressed a "No" key. The "No" response immediately terminated the current trial and initiated the next trial. "Yes" Reading times and "No" judgments were collected as dependent variables for each region. Before the experiment began, participants were asked to read the instructions that described the task with some examples. After reading the instructions, they completed five sensible trials and five nonsensical practice trials to familiarize themselves with the task and the response keys.

[3] We think that the effect of word predictability is observable only when readers carefully process the semantic information of the context. To confirm our behavioral results, we are conducting follow-up studies using sensitive methods like ERPs and eye-tracking reading rather than a straight-reading task.

Analysis and results. The self-paced reading paradigm with a judgment task yielded two dependent variables: the "No" judgments and the reading times for each segmented region to which participants pressed "Yes". The "No" judgments were used as an online check of the acceptability of the target words. Given the results of the plausibility norming, we predicted that there would be few "No" judgments. As a result, the main dependent variable of interest was the "Yes" reading times measured at each region.

No judgments. For each participant, at each region of a stimulus sentence the adjusted percentage of "No" judgments were tabulated using the procedure outlined in Boland, Tanenhaus, and Garnsey (1990). Briefly, adjusted percentages for each sentence trial were computed by dividing the number of "No" judgments at a given region by the number of remaining opportunities that a participant had for responding "No" in that sentence. Mean adjusted percentages were then computed within condition and region for each participant. Descriptively, the cumulative raw percentages of "No" responses across participants for target words were under 2% at the target word region and no more than 12% at the final region, suggesting that experimental sentences were highly acceptable with respect to grammaticality and plausibility in both conditions. Importantly, the number of "No" judgments did not differ across conditions. We did not compare this difference statistically because the number of "No" responses was low, making the results of statistical analyses unlikely to be meaningful.

Yes reading times. Prior to the analysis of "Yes" reading times of the target words, data were filtered for outliers in two steps. First, reading times greater than 3,000 milliseconds were omitted resulting in the removal of only 4 scores out of the total number of scores. We removed these extreme RTs because including them might have led us to inflated estimation of the data. Second, reading times that were 2.5 standard deviations above or below a participant's mean reading times in a specific region were replaced with that mean plus or minus the 2.5 standard deviation boundary value. Figure 2 displays the means of reading times for target words in each condition. To be brief, our hypotheses were supported; unlikely words whose roles were weakly expected were the most difficult to process (i.e., the slowest RTs), whereas highly likely words whose roles were strongly

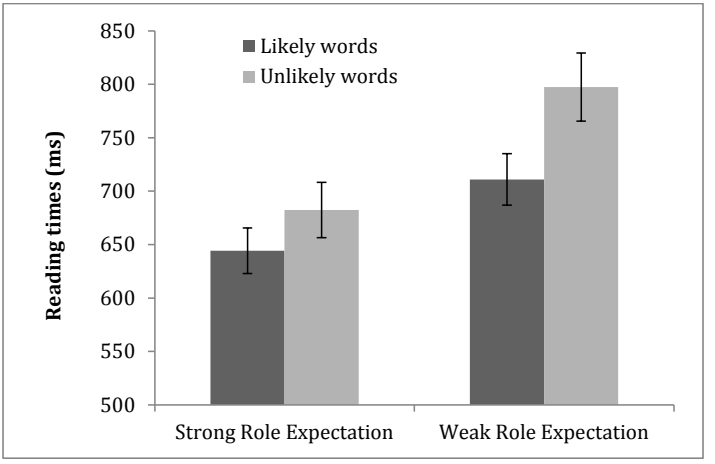

Figure 2. The means of Yes RTs (*ms*) of target words across conditions

expected were the easiest to read (i.e., the fastest RTs). [4]

One of the problems was that the lengths of target words were not equally controlled across all conditions. Especially, the lengths of target words were longer when their roles corresponded to recipients than when they did patients. This was basically because the case marker for recipients (i.e., *-eykey*) had one syllable longer than the case marker for patients (i.e., *-ul*). Unfortunately, ANOVA was not appropriate in testing the effect of role expectation associated with target words while taking into account word length. Instead of using ANOVA, we used a linear mixed-effect regression analysis for our purpose while the variances of participants and items were taken into account. We reported the results of the linear mixed-effect regression model in the following section.

2.4 Establishing a Linear Mixed-effect Regression

In order to examine the effect associated with the expectation of roles and words while the effects of lexical frequency and length were controlled

[4] Using the same methods, we also analyzed the RTs of the region immediately after the target words and found no effect at the post-critical region.

for, a linear mixed effect regression was conducted. Our analyses were conducted using the R statistics program (version 3.0.2, R Development Core Team, 2013) and languageR libraries (version 1.4.1, Baayen, 2013).

"Yes" reading times of target words that participants judged to make sense were submitted to a linear mixed-effect regression. 4 reading times that were greater than 3,000 milliseconds were omitted. In order to model the "Yes" reading times of target words, we initially used four fixed factors: Word Predictability, Role Predictability, Length, and Frequency. Word Predictability referred to how likely target words were in their given sentence contexts. Word predictability was their cloze conditional probabilities, as we reported above in Section 2.2. Role Predictability referred to how predictable thematic roles associated with target words were in given sentence contexts, as indicated in Section 2.1. Because we found high correlations between Role Predictability and Length ($r > -.7$), we residualized Role Predictability over Length. Length corresponded to the number of letters in target words. This factor was included to control for the effect associated with readers' perceptual efforts on length in sentence processing (Juhasz & Rayner, 2003). Finally, Frequency was lexical frequencies of the target words. It was initially included to control for the fact that reading times for words are inversely proportional to their lexical frequencies, even in neutral contexts (Juhasz & Rayner, 2003; Kliegl et al., 2004; Raney & Rayner, 1995). We used log-transformed lexical frequencies. Because the 3 or 4-way interactions among fixed factors and the interactions with lengths and lexical frequencies were not of our interest, we did not include them in our models when we attempted to find the best fit of the model. Participant and items were included as random factors. We simplified the initial fully crossed and fully specified random effect structure to yield the maximally justified random structure, as discussed by Jager (2009) and Baayen, Davison, and Bates (2008). An initial fit for the random intercept and slopes model performed. Approximately 3% out of the overall data were removed from the final model by Baayen's (2008) outlier removal procedure. Specifically, reading times with a standardized residual at a distance greater than 2.5 standard deviations from zero were removed. After removing non-significant variables (i.e., interaction between Word Predictability and Role Predictability, and lexical frequency), the

Table 2. Results from a linear mixed effect regression which tested the reading times of target constituents

	Estimated (ß)	S.E.	*t*-value
Intercept	652.68	19.61	33.28
Word Predictability	- 176.49 (- 16.69)	63.52	- 2.78*
Role Predictability (residual)	- 25.41 (- 9.85)	11.73	- 2.17*
Length	58.52 (43.32)	5.62	10.41*

Note. All predictors were centered. Role predictability was residualized for length. Parenthetical values next to the coefficients are standardized coefficients from an alternate version of the model with standardized predictors. If the absolute *t*-value of a fixed factor was over 2, the effect of the factor was considered to be significant at $\alpha < .05$, marked with * (Gelman & Hill, 2007).

results of our best-fitting model are displayed in Table 2. The correlations of all variables in our model were under .1.

Length. The effect of Length was significant, indicating that longer words took longer to read (Juhasz & Rayner, 2003). The results of our standardized model showed that the increase of one standard deviation of lengths led to increase about 43 *ms* of reading target words.

Word Predictability. Words of high cloze probability were read faster than those of low cloze probability. For example, *sinpwuncung-ul* in the context of *Chelwu-ka kyengchal-eykey* (Chelswu-NOM policeman-DAT ID card-ACC) was read faster than *sinpwuncung-ul* in the context of *Chelwu-ka moteyl-eykey* (Chelswu-NOM model-DAT ID card-ACC). The increase of one standard deviation of cloze probability led to the reduction of about 17 ms of reading target words.

Role Predictability. The most important result of our study was whether the effect of role predictability was additionally significant above and beyond the effect of word predictability. The target words were read faster when they followed recipients marked with *-eykey* than when they appeared after patients with *-ul* or *-lul*. Words whose roles were of high cloze probability were read faster than words whose roles were of low cloze probability. For example, *sinpwuncung-ul* in the context of *Chelwu-ka kyengchal-eykey* (Chelswu-NOM policeman-DAT ID card-ACC) was easier to process than *kyengchal-eykey* in the context of *Chelwu-ka*

sinpwuncung-ul (Chelswu-NOM ID card-ACC policeman-DAT). The increase of one standard deviation of Role Predictability led to the reduction of about 10 ms of reading target words after the length information that were correlated with role probability was taken out and while the length effect itself was controlled for.[5]

In addition, the significant effect of role predictability was also investigated by testing whether or not a model fit was improved. Two models were conducted. The first model included role filler predictability and length (Log-likelihood = - 23057; AIC = 46135; BIC = 46196) and the second model included role predictability in addition to the existing predictors (Log-likelihood = - 23051; AIC = 46130; BIC = 46216). A log-likelihood test revealed that the second model provided significantly better fit than the first model (χ^2 (4) = 21.74, $p < .01$). Clearly, including role predictability predictor accounted for readers' behaviors better than excluding role predictability predictor.

3. General Discussion

In this study, we raised a question about whether the integration of words into sentences would be easy not only when the words were highly likely for a given context but also when the roles associated with the words were strongly expected. Our hypothesis was that role expectation and word expectation would have independent effects on sentence comprehension. The results that we observed supported our hypotheses. First, the words that were highly likely for given contexts were easier to process than the words that were unlikely for given contexts. For example, *sinpuncung-ul*

[5] We residualized role predictability over length to keep the correlation of these variables in the model (under .1), so that we could be safe from any potential concern of multicolinearity. A reviewer expressed his (her) worry about the fact that we used residualized role predictability for a non-necessary reason (Wurm & Fisicaro, 2014). Crucially, even when we did not residualize the variable, we observed that the effect of role predictability was still significant (coefficient = -23.99, S.E. = 10.74, t = -2.23) while the other predictors had significant effects. As a final model, we reported the results of the model with residualized role predictability, as shown in Table 2.

(ID card) was read faster in the plausible context, *Chelswu-ka kyengchal-eykey* (Chelswu-NOM policeman-DAT) than in the less plausible context, *Chelswu-ka moteyl-eykey* (Chelswu-NOM model-DAT). Second, the words whose roles were strongly expected were easier to process than the words whose roles were weakly expected, regardless of whether the words were highly likely or unlikely for given contexts. For example, *sinpuncung-ul* (ID card) following *Chelswu-ka kyengchal-eykey* (Chelswu-NOM policeman-DAT) or *Chelswu-ka moteyl-eykey* (Chelswu-NOM model-DAT) was read faster than *kyengchal-eykey* (policeman) or *moteyl-eykey* (model) following *Chelswu-ka sinpuncung-ul* (Chelswu-NOM ID card-ACC). Consequently, as we hypothesized, the highly likely words whose roles were strongly expected were the easiest to process, whereas the least likely words whose roles were weakly expected were the most difficulty to process. In short, we successfully demonstrated that role expectation had an additional effect on sentence comprehension in concert with word expectation.

Our results suggest that readers actively and anticipatorily exploited the argument information carried by case markers as well as the situational knowledge in context during online sentence comprehension. When recipients with dative case markers were presented after agents, readers seemed to be ready to encounter theme or patient roles coming next. Recall that the conditional probability that a theme or patient role would occur after the consecutive presentation of an agent and a recipient was up to .74. Given that high role probability, readers' processing difficulty would not be greatly influenced by how likely theme role would occur. Yet, their processing difficulty would be the function of how good a word would be as a role filler for the upcoming theme or patient role. That is, upon the recognition of recipients, which role would be coming up might be activated and thus the pre-activated role information might have led to the facilitation of processing words associated with the roles. Finally, due to the use of the situational knowledge in context, words referring to likely role fillers were easier to process than words corresponding to unlikely role filler.

On the contrary, when theme or patient arguments with accusative case markers were presented after agents, accounting for readers' processing difficulty was not that simple. In this case, readers did not expect to see

a recipient role appearing after a theme or patient role. The mean of role predictability was only .03. Instead, readers highly expected to see a sentence-final verb at .9, although the sentence would be grammatical even if they encounter a recipient role instead of a verb. In this condition, readers were almost sure that the sentence fragment would be completed with sentence-final verbs. However, contrary to their strong expectation, a word corresponding to recipient roles actually appeared. On encountering recipients, readers might have been greatly surprised and had difficulty in generating a new slot for such an unexpected role. In part, due to the use of the situational knowledge in context, they might have felt easier with highly likely words than with unlikely words. Altogether, our results suggested that both the argument information by case markers and the situational knowledge in context were effectively used in facilitating the integration of upcoming words into sentences.

It is of interest to note that unlikely words whose roles were strongly expected were read faster than likely words whose roles were weakly expected. We think that the argument information carried by case markers might play a role in constituting a slot for an upcoming role and then the situational knowledge in context cues which word would be more or less likely role filler for the role slot. Presumably, which word would be coming up or the degree of thematic fit of a word to context could have an effect on comprehension only after readers are assured of which thematic role would be appearing for the upcoming position.

Our results posed problems to the processing mechanism claimed by the situational knowledge-based approach. As mentioned earlier, the approach has argued that the processing difficulty of a word in a sentence is determined as a function of the degree to which the word has a thematic fit to the context. In this approach, our results that likely words were easier to process than unlikely words made sense in that likely words provided better thematic fit to the context than unlikely words did. However, recall that we also successfully equated the ratings of plausibility for target words between the conditions of whether or not roles were expected. Thus, in this view, we should not observe the difference of processing difficulty as a function of the degree of role expectation. Nonetheless, the main effect of role expectation yielded that words whose roles were strongly

expected were processed faster than words whose roles were weakly expected. Contrary to the claim of the situation-based approach, the lexical or grammatical information carried by case markers that in particular corresponded to the argument information played its own role in sentence processing, independently from the situational knowledge in context.

Subsequently, our results drew our attention to issues on what to be considered in modeling readers' behaviors. In particular, our data cause some difficulty to computational approaches like the surprisal model. As mentioned earlier, the surprisal model basically claim that processing difficulty of a word during online sentence comprehension is entirely mediated by the predictability of a word given a context (Boston et al., 2008; Hale, 2001; Levy 2008; Pado et al., 2009). In this view, our data is not completely wrong but it is not completely correct either. First, the surprisal model predicts our finding of word predictability such that more likely words were easier to process than less likely words. Second, the surprisal model also predicts our finding of role predictability such that words whose roles were more strongly expected were easier to process than words whose roles were weakly expected. Third, however, when both role predictability and word predictability were taken into account, the surprisal model does not predict that each factor has an independent effect, respectively. Instead, the model predicts that the effect of word predictability should subsume that of role predictability. Our results clearly show that word predictability alone was not accurate enough to account for the degree of processing difficulty in the integration of a word into a sentence.

In fact, we are not the only group who argued against the surprisal model. Roland, Yun, Mauner, and Koenig (2012) showed that semantic similarity between a target word and other possible words that could occur had an additional effect above and beyond the predictability of a word in the estimation of processing difficulty. In addition to the effect of word predictability, Roland and his colleague found that readers felt easier to process words by the degree to which the words were semantically similar to the other possible word choices that could have occurred instead of the target words. Furthermore, Yun, Mauner, Koenig, and Roland (2012) demonstrated that the effect of semantic similarity emerged conditionally only when the contextual information did not strongly constrain the set

of possible words. The processing of words could be facilitated by the degree of shared semantic featural information between the words and the other possible words that could occur instead, only when the contexts did not provide strongly constraining information to what particular word should be. The modulated effect of semantic similarity as a function of the degree of the contextual constraint suggests that the unique role of word predictability is possible only when context provides particular expectation for particular words.

Taken together, we propose that a better processing model would allow multiple components that are supposed to reflect the information activation occurring across multiple levels. In particular, given our results, we claim that a processing model should have at least two components: One component takes into consideration the effect elicited by the use of the argument information at the thematic role level and the other component does for the effect by the situational knowledge in context at the word level (for similar claim, see Kuperberg, 2007). Alternatively, a processing model might allow different processes to operate in a single component instead of having different components: One process might be effective for word (lexical) processing and the other should consider the processing of how words are integrated into sentences (for a similar claim, see Brouwer, Fitz, & Hoeks, 2012). We will keep studying the modeling issue for our future studies.

4. Conclusion

The goal of our study was to demonstrate the expectation-based sentence comprehension that was effective across multiple levels, by using head-final language, Korean. Our results revealed that readers' processing difficulty was significantly influenced by readers' expectation for which role would be coming up as well as which word would appear as an appropriate role filler for a given context. Readers actively and anticipatorily used both the argument information conveyed by case markers and the situational knowledge in context during online processing. We claimed that a single-outlet processing model is not accurate enough, rather, a processing model should be able to take into account the information activated across multiple

levels.

References

Altmann, G. T. M. & Kamide, Yuki. 1999. Incremental interpretation at verbs: restricting the domain of subsequent reference. *Cognition*, 73, 247–264.

Altmann, G. T. M. & Mirković, J. 2009. Incrementality and prediction in human sentence processing. *Cognitive Science*, 33, 583-609.

Ashby, J., Rayner, K., & Clifton, C., Jr. 2005. Eye movements of highly skilled and average readers: Differential effects of frequency and predictability. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology*, 58A(6), 1065–1086.

Baayen, R. H. 2008. *Analyzing Linguistic Data: A Practical Introduction to Statistics Using R*. Cambridge University Press.

Baayen, R. H., Davidson, D. J., & Bates, D. M. 2008. Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*, 59(4), 390–412.

Baayen, R. H. 2013. LanguageR: Data sets and functions with "Analyzing Linguistic Data: A practical introduction to statistics". R package version 3.0. http://CRAN.R-project.org/package=languageR.

Bicknell,K., Elman, J. L., Hare, M., McRae, K., & Kutas, M. 2010. Effects of event knowledge in processing verbal arguments. *Journal of Memory and Language*, 63, 489–505.

Boland, J. E., Tanenhaus, M. K., & Garnsey, S. M. 1990. Evidence for the immediate use of verb control information in sentence processing. *Journal of Memory and Language*, 29(4), 413–432.

Boland,J. E., Tanenhaus, M. K., Garnsey, S., & Carlson, G. 1995. Verb argument structure in parsing and interpretation: Evidence from WH-questions. *Journal of Memory and Language*, 34, 774–806.

Boston, M. F., Hale, J., Kliegl, R., Patil, U., & Vasishth, S. 2008. Parsing costs as predictors of reading difficulty: An evaluation using the Potsdam Sentence Corpus. *Journal of Eye Movement Research*, 2(1), 1, 1–12.

Choi, Hyewon. 2007. Length and order: A corpus study of Korean dative – accusative construction. *Korean Discourse and Cognition* 14, 207-227.

DeLong, K. A., Urbach, T. P., & Kutas, M. 2005. Probabilistic word pre-activation during language comprehension inferred from electrical brain activity. *Nature Neuroscience*, 8, 1117–1121.

Elman, J. L. 1990. Finding Structure in Time. *Cognitive Science*, 14, 179–211.

Elman, J. L. 2009. On the meaning of words and dinosaur bones: Lexical

knowledge without a lexicon. *Cognitive Science*, 33, 547–582.
Elman, J.L. 2012. Lexical knowledge with a lexicon?. *The Mental Lexicon*, 60, 1–33.
Ehrlich, S. F., & Rayner, K. 1981. Contextual effects on word perception and eye movements during reading. *Journal of Verbal Learning and Verbal Behavior,* 20, 641–655.
Federmeier, K. D., Wlotko, E. W., De Ochoa-Dewald, E., & Kutas, M. 2007. Multiple effects of sentential constraint on word processing. *Brain Research,* 1146, 75-84.
Frisson, S., Rayner, K., & Pickering, M. 2005. Effects of contextual predictability and transitional probability on eye movements during reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31(5), 862–877.
Garnsey, S. M., Tanenhaus, M. K., & Chapman, R. M. 1989. Evoked potentials and the study of sentence comprehension. *Journal of Psycholinguistic Research,* 18, 51–60.
Gelman, A., & Hill, J. 2007. *Data analysis using regression and multilevel/ hierarchical models*. New York: Cambridge University Press.
Hale, J. 2001. A probabilistic Earley parser as a psycholinguistic model. In *Proceedings of the Second Meeting of the North American Chapter of the Association for Computational Linguistics* (pp. 1–8). Pittsburgh, PA: Carnegie Mellon University.
Hare, M., Jones, M., Thomson, C., Kelly, S., & McRae, K. 2009. Activating event knowledge. *Cognition*, 111, 151–167.
Hong, Upyong, Nam, Yunju, & Kim, Hyunjeong. 2012. Long before short preference in online sentence comprehension, Poster presented at the annual meeting of 2012 Amlab.
Juhasz, B. J., & Rayner, K. 2003. Investigating the Effects of a Set of Intercorrelated Variables on Eye Fixation Durations in Reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 29(6), 1312–1318.
Kamide,Yuki, Altmann, G. T. M., & Haywood, S. L. 2003. The time-course of prediction in incremental sentence processing: evidence from anticipatory eye movements. *Journal of Memory and Language*, 49, 133–159.
Kliegl, R., Grabner, E., Rolfs, M., & Engbert, R. 2004. Length, frequency, and predictability effects of words on eye movements in reading. *European Journal of Cognitive Psychology*, 16(1-2), 262–284.
Koenig, J.-P., Mauner, G., & Bienvenue, B. 2003. Arguments for adjuncts. *Cognition*, 89, 67–103.
Kuperberg, G. 2007. Neural mechanisms of language comprehension: Challenges to syntax. *Brain Research*, 1146, 23–49.
Levy, R. 2008. Expectation-based syntactic comprehension. *Cognition*, 106, 1126–1177.

Matsuki, Kanzynage, Chow, T., Hare, M., Elman,J.L., Scheepers, C., & McRae, K. 2011. Event-based plausibility immediately influences on-line language comprehension. *Journal of Experimental Psychology: Learning, Memory and Cognition,* 37, 913–934.

Mauner, G., Tanenhaus, M. K., & Carlson, G. N. 1995. Implicit arguments in sentence processing. *Journal of Memory and Language*, 34(3), 357–382.

Otten, M., & Van Berkum, J. J. A. 2008. Discourse-based lexical anticipation: prediction or priming? *Discourse Processes*, 45(6), 464–496.

Padó, U., Crocker, M., & Keller, F. 2009. A Probabilistic Model of Semantic Plausibility in Sentence Processing. *Cognitive Science*, 33(5), 794–838.

R Core Team 2013. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Raney, G. E., & Rayner, K. 1995. Word frequency effects and eye movements during two readings of a text. *Canadian Journal of Experimental Psychology/ Revue canadienne de psychologie expérimentale*, 49(2), 151–173.

Roland, D., Yun, Hongoak, Koenig, J.-P., & Mauner, G. 2012. Semantic similarity, predictability, and models of sentence processing. *Cognition*, 122, 267–279.

Staub, A. 2011. The effect of lexical predictability on distributions of eye fixation durations. *Psychonomic Bulletin & Review*, 18, 371–376.

Taylor, W. L. 1953. "Cloze procedure": A new tool for measuring readability. *Journalism Quarterly*, 30, 415–433.

Van Berkum, J. J. A., Brown, C. M., Zwitserlood, P., Kooijman, V., & Hagoort, P. 2005. Anticipating upcoming words in discourse: Evidence from ERPs and reading times. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31, 443–467.

Van Petten, C. & Luka, B. 2012. Prediction during language comprehension: Benefits, costs, and ERP components. *International Journal of Psychophysiology*, 83, 176–190.

Warren, T., McConnell, K. & Rayner, R. 2008. Effect of context on eye movements when reading about possible and impossible events. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34(4), 1001–1010.

Yun, Hongoak, Mauner, G., & Koenig, J-P. 2006. Anticipation vs. integration of syntactically infrequent but semantically obligatory arguments. Poster presented at the 19th Annual CUNY Conference on Human Sentence Processing, CUNY, NY.

Yun, Hongoak, Mauner, G., Roland, D., & Koenig, J.-P. 2012. The Effect of Semantic Similarity is a Function of Contextual Constraint. In N. Miyake, D. Peebles, & R. P. Cooper (Eds.), *Proceedings of the 34th Annual Conference of the Cognitive Science Society* (p.1191–1196). Austin, TX: Cognitive Science

Society.
Yun, Hongoak, Nam, Yunju, & Hong, Upyong. 2013. Argument order as an expectation trigger in Korean, Poster presented at the 35th annual conference of the Cognitive Science Society, Berlin, Germany.

Appendix

Experimental stimuli for the reading study. In each set, the third NPs of sentences (a) are of high role predictability and high word predictability, the third NPs of sentences (b) are of high role predictability and low word predictability, the third NPs of sentences (c) are of low role predictability and high word predictability, and the third NPs of sentences (d) are of low role predictability and low word predictability.

1a. Chelwu-ka kyengchal-eykey sinpwuncung-ul tangtanghakey ceysi-hayss-ta
Chelwu-NOM policeman-DAT ID card-ACC proudly showed
Chelwu proudly showed a policeman (his) ID card.
1b. Minho-ka moteyl-eykey sinpwuncung-ul tangtanghakey ceysi-hayss-ta
Mino-NOM model-DAT ID card-ACC proudly showed
Minho proudly showed a model (his) ID card.
1c. Hochel-ika sinpwuncung-ul kyengchal-eykey tangtanghakey ceysi-hayss-ta
Hochel-NOM ID card-ACC policeman-DAT proudly showed
Hochel proudly showed (his) ID card to a policeman.
1d. Wuseng-ika sinpwuncung-ul moteyl-eykey tangtanghakey ceysi-hayss-ta
Wuseng-NOM ID card-ACC model-DAT proudly showed
Wuseng proudly showed (his) ID card to a model.
2a. Swuyeng-ika emeni-eykey senmwul-ul kikkei sacwu-ess-ta
Swuyeng-NOM mother-DAT present-ACC willingly bought
Swuyeng willingly bought (her) mother a present.
2b. Swucin-ika miyongsa-eykey senmwul-ul kikkei sacwu-ess-ta
Swucin-NOM hair designer-DAT present-ACC willingly bought
Swucin willingly bought (her) hair designer a present.
2c. Cinyeng-ika senmwul-ul ayin-eykey kikkei sacwu-ess-ta
Cinyeng-NOM present-ACC lover-DAT willingly bought
Cinyeng willingly bought a present to (her) lover.
2d. Cina-ka senmwul-ul miyongsa-eykey kikkei sacwu-ess-ta

Cina-NOM present-ACC hair designer-DAT willingly bought
Cina willingly bought a present to (her) hair designer.

3a. Tongsik-ika yenkwuwen-eykey calyo-lul hunkhwayhi nemkyecwu-ess-ta
Tonsik-NOM researcher-DAT documents-ACC without hesitance passed
Tonsik passed a researcher documents without hesitance.

3b. Tongho-ka cihwica-eykey calyo-lul hunkhwayhi nemkyecwu-ess-ta
Tongho-NOM conductor-DAT documents-ACC without hesitance passed
Tongho passed (musical) conductor documents without hesitance.

3c. Hotong-ika calyo-lul kyoswunim-eykey hunkhwayhi nemkyecwu-ess-ta
Hotong-NOM documents-ACC professor-DAT without hesitance passed
Hotong passed documents to a professor without hesitance.

3d. Hosik-ika calyo-lul cihwica-eykey hunkhwayhi nemkyecwu-ess-ta
Hosik-NOM documents-ACC conductor-DAT without hesitance passed
Hosik passed documents to a (musical) conductor without hesitance.

4a. Cengmi-ka cihwica-eykey pakswu-lul himchakey chyecwu-ess-ta
Cengmi-NOM conductor-DAT big hands-ACC vigorously gave
Cengmi gave a (musical) conductor big hands vigorously.

4b. Cenga-ka yenkwuwen-eykey pakswu-lul himchakey chyecwu-ess-ta
Cenga-NOM researcher-DAT big hands-ACC vigorously gave
Cenga gave a researcher big hands vigorously.

4c. Miceng-ika pakswu-lul palphyoca-eykey himchakey chyecwu-ess-ta
Miceng-NOM big hands-ACC presenter-DAT vigorously gave
Miceng gave big hands to a presenter vigorously.

4d. Misen-ika pakswu-lul yenkwuwen-eykey himchakey chyecwu-ess-ta
Misen-NOM big hands-ACC researcher-DAT vigorously gave
Misen gave big hands to a researcher vigorously.

5a. Nayeng-ika kyelhonepch-eykey tuleysu-lul aswiwehamye tollyecwu-ess-ta
Nayeng-NOM marriage consultant-DAT dress-ACC unwillingly

returned
Nayeng returned a marriage consultant a dress unwillingly.

5b. Seyeng-ika hakwenkangsa-eykey tuleysu-lul aswiwehamye tollyecwu-ess-ta
Seyeng-NOM instructor-DAT dress-ACC unwillingly returned
Seyeng returned an instructor a dress unwillingly.

5c. Mwunyeng-ika tuleysu-lul yetongsayng-eykey aswiwehamye tollyecwu-ess-ta
Mwunyeng dress-ACC younger sister-DAT unwillingly returned
Mwunyeg returned a dress to younger sister unwillingly.

5d. Soyeng-ika tuleysu-lul hakwenkangsa-eykey aswiwehamye tollyecwu-ess-ta
Soyeng-NOM dress-ACC instructor-DAT unwillingly returned
Soyeng returned a dress to an instructor unwilling.

6a. Caywen-ika tamtangkyoswu-eykey swukcey-lul twinuckey ceychwul-hayss-ta
Caywen-NOM advisor-DAT assignment-ACC late submitted
Caywen submitted (her) advisor (her) assignment late.

6b. Hongwen-ika wuntongsenswu-eykey swukcey-lul twinuckey ceychwul-hayss-ta
Hongwen-NOM sportsman-DAT assignment-ACC late submitted
Hongwen submitted a sportsman (his) assignment late.

6c. Ciwen-ika swukceylul tamtangkyoswu-eykey twinuckey ceychwul-hayss-ta
Ciwen-NOM assignment-ACC advisor-DAT late submitted
Ciwen submitted (his) assignment to (his) advisor late.

6d. Sangwen-ika swukceylul wuntongsenswu-eykey twinuckey ceychwul-hayss-ta
Sangwen assignment-ACC sportsman-DAT late submitted
Sangwen sumitted his assignment to a sportsman late.

7a. Unswu-ka wuntongsenswu-eykey sayngswu-lul caypssakey cental-hayss-ta
Unswu-NOM sportsman-DAT water-ACC quickly passed
Unswu passed a sportsman water quickly.

7b. Unyeng-ika tamtangkyoswu-eykey sayngswu-lul caypssakey cental-

hayss-ta
Unyeng-NOM advisor-DAT water-ACC quickly passed
Unyeng passed an advisor water quickly.

7c. Yengca-ka sayngswu-lul emeni-eykey caypssakey cental-hayss-ta
Yengca-NOM water-ACC sister-DAT quickly passed
Yengca passed water (her) sister quickly

7d. Hyeyyeng-ika sayngswu-lul tamtang-eykey caypssakey cental-hayss-ta
Hyeyeng-NOM water-ACC advisor-DAT quickly passed
Hyeyyeng passed water an advisor quickly

8a. Senhyen-ika cikwen-eykey pwulman-ul kechimepsi tholo-hayss-ta
Senhyen-NOM worker-DAT complaint-ACC straightly spelled out
Senhyen spelled out a worker complaint straightly.

8b. Hyense-ka ai-eykey pwulman-ul kechimepsi tholo-hayss-ta
Hyense-NOM worker-DAT complaint-ACC straightly spelled out
Hyense spelled out a worker complaint straightly.

8c. Senmi-ka pwulman-ul emma-eykey kechimepsi tholo-hayss-ta
Senmi-NOM complaint-ACC mom-DAT straightly spelled out
Senmi spelled out complaint to (her) mom straightly spelled out.

8d. Hyenm-ika pwulman-ul ai-eykey kechimepsi tholo-hayss-ta
Hyenm-NOM complaint-ACC child-DAT straightly spelled out
Hyenm spelled out complaint to a child straightly spelled out.

9a. Senyeng-ika ai-eykey sathang-ul hanalum kipwuhayssta
Senyeng-NOM child-DAT candies-ACC an armful of donated
Senyen donated a child an armful of candies.

9b. Senhuy-ka cikwen-eykey sathang-ul hanalum kipwuhayssta
Senhuy-NOM worker-DAT candies-ACC an armful of donated
Senhuy donated a worker an armful of candies.

9c. Huysen-ika sathang-ul aieykey sathang-ul hanalum kipwuhayssta
Huysen-NOM candies-ACC child-DAT an armful of donated
Huysen donated an armful of candies to a child.

9d. Huyju-ka saththang-ul cikwen-eykey hanalum kipwuhayssta
Huyju-NOM candies-ACC worker-DAT an armful of donated
Huyju donated an armful of candies to a worker.

10a. Kangwu-ka chengnyen-eykey kangyen-ul kanglyekhi chwuchen-hayss-ta

Kangwu-NOM young man-DAT lecture-ACC strongly recommended
Kangwu strongly recommend a young man a lecture.

10b. Kyusik-ika pise-eykey kangyen-ul kanglyekhi chwuchen-hayss-ta
Kyusik-NOM secretary-DAT lecture-ACC strongly recommended
Kyusik strongly recommend a secretary a lecture.

10c. Wusik-ika kangyen-ul chengcwung-eykey kanglyekhi chwuchen-hayss-ta
Wusik-NOM lecture-ACC young man-DAT strongly recommended
Wusik strongly recommend a lecture to a young man.

10d. Kangho-ka kangyen-ul pise-eykey kanglyekhi chwuchen-hayss-ta
Kangho-NOM lecture-ACC secretary-DAT strongly recommended
Kangho strongly recommend a lecture to a secretary.

11a. Unmi-ka phyencipca-eykey phail-ul yelechalyey pon-ayss-ta
Unmi-NOM editor-DAT file-ACC many times sent
Unmi sent an editor a file many times.

11b. Unho-ka kohyangchinkwu-eykey phail-ul yelechalyey pon-ayss-ta
Unho-NOM hometown friend-DAT file-ACC many times sent
Unho sent (his) hometown friend a file many times.

11c. Unyeng-ika phail-ul thimwentul-eykey phail-ul yelechalyey pon-ayss-ta
Unyeng-NOM file-ACC team members-DAT many times sent
Unyeng sent a file to (his) team members many times.

11d. Uncin-ika phail-ul pwumonim-eykey phail-ul yelechalyey pon-ayss-ta
Uncin-NOM file-ACC parents-DAT many times sent
Uncin sent a file to (her) parents many times.

12a. Mina-ka kwunin-eykey phyenci-lul mwuthektayko palsonghayssta
Mina-NOM solider-DAT letter-ACC at random sent
Mina sent a soldier a letter at random.

12b. Cwunmin-ika sonnim-eykey phyenci-lul mwuthektayko palsonghayssta
Cwunmin-NOM guest-DAT letter-ACC at random sent
Cwunmin sent a guest a letter at random.

12c. Myengsik-ika phyenci-lul kwunin-eykey mwuthektayko palsonghayssta
Myengsik-NOM letter-ACC solider-DAT at random sent

Myengsik sent a letter to a soldier at random.

12d. Myengkyu-ka phyenci-lul sonnim-eykey mwuthektayko palsonghayssta
Myengkyu-NOM letter-ACC guest-DAT at random sent
Myengkyu sent a letter to a guest at random.

13a. Sohuy-ka sonnim-eykey umsik-ul cengsengkkes taycep-hayss-ta
Sohuy guest-DAT food-ACC cordially served
Sohuy cordially served (her) guest food.

13b. Socin-ika kwunin-eykey umsik-ul cengsengkkes taycep-hayss-ta
Socin soldier-DAT food-ACC cordially served
Socin cordially served a solider food.

13c. Hyenhuy-ka umsik-ul tongsayng-eykey cengsengkkes taycep-hayss-ta
Hyenhuy food-ACC brother-DAT cordially served
Hyenhuy cordially served food to (his) brother.

13d. Hyenyeng-ka umsik-ul kwunin-eykey cengsengkkes taycep-hayss-ta
Hyenyeng food-ACC brother-DAT cordially served
Hyenyeng cordially served food to a solider.

14a. Sengcin-ika ilkkwun-eykey kupye-lul ceynalccaey ipkum-hayss-ta
Sengcin worker-DAT paycheck-ACC on exact days deposited
Sengcin deposited a worker paycheck on exact days.

14b. Sengsik-ika kica-eykey kupye-lul ceynalccaey ipkum-hayss-ta
Sengsik reporter-DAT paycheck-ACC on exact days deposited
Sengsik deposited a reporter paycheck on exact days.

14c. Kyengcin-ika kupye-lul anay-eykey ceynalccaey ipkum-hayss-ta
Kyengcin payheck-ACC wife-DAT on exact days deposited
Kyengcin deposited (his) paycheck to (his) wife on exact days.

14d. Kyengho-ka kupye-lul kica-eykey ceynalccaey ipkum-hayss-ta
Kyengho paycheck-ACC reporter-DAT on exact days deposited
Kyengho deposited (his) paycheck to a reporter on exact days.

15a. Swunwu-ka kica-eykey maikhu-lul kapcaki phayngkaychy-ess-ta
Swunwu-NOM reporter-DAT microphone-ACC suddenly threw
Swunwu suddenly threw a reporter a microphone.

15b. Swunsik-ika ilkkwun-eykey maikhu-lul kapcaki phayngkaychy-ess-ta
Swunsik-NOM worker-DAT microphone-ACC suddenly threw
Swunsik suddenly threw a worker a microphone.

15c. Kyengswun-ika maikhu-lul sahoyca-eykey kapcaki phayngkaychy-ess-ta
Kyengswun-NOM microphone-ACC moderator-DAT suddenly threw
Kyengswun suddenly threw a microphone to a moderator.
15d. Kyenga-ka maikhu-lul ilkkwun-eykey kapcaki phayngkaychy-ess-ta
KyengaNOM microphone-ACC worker-DAT suddenly threw
Kyenga suddenly threw a microphone to a worker.
16a. Hongcwun-ika salamtul-eykey yensel-ul panpokhayse tullyecw-ess-ta
Hongcwun-NOM people-DAT speech-ACC repeatedly gave
Hongcwun gave people (his) speech repeatedly.
16b. Hongil-ika kacoktul-eykey yensel-ul panpokhayse tullyecw-ess-ta
Hongil-NOM family-DAT speech-ACC repeatedly gave
Hongil gave (his) family (his) speech repeatedly.
16c. Ilcwun-ika yensel-ul haksayngtul-eykey panpokhayse tullyecw-ess-ta
Ilcwun-NOM speech-ACC students-DAT repeatedly gave
Ilcwun gave (his) speech to students repeatedly.
16d. Pemcwun-ika yensel-ul kacoktuleykey panpokhayse tullyecw-ess-ta
Pemcwun-NOM speech-ACC family-DAT repeatedly gave
Pemcwun gave (his) speech to (his) family repeatedly.
17a. Minyeng-ika panchinkwu-eykey kwacey-lul sangseyhakey malhaycwessta
Minyeng-NOM classmates-DAT homework-ACC in detail told
Minyeng told (her) classmates about homework in detail.
17b. Pemsek-ika halapeci-eykey kwacey-lul sangseyhakey malhaycw-ess-ta
Pemsek-NOM grandfather-DAT homework-ACC in detail told
Pemsek told (his) grandfather about homework in detail.
17c. Sekyeng-ika kwacey-lul tanccak-eykey sangseyhakey malhaycw-ess-ta
Sekyeng-NOM homework-ACC friend-DAT in detail told
Sekyeng told homework to (her) close friend in detail.
17d. Sengcin-ika kwacey-lul anay-eykey sangseyhakey malhaycw-ess-ta
Sengcin-NOM homework-ACC wife-DAT in detail told
Sengcin told homework to (his) wife in detail.
18a. Unhuy-ka sungmwuwen-eykey umlyoswu-lul ekcilo kwen-hayss-ta
Unhuy-NOM flight attendant-DAT drink-ACC forcefully recommended

Unhuy forcefully recommend a flight attendant a drink.

18b. Hwacinika kwancwungeykey umlyoswulul ekcilo kwenhayssta
Hwachin-NOM flight crowd-DAT drink-ACC forcefully recommended
Hwachin forcefully recommend crowd a drink.

18c. Hwalanika umlyoswulul ennieykey ekcilo kwenhayssta
Hwalan-NOM drink-ACC sister-DAT forcefully recommended
Hwalan forcefully recommend a drink to (her) sister.

18d. Nanyengika umlyoswulul kwancwungeykey ekcilo kwenhayssta
Nanyeng-NOM drink-ACC crowd-DAT forcefully recommended
Nanyeng forcefully recommend a drink to crowd.

19a. Soyeng-ika chengsopwu-eykey piscalwu-lul sayngkakepsi naytency-ess-ta
Soyeng-NOM janitor-DAT broom-ACC accidentally threw
Soyeng accidentally threw a janitor a broom.

19b. Sola-ka hyengsa-eykey piscalwu-lul sayngkakepsi naytency-ess-ta
Sola-NOM detective-DAT broom-ACC accidentally threw
Sola accidentally threw a detective a broom.

19c. Minse-ka ssuleyki-lul mihwawen-eykey sayngkakepsi naytency-ess-ta
Minse-NOM garbage-ACC janitor-DAT accidentally threw
Minse accidentally threw garbage to a janitor.

19d. Mincin-ika ssuleyki-lul hyengsa-eykey sayngkakepsi naytency-ess-ta
Mincin-NOM garbage-ACC detective-DAT accidentally threw
Mincin accidentally threw garbage to a detective.

20a. Cwunyeng-ika ayngpeli-eykey tonmwungchi-lul sulkumeni cwiecw-ess-ta
Cwunyeng-NOM street beggar-DAT a bundle of money-ACC secretly gave
Cwungeng secretly gave a street beggar a bundle of money.

20b. Yunyeng-ika yencwuca-eykey tonmwungchi-lul sulkumeni cwiecw-ess-ta
Yunyeng-NOM musician-DAT a bundle of money-ACC secretly gave
Yunyeng secretly gave a musician a bundle of money.

20c. Cwuyeng-ika tonmwungchi-lul yecikwen-eykey sulkumeni cwiecw-ess-ta
Cwunyeng-NOM a bundle of money-ACC female worker secretly

gave
Cwungeng secretly gave a bundle of money to a female worker.

20d. Hayyeng-ika tonmwungchi-lul yencwuca-eykey sulkumeni cwiecw-ess-ta
Hayyeng-NOM a bundle of money-ACC musician secretly gave
Hayyeng secretly gave a bundle of money to a musician.

21a. Sohyen-ika ceyppangsa-eykey milkalwu-lul sinsokhakey paytal-hayss-ta
Sohyen-NOM baker-DAT flour-ACC quickly delivered
Sohyen quickly delivered a baker flour.

21b. Hyenok-ika kwankwangkayk-eykey milkalwu-lul sinsokhakey paytal-hayss-ta
Hyenok-NOM tourist-DAT flour-ACC quickly delivered
Hyenok quickly delivered a tourist flour.

21c. Hyenho-ka milkalwu-lul yolisa-eykey sinsokhakey paytal-hayss-ta
Hyenho-NOM flour-ACC female doctor-DAT quickly delivered
Hyenho quickly delivered flour to a female doctor.

21d. Miho-ka milkalwu-lul kwankwangkayk-eykey sinsokhakey paytal-hayss-ta
Miho-NOM flour-ACC tourist-DAT quickly delivered
Miho quickly delivered flour to a tourist.

22a. Namsek-ika chengsonyen-eykey kanguy-lul kensengulo sokay-hayss-ta
Namsek-NOM teenagers-DAT lecture-ACC pointlessly introduced
Namsek pointlessly introduced teenagers a lecture.

22b. Yunhyeng-ika ceyppangsa-eykey kanguy-lul kensengulo sokay-hayss-ta
Yunhyeng-NOM baker-DAT lecture-ACC pointlessly introduced
Yunhyeng pointlessly introduced a baker a lecture.

22c. Hyengsek-ika kanguy-lul swukangsayng-eykey kensengulo sokay-hayss-ta
Hyengsek-NOM lecture-ACC students-DAT pointlessly introduced
Hyengsek pointlessly introduced a lecture to students.

22d. Yunsek-ika kanguy-lul ceyppangsa-eykey kensengulo sokay-hayss-ta
Yunsek-NOM lecture-ACC baker-DAT pointlessly introduced
Yunsek pointlessly introduced a lecture to a baker.

23a. Sungmin-ika kenmwulcwu-eykey welsey-lul kkopakkkopak songkum-hayss-ta
Sungmin-NOM landlord-DAT rent-ACC directly paid
Sungmin directly paid (his) landlord rent.
23b. Sungho-ka senpay-eykey welsey-lul kkopakkkopak songkum-hayss-ta
Sungho-NOM senior-DAT rent-ACC directly paid
Sungho directly paid (his) senior rent.
23c. Hosung-ika welsey-lul cipcwuin-eykey kkopakkkopak songkum-hayss-ta
Hosung-NOM rent-ACC landlord-DAT directly paid
Hosung directly paid rent to (his) landlord.
23d. Hosek-ika welsey-lul senpay-eykey kkopakkkopak songkum-hayss-ta
Hosek-NOM rent-ACC senior-DAT directly paid
Hosek directly paid rent to (his) senior.
24a. Cengwu-ka sase-eykey soselchayk-ul ceysikaney pannap-hayss-ta
Cengwu-NOM librarian-DAT novel-ACC on time returned
Cengwu returned a librarian a novel on time.
24b. Cenghyen-ika hangin-eykey soselchayk-ul ceysikaney pannap-hayss-ta
Cenghyen-NOM pedestrian-DAT novel-ACC on time returned
Cenghyen returned a pedestrian a novel on time.
24c. Cengk-ika soselchayk-ul sase-eykey ceysikaney pannap-hayss-ta
Cengwu-NOM novel-ACC librarian-DAT on time returned
Cengwu returned a novel to a librarian on time.
24d. Kihyen-ika soselchayk-ul hayngin-eykey ceysikaney pannap-hayss-ta
Kihyen-NOM novel-ACC pedestrian-DAT on time returned
Kihyen returned a novel to a pedestrian on time.