Definiteness Hierarchy Effects in Referential Processing in Korean: An Eye-tracking Study

Hanjung Lee
Sungkyunkwan University
hanjung@skku.edu

1. Introduction

The present study reports results from three eye-tracking experiments investigating how the relative markedness of noun phrases (NPs) as a subject and an object influences referential processing in Korean, a verb-final language with canonical SOV order. The experiments provide new evidence about the active cognitive status of the system of markedness constraints suggested in recent (stochastic) OT approaches to morphosyntactic variation.

1.1 Background

- The effect of NP types on sentence processing has become an important focus of recent psycholinguistic research.
- Most discussions of NP type and sentence processing have been focused on complex sentences in English and other Germanic languages, most notably relative clauses.
- In this study we examine how NP characteristics affect the processing of different types of sentences in Korean.
- Why Korean?
  - In Korean it is possible to stack a large number of sentence initial NPs without causing severe

processing difficulty.
This makes Korean a good language to focus on to study memory limitation in processing.

1.2 Overview of recent work

- A great deal of research has shown that sentence complexity effects are moderated by the types of NPs in a sentence. However, it is still a matter of debate what characteristics of NPs cause the reduction in processing difficulty and when.
- For instance, in a complexity rating study, Gibson (1998) found that complexity of object-extracted relative clauses (RCs) (e.g., (1)) was most reduced by having indexical pronouns (e.g., *you* or *I*) in the subject position within the RC.

(1) The reporter that you/the doctor met spoke very quickly.

- Gibson proposes that indexical pronouns impose less of a load on working memory than other types of referring expressions because they refer to entities that are immediately available and most accessible in the comprehender's environment.
- More recently, Warren and Gibson (2002) found that sentence complexity is more closely related to gradations of the prominence of the embedded subject, such as proposed in the definiteness hierarchy (2) (Aissen 2003) or in the givenness hierarchy (Gundel et al. 1993; Ariel 1991) than to whether the embedded subject was indexical pronouns or not.

(2) Definiteness Hierarchy:
Personal pronoun > Proper name > Definite NP > Indefinite specific NP > Non-specific NP

- However, the similarity-based interference account (e.g., Bever 1974; Gordon et al., 2001) views definiteness effects in a different way. In a series of self-paced reading experiments, Gordon et al. found greatly decreased difficulty in object-extracted RCs when the sentential subject and the

subject in the RC came from different referential types (e.g., when one was a pronoun and the other was a common noun).

- Because Gordon et al. found the greatest decrease in difficulty when the two critical NPs were dissimilar referential forms, they conclude that their results are not compatible with Gibson's account or pure memory load account of relative clause processing (e.g., Ford 1983; Frazier and Fodor 1978; MacWhinney 1987; Wanner and Maratsos 1978). Instead, they favor an account under which interference occurs when the critical NPs are of the same referential form
- We conjecture that this disagreement about factors affecting processing difficulty is in part due to differences in methods used in different experimental studies.
- Using eye tracking during reading that gives us an excellent chance of detecting subtle, early processing effects (Rayner 1998; Rayner and Pollatsek 1989), we examined how and when the definiteness of individual subject and object NPs and the similarity of two critical NPs affect the processing of complex sentences in Korean.
- The three experiments show that these two factors have effects in different points over the time course of comprehension and that definiteness effects tend to occur earlier in comprehension than similarity-based interference.

2. Experiment 1 and 2

- The first experiment tested center-embedded complement clause structures in Korean to determine how the definiteness and similarity of two adjacent *subject* NPs contribute to processing difficulty.
- We varied whether the matrix subject NP and the embedded subject NP were pronouns or descriptions as shown in (3).
- Forty eight sentences were created with different matrix verbs and embedded verbs. Eye movements were recorded as subjects read the experimental sentences. Twenty four native speakers of Korean were tested in the experiment.

(3) Kutul-/uysa-ka wuli-/haksayng-i silhum-ul
They/doctor-nom we/student-nom experiment-acc
haysstako malhayssta.
ran said
'They/the doctor said that we/the student ran experiments.'

- There were two measures of interest for the reading of the object NP: first-pass gaze duration, which is the sum of the duration of the first fixation on a word plus any subsequent fixations on that word that occur before a successive word is fixated, and rereading time, which is the sum of the duration of any fixations made on a region after subsequent regions have already fixated.
- Both first-pass reading and rereading time data produced a significant effect of the type of the matrix subject NP, with the description condition taking longer to read than the pronoun condition in all critical regions.
- Subject similarity effects were not detectable in first-pass times but were significant in rereading times.
- In the second experiment pronouns were replaced with names. While no effects approached significance in the first-pass times, there was a significant interaction between the type of the matrix and embedded subject NP in rereading.
- These interactions showed that reading time for the matrix subject NP was elevated when the following, embedded subject NP was of a matched as compared to non-matched type.
- These results provide evidence that the referential form of individual NPs and the similarity of two adjacent NPs both contribute to processing difficulty and that similarity-based interference occurs later in comprehension (rereading).

3. Experiment 3

- This experiment examined whether the types of an *object*NP influence processing. The experiment focused on causative constructions whichcontain two objects that are accusative-marked as shown in (4). We varied whether the first object NP (causee) and the second object NP were names or descriptions.

(4) Ku-ka Yumi-/uysa-lul Minswu-/haksayng-ul
he-nom Yumi/doctor-acc Minswu/student-acc
mannakey hayssta.
meet made/let
'He made/let Yumi/the doctor meet Minswu/the student.'

- Names are widely considered to be less marked and more natural than descriptions as clausal subjects but more marked as clausal objects (Croft 1990; Givn 1984; Aissen 2003). Thus, sentences containing a name object should be more difficult to process than sentences containing a description object if this type of markedness as an object affects referential processing.
- Significant effects of the markedness of the object NP were found on both reading time measures in the four critical regions: the first object NP (causee) and the first (embedded) verb were read significantly slower in the name condition than in the description condition.
- In the second object region and the second verb, both reading time measures revealed a significant effect of the markedness as an object, with the second object (object of the embedded non-finite verb) and the verb being read more slowly in the name condition than in the description condition.
- No object similarity effect was found in this experiment. The reason for this will require further investigation.
- Taken together with the results of Experiment 1 & 2, this result shows that the processing difficulty associated with

referential expressions is more closely related to markedness as a subject and an object than to the referential form of NPs.

4. Discussion and Conclusion

- The markedness effects can be interpreted as resulting from a preference of more prominent expressions (i.e., pronouns and names) to be assigned a syntactically more prominent position (i.e., (matrix) subject position).
- Greater difficulty in the processing of disharmonic nominal expressions (e.g., low-prominence subject and high-prominence object) provides new evidence for the active cognitive status of the system of markedness constraints suggested in Aissen and Bresnan's (2002) stochastic OT approach to morphosyntactic variation.
- Although the definiteness constraint subhierarchy (see e.g., Aissen 2003; Aissen and Bresnan 2002; Dingare 2001) does not have categorical effects in the grammar of Korean, its active cognitive status can nevertheless be empirically detected by psycholinguistic experimentation.
- Further the experiments show that the markedness effects over the time course of comprehension can be measured using eye-tracking under natural reading conditions.
- Further research is required as to why definiteness effects tend to occur earlier in comprehension than similarity-based interference.

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