

Optimality Theory in Semantics and the Anaphora Resolution in Korean: An Adumbration

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Minpyo Hong. 2002. Optimality Theory in Semantics and the Anaphora Resolution in Korean: An Adumbration. *Language and Information* 6.2, 129–152. This paper argues for a need to adopt a conceptually radical approach to zero anaphora resolution in Korean. It is shown that a number of apparently conflicting constraints, mostly motivated by lexical, syntactic, semantic, and pragmatic factors, are involved in determining the referential identity of zero pronouns in Korean. It is also argued that some of the major concepts of Optimality Theory can provide a good theoretical framework to predict the antecedents to zero pronouns in general. A partial formalization of OT-based constraints at the morpho-syntactic and lexico-semantic level is provided. It is argued that the lexico-semantic restrictions on adjacent expressions play the most important role in the anaphora resolution process along with a variant of the binding principle, formulated in semantic terms. Other pragmatically motivated constraints that incorporate some important intuitions of Centering Theory are proposed too. (Myongji University)

Key words: anaphora resolution, Optimality Theory, zero pronouns, Centering Theory, binding

1. Introduction

It has long been observed that a correct interpretation of Korean zero pronouns hinges on a variety of factors.¹ Hong's (2000) analysis emphasizes the importance of information structure and local coherence of discourse and adopts the Centering Theory of Grosz et al. (1995). Lee & Lee (2000) propose to extend Vallduvi's (1994) Information Packaging Theory to incorporate major concepts of Centering Theory. Lee (2002) proposes to extend Asher's (1993) DRT framework to correctly capture the context-sensitivity observed in the phenomenon.

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1. An earlier version of this paper was presented at the 2002 Annual Conference of the Korean Society for Language and Information that took place in June 2002 at Kyungbuk National University. I thank the audience at the Conference whose comments greatly helped improve the quality of this paper. I also thank the anonymous reviewers of *Language and Information* for their invaluable comments, which I tried my best to reflect during the revision process. I regret however that some of the questions raised by the reviewers still remain unresolved at this stage, waiting for further research.

In this paper, I show that a rather novel approach is needed to deal with the issue in a comprehensive way. I point out that the previous attempts were limited in scope in that they failed to comply with the diversity of factors involved therein. Instead, I argue that the Optimality Theory of Prince & Smolensky (1993, 1997) can provide a conceptually and empirically well-founded framework for zero anaphora resolution projects in Korean.

I begin with a brief discussion of syntactic anomalies observed in zero pronoun constructions and the referential diversity of those zero pronouns in Korean in section 2, followed by a short overview of the major concepts of Optimality Theory that will play some key roles in the subsequent discussions in section 3. In section 4, I propose a series of constraints to implement an OT-based account of the phenomena and discuss a way of formalizing those constraints and their interactions with each other.

2. Initial Observations on Zero Anaphors in Korean

In this section, I begin with some problematic cases observed in literature concerning the interpretation of zero pronouns in Korean. It is purported to show why we need a rather different approach to the Korean anaphora resolution.

2.1 Syntactic Constraints Overridden by Context

Some constructions in Korean that contain a set of zero pronouns, often referred to as “referentially dependent zero pronouns” (cf. Lee 1999), seem to require a syntactic condition to be met for a correct interpretation. For example, the contrast between (1) and (2) below, from Lee (1999), is explained by the syntactic notion of c-command:

- (1) John_i-i [S' [e]_i Sue-lul mannassta-ko] malhayssta.
 John-Nom [S' [e] Sue-Acc met-that] said.
 “John said that (he) met Sue.”
- (2) John_i-uy hyeng_j-i [S' [e]_{*i/j} Sue-lul mannassta-ko] malhayssta.
 John-Gen brother-Nom [S' [e] Sue-Acc met-that] said.
 “John’s brother said that (he) met Sue.”

The zero pronoun in (1) refers to the matrix subject ‘John’ as it is c-commanded by the antecedent. In (2), the null pronoun subject is understood as referring to ‘John’s brother’ not ‘John.’ This is because of the genitive NP that fails to c-command the zero pronoun in the embedded clause. As Lee (1999) admits, however, when (2) is preceded by (3) below, the same embedded zero subject in (2) can refer to ‘John’ despite its failure to meet the syntactic requirement.

- (3) John-i nwukwunka-lul cohahako issta-nun somwun-i issessta.
 John-Nom someone-Acc like was-that rumor-Nom was

“There was a rumor that John loved someone.”

This is a clear case of more than one constraint interacting with each other, no matter how the other constraints may be formulated. Furthermore, the syntactic requirement is sometimes totally ignored, in particular when the anaphoric link is established between two different utterances as in the following:

- (4) U₁: Younghee oass-ni?
 came-Q
 “Has Younghee come?”
 U₂: Ung, [e] oasse.
 yes, came.
 “Yes. (She) came.”

No syntactic theory will ever be able to establish a structural relationship between ‘Younghee’ in (4) uttered by one speaker and the null pronoun occurring in the response uttered by another speaker.² In short, we are witnessing one form of constraint that seems so strong, but at the same time so vulnerable due to its interaction with others or for no particular reasons at all. This implies that the constraints involved in the zero pronoun interpretation are inherently violable, or “soft” as often called in the Optimality Theory literature.

2.2 Diversity of Reference

The Korean zero pronouns do not only refer to an entity introduced previously in the discourse, but also to an entity that is not overtly expressed at all. The following example comes from a Korean textbook for first graders in elementary school:

- (5) U₁: Acessi-kkeyse kangaci han mari-lul [e] cwusyessupnita.
 uncle-Nom. puppy one CL-Acc. [e] give-Pst
 “My uncle gave (me) a puppy.”
 U₂: [e] Thel-i kil-ko kwui-ka khun kangaci-ipnita.
 hair-Nom. long-Conj. ear-Nom. big puppy-copula
 “(It) is a puppy with long hair and big ears.”
 U₃: [e] Ilum-ul Talongi-lako ciessupnita.
 name-Acc. Talongi-as build-Pst
 “(I) named it Talongi.”
 U₄: Talongi-nun cangnan-ul cohahapnita.
 Talongi-Top. trick-Acc. like
 “Talongi likes to play tricks.”

2. Of course, a formalization is possible in principle that can capture the relationship involved between the zero pronoun and its antecedent across the sentence boundary. See, for example, Lee & Lee (2000: 79) for an intersentential structural relationship, a pragmatic notion called D(iscourse)-Command within a modified DRT framework.

- U₅: [e] Nay sinpal-ul mwule-ta swumkipnita.
 my shoe-Acc. carry-Conj. hide
 “(It) carries my shoes to hide them.”
- U₆: [e] Nay kapang sok-eyse cam-ul caki-to hapnita.
 my bag inside-Loc. sleep-Acc. sleep-also do
 “(It) also sleeps in my bag.”
- U₇: Kulayto na-nun cangnankkwuleki Talongi-ka kwuiyepsupnita.
 even so I-Top. playful being -Nom. cute
 “For all that, I like the playful creature as it’s so cute.”

The first occurrence of a zero pronoun in (U₁) above refers to the speaker/writer of the discourse, which was not phonologically realized at all. This means that the syntactic constraint is almost useless in this case since it is impossible to obtain any structural relationship between the zero pronoun in the object position of (U₁) and the entity being referred to by it.

To account for such an observation that zero pronouns can sometimes refer to discourse participants, Lee (2002) proposes to extend Asher’s (1993) Segmented Discourse Representation Structure into what he calls Korean Discourse Representation Structure, in which all the contextual information, including the speaker of the utterance, addressee, and their relative status as well as the speech act of the utterance, is represented in a DRS.³ In a somewhat different framework, on the other hand, Lee & Lee (2000) propose to adjust the forward-looking center hierarchy for Korean in their Extended Information Packaging Theory, following the suggestions in Choe & Lee (1999) so that the speaker or the hearer of an utterance comes higher in the hierarchy than the ordinary subjects or objects.⁴

Further challenging examples to any accounts proposed so far involve those zero pronouns that refer to an entity that comes into being only through some pragmatic inferences. The following examples come from Park (1983: 140):

- (6) a. [e] Ecey sen-ul poassnuntey, [e] nemwu nulg-esse.
 [e] yesterday marriage meeting-Acc. saw, [e] too old-Past.
 “(I) went to a marriage meeting yesterday, but (he) was too old.”
- b. [e] Akka kyomwusil-ey kassteni, [e] hwoyui-lul hako kyesitela.
 [e] a while ago teachers’ room-Loc. went, [e] meeting-Acc. do be.
 “A while ago, (I) went to the teachers’ room, (he/she) was in a meeting.”

The first occurrences of null pronouns in both (6a) and (6b) refer to the speaker, while the referents of the second zero pronouns can only be determined by an inference from the lexemes of the previous clause. In (6a), for example, the word

3. See Hong (2002) for a criticism on Lee’s (2002) approach to anaphora resolution in Korean.

4. See 4.3.4 for further discussions, and a criticism, on Lee & Lee (2000).

sen ‘a marriage meeting’ or ‘a blind date’ brings into the hearer’s consciousness a ‘frame’ of marriage (Minsky 1975) which should contain a ‘slot’ for a bride or a bridegroom, which is then picked up by the zero pronoun of the following clause. (cf. Lee & Lee 1998) In (6b), similarly, the zero pronoun of the second clause refers to an entity evoked by the presence of *kyomwusil* which instigates a similar inference on the hearer’s part. Note that the inference involved here can only be captured through a process based on an enriched lexical representation.

So far, I have shown that the issue being treated here is based on the interaction of quite complicated processes. A proper analysis will need to take into account not only such structural notions as c-command, but also lexico-semantic and pragmatic inferences. In short, a totally new perspective is needed to understand the issue here.

3. Fundamentals of OT

In this section, I discuss some fundamentals of Optimality Theory, the main ideas of which were first introduced in Prince & Smolensky (1993, 1997). For expository purposes, I will follow the terms and conventions of the non-technical version given in Kager (1999).

Optimality Theory is an input-output mechanism that pairs an output form to an input form, consisting of two components: Generator (or *Gen*) which generates logically possible candidate outputs and Evaluator (*Eval*) which evaluates the candidates according to the ranked constraints. The following is a rather simplified functional structure of those two main components:

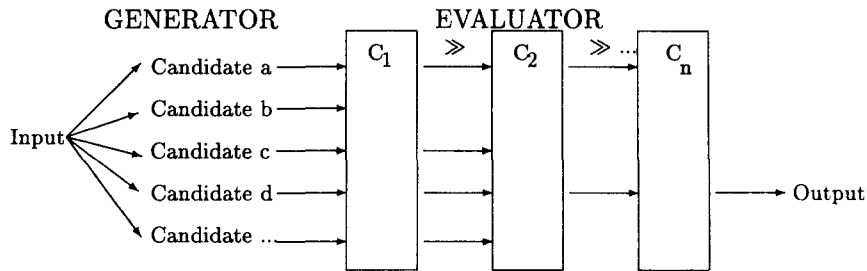
$$(7) \text{ Gen(input) = \{candidate}_1, \text{ candidate}_2, \dots, \text{ candidate}_n\}$$

$$\text{ Eval(\{candidate}_1, \text{ candidate}_2, \dots, \text{ candidate}_n\}) = \text{optimal output}$$

Gen is a function that applies to an input, producing a set of candidate outputs, all of which are logically possible analyses of the input. *Eval* is also a function that, when applied to a set of output candidates, produces an output, the optimal analysis of the input.

According to Kager (1999), the Optimality Theory is based on the assumption that grammar, or language in general, is a system of conflicting forces, which are embodied by a series of constraints that can be either observed or violated by an output form. These constraints are hierarchically ranked according to independent principles where a lower-ranked constraint can be violated to avoid the violation of a higher-ranked constraint. Note that constraints are universal but violable. A schematic representation is given below to show how the generator, evaluator, and the constraints interact with one another to produce the optimal output:

$$(8) \text{ A schematic representation of Gen and Eval (Kager 1999: 22)}$$



(9) Sample Tableau (Kager 1999: 22)

Candidates	Constraint ₁	Constraint ₂
√a.		**
b.	*!	

OT constraints are calculated according to a principle called “strict domination,” which states that violation of higher-ranked constraints cannot be compensated for by satisfaction of lower-ranked constraints. Thus, the candidate (a) in the tableau above is chosen as the optimal output even though it violates Constraint₂ twice. Candidate (b) is ruled out as it violates the higher constraint. Fatal violations are marked by ! and the most “harmonious” or the optimal output is the one marked with √.

4. An OT Account of Korean Zero Anaphora

In this section, I sketch an account of the referential indeterminacy of zero pronouns in Korean using the OT concepts introduced in the previous section. In 4.1, I begin with some assumptions for the following discussion. Then, in section 4.2 and on, I provide an OT-based analysis of the reference determination process.

4.1 Some Assumptions: Indexing & Free Reference Hypothesis (FRH)

First of all, I will assume that the input to *Gen* is a well-formed syntactic structure and that a noun phrase is freely assigned its reference in terms of indices, *i*, *j*, *k*, etc. I will further assume that every noun phrase that is phonetically realized is assigned an index. For the sake of simplicity, I will also assume that the phonetically realized noun phrases are exempt from the application of the *Gen* function. In other words, only the zero pronouns will undergo relevant evaluation processes in the following discussion.

Second, I will follow Hendriks & de Hoop (2001) in several respects. In an attempt to provide an Optimality Theoretic analysis of quantificational forces in constructions involving determiners and comparatives, they adopt a radical hypothesis to derive a compositional meaning based on syntactic structures. They propose to begin with an assumption, namely the Free Interpretation Hypothesis, that an utterance can be associated with an infinite number of possible interpre-

tations.⁵ That is, when hearers encounter a sentence, they are in essence given an infinite number of meanings, which are later filtered out by a set of relevant constraints in the *Eval* component. In a similar vein, in order to provide an OT framework that will be spelled out below, I will assume the following:

- (10) Free Reference Hypothesis (FRH)
A zero pronoun can refer to any entity.

This hypothesis allows the *Gen* component to generate all possible candidate interpretations for a given zero pronoun. So, the set of output candidates will include not only the indices of previously-mentioned discourse referents but also those of the discourse participants (the speaker and the hearer) and the unspecified general public.

4.2 For an Optimal Interpretation: Various Constraints and Their Interactions

Given the basic tools of OT outlined in the previous section, I will begin with some insights from the previous literature. The first constraint that I would like to adopt is called *DOAP*, proposed by Williams (1997) and adopted in Hendriks & de Hoop (2001: 15) as in the following:

- (11) Don't Overlook Anaphoric Possibilities (DOAP)
Opportunities to anaphorize text must be seized.

This is a principle that can account for the tendency in natural languages that language users prefer to interpret a sentential element as anaphors that are related to the previous discourse. In the present discussion, it will allow us to capture the tendency of zero anaphors to prefer those candidates that are anchored to the discourse referents introduced in the previous discourse to those that are not. Let's consider the example below:

- (12) U₁: Chelswui-nun chakhan ai yessta.
-Top. good-natured child was
"Chelswu was a good-natured child."
U₂: [e]_i/?*sp*/*?hr* kongbwu-to cal hayssta.
study-also well did
"(He) studied well, too. / (He) was a good student at school."

5. Hendriks & de Hoop's main interest lied in the interpretation of quantificational determiners and comparative constructions and they proposed two different versions of the Free Interpretation Hypotheses as in the following:

- (i) Free Interpretation Hypothesis w.r.t. determiners: The argument sets A and B of a determiner expression can be any sets A and B that are a member of the power set of the domain of individuals: $A, B \in \wp(E)$.
(ii) Free Interpretation Hypothesis w.r.t. comparatives: The argument degrees d and d' of a comparative morpheme can be any degrees d and d' that are a member of the set of degrees that project onto the same scale.

For further details on the motivation for such hypotheses, see Hendriks & de Hoop (2001).

The zero pronoun in (U_2) is normally interpreted as referring to *Chelswu* rather than the speaker or the hearer or any other entity available in the context. When it refers to any entity other than *Chelswu*, it would violate *DOAP*.

I will also follow Hendriks & de Hoop (2001) and assume that the semantic relations in natural language are usually interpreted as involving two non-identical entities, as given below (Hendriks & de Hoop 2001: 16):

(13) Principle B

If arguments of the same semantic relation are not marked as being identical, interpret them as being distinct.

This is to account for the tendency in natural language that a reflexive relation is marked by a linguistic device of an appropriate form. This can be thought of as a semantic version of the binding condition B in syntax. It will help us to exclude the subject argument from being interpreted as the referent of the zero pronoun in the following:

- (14) Chelswu-ka [e] mekess-ni?
 -Nom. [e] ate-Q
 “Did Chelswu eat (it/them)?”

This is because if the speaker intended the utterance to be interpreted as denoting the proposition *eat(Chelswu, Chelswu)*, s/he must have adopted a linguistically marked form, such as a reflexive pronoun. I will assume, again following Hendriks & de Hoop (2001) without further argument, that *Principle B* is stronger, and thus comes higher in ranking, than *DOAP*.

4.2.1 *Feature Mismatch. One of the most important constraints in the interpretation of Korean zero pronouns seems to be the lexico-semantic requirement of feature agreement between adjacent elements. The feature may be based on morphology, syntax or semantics. Thus, given two candidate interpretations of a zero anaphor, the one that does not agree with the various semantic features of the predicate will be ruled out. This is captured in a constraint that requires the lexical information of a candidate referent to be in accordance with that of the adjacent functors such as a predicate or other relation-holders. In other words, the selectional restrictions of a predicate must be respected by its arguments. The following will suffice for our purposes:

- (15) *Feature Mismatch⁶
 A linguistic element must match its licensor in (phonological, morphological, syntactic, and semantic) features.

6. Of course, this can sometimes be violated in a metaphoric or figurative interpretation of a sentence, which I do not want to deal with in this paper. A different version that maintains

Note that this is a very general (and presumably, universal) constraint independently motivated for many other purposes, not only in Korean but in all other languages. It can exclude many candidates that do not agree in syntactic or semantic features with the adjacent predicates. For example, it explains the contrast between the following:

- (16) U₁: Chelswu-nun kicha-eyse kimpap-ul sa mekessta.
 -Top. train-Loc. seaweed rice-Acc. buy ate
 “Chelswu bought and ate seaweed rice in the train.”
 U₂: [e] sanghay issessta.
 gone bad was
 “(It) was bad.”
- (17) U₁: Chelswu-nun kicha-eyse kimpap-ul sa mekessta.
 -Top. train-Loc. seaweed rice-Acc. buy ate
 “Chelswu bought and ate seaweed rice in the train.”
 U₂: [e] mwuci nulikey ganun kes kathassta.
 very slow go thing seemed
 “(It) seemed to be going very slowly.”

Notice that the zero pronoun in (16) refers to the seaweed rice Chelswu bought and ate while that in (17) refers to the train Chelswu was in simply because of the semantic feature clash between the assumed referents and the predicates. I assume, without further argument as it is so obvious, that **Feature Mismatch* is higher in the hierarchy of constraints than *Principle B* or *DOAP*, i.e., **Feature Mismatch* > *Principle B* > *DOAP*. The relevant tableau for (16U₂) above is given below:⁷

(18) Tableau for (16U₂)

	*Feature Mismatch	Principle B	DOAP
Chelswu	*!		
train	*!		
√rice			

the same spirit as my constraint **Feature Mismatch* can be found in Chung (1998) and Lee & Lee (2000) in their constraint on conceptual compatibility: “The referent of each term that is not explicitly expressed must be determined on the basis of the meaning of the predicate which is predicated of it.” (Lee & Lee 2000: 76)

7. A full tableau for (17U₂) would look as follows, which includes the speaker and the hearer among the candidates and better predicts the reference possibilities of the zero pronoun in point, especially when we loosely interpret the constraint on feature mismatch:

	*Feature Mismatch	Principle B	DOAP
√Chelswu			
√train			
rice	*!		
speaker			*
hearer			*

Note that nothing prevents *Chelswu* from being referred to by the zero pronoun in the second utterance in (17).

The zero anaphors in (16U₂ and (17U₂) are interpreted as referring to [seaweed rice] and [train]/[Chulswu], respectively, as the other candidates are not congruent with the necessary semantic features required by the relevant predicates. That is, a train cannot go bad and a lump of rice wrapped in seaweed cannot go slowly.

As far as Korean zero anaphors are concerned, this ban on feature mismatch seems to be the strongest of all, and consequently ranks highest in the set of constraints to be spelled out below. Failure to satisfy this constraint leads to a fatal violation.

**Feature Mismatch* and *DOAP* can jointly predict the reference of zero pronouns involving discourse participants. For example, the zero pronouns in the following sentences are understood as the hearer of the utterance:

- (19) a. [e] Ecey na-hanthey cenhwa hay-ssesse-yo?
 [e] yesterday I-to phone call do-past-Q
 "Did (you) call me yesterday?"
- b. [e] Edi sasi-nun nwukwu-sey-yo?
 [e] where live-Rel. who-be-Q
 "Where do (you) live, and who are (you)? (Who is this, and where are you calling from?"
- c. [e] Ttal sicip ponayl ttay wu-si-esse-yo?
 [e] daughter wedding send when cry-Hon.-past-Q
 "Did (you) cry on your daughter's wedding day?"

One of the common characteristics of these sentences is that the candidate referents are not linguistically realized. Instead, they are present contextually. For example, in (19a), the speaker and the hearer are participating in the dialogue and are considered as being present at the time of utterance. The following tableau shows how the hearer of the utterance is chosen as the referent of the zero pronoun:

(20) Tableau for (19a)

	*Feature Mismatch	Principle B	DOAP
speaker	*!	*	*
√hearer			*

Note that due to the lack of any other discourse referents realized in the utterance, the hearer is interpreted as the antecedent of the pronouns in these examples.

4.2.2 Parallelism. There is another inter-sentential structural property that should not be overlooked in the interpretation of zero pronouns in Korean. Structural parallelism seems to be respected by language users in general. As pointed out by Dalrymple et al. (1991) and Hendriks & de Hoop (2001) among others, parallelism indeed plays an important role in the interpretation of ellipsis and anaphora resolution.

- (21) U₁: Chelswu-nun pan-eyse Minswu-ka ce-yil cohassta.
 -Top class-Loc. -Nom. most liked
 “Chelswu liked Minswu most in his class.”
 U₂: [e₁] ku taumulo Cinswu-ka cohassta.
 next -Nom. liked
 “(He) liked Cinswu next.”
 U₃: [e₂] kyohwoy-eyse-nun Younghee-ka ce-yil cohassta.
 church-Loc.-Top. -Nom. most liked
 “In the church, (he) liked Younghee most.”

The zero pronouns in (U₂) and (U₃) strongly prefer *Chelswu* over *Minswu* as its antecedent. This could be captured in the following constraint, following Hendriks & de Hoop (2001: 26):

- (22) Parallelism

As the antecedent of an anaphoric expression, choose a (logically, structurally, or thematically) parallel element from the preceding clause.

This is a rather loose constraint that should be ranked lower than the other constraints introduced previously. That is, the relevant ordering should look as follows:

- (23) *Feature Mismatch > Principle B > DOAP > Parallelism

- (24) Tableau for (21U₂)

[e ₁]	*Feature Mismatch	Principle B	DOAP	Parallelism
√Chelswu				
Minswu				*
class	*!			
Cinswu		*!		*
speaker			*!	*
			*!	*

As shown in the tableau, the optimal choice for the zero pronoun in (21U₂) depends on which one of the two previously mentioned entities *Chelswu* and *Minswu* violates *Parallelism*. I will assume that *Parallelism* applies only when the structurally parallel constructions are involved in the evaluation.⁸

8. One of the reviewers pointed out that the following conversation could be a counterexample to the ranking between Principle B and Parallelism given in (23), arguing that the null pronoun [e] below referring to its subject *na*_i is the most natural reading in Korean:

4.2.3 Some Insights from Centering Theory: Continuation. Due to their similarity to English unstressed pronouns, Korean zero pronouns have long been understood as a means of maintaining the local coherence of a given discourse, thus falling into the realms of analysis in the framework of Centering Theory (Grosz et al. 1995). Earlier proposals to adopt the major findings of Centering Theory to explain various phenomena in Korean can be found in No (1991) and Cha et al. (1997).

The constraint I would like to propose below is intended to capture one of the universal tendencies of utterances within a discourse segment to be about the same entity that was introduced in the previous discourse. This could be stated in the following way utilizing the concepts of Centering Theory proposed in Grosz et al. (1995):

(25) CONTINUE

Centers are continued (within a discourse segment). That is, CONTINUING > RETAINING > SMOOTH SHIFT > ROUGH SHIFT

The following are the relevant notions of Centering adopted in this paper:

(26) Transition Patterns: (Brennen et al. 1987)

	$C_b(U_n) = C_b(U_{n-1})$	$C_b(U_n) \neq C_b(U_{n-1})$
$C_b(U_n) = C_p(U_n)$	CONTINUING	(SMOOTH) SHIFT
$C_b(U_n) \neq C_p(U_n)$	RETAINING	(ROUGH) SHIFT

(27) Backward-looking center (C_b) of U_n : the most highly ranked element in the C_f list of the previous utterance, U_{n-1} , that is realized in U_n .

(28) Preferred center (C_p) of U_u : the highest member of the $C_f(U_n)$

Two notes are in order here. First, there may be cases where the backward-looking center is not established due to the structural factors of the discourse segment and consequently the constraint (25) cannot apply. For example, in (21) above, the backward looking center of (U_1) cannot be established as it is the discourse-initial utterance. Thus I will assume that for ($21U_1$), the constraint

-
- Chelswu: Na_i -nun ne_j -lul ceil cohay.
 I-Top. you-Acc. most like
 "I like you most."
 Minswu: Sasil, na_j -nun $[e]_{i/j}$ silhehay.
 in fact, I-Top. $[e]_{i/j}$ hate.
 "In fact, I hate you/myself."

Notice that the empty pronoun can in fact refer either to the speaker_j or to the hearer_i. My judgement prefers the zero pronoun referring to i rather than j falling neatly under the account given above. The problem, however, is how my account will admit the zero pronoun referring back to the subject pronoun na_j , which will be filtered out by Principle B. Note also that in this example, there is a confusion between either the deictic or the anaphoric interpretation of the pronouns used as arguments of the predicate. I will leave this open for future research.

(25) is irrelevant. Second, the backward-looking center of an utterance can be defined retrospectively since the referent of the zero pronoun is sometimes not established at the time of evaluation. (Note that the backward-looking center, as defined in (27), is the highest entity in the forward-looking center list of the previous utterance U_{n-1} , which is *realized* in the current utterance U_n .)

The forward-looking centers are ranked according to the hierarchy below. I assume No's (1991) center hierarchy as in the following:

(29) Forward-looking Center Hierarchy in Korean⁹

Topic > (Non-cased marked) Subject > (Non-case marked) Object > others

Let us now turn our attention to the interaction between the constraints that have been introduced so far and determine their relative ranking in the constraint hierarchy. As **Feature Mismatch* and *Principle B* essentially reflect the core grammatical aspects of human language, I will assume that they should come first in the hierarchy and that *Parallelism* comes last, as I mentioned previously. As for the interaction between *DOAP* and *CONTINUE*, the former seems to come before the latter, which is attested in the discourse below:

- (30) U_1 : Chelswu-nun pan-eyse Minswu-ka ceyil cohassta.
 -Top class-Loc. -Nom. most liked
 "Chelswu liked Minswu most in his class."
 U_2 : [e₁] maumssi-ka chakhayssta.
 heart-Nom. gold-Pst
 "(He) had a heart of gold."
 U_3 : [e₂] congicepki-to cal hayssta.
 origami-also well did
 "(He) was good at origami, too."

If *DOAP* were ranked lower than *CONTINUE*, we would not be able to exclude the speaker or the hearer as the referent of the zero pronouns in (30 U_2) and (30 U_3) since the candidates *Chelswu* or *Minswu* satisfy *DOAP* while the speaker or the hearer does not. The tableau for (30 U_2) is given below:

(31) Tableau for (30 U_2)

9. This is different from Choe & Lee (1999) or Lee & Lee (2000) in that such elements as the speaker or the hearer are not included in the ranking. This is because the discourse participants such as the speaker or the hearer are automatically generated by the Gen function in my account due to the Free Reference Hypothesis. See 4.2.4 for further details on this.

[e ₁]	*Feature Mismatch	Principle B	DOAP	CONTINUE
√Chelswu				?
class	*!			
√Minswu				?
speaker			*!	*
hearer			*!	*

Note that the two candidates *Chelswu* and *Minswu* are undetermined with respect to the constraint *CONTINUE* at the time of evaluating the utterance (30U₂) since the previous utterance (30U₁) is discourse-initial whose C_b is not defined, and consequently we cannot decide whether the transition is *CONTINUATION*, *RETAIN* or *SHIFT*. Thus, it is predicted that at the point of evaluating (30U₂), the zero pronoun can either refer to *Chelswu* or *Minswu* according to the tableau, which does seem to conform to native speaker's judgement. The second occurrence of the zero pronoun can be similarly treated as the following tableau shows:

(32) Tableau for (30U₃)

[e ₂]		*Feature Mismatch	Principle B	DOAP	CONTINUE	Parallelism
[e ₁] = Chelswu	√Chelswu					
	class	*!			*	*
	Minswu				*!	*
	speaker			*!	*	*
[e ₁] = Minswu	hearer			*!	*	*
	Chelswu				*!	*
	class	*!			*	*
	√Minswu					
speaker				*!	*	*
	hearer			*!	*	*

That is, when [e₁] refers to *Chelswu*, [e₂] is interpreted as *Chelswu* too. When [e₁] refers to *Minswu*, [e₂] should refer to *Minsu*. This is another advantage of an OT-based account presented here since it not only correctly predicts the logically and contextually possible interpretations, but also explains the tendencies of preserving coherence of a discourse under a given reading.¹⁰

The ordering proposed here accounts for the interaction between more than two discourse participants and the entities introduced in the previous discourse. The following comes from Lee (2002):

10. One of the reviewers pointed out to me that there is some redundancy between DOAP and CONTINUE and that the former is entailed by the latter. Note however that they are not equivalent to one another as the latter is mainly concerned with capturing the tendency of utterances to be about the same discourse referent while the former is more concerned with anaphoric possibilities. Of course, it is true that there is some redundancy between the two. As for the ways to resolve the redundancy, I would rather leave it open for future research.

- (33) U₁: [e₁] cinan thoyoil-ey yenghwa-lul po-ass-ni?
 last Saturday-on movie-Acc. watch-Pst-Q?
 (Speaker: Chanhee, Addressee: Cwuho)
 “Did (you) watch a movie last Saturday?”
- U₂: Doochul-i [e₂] poasse.
 -Nom. saw
 (Speaker: Cwuho, Addressee: Chanhee)
 “Doochul saw (it).”
- U₃: Doochul-a, yenghwa-ka caymiissess-ni?
 -Voc., movie-Nom. interesting-Pst-Q?
 (Speaker: Chanhee, Addressee: Doochul)
 “Doochul, was the movie fun?”
- U₄: [e₃] insangcek-iesse.
 impressive-was
 (Speaker: Doochul, Addressee: Chanhee)
 “(It) was impressive.”

The tableaux below show how the referents for each null pronoun above can be interpreted in my analysis (I have suppressed irrelevant constraints from consideration below):

- (34) Tableau for (33U₁)¹¹

[e ₁]	*Feature Mismatch	Principle B	DOAP
sp(Chanhee)	*!		*
√hr(Cwuho)			*
movie	*!	*	

- (35) Tableau for (33U₂)

11. When the zero pronoun refers to the speaker, it violates *Feature Mismatch in this tableau because of the interrogative mood. Note however that, as one of the reviewers pointed out, the following examples cannot be explained especially when the zero pronoun refers to the speaker:

- (i) (to a friend right before a job interview)
 Ettay, [e] gwaynchana?
 how, [e] ok?
 “What do you think?
 Do (I) look okay?”
- (ii) (to a friend)
 [e] cikum ttel-koissni?
 [e] now shiver-Prog.
 “Am (I) shivering now?”

A highly sophisticated contextual information seems to be at work here, which goes beyond the scope of this paper. I would rather leave this open for future research.

[e ₂]	*Feature Mismatch	Principle B	DOAP	CONTINUE
sp(Cwuho)			*!	
hr(Chanhee)			*!	*
Doochul		*!		*
√movie				

(36) Tableau for (33U₄)

[e ₃]	*Feature Mismatch	Principle B	DOAP	CONTINUE
sp(Doochul)	*!		*	
hr(Chanhee)	*!		*	*
√movie				

An interesting interaction between the discourse participants and the previously mentioned entities can be observed in the following discourse, as the zero pronoun referring to the speaker is introduced as an object in the first sentence, repeated here from (5) above:

- (5) U₁: *Acessi-kkeyse kangaci han mari-lul* [e₁] *cwu-si-essupnita*.
 uncle-Nom. puppy one CL-Acc. [e] give-Hon.-Pst
 “My uncle gave (me) a puppy.”
 [e₂] *Thel-i kil-ko kwui-ka khun kangaci-ipnita*.
 U₂: hair-Nom. long-Conj. ear-Nom. big puppy-copula
 “(It) is a puppy with long hair and big ears.”
 U₃: [e₃] *Ilum-ul ‘Talongi’-lako ciessupnita*.
 name-Acc. ‘Talongi’-as build-Pst
 “(I) named it ‘Talongi.’”

Relevant tableaux for each occurrence of zero pronouns are given below:

(37) Tableau for (5U₁)

[e ₁]	*Feature Mismatch	Principle B	DOAP
uncle		*!	
puppy		*!	
√speaker			*

Two candidates *accessi* ‘uncle’ and *kangaci* ‘puppy’ are ruled out as they both violate *Principle B*: an uncle cannot give a puppy to himself and a puppy cannot be given to a puppy by an uncle. The most harmonious output is the speaker. Note that the hearer is not considered here even though the *Generator* does present it as one of the candidates. This is due to the written nature of the discourse, in which the hearer/addressee is not explicit.

(38) Tableau for (5U₂)

[e ₂]	*Feature Mismatch	Principle B	DOAP
uncle	*!		
√puppy			*!
speaker	*!		*
hair	*!		*
ear	*!		*

This is a rather simple case because all the other candidates violate the selectional restriction constraint. The puppy is the only optimal choice. Let's now move on to (2U₃).

(39) Tableau for (5U₃)

[e ₃]	*Feature Mismatch	Principle B	DOAP	CONTINUE
uncle	*!			*
puppy	*!			
√speaker			*	*
hair	*!			
ear	*!			
name	*!		*	

Uncle is ruled out as it does not match with the non-honoric marking of the predicate. Note that if the null subject were intended to refer to the uncle, an honorific marking must have been used in the sentence.

Complications arise when an utterance contains an embedded clause as in the following:

- (40) U₁: Ecey cenyek-ey [e₁] Chelswu-hanthey cenhwa-lul hayssta.
 last night-at -to phone-Acc. did
 "(I) called Chelswu last night."
 U₂: [e₂] Minswu-lang kachi issessta.
 -with together was
 "(I/He) was with Minswu."
 U₃: [e₃] [e₄] [caki cip-ulo o]-lako hayssta.
 self house-to come]-Comp. said
 "(He) asked (me) to come to his house."

The zero pronoun in (40U₂) is correctly predicted to refer to *Chelswu* because *DOAP* is higher than *CONTINUE*. As shown below, *Chelswu* violates no constraints while the discourse participants violate *DOAP*.

(41) Tableau for (40U₂)¹²

[e ₂]	*Feature Mismatch	Principle B	DOAP
√Chelswu			
Minswu		*!	*
speaker			*!
hearer			*!

The ordering *DOAP* > *CONTINUE* correctly chooses the referent for the zero pronoun in (40U₂).¹³

Now the third utterance of (40) contains two zero pronouns: one for the matrix subject and the other for its indirect object. Tableaus for each pronoun interpretation are given below:

(42) Tableau for (40U₁ [e₃])

12. In this tableau, the speaker is treated as violating DOAP even though it was established in the previous discourse as the referent of the null subject. This is because of the somewhat tricky contrast between the discourse (40) in which the speaker is not mentioned in the first sentence and the one that begins with (i) below, which explicitly mentions the speaker in the first person pronoun form:

- (i) Ecey cenyek-ey Na-nun Chelswu-hanthey cenhwa-lul hayssta.
 last night-at I-Top. -to phone-Acc. did
 "I called Chelswu last night."

When (40U₁) is replaced by (i), it seems that the zero pronoun of the second utterance (40U₂) can either refer to the speaker or *Chelswu*. This is a problem in my account that awaits future research. Note however that this Korean example gives an interesting implication concerning the notion of "realization" in Centering Theory and the use of discourse participant-oriented zero pronouns in Korean. When it is not mentioned explicitly, it is treated deictically not anaphorically in the subsequent discourse. This is a very interesting issue that, again, awaits further research.

13. Note however that my analysis still predicts that the zero pronoun refers to *Chelswu* in a slightly different discourse, e.g., as in the following:

- a. Ecey cenyek-ey Chelswu-ka [e₁] cenhwa-lul hayssta.
 last night-at -Nom. phone-Acc. did
 "Chelswu called (me) last night."
 b. [e₂] Pap-ul mek-ke issessta.
 rice-Acc. eat-Prog. was
 "(He/I) was having dinner."

[e ₁]	*Feature Mismatch	Principle B	DOAP
√Chelswu			
speaker			*!
hearer			*!

We see here that the candidate *Chelswu* does not violate any constraints and becomes the most optimal choice, contrary to native speakers' judgement that the zero pronoun is more likely to be interpreted as the speaker of the utterance. To avoid such an unwanted misunderstanding, it seems that native Korean speakers opt out to use an overt pronoun *Na-nun* in those cases, ie., "Na-nun ku ttay pap-ul mek-koissessta" (I was having dinner then.) This is another advantage of the OT-based account presented in this paper, predicting the language users' repair strategy.

[e ₃]	*Feature Mismatch	Principle B	DOAP	CONTINUE
√Chelswu				
Minswu				*
house	*!			*
speaker			*!	*
hearer			*!	*

Since the backward-looking center of the second utterance is established as *Chelswu* according to the evaluation for (40U₂), *Minswu* violates *CONTINUE*. Thus, *Chelswu* is the most harmonious interpretation for [e₃].

The indirect object pronoun [e₄] will have the following tableau:

(43) Tableau for (40U₃ [e₄])

[e ₄]	*Feature Mismatch	Principle B	DOAP	CONTINUE
Chelswu		*!		
Minswu	*!			*
house	*!			*
√speaker			*	*
hearer	*!		*	*

Chelswu violates Principle B since it involves a reflexive relation with its subject whose referent is already determined as *Chelswu* in Tableau (42). *Minswu* and the hearer are also excluded based on **Feature Mismatch* since it is not conceptually congruent with our world knowledge about phone calls. The speaker is the optimal interpretation for [e₄].

4.2.4 Bridge Effects: Slot-Links. Bridge effects refer to an anaphoric link involving a certain degree of pragmatic inference as seen in the following:

(44) Nigel bought a fridge. *The door* fell off three weeks later.

The door here refers to the door of the fridge mentioned in the previous sentence. This is based on the world knowledge that a fridge has a door.

Similar effects are observed with Korean zero pronouns by Park (1983). Consider the following examples, repeated from (6).

- (6) a. [e₁] Ecey sen-ul poassnuntey, [e₂] nemwu nulg-esse.
yesterday marriage meeting-Acc. saw, [e] too old-Past.
“(I) went to a marriage meeting yesterday, but (he) was too old.”
- b. [e₁] Akka kyomwusil-ey kassteni, [e₂] hwoyui-lul hako kyesitela.
[e] a while ago teachers’ room-Loc. went, [e] meeting-Acc. do be.
“A while ago, (I) went to the teachers’ room, (he/she) was in a meeting.”

The first occurrence of zero pronouns here refers to the speaker, while the second refers to an entity that can be obtained through an inference from the word introduced in the previous utterance. *Sen* ‘marriage meeting or a blind date’ and *kyomwusil* ‘teachers’ room’ seem to activate such entities as ‘partner’ or ‘teacher,’ which is then referred to by the zero pronouns.

In an attempt to account for such an indirect reference between a zero pronoun and its quasi-antecedent, Lee & Lee (2000) propose to extend some of the important concepts of Information Packaging Theory and incorporate them into the Centering Theory. In a nutshell, their analysis predicts that the zero anaphors refer to the backward-looking center, or the most salient element of the previous utterance, given the forward-looking center hierarchy in Korean as follows (Lee & Lee 2000: 68):

- (45) Slot-Link Component > {speaker/hearer} > Subject > Indirect Object
> Direct Object > Others

One of the drawbacks of Lee & Lee’s approach is that such functional notions as the slot-link or the speaker/hearer always take precedence over other syntactically defined elements like subjects or objects, resulting in too powerful a theory that sometimes gives wrong predictions. Let’s consider the following example, from Lee & Lee (2000: 73):

- (46) U₁: Tokkocwun-un ssuki-lul memchwu-essta.
-Top. writing-Acc. stop-Past Decl.
“Tokkocwun stopped writing.”
U₂: [e] Han kay nam-un kamca-lul cip-ese ip-ey neh-essta.
[e] one remain-Rel. potato-Acc. pick-and mouth-Loc. put in.
“(He) picked up one remaining potato and put it in his mouth.”
U₃: [e] Son-ul ppet-ese pyekcang mwun-ul yenta.
[e] hand-Acc. stretch closet door-Acc. open
“(He) stretches out (his) hand and opens the closet door.”
U₄: Wi alay twu khan-ulo nanwi-ecin pyekcang an-un tachaylopta.
up down two part-Instr. divided closet inside-Top. colorful
“The inside divided into two parts is colorful.”

The null pronoun in (46U₂) is understood as the subject of the previous utterance, *Tokkocwun*. Their theory, however, predicts that the speaker or the hearer of the utterance will be the referent of the zero pronoun as they are higher in the C_f ranking (45). If we take into account the slot-links in the frame for the predicate nominal *ssuki* in (46U₁), which will undoubtedly contain such entities as a piece of paper or a pen, it will wrongly predict that the zero pronoun in (46U₂) can refer to them, too. Such a confusion results from conflating the structural notions such as subjects or objects with functional notions such as the speaker/hearer or the slot-link.

Under the OT account presented here, however, there arise no such problems since my approach basically assumes the Free Reference Hypothesis. *Generator* produces as many candidate outputs as it can, which are then ruled out by independent constraints governing the referential properties of anaphors in general. That is, such candidates as a piece of paper or a pen are excluded because they do not satisfy **Feature Mismatch*, leading to a fatal violation. Note that the speaker or the hearer is also excluded because they violate *DOAP*.¹⁴

Let us now see how the zero pronouns of so-called bridge phenomena are dealt with in the OT account. I will assume that nothing prevents *Generator* to generate such candidates as the match-maker, partner, the wait person of the place where the meeting was held, etc. due to the presence of the lexeme *sen* ‘marriage meeting’ as well as the usual discourse participants and the previously-mentioned discourse entities. Similarly, our *Gen* will produce such human entities as teachers as well as such physical objects as desks or chairs that are typically present in the communal teachers’ room. The tableau for evaluation of the second null pronoun in the teachers’ room example (6U₂) above will then look as follows:

(47) Tableau for (6U₂)

[e ₂]	*Feature Mismatch	Principle B	DOAP
speaker	*!		*
hearer	*!		*
√teachers			*
desks	*!		*
chairs	*!		*

Note that the referent of the zero pronoun in the first utterance is already established as the speaker. There is only one candidate that satisfies **Feature Mismatch* as we see in the tableau above. Thus, *teachers* will be correctly interpreted as the referent of the zero pronoun [e₂].¹⁵

4.2.5 Cumulative Reference. There is an interesting case in Korean where two discourse entities are merged into one and understood as an antecedent to a zero pronoun. Such a phenomenon can be observed in the following ((48) comes from No (1991) and (49) from Park (1983:142)):

-
14. There are some ingenuities in Lee & Lee’s (2000) analysis though, which I would like to follow as a guiding principle at an operational level. There seem to be two possibilities of implementing their ideas in the OT-based analysis. First, since such notions as ‘frame’ or ‘slot-link’ do seem to be useful in that they help *Generator* to produce output candidates, I could adopt them as a guiding rule for the Generator function. That is, *Generator* refers to such information as frames or slots since they form an integral part of world knowledge in language users. Another option would be leaving such notions as frames or slots as a matter of lexical representation and keep *Gen* stated in a very simple way, as I did previously. Unfortunately, however, I can’t decide which option will make the overall analysis look more elegant at this point.
15. There is a slight complication, and possibly too generous a prediction in my analysis, about the marriage meeting example (6U₁), whose tableau will be as follows:

- (48) a. A: Younghee oass-ni?
 came-Q
 “Has Younghee come?”
- b. B: Ung, [e₁] oasse. [e₂] Cenghwuni-hako kathi oa-se, [e₃] cikum
 kongpwu hako-issee.
 Yes, came. -with together came-and, now
 study do-Prog.
 “Yes, (she) did. (She) came with Cenghwuni and (they)’re study-
 ing together now.”
- (49) U₁: [simeyntu han phoday]_i-ey [molay twu thong]_j-ul nehu-si-o.
 [cement one bag]-with [sand two bucket]-Acc. put-Hon.-Imp.
 “Put two buckets of sand into a bag of cement.”
- U₂: kuliko [mwul sey yangdongi]_k-lul pwuun hwu, [e]_{i&j&k} cal sekku-
 si-o.
 and [water three pail]-Acc. pour after, well mix-
 Hon.-Imp.
 “And after pouring three pails of water, mix (them) well.”

The zero pronoun [e₃] in (48b) refers to an entity that is created as a result of merging the two individuals mentioned in the previous discourse, *Younghee*+*Cenghwuni*. Similarly, in (49U₂), the zero pronoun cumulatively refers to the construction materials mentioned previously, ie., the cement, sand and the water.

The cumulative reference can be easily dealt with in my analysis only if we extend our ontology or the domain of discourse to contain sum-individuals as well as ordinary individual objects. Note that (48) is different from (49) in that [e₃] is ambiguous between the cumulative reference and the single reference, while the null pronoun in (49) is obligatorily interpreted as referring to the sum-individual. It is quite obvious that my analysis correctly predicts the referent of these zero pronouns. Again, this is possible as I assume the Free Reference Hypothesis.

5. Conclusion

So far, I have argued for a novel approach to zero anaphora resolution in Korean that encompasses a variety of constraints. The following is the summary of the

[e ₂]	*Feature Mismatch	Principle B	DOAP
√speaker			*
hearer	*!		*
match-maker	*!		*
√partner			*
√wait person			*

According to the tableau above, the inferred partner of the meeting event is not singled out as the optimal output. Note, however, that my prediction faithfully reflects the referential possibilities of the zero pronoun in (5U₁). The zero pronoun can indeed refer to the speaker of the utterance especially when the speaker is making a hindsight comment on him/herself after the meeting.

major findings in this study.

The lexically-motivated semantic constraint **Feature Mismatch*, which demands that any linguistic element agree in semantic and morpho-syntactic features with an adjacent expression, seems to be an inviolable principle in any forms of grammar. The syntactic constraint, rephrased in semantic terms as *Principle B* here in this paper, also plays an important role in anaphora resolution. These two conditions are in fact motivated by the most deeply rooted principles of language production and generation, thus ranking the highest among the constraints. The rest of the constraints seem to be much softer, and more likely to be violated, than the two.

In this paper, I have dealt with a set of relatively simple zero pronoun constructions available in the literature, which apparently fell nicely into the framework proposed here. Future research will have to extend its scope to deal with a larger set of constructions, both from spoken and written corpora. Ways of implementing the major ideas of this paper in natural language processing should be promising too.

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