THE NESTED DEPENDENCY CONSTRAINT
AND
THE THEORY OF GRAMMAR

CONTENTS

1. THE NESTED DEPENDENCY CONSTRAINT ..........2

2. KOREAN BINDING THEORY .................7

3. THE PRO-DROP PHENOMENON ..........10

4. PRO? ..............24

5. VARIABLE ..........29

REFERENCES ..........38

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1. The Nested Dependency Constraint

The purpose of this paper is to know how the grammar and the parser for a natural language are related to each other, and to gain some insight into this by considering how they might optimally be related in particular, by considering what sort of grammar would facilitate sentence parsing.

To get some perspective on this, let us consider first how a grammar could make life difficult for a parser. One obvious problem for any parsing system is ambiguity, including temporary ambiguity for a system that operates "from left to right". The avoidance of ambiguity has been held to motivate a number of grammatical constraints.

Fodor (1978) has proposed that the prohibition against intersecting filler-gap associations in a construction like (1) serves to eliminate an ambiguity that would otherwise be troublesome to the parser.

(1) a. *What_i are boxes_j easy to store e_i in e_j ?
   b. *This form_i, foreign students are required to list e_j on e_i [the dates of all previous visits to the United States]_j
   c. *Which of the guests_i did you have to ask Mother who_j to introduce e_i to e_j ?

In order to rule out _i - j - i - j filler-gap dependencies such as (1) above, she has formulated the constraint as a no-ambiguity constraint as in (2): Fodor (1978 : 448)

(2) The Nested Dependency Constraint (NDC)

If there are two or more filler-gap dependencies in the same sentence, their scopes may not intersect if either disjoint or nested dependencies are compatible with the well-formedness conditions of the language.

For example in (1a) and (3) below, there are two logically possible ways of associating the fillers with the gaps. But the speakers of English reportedly only get the readings where the dependencies are nested, as shown in (3).

(3) What_i are boxes_j easy to store e_j in e_i ?

The deviance of the sentence of (1) seems to be a likely candidate for a perceptual explanation.

Is the NDC then simply an artifact of the human (or the English speakers') ability to process certain types of complex sentence (1) ?

The crucial evidence comes from sentences of the form of (4):

(4) * Which boy_i did you shout e_j to e_i [that there was a bull in the field]_j ?

Sentence (4) violates the NDC and is judged not fully

See Foot note 1. on the next page.
Foot note 1.

This constraint seems not to be universal, however, since intersecting readings are possible in Swedish, and the other Scandinavian languages (Engdahl 1985) and perfectly acceptable in Italian (Rizzi 1978). Swedish (example due to Engdahl 1985)

1. Minna faraldrar ar det fa personer jag vill presentera for.
   Det ar fa personer ...
   My parents, there are few people I'd like to introduce to.
   There are few people ...

Italian (example due to Rizzi 1978)

2. l'uomo che' non so chi e1 conosca e_j
   the man who I don't know who e1 knows e_j
   This apparent NDC violations also show that the NDC cannot be merely an artifact of the communicative process.

acceptable by speakers of English. Yet, as Fodor reports, it is not in the least uninterpretable. Speakers have no difficulty in linking the fillers and the gaps properly. In other words, the NDC is a grammatical constraint.

In order to generalize the NDC as a no-ambiguity constraint, she considers two main violations of the NDC which accepted in English grammar. First case is so called Equi-NP deletion. According to her explanation, Equi normally creates a gap so close to its filler that no other filler-gap dependency could possibly intersect with it. Verbs like promise, for which Equi applies over an intervening noun phrase, provide the only possible examples:

(5) a. Who_j did you_j promise e_i e_j to be kind to Mary?
   b. Who_j did you_j promise e_j e_i to be kind to Mary?

But the nested dependency assignment here is impossible because Equi can only delete a noun phrase in the lower clause, and so the intersecting dependency assignment is predicted to be well-formed whether or not Equi falls under the NDC. She further concludes the explanation of this violation by regarding Equi phenomena as different (inappropriate) input for the NDC to apply, in contrast with Wh-movement, Too / Enough Deletion, Topicalization, and the like.

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2. Within the GPSG framework, Fodor (1983) followed the claim that verbs of the Equi class would be specified by the grammar as occurring with VP complements rather than with S complements containing gaps. Thus there would be no Equi gap (so called 'PRO') at all in examples like (5), and no filler-gap traffic could occur. The link between the absent subject on the subordinate verb and the subject of the matrix verb would be established by semantic principles rather than by syntactic binding.
Another important violations of the NDC is in Anaphora Dependencies. According to her, the one restriction in the NDC is that it applies only to movement and deletion rules that create gaps, i.e. that leave no phonologically realized material in the original position of the moved or deleted constraint. Therefore, the intersecting pronominalization relations are permitted, even when they are ambiguous as in (6).

(6) a. Mary$_i$ told Ann$_j$ that she$_j$ really needed her$_i$

b. Mary$_i$ told Ann$_j$ that she$_j$ really needed her$_i$

To distinguish the complementary environment to apply the NDC is basically correct.

But the reason to choose the special case such as wh-movement Tough/Too construction, etc. as a structural description for the NDC needs more theoretical and empirical explanation.

In order to show how Korean Binding theory based upon GB-framework correctly predicts the nature of the NDC as a grammatical constraint on interpreting the filler-gap dependencies, the various types of possible gaps will be discussed.

Hopefully, this study on the natural class of the gaps can clarify not only the theoretical problems in GB-theory but also the NDC as the constraints on competence grammar for the parser.

2. Korean Binding Theory

Current theories of linguistic structure recognize two important categories of expression - anaphors and pronouns. Anaphors are expressions lacking intrinsic reference which must be bound to an antecedent in a certain syntactic domain; pronouns are expressions which may be referentially dependent but which must be free in a certain syntactic domain. The delination and parameterization of the relevant domains of anaphoric identity and distinctness constitute the research area known as binding theory.

Interpreting the categories anaphora and pronominal as binary features, Chomsky (1981, 1982) observes that we ideally expect to find four categories of expressions with respect to binding properties:

(7) a. [+ anaphora, - pronominal]
b. [- anaphor, + pronominal]
c. [+ anaphora, + pronominal]
d. [- anaphora, - pronominal]

Let us consider first lexical NPs and how they partition in terms of (7). An example of (7a) will be overt anaphors such as each other or herself. There are pure anaphors subject

3. foot note is on the next page

(I) Binding Principles

A. An anaphor is bound in its Governing Category
B. A pronominal is free in its Governing Category
C. An R-expression is free

The notion Governing Category (GC) is defined in terms of structural government and the structural notion SUBJECT.

(II) \( \beta \) is a Governing Category for \( \alpha \) iff \( \beta \) is the minimal category containing \( \alpha \), a governor of \( \alpha \), and a SUBJECT accessible to \( \alpha \).

The notion SUBJECT attempts to capture the idea of 'most prominent nominal element', where agreement inflection (AGR) counts as a nominal element;

(III) SUBJECT

a. AGR is SUBJECT when it is present;
b. The subject of an infinitive, NP or small clause is the SUBJECT elsewhere.

The notion accessible is defined as follows

(IV) Accessibility

\( \alpha \) is accessible to \( \beta \) iff \( \beta \) is in the c-command domain of \( \alpha \) and the assignment to \( \beta \) of the index of \( \alpha \) would not violate the filter (V)

(V) i-within-i filter

\[ \cdots [\ldots \beta \ldots ] \ldots ] \ldots \], where and bear the same index.

to condition A of Binding theory. Overt pronouns such as he, them, illustrate the type (7b), elements subject to condition B, and, (7d) is illustrated by R-expressions such as Tom, the farmer.

Notice that there cannot be an overt expression satisfying (7c); a pronominal anaphor must be an ungoverned element and hence if lexical Case is assigned under government, such an element would violate the Case Filter.

Consider next the case of empty categories and their partition in terms of (7). The simplest assumption would be that the typology of empty categories mirrors that of overt ones; and indeed that seems to be the case.

A preliminary inventory renders four of empty categories which satisfy the four types of expressions predicted by (7). An example of (7a) is an NP-trace, a pure anaphor that must be bound in its governing category following condition A of the Binding theory. In this sense, an NP-trace is the empty counterpart of lexical anaphors such as each other, herself.

(7b) is illustrated by the empty pronominal pro, the phonologically-null counterpart of lexical pronouns (and hence, is subject to condition B). Type (7c) is illustrated by PRO, the ungoverned Subject of tenseless sentences. And (7d) is illustrated by variables (WH and QR traces).

Consequently, we arrive at the following partition of elements, overt and empty:
Sentence (9a) shows that Korean anaphor doesn't observe the locality condition viz. 'caki' can also refer to John. But note that 'caki' cannot be bound by Bill since Bill is not in subject position. It seems that Korean anaphor is subject-oriented. (cross-linguistic study for 'subject-oriented' anaphor, see Yang (1983))

Sentence (9b) shows that Korean pronominal 'ku' may observe principle B of standard Binding theory. But unlike English pronominal Korean pronominal cannot precede its binder, as (10) shows, whereas anaphor 'caki' can precede whenever it doesn't c-command its antecedent.

*ku_1 ..........................

'His mother saw John'

According to Saito & Hoji (1983), anaphor 'zibun' and null pronouns, but not overt pronominal 'kare', can be interpreted as logical variables, in Japanese.

Observe the following contrast between 'zibun' and 'kare'.

(11) Daremo_ga [zibun_ga/*kare_ga Mary-ni kirawareteiru to] omokondei:  
    everyone NOM he NOM DAT is disliked that  

    'Everyone is convinced that he is disliked by Mary.'

Along their observation, consider Korean examples as follows;

(12) a. nu_1-ga [caki_1/*ku_1 -uy umma -lul] mannat-ni?  
    who NOM self/he POSS mom ACC meet -Q  
    Who met his mother?
b. [\(\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texture
logically null) nominals as follows.

\[(15)\] a. [+ caki, -ku] caki, soro caki-Pro
b. [- caki, +ku] ku, kunyo ku-Pro
c. [- caki, -ku] John, the boy VARIABLE
d. [+ caki, +ku] Logically Irrelevant

Let us consider the distribution of Korean gaps with English sentences next.

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6. Let us assume that both Korean anaphor 'caki' and pronominal 'ku' have their lexically empty counterparts. Let's name these phonetically null elements 'caki-Pro' \
& 'ku-Pro' respectively.
In order to avoid the confusion with PRO (so called 'big /pro/') and pro (so called 'small /pro/'),
I write Korean neutral /pro/ as Pro (capital letter "P"
with small letter "ro"). I also assume that each empty category is a proper-subset of overt counterpart (pronoun)
with regard to its function, in other words, for example, 'caki-Pro' must be Bound, can precede its antecedent
and so forth.

7. foot note 7 is in p.16

\[(16)\] a. e came.
b. John saw e
c. e saw e
d. John said that e saw Bill
e. John said that Bill saw e
f. John tried e to come
g. John told Bill that e saw e

In sentences (16, a.b.c.), all the gaps are 'ku-Pro' in unmarked case, since they receive their reference from
outside of the sentence.
Consider (16,d.e.g.), if the gaps are referentially dependent
upon the elements within the sentence, so called proximate
use, then the gaps can be 'caki-Pro', in other case, the
gaps are 'ku-Pro'. Since the gap in (16,f) can only refer
to John, this gap should be 'caki-Pro'.

To summarize, the Chomsky's Binding system is not
enough to show the sharp complementarity between anaphor
'caki' and pronominal 'ku' in Korean. The crucial reason
to cause the neutralization of pronouns in Korean is best
explained by the fact that the loss of strict local domain
promotes the destruction of the distinction between their
occurrence.

Instead of Chomsky's standard binary features, I have
suggested the new features (so called [+ caki], [+ku])

foot note 8 is in the next page.
7. I only illustrate English sentences instead of giving actual Korean data since the difference of lexical items and word order is irrelevant to my discussion here.

8. Huang (1984, 1985) argues that the object gap in natural languages should be variable⁹, since in pragmatically neutral environment, the object gap in natural language (at least in Chinese) cannot refer to any elements within the whole sentence.
In order to concentrate my main topic, I will not pursue this matter here.

9. The basic notion of the term 'variable' is defined in Chomsky (1981:185, 320)
   1. \( \alpha \) is a variable iff
      i) \( \alpha = [_{np} \ v] \)
      ii) \( \alpha \) is in an A-position (hence bears an A-GF)
      iii) there is \( \beta \) that locally \( \alpha \)-binds \( \alpha \)
I assume that there are only two major empty categories.
They are variable and non-variable (which is neutralized Pro')
And the neutralized 'Pro' is split into 'caki-Pro' and 'ku-Pro'. Variable may be split into trace-variable
(such as wh-trace, trace left by Abstract operation), and base-generated, (may be parasitic gap can be a possible applicant.) variable.

which can generate the environment in which the anaphor and pronominal can be distinguished. We will see how the Korean binding system can explain the gaps in other languages in later chapters.
3. The Pro-drop phenomenon

Pro-drop phenomenon has traditionally explained by the rich inflectional morphology, in particular, a rich system of agreement.

According to Chomsky (1981) and many other people, Italian and Spanish allow a pronoun to drop from the subject position of a tensed clause because there is a rich system of verb-subject agreement in these languages.

The AGR(eement) marking on a verb is rich enough to determine, or recover, the content of a missing subject; therefore, such a missing subject is allowed.

But if we scrutinize the 'Pro-drop phenomenon' more precisely, we may find that traditional approach is less plausible.

There are at least four argument against their proposal.

First, although German and French also have rich AGR marking system, they normally do not drop the subject pronoun.

Therefore Pro-drop parameter cannot be explained by the richness of AGR marking.

Second, for instance, in Spanish, verbal morphology is not perfectly rich enough to match case-markers with their relating subject pronoun in other words, the AGR-markers in Spanish do not include gender-agreement and they are more meager in some tense and mood as the following verbal conjugation shows:

(17) Cantar ' to sing'

\[
\begin{array}{lllll}
\text{pres. IND} & \text{pres. SUB} & \text{Imp. IND} & \text{Imp. SUB} \\
1st sg. & canto & cante & cantaba & cantara \\
3rd sg. & canta & cante & cantaba & cantara \\
\end{array}
\]

Consider, for example, the verb form 'cante' can only identify the subject as singular non-1st or 2nd person in pres. sub. mood. If we don't have any discourse information, how can we correctly identify the missing subject?

Third, Brazilian-Portuguese, for example, can drop the object pronoun in certain environment besides dropping subject pronoun. We may explain the subject pronoun drop in terms of traditional pro-drop parameter, but how can explain the missing element in object position? Do we need both pro-drop parameter and the empty Topic parameter\(^{10}\) for this language?

Finally, there are some languages which show the perfect Pro-drop phenomenon.

Considering the Standard Arabic (Tuller 1982) as follows, INFL is morphologically complete only when the subject is

\[\text{-}\]

10. According to Huang (1984), the Empty Topic Parameter may involve the following notion:

For example like Chinese and Korean,...etc.

When there is no AGR to identify the missing element, its reference is determined by a closest SUBJECT.

And when there is a gap in object position, this gap should be identified by the empty Abstract Topic Operator.
dropped. When the subject is overt, only person and gender are marked.

(18) a. darasa z- zayda:ni (*darasa: z-zayda:ni)
    study-3.s.m the-two-z
    'The two z. studied'

b. darasa: (*darasa)
    study-3.dual.m

Note that the length of vowel can be a separate morpheme in this language. Along these four evidences, the Pro-drop parameter may be reformulated somehow.

Let us look at following Spanish examples:

(19) a. e habla espanol
    's/he speaks Spanish'

b. Juan cree que e habla espanol.
    'Juan thinks that he speaks Spanish.'

(20) a. Muchos estudiantes creen que ellos son inteligentes.

b. ......................... e .........................
    'Many students believe that they are intelligent.'

(21) Cuando e1 me vio Juan se fue.
    *él
    'When he saw me, Juan went away.'

Let us compare the Spanish referential dependence situation of (19,a.b.) with Korean situation in (16,a.d.)

We may explain the gap in Spanish either 'caki-Pro' (if proximate) or 'ku-Pro' (if deictic).

If we consider the Overt Pronoun Constraint (OPC)\(^1\)\(^1\) in Spanish (suggested by Montalbetti 1984), it will be more clear to regard the pro-drop phenomenon as the partial function of Korean Binding system.

Example (20) deserves attention in this sense. In (20,b), Empty pronoun (say, 'pro') can behave like a bound variable, thus receiving the following LF description:

(20,b) (many x: x a student) x believes that x is intelligent.

An attractive phenomenon, however, happens in (20,a).

In this sentence we have replaced 'pro' by its overt counterpart, the lexically realized pronoun 'ellos'(they).

Although (20,a) is perfectly grammatical, it cannot (and does not) mean (20,b). In other words, in (20,a) the overt pronoun cannot act as a bound pronoun.\(^1\)\(^2\)

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\(^1\) Montalbetti (1984) suggested following constraint.

**Overt Pronoun Constraint (OPC 1):** for Spanish type languages

OP link to formal variables iff the alternation overt/empty obtains. **OPC 2:** for Japanese (Korean) type languages

Overt Pronoun cannot have formal variables as antecedent.

\(^2\) Evans (1980) argues that there are only two kinds of pronouns: referential and bound. The two typologies are interconnected: pronouns used as 'free', 'coreferential', or 'E-type', belong to the referential kind; a pronoun used as a 'bound'pronoun belongs, predictably enough, to the bound kind.

Bound pronouns, he defined, that is, "pronouns which have quantifier expressions as antecedents, and are used in such a way as to be strictly analogous to the bound variables of the logician." (p.337)
Note that Korean anaphor 'caki' can only be logically variable-bound interpretation possible, whereas pronominal 'ku' cannot. If we assume that Spanish 'pro' bears [+caki] feature, and 'ellos' [+ku] feature, then we can predict that only variable interpretation is possible for empty pronoun in Spanish.

In case of English, as the gloss of (20) shows, the two different readings (bound variable reading and coreferential reading) are neutralized since English doesn't allow pro-drop in tensed clause.

Another evidence is shown in (21). According to Berent (1980), some Spanish speakers have indicated that in (21) the empty subject of 'vío' and 'Juan' may be co-referential but where the subject pronoun 'él' is specified, 'él' and 'Juan' must be distinct.\footnote{13}

In this case also, we can plausibly assume that Spanish zero-pronoun has the feature [+caki] which allow anaphora to precede its antecedent. It goes without saying that overt pronoun in Spanish should be regarded as 'ku' pronoun.

To summarize the pro-drop phenomenon in Spanish, the true identifier for the missing element is not AGR but discourse-binder or some potential antecedent in given sentence. The former case is explained by [+ku] feature and the latter case by [+caki] feature respectively. If my assumption really works also in all pro-drop languages, we can reduce the pro-drop phenomenon to one of by-products of Korean Binding Theory \footnote{14}.

\footnote{13} It seems also reasonable to argue that the coreferential avoidance reading in Spanish overt pronoun may be due to Avoid Pronoun Principle (Chomsky 1981)

But I want to reduce this principle into more general principle so called Korean Binding Theory. If one principle can cover the case of other separate principles, it seems more reasonable to choose only on general principle, whose covering set is larger than any of similar theory.

\footnote{14} One might ask why the pro-drop languages, then, need luxurious agreement marker. The answer is human languages sometimes (not rarely) bear in uneconomical feature.
4. PRO?

In this chapter I will discuss what is the nature of PRO in English.

Consider following example:

(22a) John wanted [him to go.]

b. John wanted [PRO to go.]

In all dialects (22a) requires disjoint reference between 'John' and 'him'. Whereas, PRO in (22b) requires coreferential reading with 'John'. Therefore PRO and pronominal 'him' are in complementary distribution with respect to locality condition. But consider following example (Chomsky 1982: 27)

(23) a. They think [John said that it was difficult for PRO learning to cooperate, PRO helping each other.]

b. We feel that [PRO learning to cooperate, PRO helping each other] is important for their development.

In both (23a) and (23b), the antecedent of PRO is 'they'. Also the relation of 'they' to PRO in (23a) violates the SSC in that PRO need not be bound by the "nearest" c-commanding subject, namely, John. This is apparent violation of principle A of standard Binding Theory, and this also cannot be sufficiently explained by principle B since PRO should be bound in this case.

Therefore we can conclude that PRO neither has [+ana, -pro] nor [-ana, +pro]. Of course PRO cannot be in [-ana, -pro] category since PRO must be bound in some case.

But as we see above, PRO partially have +ana and +pro features. Therefore, Chomsky (1981) suggested to put PRO in [+ana, +pro] category which seems logically contradictory.

But if we assume that PRO should be categorized in terms of [+caki, +ku] features, we can easily put PRO into [+caki, -ku] place, since PRO must be generally BOUND. Note that +caki feature doesn't require the strict locality condition of principle A.

In order to support this claim, let us look at some more function of PRO: examples due to Bouchard (1985a)

(24) John tried PRO to leave early, and Bill did, too.

(25a) Only Bill expects PRO to win.

b. .................himself ....

c. ...................that he will win.

(25c) has two readings; on the strict reading, Bill expects that he (Bill) will win, but other people (say, Peter and Paul) do not expect Bill to win; on the sloppy reading, Bill expects that he (Bill) will win, nor does Paul expect that he (Paul) will win.
Interestingly enough, both (25a) and (25b) show that 'PRO and himself'in this environment only require sloppy reading. Comparing (24) in which only sloppy reading is possible, let us consider following example in English.

(example due to Bouchard (1985b)

(26) a. John thought that he would win, and Bill did, too.
    =John thought that John would win, and Bill thought that Bill/John would win.

b. John likes himself, and Bill does, too.
   =John like John, and Bill likes Bill/*John.

As was first noted by Ross (1967), when a deleted VP contains a pronoun coreferential with the subject, two readings arise; one in which the deleted pronoun is treated as a bound variable that refers back to the subject, and one in which the pronoun refers to the same entity picked out by the corresponding pronoun in the first conjunct.

But a bound anaphor in a deleted VP is obligatorily interpreted as a bound variable. Thus (26a) is ambiguous but (26b) is not ambiguous. When VP deletion takes place, then, a deleted pronoun can have two readings, whereas a deleted anaphor has only one, so called 'sloppy identity'.

In parallel with (26b), only sloppy reading is relevant in (24).

However let's consider following Korean sentence and its English counterpart.

(27) a. [John$_1$-uy umma-ka]ku$_1$/[caki$_1$ -lul saranghanda, love
    Bill -uy umma-do gruta. too so

b. John's mother loves him$_1$ and so does Bill's mother

As Reinhart (1983) observes, (27b) can have sloppy reading. But Korean sentence cannot be interpreted in a sloppy way, since 'caki' cannot be accepted in this environment.

(note that 'caki' should be BOUND viz, c-commanded by its antecedent.)

Sloppy reading, one of variable-bound reading may not occur in Korean sentence (27a)

But the sloppy reading is obligatory in Korean counterpart of English sentence in which the sloppy reading is optional.

(28) Jokes about his$_1$ wife upset Max$_1$ but not Felix.

The obligatoriness of sloppy reading in Korean is naturally explained by Korean Bind system, since only the anaphora which bears +caki feature, but not +ku feature can precede its antecedent whenever the anaphor doesn't c-command it$^{15}$. ```
15. The Korean counterpart of (28), Korean allow at least two kind order with respect to subject (' Jokes ...') and object ('Max').
Roughly schematized as follows; (with Korean order)

1. a. [NP ........his_i ........] ...... Max_i ........
b. Max_i .............[NP........his_i ........]

In case of (1b) 'his' can be either replaced by 'caki' or 'ku'. If 'his' is replaced by 'ku', coreferential reading is preferred but sloppy reading is not totally rejected. If 'ku' in this position purely bears +ku feature, then sloppy reading (variable-bound reading) must be unacceptable. In order to retain my Korean Binding System, I may regard 'ku' in this position as 'false pronominal ('ku')," in other words, the 'ku' in this position actually plays a role of syntactic anaphor (caki); viz, variable-bound like 'caki' pronoun.

16. Bouchard (1985b) developed the notion 'false reflexives' with which he tries to explain the apparent violations of strict complementarity of anaphor/pronominal in English.

'False reflexives' are not syntactic anaphors but only morphological anaphors.

5. Variable

Let us consider following sentences; (Chomsky 1982; 30)
(29) a. The men are too stubborn e_1 to talk to Bill.
b. The men are too stubborn e_2 to talk to e_3.
The interpretation of these sentences makes it clear that e_1 and e_2 are PRO; e_1 is bound by 'the men', while e_2 lacks an antecedent and has the arbitrary interpretation of PRO. Let us focus on the Gap e_3.
Since it is governed by 'to', it cannot be PRO(by PRO-theorem). Therefore, it is trace. It cannot be the trace of e_2, because e_3 cannot refer to e_2. Furthermore, e_3 cannot be A-bound by 'the men' since it will violate principle A of Binding theory. Therefore, the final option is variable, that is, which must be A-bound by an operator O.
The actual S-structure of (29b) then, must be (30).
(30) The men are too stubborn[O_3 O_3 PRO to talk to e_3.]]

According to Chomsky (1982)
The operator O is an empty category and is semantically empty, unlike a wh-phrase for example.

18. Of course, it is possible to assume the base-generated non-PRO which I already mentioned in Footnote 9.
In order to simplify my discussion, I will not pursue this matter here.
Therefore, e₃ is in effect a free variable, assigned no range by its operator, in the embedded clause. Suppose following Chomsky (1982), that we supplement the principle barring vacuous operators by the requirement that each LF variable either be assigned a range by its operator or be assigned a value by an antecedent that attaches it. It follows that e₃ must be bound by 'the men', though it is not locally bound by 'the men' (rather, by O) and is not the trace of 'the men'. Let us consider (29b) within Korean Binding System, e₃ cannot be 'caki-Pro' since it must be free with local potential SUBJECT e₂ (PRO). e₃ cannot be 'ku-Pro', either, since e₃ should be bound by 'the men' (at least referentially dependent upon it.) Therefore the last possible category is variable. Since, by assumption, variable needs local A-binder, we can postulate abstract empty Operator in comp position of embedded clause. Then how O₃ can correctly (obligatorily) be coindexed with 'the men'? Within Korean Binding Theory, it is impossible to explain this fact.

But suppose, O₃ can contain some nature of +caki feature, and let's name O₃ caki-Operator (henceforth caki-O), then the only difference between caki-O and caki-Pro is that the former is in A-position. Then, how can variable correctly be transmitted its reference from 'the men'? Since its local A-binder (caki-O) already earned the reference from 'the men', the variable (e₃) automatically can have reference from caki-O. Let's call this assumption: Caki-Transitivity Condition. (31) Caki Transitivity Condition (CTC)

Variable can be referentially dependent on any element through its intervening 'caki-O' which binds it.

Let's look at 'parasitic' gap in English, with the knowledge of Korean Binding Theory and CTC. Consider the following examples:

(32) a. John is a man whom everybody who meets e admires t.
   b. Which articles did John file t without reading e ?

According to Chomsky (colloquium 1983), for example, (32b) has the following S-structure or LF; (see also Contreras 1984)

(32'b) Which articles did John file t without [S [O₁ [PRO reading]₁]

In (32b), (which articles, t) form a chain, and so do (O₁, e). Both chains are then hooked up (possibly by a rule of prediction, see Williams (1980)). Notice that under this chain-composition approach the parasitic gap is not bound by the overt operator ('which articles'), but by an empty operator O. This chain-formulation also shows

foot note 19 is on p.32
(32b') doesn't violate the Bijection Principle (Koopman & Sportiche 1984) which states that there is a one-to-one relation between operators and variables. Let's try to explain the assumption I made. e in (32b) cannot be 'caki-Pro' since it is free with PRO in local A-position. e in (32b) cannot be 'ku-Pro' since it must be always referentially dependent upon 'which articles' or t. Then likewise 'too-stubborn to' construction, e should be variable A-bound by empty operator which must be locally bound by t.

19. The rule of predication can also apply to the principle of relative clause interpretation between the head of relative clause and its coindexed relative pronoun:
Consider the following relative clause:
1. the man who John saw.
2. the man who John saw tj
The rule of Predication, applying to the LF representation
2. identifies i and j, yielding the representation 3.:
3. the man who John saw tj

20. I assume that the gap left by syntactic movement (t) c-commands the "parasitic" gap(e) in (32b).
More discussion, see Contreras (1984)

Then, CTC gives referential index same as t to e. According to the analysis of 'parasitic gap' based upon Korean Binding system and CTC, we may yield following s-structure for (30a);
(30a) John is a man [s whom [s everybody] Oj who j [s tj meets ei] admires tj]
Consider the chain (whom1, t1), (O1, e1) and (whoj, ej), and note that t1, e1, ej are all variables.
If we look at the filler-gap dependency schema for those three chains;

(31) Whom1......O1......whoj......ej......e1......t1
(31) exactly observes NDC viz, neither of their dependencies are intersected.
Recall the example (1) on page 1. and write the filler-gap schema here;
(1)' a. Whatj......Oj......e1......ej

b. This formj......ej......e1......the dates......states

    c. Which......guests1......whoj......ej......ej

Assume the chains of the filler-gap dependencies;
(what1, e1), (Oj, ej) for (1'a), (this formj, ej), (the......ej) for (1'b) and (which......i, ej), (whoj, ej) for (1'c) respectively.
All these chain formulation shows that the relation between first element and second element in chain is (A-binder, variable).

Recall the example (5a) and (6), and imagine the chain of the filler-gap (or binder-bindee) dependencies;

for (5a), the second chain is \((\text{you}_j, \text{PRO}_j)\) and for (6), both first and second chain can be \((\text{binder, bindee})\).

The common property between the chain of (5a) & (6) is that first element in chain is in A-position and second one in chain is Pro-form (either overt or empty.)

Now we can conclude that NDC can only apply to (A-binder, variable) chain relations.

Define this assumption on NDC as follows:

(32) The Extended Nested Dependency Constraint (ENDC)

If there are two or more filler-gap dependencies in the same sentence, their scopes may not intersect iff the chain formations are composed of (A-binder, variable)’s

Let us call the chain (A-binder, variable) V-chain and other chains which do not satisfy the property of V-chain, we may call \(\tilde{V}\)-chain.

Therefore NDC is only relevant to V-chain but not \(\tilde{V}\)-chain.

Consider following examples and their filler-gap dependencies;

\[(30^a) \quad \ldots\text{whom}_i \ldots\text{everybody}_j \ldots\text{e}_i \ldots\text{wh}_j \ldots\text{e}_j \ldots\text{e}_1 \ldots t_1\]

(32a). To whom does John seem \(e_i e_j\) to be crazy?

b. \(\ldots\text{whom}_i \ldots\text{John}_j \ldots\text{e}_i \ldots\text{e}_j\)\]

As (30^a) shows, there is only one intersecting dependency, between (everybody\_j, who\_j). By assumption, this chain is \(\tilde{V}\)-chain, therefore ENDC is irrelevant here.

Considering (32a), \(e_i\) is wh-trace left by 'to whom' and \(e_j\) is NP-trace left by 'John’. Since the chain (John\_j, \(e_j\)) is \(\tilde{V}\)-chain, it doesn’t matter whether the dependencies are intersecting or not.\textsuperscript{21}

To summarize this paper, I have suggested that all the gaps in natural languages (especially Korean, Japanese, Spanish, English) can wear the uniforms either 'Pro', or VARIABLE. According to Korean Binding system, we can distinguish variable, caki-Pro and ku-Pro, three of which separately plays important roles in natural languages. The NDC is more naturally explained by cutting two major categories so called Variable and

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foot note 21. is on the page 36
21. Engdahl (1985) suggests that the superiority restriction can be just one instance of the ENDC, which is applicable to extractions in English. Thus, structures that obey the superiority restriction will automatically obey the ENDC. Therefore, the following minimal pairs in English (Chomsky 1981; 255) can be explained by either superiority restriction or ENDC. (LF representation is mine)

S-structure
1. * it is unclear \[ s \ \text{what} \ [ s \ \text{who said} \ t_j ] \]
2. it is unclear \[ s \ \text{who} \ [ s \ t_i \ \text{said what} ] \]

LF
1'. * it is unclear \[ s \ \text{who} \ [ s \ \text{what} \ [ s \ t_i \ \text{said} \ t_j ] ] \]
2'. it is unclear \[ s \ \text{what} \ [ s \ \text{who} \ [ s \ t_i \ \text{and} \ t_j ] ] \]

Although it is unclear whether she posits same
LF as mine, the ungrammaticality of (1) & (2) can be explained by ENDC as a constraint on LF, too.

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Pro-form, that is, NDC is only applicable in Filler-Variable dependency. With regard to NDC as no-ambiguity constraint (Fodor 1978) and ENDC as competence grammar for parser to avoid the ambiguity of filler-gap dependencies, it should be noted that ambiguity and structural complexity are facts about the language; they are independent of how we describe it. It is also necessary to consider how the human sentence parsing mechanism goes about its task of determining the structure of sentences, the nature of gaps, and what kinds of information it needs to draw on at various stages. We should think that some general points about optimal grammar format can sensibly be made just on the basis of what it is that a parser has to be able to do. But empirical data are undoubtedly going to be needed, for it is also obvious that what kind of grammar does or does not suit a parser depends, at least in part, on the particular design and resources of that parser.
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