Minimalist Parsing and Japanese: On Theory and Experiential Factors

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1. Introduction

We assume the design framework of the *probe-goal* (PG) model, e.g. (Chomsky 1998,1999), a theory in the *Minimalist Program* (MP), and propose an incremental parser that recovers phrase structure from overt input and computes probe-goal relations in an efficient manner. The design challenge addressed here is to come up with a parser architecture, compatible with the PG model, that minimizes search during the recovery of structural descriptions while accounting for parsing preferences. More specifically, we report on (and provide theoretical support for) experimental data on parsing preferences in possessor relativization, a *dispreferred* construction for Japanese, bringing into play experiential factors in the case of naïve speakers. By theoretical support, we mean that the preferences are traced to architecturally justifiable features under the PG model. The same mechanism proposed to support the facts on Japanese (and also Korean) possessor relativization is also independently required for Turkish data. The central hypothesis explored in this paper is that specifier-T is a distinguished position for the parser in the sense that its contents

can be accessed directly, i.e. without having to search the derivational history to find it. Motivation for its special status comes from theoretical considerations: specifier-T is the specifier position guaranteed to be present by the EPP (Chomsky 1982:10); consequently, it must be filled in narrow syntax. It is the target of phrasal movement from the *v*P kernel, including subjects, e.g. standard declarative sentences, objects, e.g. passivization or unaccusative constructions, and scrambling, e.g. OSV word order, (Ishihara 2000) and (Miyagawa 2004). In the case of Japanese (and Korean) possessor relativization, the so-called "option" of short-distance scrambling permits the parser to determine possessor-possessee relation without search. In the case of Turkish, temporary subject-object ambiguities with bare (or non-case-marked) NPs can also be resolved by direct access to specifier-T.

2. The Experimental Data

In this section, we introduce the Japanese possessor of object relativization data. Informal judgments from experts indicate that there should be a general preference for the OSV scrambled word order (compared to the canonical SOV one). This preference is surprising given the body of psycholinguistic studies that show there is a measurable cost to scrambling in Japanese, e.g. (Chujo 1983; Miyamoto & Takahashi 2002; Ueno & Kluender 2003; Koizumi & Tamaoka 2004, among others). We tested the possessor of object relativization construction on naïve native speakers, eliciting easiness/difficulty ratings for the scrambled/canonical distinction with non-possessor object relativization data forming the baseline. One difficulty that must be addressed in experimental design is that this construction is generally dispreferred in Japanese. This poses difficulties for testing given that the contrast we are asking naïve native

speakers to make depends on their ability to correctly process and comprehend two varieties of so-called "marginal" constructions. We propose and show that this concern can be addressed by using a two-stage experimental design, incorporating a training or familiarization phase as the first stage.

2.1 Japanese Possessor Relativization

Restrictive relative clauses in Japanese may involve a possessor-possessee relation, as shown in the examples in (1), where the accusative Case-marked object *musume* (*daughter*) is related to the head of the relative clause *otoko* (*man*).

(1) a. musume-o watashi-ga mita otoko
daughter-ACC I-NOM see-PAST man
b. ?watashi-ga musume-o mita otoko
I-NOM daughter-ACC see-PAST man
"the man whose daughter I saw"

Based on expert intuitions, the OSV scrambled word order in (1a) should be easier to process than its canonical SOV counterpart in (1b).[1] Results of experiments for naïve native speakers on data of the sort presented above will be given in section 2.3.

Possessor relativization also obtains with subjects. The relative clauses in (2) below are the subject-oriented counterparts of (1).

(2) a. musume-ga watashi-o mita otoko
daughter-NOM I-ACC see-PAST man
b. ?watashi-o musume-ga mita otoko
I-ACC daughter-NOM see-PAST man
"the man whose daughter saw me"

However, in contrast to (1), (2a), the canonical word order case, is easier to process than (2b), which exhibits object scrambled word order.

The Japanese data also receive (informal) independent confirmation from Korean, (Shin & Kang, p.c.). The Korean counterparts of (1) and (2) and their processing judgments are given in (3) and (4), respectively.

(3) a. ttal-ul nay-ka po-ass-ten namca
daughter-ACC I-NOM see-PAST-REL man
b. ?nay-ka ttal-ul po-ass-ten namca
I-NOM daughter-ACC see-PAST-REL man
"the man whose daughter I saw"

(4) a. ttal-ka nay-ul po-ass-ten namca
daughter-NOM I-ACC see-PAST-REL man
b. ?nay-ul ttal-ka po-ass-ten namca
I-ACC daughter-NOM see-PAST-REL man
"the man whose daughter saw me"

2.2 Syntactic Analysis

We assume the basic Japanese phrase structure shown in Figure 1 below. Following Chomsky's (1998, 1999) probe-goal model, we assume that V selects for but does not Case-mark its object. Instead, transitive v* selects for V and is a probe that has the property of valuing `acc` (accusative) Case. v* also selects for a specifier, to be occupied by the sentential subject at (first) Merge time. This maximal phrase formed by v* is the theta kernel for simple transitive sentences. T selects for v* and is a probe that has the property of valuing `nom` (nominative) Case. (Formally, we note that probes v* and T have uninterpretable Φ-features that also must be valued, though in Japanese these agreement features are not visible.) Through its `epp` (EPP) property, T also projects a specifier position that may be the target of Move, i.e. internal Merge. The claim to be advanced in this paper is that the parser has special access to

this specifier-T position. Finally, we assume the complementizer (c) selects for T. In the case of Japanese relative clauses, we assume there is a covert relativizer that probes for a matching gap in its c-command domain. (In the case of Korean, we assume this relativizer is overt.)

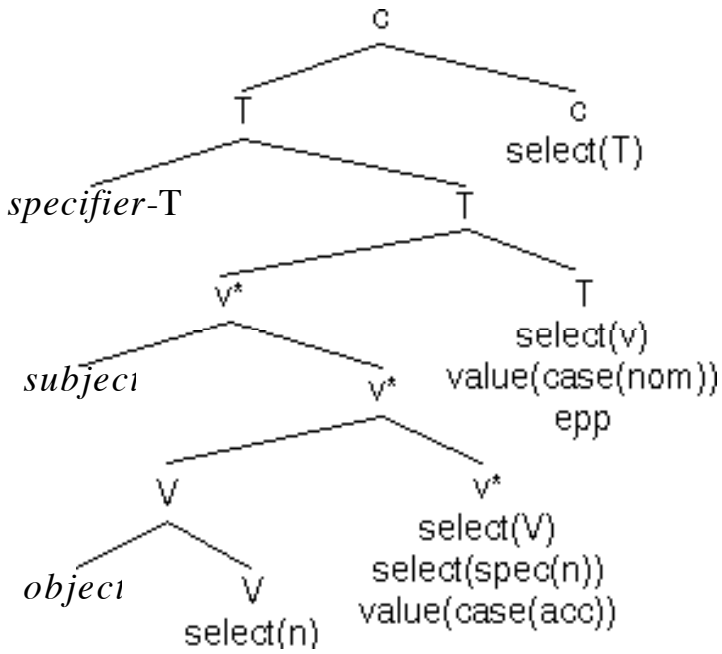

Figure 1: Basic Japanese Phrase Structure

Given these assumptions about basic SOV phrase structure, the task of the online parser is then to fill in the entire open left edge of Figure 1 in an incremental, left-to-right manner, recover any movement out of the theta kernel and compute probe-goal relations as relates to Case and Φ-feature agreement. Note that we are assuming that an incremental, left-to-right parser necessarily operates in a different mode from Chomsky's (1998, 1999) account of bottom-up Merge/Move computation. Instead of bottom-up assembly, we propose that basic skeletal phrase structure is already predicted (top-down), and open positions are filled in during the course of left-to-right parsing. See (Fong 2005) for a computation implementation of the procedure using elementary

trees with open positions.

Within theories in the MP, there are proposals that object scrambling of the kind in (1a) results from EPP-driven Move, e.g. (Miyagawa 2004). Under this proposal, the object raises from its original position to occupy specifier-T without creating additional phrase structure, and the subject remaining *in situ*, i.e. in specifier-v. We adopt this mechanism, together with the idea that the relativizer (henceforth REL) is a probe that seeks a licensing gap.[2] The data in (1) can now be given the analyses in (5). (Notation: *t* represents the copy of movement.)

(5) a. [$_c$[$_T$ [*e* musume]-o [$_{v*}$ watashi-ga [$_V$ *t* mita]]] REL] otoko
daughter-ACC I-NOM see-PAST man

b. ? [$_c$[$_T$ watashi-ga [$_{v*}$ *t* [$_V$[*e* musume]-o mita]]] REL] otoko
I-NOM daughter-ACC see-PAST man
"the man whose daughter I saw"

REL in (5) probes for the matching goal *e*, i.e. the empty possessor in the DP [*e* musume], in the c-command domain headed by T. In (5a), given the specifier-T account of scrambling, *e* is embedded within specifier-T. In (5b), *musume* (*daughter*) remains *in situ*, embedded as the deepest phrase in the structure, and the subject *watashi-ga* (*I-NOM*) raises to satisfy the EPP property of T.

The processing preferences can be predicted if the parser must also compute probe-goal relations online, essentially at the same time as open positions in phrase structure are being filled. In (5), the parser only activates REL when the head noun *otoko* (*man*) is encountered. In other words, until the head noun the parser has been operating with the (top-down) assumption that it is processing a simplex SOV sentence (and has no reason to assume otherwise). There is psycholinguistic evidence to suggest this is correct, i.e. Japanese

relative clauses are initially processed as main clauses with dropped arguments, see (Yamashita 1995) and (Miyamoto 2002). On encountering *okoto*, the parser must revise its initial simplex sentence assumption. It does this by creating the additional structure necessary to support a restrictive relative clause, as shown in (6a–b).

(6) a. $[_c$ TP [c]] ⇧ *otoko*
b. $[_N[_c$ O $[_c$ TP $[_c$ REL]] *otoko*⇧]

In (6a), the marker (⇧) indicates that the parser is yet to see the head noun *otoko*. In (6b), it inserts the empty relativizer REL, the empty operator O (assuming a empty operator analysis of restrictive relatives), and adjoins the relative clause to *otoko*. The insertion of REL triggers probe-goal action. Since both (1a) and (1b) are convergent in the sense that REL will find the matching *e* even if it is embedded in the deepest phrase, as in (1b), the probe-goal mechanism must be a general one capable of searching the history of derivation as recorded in the phrase structure TP. The simplest assumption is that this is based on the same mechanism used for Case/Φ-feature system, which is known to exhibit long-distance agreement effects, see (Chomsky 1998).

There are two possibilities to be explored at this point: (A) the difference in processing difficulty between (1a) and (1b) simply lies in the depth of embedding, T vs. V, or (B) the parser has targeted access to specifier-T and thus can perform (without search) a direct probe-goal check that can complete before the general search mechanism returns.[3] Both models are compatible with the generally recognized fact about subject/object asymmetry with respect to the processing of Japanese relative clauses. That is, as with English but not Chinese, Japanese subject relative clauses are considered to be easier to process than

object relative clauses, (Miyamoto & Nakamura 2003). Under the assumptions of Chomsky's model, subjects (not objects) in non-scrambled clauses raise to specifier-T to satisfy the EPP requirements of T. Since specifier-T is also higher than any phrase inside *v*P, this supports both options. The judgment for the canonical word order over the object scrambled word order in (2) is also compatible with both choices. We now turn to data indicating that a model incorporating option (B) should be preferred.

The *mo*-phrase data in (7) corresponding to the object possessor relativization data in (1), assuming the judgments indicated (Hasegawa, p.c.), suggests that (B), i.e. the targeted access account, may be correct.

(7) a. ?musume-o watashi-mo mita otoko
daughter-ACC I-NOM see-PAST man
b. watashi-mo musume-o mita otoko
I-NOM daughter-ACC see-PAST man
"the man whose daughter *I also* saw"

As (7) indicates, the judgments in (1) are reversed when the focus particle *-mo*, (*also*) is substituted for the nominative marker *–ga*. Hasegawa (2005) argues that mo-marked phrases such as *watashi* (*I*) in (7a–b) should occupy the specifier-T position. Given this assumption, *musume* (*daughter*) in (7a) must appear at a higher position at the edge of T, and option (A) cannot be maintained.[4] In other words, it is only the lowest (or canonical) specifier-T position that the parser has direct access to. In keeping with the model in (Fong 2005), in computational implementation terms there should be a single designated "box", i.e. register, to be filled at the same time as specifier-T. The designated box account is a reasonable one given that we know the box will always be utilized, i.e. the first (or initial) specifier-T position is guaranteed to

be always present in syntax by the EPP. Given bare phrase structure considerations, additional edge positions at T are generated only when required.

In terms of computational motivation, a box model allows the parser to completely avoid any search of the derivation history in cases where the REL gap is associated with the specifier-T box. Moreover, a single box is simpler than, say, a stack or queue based model in which additional choice points have to be introduced for data structure management. Given the left-to-right nature of the parser, the canonical specifier-T position corresponds to the last encountered (or rightmost) edge-of-T position. Procedurally, the single register is filled (overwriting prior contents if necessary) every time an edge-of-T position is encountered. In case of multiple edge positions, the result after processing all edge positions is that the register will hold the same contents as the lowest (or canonical) specifier-T.

2.3 Two-Stage Experimental Design

Psycholinguistic testing of theoretical linguistic data with naïve speakers can be a daunting challenge for experimental design, especially when judgments may be subtle and require appropriate or extensive contextual support, e.g. see the survey in (Schütze 1996). In the case of the possessor of object relativization data, the fact that the construction is strongly dispreferred proved problematic in direct testing. Consider the test examples in (8). The passive and resumptive pronoun counterparts are given in (9) and (10), respectively. In general, speakers prefer the rendering in (9) over (10) with *sono* (*whose*) as a resumptive pronoun. The test data in (8) comes in as a distant third choice.

(8) a. sutookaa-ga musume-o neiratteiru hahaoya
stalker-NOM daughter-ACC going after-PRES-PROG mother
b. musume-o sutookaa-ga neiratteiru hahaoya
daughter-ACC stalker-NOM going after-PRES-PROG mother
"the mother whose daughter the stalker is going after"

(9) musume-ga sutookaa-ni nerawareteiru hahaoya
daughter-NOM stalker-DAT going after-PASS-PRES-PROG mother
"the mother whose daughter is being chased by a stalker"

(10) sono musume-o sutookaa-ga neratteiru hahaoya
whose daughter-ACC stalker-NOM going after-PRES-PROG mother
"the mother whose daughter the stalker is going after"

An initial experiment with thirty-six naïve native speakers revealed that experiential factors had to be carefully controlled. At first glance, the results from Experiment 1 (summarized in Figure 2 below) indicate an apparent disharmony with expert judgments; in other words, the scrambling cases were uniformly considered more difficult.

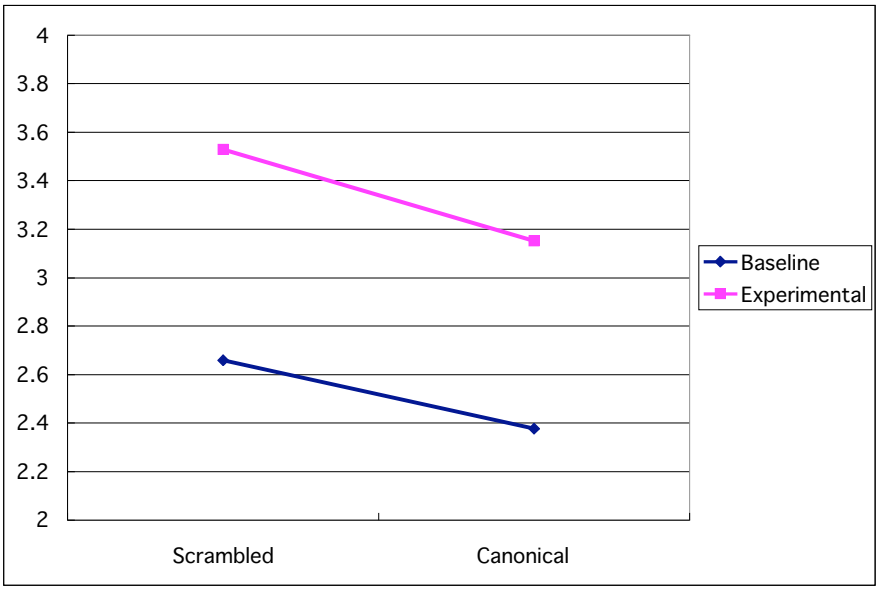

Figure 2: Experiment 1 Results

However, many subjects failed to or had extreme difficulty in arriving at the

intended interpretation for the test data, indicating that careful control and strong contextual support was needed to avoid comprehension problems.[5] The experiment details are as follows:

Experiment 1: Difficulty Rating (no training)

Subjects: 36 native speakers (college students in the Tokyo area).

Materials: Two types of relative clause constructions divided into object possessor (PRC) and non-possessor (baseline) (NPRC). Twelve pairs of each type were created. Possessor cases were further divided into object scrambled (SPRC) and canonical word order (CPRC) sub-cases. Similarly, NPRCs were subdivided into object scrambled (SNPRC) and canonical (CNPRC) sub-cases. The test items were counterbalanced into two lists together with an additional twenty-four filler sentences varying in construction and structural complexity.

Procedure: 6 point difficulty rating scale.

Results: The main effect of relative clause type was observed, i.e. PRCs were rated as being more difficult than NPRCs, as expected ($F_1(1,35) = 64.15$, $P<.001$, ($F_2(1,13) = 15.58$, $P<.005$). The main effect of word order was also significant ($F_1(1,35) = 19.67$, $P<.001$, ($F_2(1,13) = 10.59$, $P<.01$), confirming the processing cost associated with the scrambled word order. The interaction between the two factors was not significant ($F <1$ for both analyses).

A two-stage experiment with an initial familiarization phase (to be described in section 2.4) was proposed to address the comprehension problem. Experiment 2, a repeat of Experiment 1 after familiarization, was run with eighty naïve native speakers. This time there was a interaction effect between the relative clause type (possessor vs. non-possessor) but the strong word order

(scrambled vs. canonical) effect was not obtained anymore, apparently limited only to the non-possessor relative clauses, as summarized in Figure 3. Assuming, as has been shown in the literature, (see the references in section 2), that there is a general processing penalty associated with scrambling, it is reasonable to posit that there is some additional factor in processing of the possessor relative clauses that favors the scrambled version, thereby ameliorating the cost inherent in scrambling. (We return to discuss possible explanations in section 2.5.)

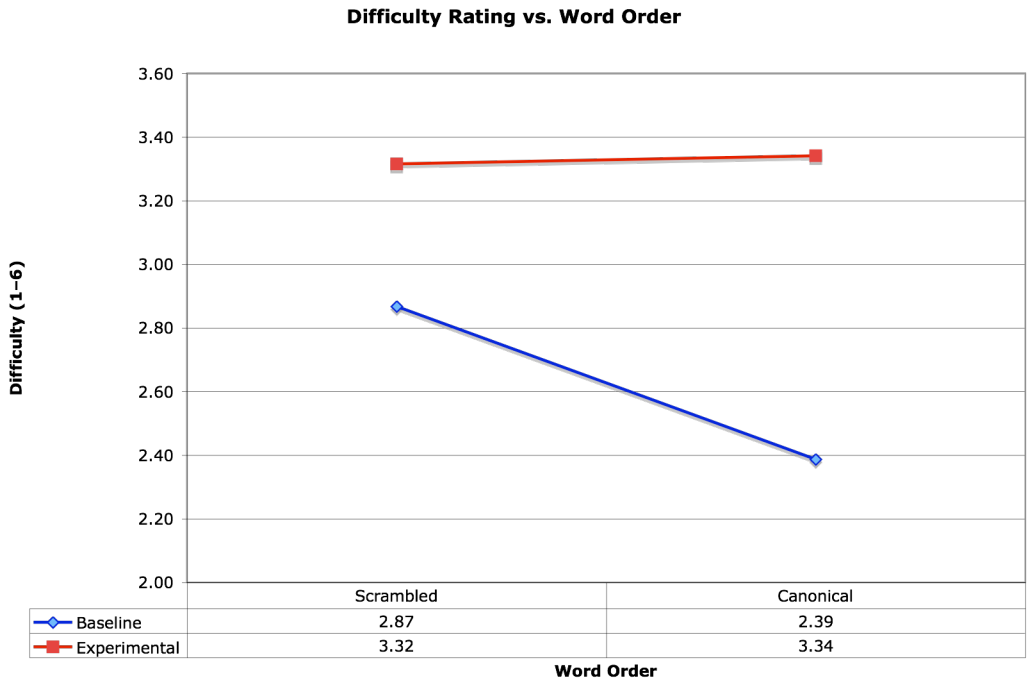

Figure 3: Experiment 2 Results

The experiment details are as follows:

Experiment 2: Difficulty Rating (post-training)

Subjects: 80 native speakers (college students).

Materials: Twelve pairs of scrambled (SPRC/SNPRC) and non-scrambled (CPRC/CNPRC) examples for object possessor (PRC) and non-possessor object relative clauses (NPRC), as in the case with Experiment 1. All data were counterbalanced into two lists together with an additional twenty-four filler sentences varying in construction and structural complexity.

Procedure: 6 point difficulty rating scale.

Results: The results show a main effect of relative clause type: PRCs were rated as being more difficult to process than NPRCs as expected ($F_1(1,57) = 47.33$, $P<.001$, ($F_2(1,13) = 14.80$, $P<.005$). The main effect of word order was significant only by the item analysis ($F_1 <1$, ($F_2(1,13) = 7.24$, $P<.05$). The analysis of interest was the interaction between the relative clause type and the word order, which was significant ($F_1(1,57) = 7.90$, $P<.01$, ($F_2(1,13) = 10.97$, $P<.01$).

2.4. The Familiarization Phase

The familiarization phase consisted of a series of pictures accompanying the experimental data, each of which described the event or situation denoted by the relevant possessor relative clause. The goal of this initial phase is to provide strong contextual support for, and make available to the naïve speaker, i.e. facilitate, the intended interpretation, thereby avoiding the comprehension failures seen in Experiment 1. For example, the picture in Figure 4 illustrates the contextual situation for example (8).

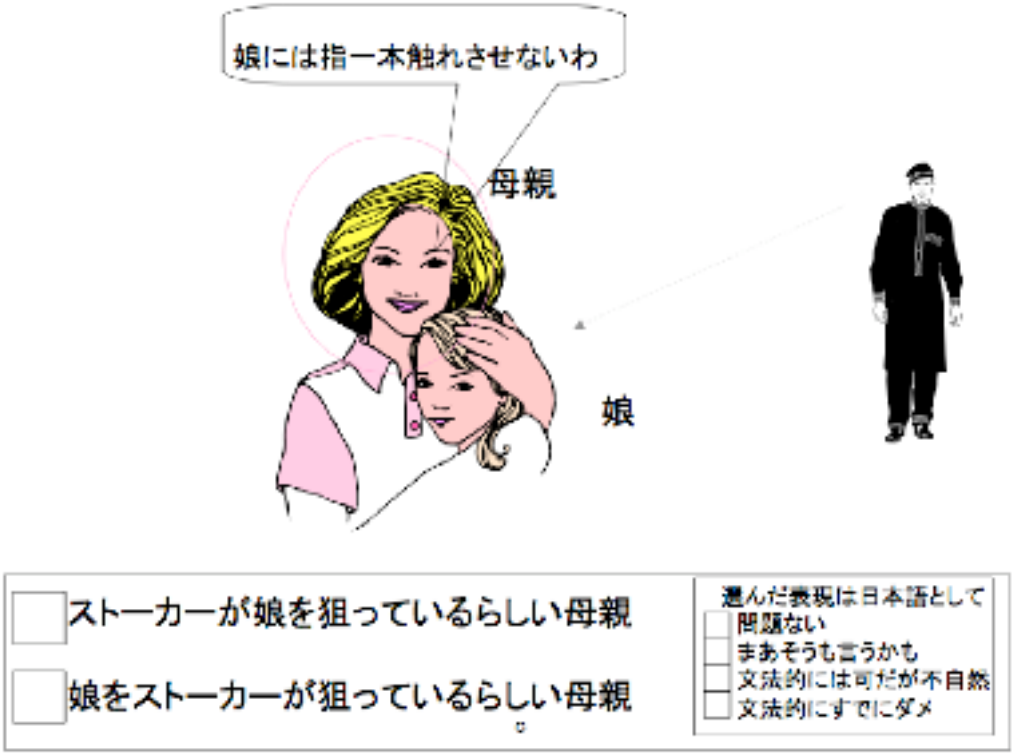

Figure 4: Familiarization phase for example (8)

Subjects were assigned the dual tasks of (A) making a forced choice between the scrambled and canonical versions of the possessor relative clause, and (B) judging the acceptability of the selected example.[6]

2.5. Distinguishing Possessor and Non-Possessor Relative Clauses

Experiment 2, as summarized in Figure 3 earlier, shows a striking difference in subjective processing difficulty between possessor and non-possessor object relative clauses when it comes to scrambling. Moreover, speakers generally found possessor relative clauses harder to process than non-possessor ones. We speculate that possessor relativization cases may be generally harder to process because there is no apparent gap.[7] In non-possessor

restrictive relative clauses there is always a candidate gap associated with a theta role assigned by a verb or main predicate. By the projection principle, the parser must insert an empty noun for these cases, and relative clauses are initially parsed as main clauses with dropped arguments. The probe REL targets these dropped arguments in accordance with the procedure described in section 2.2. In the possessor cases, there are no direct dropped arguments to target; instead REL must also make a pass to target nouns that support possessor gaps. This extra pass is reflected in extra processing cost for possessor relativization. For example, in (5a), we assumed *musume* (*daughter*) supports an internal gap *e* that is targeted by REL. A question remains as to how [*e* musume] (*x's daughter*) gets inserted into phrase structure. Initially, there is no reason to suppose that *musume* has complex structure. One possibility is that second pass REL triggers access to the lexicon and lexical reanalysis is enabled.

Let us assume that object scrambling encoded as movement to specifier-T results in extra processing cost over canonical word order as reflected in Figure 3 for the non-possessor (baseline) case.[8] An example is given in (11).

(11) hanseifugun-ga korosiya-o sasimuketa daijin-ni
rebel army-NOM assassin-ACC sent minister-DAT
kyuukyo bodiigaado-ga tsukerareta
readily bodyguard-NOM assigned
"The bodyguard was readily assigned to the minister to whom the rebel army sent the assassin"

Scrambling of the direct object *korosiya* (*assassin*) in (11) is independent of REL gap identification. REL targets the implied dative object of *saismuketa* (*sent*). In contrast, in the case of object possessor relativization, as in (8), scrambling moves the probe target up to specifier-T in (8b). Hence, in (8b)

since specifier-T is readily accessible, there is only a small increment in processing difficulty compared to that of (8a), which requires search. We speculate that this small increment compensates for the inherent penalty due to scrambling, and thus provides a possible explanation for Figure 3.

3. Evidence from Turkish

In Turkish, possessor relativization is signaled overtly by a possessive AGR morpheme. Consider the example in (12) (taken from (Fong ms.)).[9]

(12) Hasta-sI oku-yan adam
patient-AGR3sg read-SREL man
"the man whose patient read (something)"

The possessive-marked noun *hasta* (*patient*) is a bare noun phrase (BNP), i.e. a noun unmarked for case and theoretically free to occupy either subject or object position. Schematically, (12) can be represented as (13a) with the subject and object options represented as (13b) and (13c), respectively. (In the schemata in (13), BNP-AGR, pro and H represent the BNP with possessive agreement, an empty pronominal and the head of the relative clause, respectively.)

(13) a. BNP-AGR V-SREL H
b. $[_C[_T$ BNP-AGR $[_{v*}$ *t* $[_V$ pro V]]]-SREL] H
c. $[_C[_T$ pro $[_{v*}$ *t* $[_V$ BNP-AGR V]]]-SREL] H

However, there is a strong preference for BNP-AGR in (13a) to occupy the subject position, as in (13b), and as indicated by the gloss for (12). This contrasts with the case where there is no possessive agreement. In (14), there is a strong preference for the BNP to be interpreted as the (indefinite) object.

(14) Kitap oku-yan adam
book read-SREL man
"the man that read a book"

These subject/object preference facts constitute independent (of scrambling) support for the computational model given in section 2.2. In the case of (12), *hasta* (*patient*) occupies specifier-T and SREL can identify the gap signaled by AGR without search. In (14), *kitap* (*book*) occupies the canonical object position, leaving specifier-T free for the relative clause gap as indicated in (15).

(15) $[_C[_T$ pro $[_{v*}$ *t* $[_V$ kitab oku]]]-yan] adam

4. Conclusions and Further Work

The experimental side of this work has covered the interaction of object scrambling with possessor relativization as it relates to possessive objects. We have shown that it is possible to confirm expert intuitions about such complex constructions for naïve speakers once they have undergone a training, or familiarization, phase. These intuitions are supported by considerations of computational efficiency in minimalist parser design. Similar experimental confirmation presumably awaits the possessor of subject case in (2), where the prediction is reversed, i.e. canonical word order should result in easier processing than the scrambled sub-case. Moreover, confirmation of the interaction of object scrambling with focus in the case of *mo*-marked phrases, e.g. (7), will pose additional challenges to experimental design.

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[1] Judgments indicated are relative. We use a question mark ? in (1b) to simply indicate that the marked example is judged to be harder to process than the unmarked one.

[2] We note here that there are implementation details that may appear to result in additional complexity for the non-overlapping stack-based Move Box model in (Fong 2005). Unlike the case of object *wh*-movement in English, this additional complexity is only apparent. If, following (Ishihara 2000), object scrambling occurs via Object Shift (OS), and assuming that the subject stays *in situ*, no overlapping movement results and the stack-based Move Box model can be maintained.

[3] One possible implementation would be to (speculatively) run the direct check first in an attempt to avoid search, paying a (small) penalty if it fails. Another is to run both the direct check and the general search mechanism in parallel and take the result of whichever one completes first.

[4] The scrambled object needs to be at the edge of T rather than at the edge of a higher phrase, e.g. C, because it needs to be in the c-command domain of C to be visible to REL. In contrast, Hasegawa (2005) assumes that higher-than-*mo* elements appear in C.

[5] The post-experimental survey (free-description) revealed that many subjects had trouble understanding the possessor relativization sentences. A considerable number of subjects introspectively reported that they had initially interpreted

the test sentence in (8) up to the first verb as a main clause, associated with an interpretation "*the stalker is going after the daughter/young girl*" and even after reading the whole sentence, the initial analysis somehow persists. Although the following noun *hahaoya* (*mother*) should have disconfirmed such misanalyses, revision by finding the appropriate gap position is difficult, as all the required argument positions have been filled. This kind of difficulty may have obscured the subtle effect that was reported in the expert judgment.

[6] We did not make use of the forced choice results or the graded acceptability judgments. Given the variability in the dynamic range of acceptability judgments across naïve speakers, it is unclear how to correlate these with the results of the forced choice experiment.

[7] See the discussion of experiment 1 in note 5.

[8] This is not immediately apparent given Figure 1. Any extra cost may be attributed to structure building only if scrambling involves Object Shift. (See note 2.) Otherwise, perhaps the extra cost can be attributed to the extra distance involved in recovering Move between specifier-T and the canonical object position, i.e. complement-V, vs. the canonical subject position, i.e. specifier-v*.

[9] Turkish normally distinguishes between the subject and object relativizers. SREL represents the subject relativizer morpheme –An. However, SREL need not always signal a subject relative clause.

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