Multiple Subject Constructions in Japanese: A Dynamic Syntax Account

Hiroaki Nakamura[1], Kei Yoshimoto[2], Yoshiki Mori[3], and Masahiro Kobayashi[4]

[1] Department of Liberal Arts, Japan Coast Guard Academy, 5-1, Wakaba-cho, Kure City, Hiroshima 737-8512, Japan
hiroaki-nakamura@ax2.mopera.ne.jp
[2] Graduate School of International Cultural Studies,Tohoku University
kyoshimoto@mail.tains.tohoku.ac.jp
[3] Doctoral Program in Linguistics and Literature, Graduate School of Humanities and Social Sciences, University of Tsukuba
mori@lingua.tsukuba.ac.jp
[4] University Education Center, Tottori University
kobayashi@uec.tottori-u.ac.jp

Abstract. Though Multiple Subject Constructions have long received much attention mainly from syntactic points of view because they show distinctive features of languages like Japanese, a unified treatment which tries to translate MSCs into appropriate semantic representations/logical forms has not been proposed yet. This study presents how logical structures of MSCs are built up in a time-linear parsing perspective. We highlight an important semantic feature of a set of common nouns often called relational nouns which enables the layers of predication to be formed in MSCs. This group of nouns inherently have an extra variable inside, which can be bound by the preceding subjects in MSCs. We argue that subjects are licensed not by argument structures of verbs but by open propositions in Japanese stative sentences, and show that our analysis can account for some asymmetries in extraction constructions, such as relative and cleft constructions.

Keywords: Multiple Subject Construction, relational noun, major subject, Dynamic Syntax, time-linear parsing.

1 Introduction: Multiple Subject Constructions in Japanese

In this study[1], we will present how to translate the so-called Multiple Subject Constructions (hereafter, MSC) into semantic representations. It is important to establish the mechanism of translating all syntactic constructions, not fragments, of one language into some kind of logical forms to prove a grammar formalism to be both syntactically and semantically sound. We may safely say that any framework with a syntax/semantic interface does not seem to be well-established without such mechanism. Taking MSCs as an example, we explore how a grammar formalism can parse

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sentences in a incremental fashion, and build up interpretations for them. MSCs, where more than one nominative-marked noun phrases occur in a single sentence, have long been a central object of theoretical and empirical studies, due to their outstanding characteristics from a typological perspective. Japanese MSC are illustrated in (1) (see also Kuno 1973, Sugimoto 1990):

(1) a. Syusyoo-no byojoo-ga saikin omo-i.
Prime-Minister-GEN condition-NOM recently serious-PRES
'The Prime Minister's condition of the desease is recently serious.'

b. Syusyoo-ga saikin byojoo-ga omo-i.
Prime Minister-NOM recently condition-NOM serious-PRES

c. Sono jisyo-ga hotondo-no gakusei-ga riyoosuru.
the dictionary-NOM most-GEN student-NOM use-PRES
'The dictionary is the one the most of students are using.'

d. Kono settyakuzai-ga kawa-ga yoku tuku.
this cement-NOM leather-NOM fast stick-PRES
'This cement is the one by which we can stick leather to something.'

The MSC in (1b) is often said to be derived from the non-MSC in (1a). For instance, Hasegawa (1999) proposes the analysis in which the derived subject, called the 'major subject', moves up from its original position in the specifier of the following subject by NP-movement.

(2) $[_{IP}$ Neko-ga$_j$ [IP [NP t_j karada-ga $]_i$ [AP t_i yawaraka-$_i$].
cat-NOM body-NOM pliant-PRES

'Lit. Cats are such that their bodies are pliable.'

She argues that the new subject *Neko-ga* raises to the higher [Spec,IP] position to get the nominative case licensed by the INFL. Incidentally, she also suggests that the nominative NP gets an interpretation as the subject of the derived predicative phrase (i.e., the lower IP) due to its higher position. However, it remains unclear how to construct the semantic interpretation she argues from structure (2), reflecting the new predication relation between the major subject and the remaining part of the sentence. We present the formal method to parse MSCs as in (1) to construct the logical forms in terms of the syntax-semantics interface, which are represented by a modal logic of finite trees (LOFT), and how it extends to relativization of MSCs.

In MSCs involving subjectivization of the possessors of following subjects, a remarkable semantic property of the following subjects must be taken into account in the analysis. Observe sentence (3).

(3) Kono atari-wa subete-no kawa-ga kakoo-ga suisin-ga fukai.
here-Top all-GEN river-NOM mouth-NOM depth-NOM deep-PRES
'Lit.: In this region, all rivers are such that their river mouths are deep.'

The values of the second and third subjects in (3) obligatorily covary with the value of the first subject. This property of following subjects in MSCs shows a sharp contrast in interpretation with normal sentences with more than one arguments like (4), the preferred reading of which is that the nominative object takes scope over the preceding subject.

(4) Siken-de-wa dono gakusei-mo aru mondai-ga tokenakatta.
exam-in-Top every student-NOM a certain question-NOM solve-Cannot-Past
'In the math exam, every student couldn't solve a certain problem.'

The object NP *aru mondai* 'a certain problem' takes wide scope with respect to the universally quantified subject *dono gakusei* 'every student' in (4), so this sentence should be true if there was at least one question in the math exam which could not be solved by all the students. On the other hand, in MSC (3) we do not have the interpretation that at least one river mouth all the rivers have in common is deep in this district.

In this study, we also attend to long-distance dependency phenomena involving MSCs, in which non-arguments are allowed to be extracted, unlike in English:

(5) a. saikin byojoo-ga omoi syusyo
recently condition-NOM serious prime minister
'prime minister whose condition of the disease is serious.
b. toshin-ni kumanezumi-ga ooino Tokyo-da
downtown-IN black rats-NOM many-exist-TOP Tokyo-BE-Pres
'Tokyou in the down town of which there are many black rats
(6) a. Saikin byojyo-ga omoi-no-wa syusyo-da.
Recently condition-NOM serious-N.-Top prime-minister-BE-Pres
'It is the prime minister whose condition of the disease is serious.'
b. Toshin-ni kumanezumi-ga ooi-no-wa Tokyo-da.
downtown-IN black-rats-NOM many-N.-Top Tokyo-BE-Pres
'It is in Tokyo that there are many black rats in the downtown.

On the other hand, the following subjects cannot be extracted, as shown in (7) and (8).

(7) a. *[Syusyo-ga saikin omoi] byojyo
prime-minister-NOM recently serious-Pres condition
b. *[Tokyo-ga kumanezumi-ga ooi] toshin-bu
Tokyo-NOM black-rats-NOM many-BE-Pres downtown
cf. Tokyo-de kumanezumi-ga ooi] toshin-bu
Tokyo-IN black-rats-NOM many-BE-Pres downtown
(8) a. *[Syusyo-ga saikin omoi-no-wa] byojyo-da
prime-minister-NOM recently serious-N.-TOP condition-BE-Pres
b. *[Tokyo-ga kumanezumi-ga ooi-no-wa] toshinbu-da.
Tokyo-NOM black-rats-NOM many-BE-N.-TOP downtown-BE-Pres

We will offer an explanation to such surprising asymmetry in extractability between major and non-major subjects in MSCs. Especially, we will explore the nature of indefinites which seem to play a crucial role in forming the layers of predication in a sentence projected from a single verb.

2 Dynamic Syntax

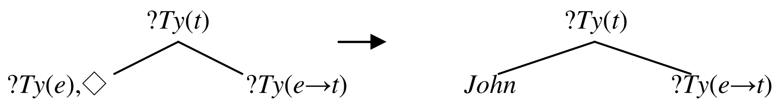
We adopt the Dynamic Syntax model (Kempson, et al. 2001, Cann, et al. 2005) as a framework of description. In Dynamic Syntax, syntactic properties of expressions are defined as a set of actions to parse input sentences and construct partial trees representing their semantic contents strictly on left-to-right basis. No syntactic representation is needed in any component of grammar, and syntactically ill-formed information simply cause parsing actions to abort. Various forms of underspecification are permitted in the course of parsing input sequences and building logical forms. Initial underspecification must be resolved during the construction process of semantic trees step by step. There are many competing actions at each stage of parsing, and pragmatic factors are relevant for choice of transition possibilities (Sperber and Wilson, 1986). Each node of a partial tree is decorated by formulae called Declarative Units (DUs) comprising first-order predicates. The decoration of each node includes a Formula value (Fo) representing semantic content and a Type value (Ty) with a form of typed lambda calculus. For instance, a root node eventually becomes a propositional node of type *t* with a Fo value representing the logical meaning of an input sentence.

Let us take sentence (9) to show an example of parsing in DS. Parsing of input sequences is reflected in the process of semantic structure building, which is defined in terms of transitions between partial trees. The interpretation process starts with the introduction of the root node with a requirement (represented by '?') and proceeds by unfolding and decorating the tree node by node, as information from the words progressively enables a tree to be constructed. A structures given at each step is represented as a pointed partial tree in which the pointer ◇ indicate a node under development.

(9) John upset Mary.

The root node decorated with a requirement of propositional formula of type *t* is expanded into the subject of type *e* and the predicate phrase of type *e*→*t* by the transition rules called INTRODUCTION and PREDICTION.[2] Notice that the pointer is at the subject node now.

(10)



After *John* is scanned, the requirement of noun is satisfied and removed, and the pointer moves to the predicate node of type (e→t). Then, the verb *upset* is parsed and the predicate phrase is constructed according to its lexical specification as in (11):

(11)	IF	?*Ty*(*e*→*t*)	Predicate trigger
	THEN	go<↑$_1$>?*Ty*(t);	Go to propositional node
		put(*Tns*(*PAST*));	Tense Information
		go(<↓$_1$>?*Ty*(*e*→*t*);	Go to predicate node
upset		make(<↓$_1$>);	Make functor node
		put(*Fo*(Upset'),*Ty*(*e*→(*e*→*t*)),[↓]⊥);	Annotation
		go(<↑$_1$>);	Go to mother node
		make(<↓$_0$>);	Make argument node
		go(<↓$_0$>);	Go to argument node
		put(?*Ty*(*e*))	Annotation
	ELSE	Abort	

Fo(Upset') in the decoration is precisely expressed via a lambda operator specifying the number and type of its arguments, and as the order of combination (i.e.,

[2] Transition rules generally have the following form as schematically shown below:

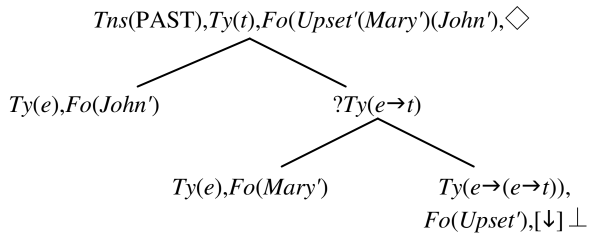
Input Tree Description

Output Tree Description

They are general rules to build up structures top-down, universally available and optional.

Fo(λ*y*. λ*x*[Upset'(*x*,*y*)]). More importantly, the actions specified in the lexical information in (11) do participate in construction of the semantic representation. After processing *Mary*, the accumulation of information is carried out by the COMPLETION/ELIMINATION rules (see Kempson et al. 2001, Cann, et al. 2005), all the requirements are removed, and the pointer moves back to the top node, resulting in the formula 'Upset'(Mary')(John').

(12)



The concept of structural underspecification is central to the explanation of Dynamic Syntax. Let us introduce another aspect of such underspecification, by using an example of Scrambling in Japanese, as in (13):

(13) Mary-o John-ga home-ta.
Mary-ACC John-NOM praise-PAST
'Mary, John praised.'

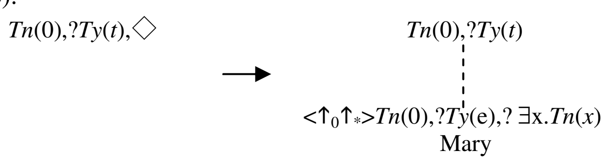
Because the word-order is relatively free in Japanese, the INTRODUCTION rule cannot be invoked for introducing the subject and predicate in parsing (12). Japanese noun phrases actively contribute to tree growth and verbal templates are simply unified with trees already constructed when verbs are finally processed. Noun phrases are incrementally processed by Local *Adjunction as if they formed a flat structure. By Local *Adjunction an noun phrase with an arbitrary role projects an (initially) unfixed node decorated with a modality $<\uparrow_0\uparrow_*>$ indicating an underspecified modal relation pointing to some node that dominates the current node. Local *Adjunction is defined as in (14):[3]

(14) Local *Adjunction (Cann et al. 2005:236)

$$\frac{\{\ldots\ \{Tn(\mathrm{a}),\ \ldots,\ ?Ty(t),\ \diamond\}\ \ldots\}}{\{\ldots\{Tn(\mathrm{a}),?Ty(t)\ldots\}\ldots\{\ldots\{<\uparrow_0\uparrow_1^*>Tn(\mathrm{a}),?Ty(e),?\exists \mathrm{x}.Tn(x),\ \diamond\}\ldots\}}$$

A locally scrambled NP is introduced into the tree, with a locally unfixed node decorated by ?*Ty*(e).

(15)



[3] The underspecified modal relation indicated by $<\uparrow_*>$ is defined over the reflexive, transitive closure of the mother relation as shown in (ia) and its obverse, $<\downarrow_*>$, over the daughter relation as in (ib).

(i) a. $<\uparrow_*>\alpha =_{def} \alpha \vee <\uparrow><\uparrow_*>\alpha$

b. $<\downarrow_*>\alpha =_{def} \alpha \vee <\downarrow><\downarrow_*>\alpha$

A modality like $<\uparrow_*>?Ty(t)$ holds just in case either the current node is decorated by ?*Ty*(*t*) or some node dominating the current node is so decorated.

The dotted line indicates that the introduced position is currently unfixed and must be resolved within the local domain given by the propositional template of a verb introduced later. Next, the accusative marker *-o* is scanned and it induces the action defined in (16). The overt case markers serve as output filters and also play more constructive roles in the process of structure-building.

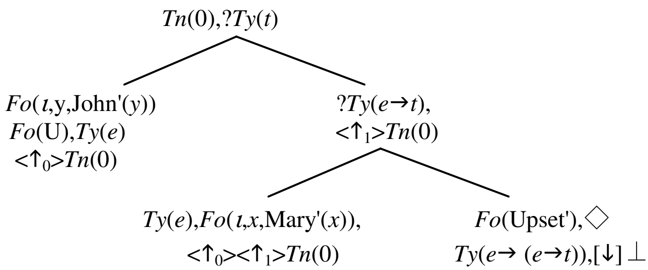
(16)

	IF	$Ty(e)$	
	THEN	IF	$<\uparrow_*>(Tn(a) \wedge ?Ty(t))$
-o		THEN	$put(?<\uparrow_0>Ty(e\rightarrow t))$
		ELSE	Abort
	ELSE	Abort	

The introduced NP must be interpreted within the local clause due to the locality restriction defined by Local *Adjunction. Then the unfixed node of the scrambled object NP simply identified with the object argument node of the propositional template of the verb *homer-,* and the pointer moves back to the local $Ty(t)$-node.

The subject *John-ga* is processed in a similar way, initially introduced as an unfixed node with the local relation to the dominating type-*t*-requiring node, which is fixed by the action depicted by its case specification. The application of MERGE is not imposed here because the fixed node is vacuously be duplicated by the associated argument node, creating one and the same tree relation. Finally, we get the tree representation like (17):

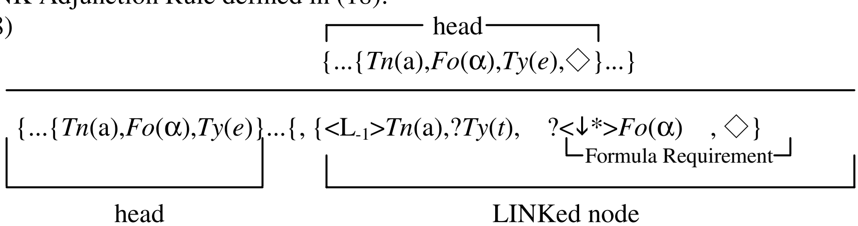
(17)



The ELIMINATION rule applies to compile the sentence meaning, yielding the formula Fo(Upset'(Mary')(John')), the same result as in (12) in English.

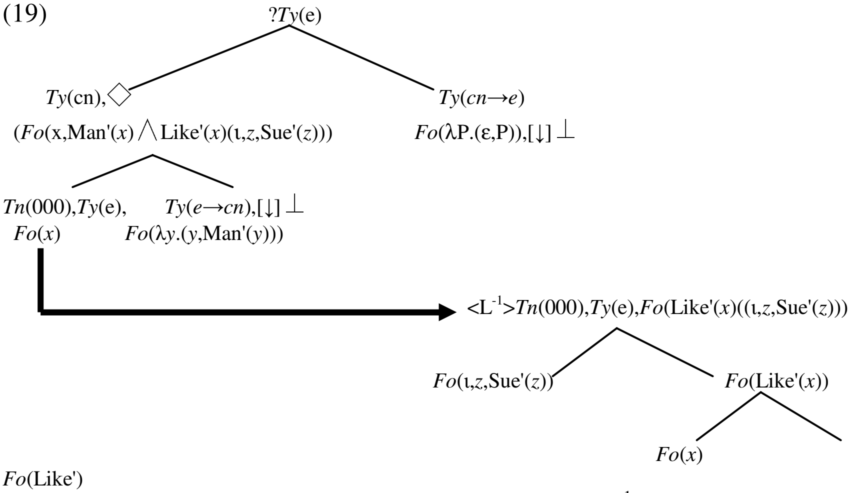
Here we should introduce another important device necessary to deal with relative clauses of MSCs later, in which we again have recourse to underspecification of tree positions. A relation between a head noun and relative clause is called LINK relation in DS. A semantic tree for a relative clause (a LINKed structure) is projected by LINK Adjunction Rule defined in (18):

(18)



Suppose that the parser is processing sentence *A man who Sue likes smokes* and *a man* is already introduced in the tree. The LINK Adjunction rules applies, imposing the requirement to find a copy of this variable somewhere inside it. The newly introduced node, with the modality $<\uparrow_*><L^{-1}>$, constructed by the lexical actions of the relative pronoun is unfixed initially, and its decorations provide updates to the object node with the requirement ?Ty(e) in the MERGE process.

(19)



The new modality <L> and its inverse modality $<L^{-1}>$ are introduced, with the former pointing to the newly built (relative clause) structure and the latter pointing back to the node of the head noun variable. The point is that a LINKED tree must have a requirement to find the copy of a head noun, so the interpretation involves a kind of anaphora resolution. Relative clauses are interpreted by one of the LINK Evaluation rules, and we indicate the version for restrictive construal for relative clauses.

(20) LINK Evaluation 2 (Restrictive construal):

$$\frac{\begin{array}{c}\{\ldots \{Tn(a), ?Ty(cn)\ldots\}, \{\langle\uparrow_0\rangle Tn(\mathrm{a}), Fo(x), Ty(e)\},\\ \{\langle\uparrow_1\rangle Tn(\mathrm{a}), Fo(\lambda X.(X,\psi(X)), Ty(e\rightarrow cn)\}\ldots\}\\ \{\langle L^{-1}\rangle\langle\uparrow_0\rangle Tn(a), Fo(\varphi), Ty(t), \Diamond\}\end{array}}{\begin{array}{c}\{\ldots\{Tn(a), Fo(x,\varphi\wedge\psi(x), Ty(cn),\ldots,\Diamond\}, \{\langle\uparrow_0\rangle Tn(a), Fo(x), Ty(e)\},\\ \{\langle\uparrow_1\rangle Tn(a), Fo(\lambda X.(X,\psi(X))), Ty(e\rightarrow cn)\}\ldots\}\\ \{\langle L^{-1}\rangle\langle\uparrow_0\rangle Tn(a), Fo(\varphi), Ty(t)\}\end{array}}$$

As the interpretation for the common noun *man who Sue likes* shows, the conjoined restrictor Man'(x) ∧ Like'(x)(ι,z,Sue'(z)) is derived by (20), and finally, the interpretation of the noun phrase should be represented as formula Fo(ε,x,Man'(x) ∧ Like'(x)(ι,z,Sue'(z)), as shown in (21):

Finally, let us touch on the treatment of quantification in Dynamic Syntax very briefly. Because noun phrases always appear without articles in Japanese, quantifier construal is crucial for interpretations of all indefinite NPs. Quantified noun phrases are represented in terms of the epsilon calculus (see Kempson et al. 2001, Cann et al. 2005, Kempson and Meyor-Viol 2004 for detailed discussion). Indefinites show quite different behaviors from universal quantifiers and in general scope freely (i.e., not clause bound). Dynamic Syntax assumes that all noun phrases including quantified expressions project the structure of type *e*, indefinites share some property with anaphoric expressions, and try to model the choice of dependency of indefinites using the notion of epsilon term and quantified NP representations are formed by variable-binding operators. For instance, *a man* is represented as in (21):

(21) $(\epsilon,x, Man'(x)) = \exists x.Man'(x)$

The structure of Quantified NPs have the three parts:

1. The Binder (e.g. ε) indicating a mode of quantification
2. The Variable (e.g. x) indicating a variable bound by the binder
3. The Restrictor (e.g. Man'(x)) indicating the binding domain of a variable

In addition, a sequence of scope statement is accumulated during the construction process to characterize relative scope among quantified terms, as in (22):

(22) $x < y$

where x and y are arbitrary variables of type *e* stating that the quantifier binding *x* has scope over the quantifier binding *y*. The scope relation in a clause is defined in the linear order of variables in the sequence of scope statements, which should also includes the index of evaluation for ψ, S_i:ψ, with S_i is taken to be a temporal index of a clause. The scope of indefinites is determined by the free choice mechanism, where every indefinite must take narrow scope. When an indefinite is interpreted with a wide scope over other quantified terms, its scope is taken to be dependent on the term S_i (which is associated with the tense specification of a clause). For example, observe sentence (23):

(23) Every dog ate a biscuit.
every dog = $(\tau,x,Dog'(x))$ a biscuit = $(\epsilon,y,Biscuit'(y))$
$\psi = Ate((\tau,x,Dog'(x))(\epsilon,y,Biscuit'(y)))$

If the scope relation is defined as $<_B = \{<S_i, x, y>\}$, then we get the final representation like (24a) and if defined as $<_B \{<S_i, y, x>\}$, we eventually get (24b).

(24) a. $\forall x(Dog(x) \rightarrow \exists y(Biscuit(y) \wedge Ate(x,y)))$
b. $\exists y(Biscuit(y) \wedge (\forall x(Dog(x) \rightarrow Ate(x,y)))$

In (24b), the indefinite should pick up some referent in the speaker's mind. With these basic assumptions in Dynamic Syntax, let us turn to the syntax/semantics of MSCs.

3 Layers of Predication in MSC

As we have already seen, Japanese subjects are licensed by open propositions in stative sentences.[4] We want to explore a syntactic/semantic analysis reflecting the following intuitions on MSCs. Observe the sentences in (25):

(25) a. Neko-wa/[?] -ga [$_\alpha$ karada-ga yawarakai] (Assertive sentence)
Cat-Top body-Nom Be_pliant-Pres
'Lit. As for cats, their bodies are pliant.'
b. Nani-ga/*-wa [$_\alpha$ karada-ga yawarakai-no]? (Interrogative sentence)
what-Nom/-Top body-Nom Be_pliant-Q

First, MSCs must convey kind/individual-level interpretations (which should also be represented somehow in the semantics), and the subjects of these kinds of predicates

4 Even in English, we often find sentences which seem to be simply licensed by predicate phrases with gaps, not by the propositional templates (argument structures) of predicates:
(i) a. This violin [is easy to play the sonata with e].
b. This book [is said to be worth reading e].
c. This wall [seems to need repainting e].

exhibits strong tendency to get marked by the topic marker -*WA*, not by the nominative *GA* in declarative sentences. The nominative major subject in (25a) must be taken as foci and receive exhaustive-listing reading (see Kuno 1973) and usually becomes acceptable only in embedded clauses. On the other hand, interrogative words never get marked as topic, so MSCs are obligatory in questions. The point is that the structures indicated by $[_{\alpha}$ ...] have something in common.[5] Second, we want to capture the structural symmetry observed in the examples below.

(26) a. Neko-ga $[_{\alpha}$ karada-ga yawarakai] (= (2))
b. $[_{\alpha}$ karada-ga yawarakai] neko
body-Nom Be_pliant-Prescats
'cats whose bodies are pliant'
cf. [karada-ga yawarakai] no-wa neko-da.
body-Nom Be_pliant-Pres Gen-Top cat-be-Pres
'It is the cats whose bodies are pliant.'
c. Major Subject [OPEN PROPOSITION] head of relative clause
licensing the major subject licensing the relative head

It is clear that the major subject *Neko-ga* and the head of the relative clause are both licensed by the "embedded" sentence, in which the argument structure of the verb *yawarakai* is fully saturated, but it has a "gap" in the possessor position of the subject. It should be noticed that all MSCs in (1) have an open position somewhere in the predicative sentences following the major subjects.

A purely syntactic approach will find much difficulty in associating these subjects and their corresponding 'gaps' occurring anywhere inside "predicative clauses" but we assume that the open propositions indicated by the brackets denote (enduring/inherent) properties the referents of subjects should have, so the predication relations between the major subjects and the open propositions must be established during the construction process of their semantic representations. The predicative propositions must contain at least one gap somewhere inside them, but there is no restriction on the positions of gaps. Observe the following sentences.

(27) a. Tokyo-ga $[_{PredP}$[*e* tosibu]-ni kumanezumi-ga ooi].
Tokyo-NOM downtown-IN blackrats-NOM many-BE-Pres
b. Kono naifu-ga $[_{PredP}$ [*e* sentan]-de enpitsu-ga/-o kezurer-u].
this knife-NOM edge-WITH pencil-NOM/-ACC sharpen-CAN-Pres
'This knife is such that they can sharpen points of pencils with its edge.'

If there is no gap inside a clause following the major subject, the derived MSC is ungrammatical.

(28) a. Tanaka-sensei-ga $[_{PredP}$ deshi-tati-ga yuusyu-da].
Tanaka-Mr.-Nom [student-Pl.Nom excellent-Be-Pres
'Lit. Mr. Tanaka is such that his students are excellent.'
b.*Tanaka-sensei-ga $[_{PredP}$ gengogakusya-ga yuusyu-da].
Tanaka-Mr.-NOM linguist-Nom excellent-Be-Pres

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5 Here we do not intend to argue that the predicative clauses following the topic and major subject project the same structure. Rather, we assume that the syntactic structures of the two clauses should be distinguished in principle, but we leave this question open.

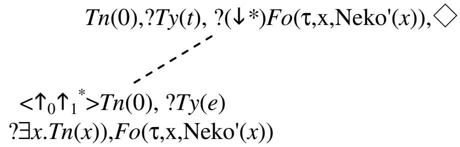
Because the factor causing the difference in grammaticality between (28a) and (28b) is only the meaning of the second subject, we should examine the semantic difference among common nouns more carefully. While nouns like *linguist* simply denotes a set of individuals, *students* in this context denotes relations between individuals, or in other words, functions from individuals to sets, which take particular individuals to return individuals who stand in the teacher-student relation to the former. Let us define the meaning of relational noun *student* as $\lambda y.\lambda x.$Student-of'$(y)(x)$ (for discussion, see Vikner & Jensen 1999, Barker 1995, Asudeh 2003, Jacobson 1999, 2000, Partee & Borschev 2000, Nakamura 2002). Relational nouns tend to get bound by other terms in the local domain. In languages like English, this binding is immediately done by the preceding possessors within NPs, whereas, in Japanese, the possessor variable binding can be delayed. So major subjects can bind the possessor variables contained in the following subjects via predication after subjectivization applies to the former. We do not mean to argue that there is syntactic connectivity between a major subject and the corresponding gap. Our proposal is that the semantic relation between the major subject and its gap within the predicative proposition can be established in the course of building the semantic representation of a MSC, given the notion of initial underspecification and subsequent resolution during the process of constructing an interpretation.

Let us start with an assumption that an open proposition predicated of a MSC subject have a requirement to find the copy of the subject, and this requirement can be resolved step-by-step in the course of parsing on line during left-to-right processing. To construct a semantic representation for (26a), the position for the major subject *Neko* 'cats' is constructed as an unfixed node by Local *Adjunction in (14) exactly as we expect in projecting unfixed nodes for ordinary argument NPs in Japanese sentences, but it should be noticed that the major subject can NOT be directly associated with any argument node of the propositional template of the verb *yawarakai* 'pliable' though Cann, et al. (2005) argues that 'it is the verbs that which project a full predicate-argument structure whose argument values can be identified directly from context' (p. 230). Here the parser must leave the tree node relation unfixed. As a first approximation, let us assume that we have two different lexical entries for the nominative marker *-GA,* one for regular subjects and the other for major subjects, which is defined in (29). The latter does not fix a subject node for *Neko-ga* after processing of the nominative marker, and simply return the pointer to a local type-*t*-requiring node with a requirement of its copy in a subsequent structure, as in (30):[6]

(29)	IF	$Ty(e)$, Fo(α)	
-ga	THEN	IF	$<\uparrow_0\uparrow_1^*>(Tn(a)\wedge Ty(t))$
		THEN	put$(?\exists x.Tn(x))$;
			go$(<\uparrow_0\uparrow_1^*>)$; put$(?<\downarrow_*>Fo(\alpha))$;
		ELSE	Abort
	ELSE	Abort	

6 Notice that the lexical actions of regular nominative and other case markers does not return the pointer-return to a local *$Ty(t)$ node. This process is ensured by Completion. See Cann, et al. 2005:237 for discussion.

(30)



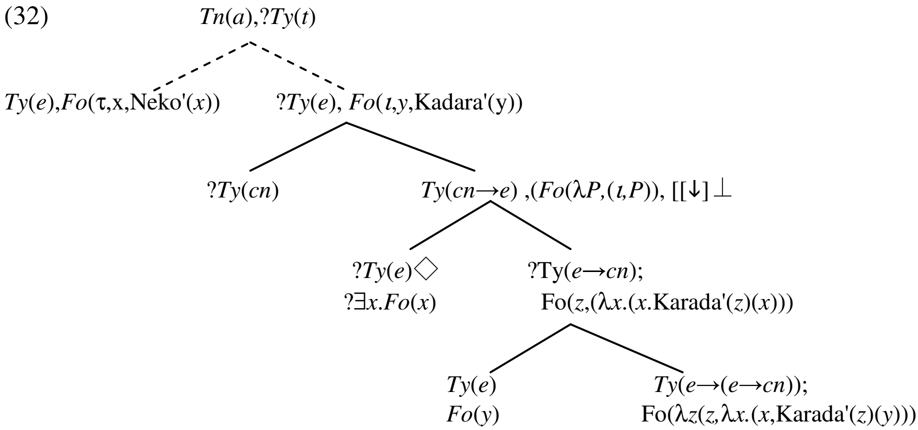
Then, the second subject *karada* 'body' is introduced, again, by Local *Adjunction, which project the complex internal structure with an extra node for a possessor variable by lexical actions defined in its entry as in (31):

(31) *karada* 'body'

IF	?*Ty*(*e*)
THEN	make(<$\downarrow_1$>);go(<$\downarrow_1$>);put(*Ty*(*cn*→*e*),*Fo*(λP.(ε.P)),[↓]⊥;
	go(<$\uparrow_1$>);make(<$\downarrow_0$>;go(<$\downarrow_0$>);put(?*Ty*(*cn*));
	make(<$\downarrow_1$>);go(<$\downarrow_1$>);put(?*Ty*(*e*→(*e*→*cn*)),*Fo*(λ*x*(x,λ*y*(y,Karada'(*x*,*y*)));
	make(<$\downarrow_1$>);go(<$\downarrow_1$>);put(Ty(*e*→*cn*),*Fo*(λy.Karada'(*y*))[↓]⊥;
	go(<$\uparrow_1$>);make(<$\downarrow_0$>);go(<$\downarrow_0$>);freshput(*x*,Fo(*x*))
	go(<$\uparrow_0$>);go(<$\uparrow_1$>);make(<$\downarrow_0$>);go(<$\downarrow_0$>);put(?*Ty*(*e*)), freshput(*z*,Fo(*z*));
ELSE	Abort

The partial tree constructed at present should be something like (32):

(32)



The higher type-*e*-requiring node is constructed by the lexical specification for the relational noun *karada* 'body', which is roughly a function of type (*e*→(*e*→*cn*)) from possessors to their bodies. In the non-MSC counterpart in (33), the possessor argument marked with genitive case fills the position corresponding to the first *e*.

(33) [$_{NP}$ Neko-no karada-ga] yawarakai.
Cat-Gen body-Nom pliant-Pres.
'Cats' bodies are pliant.'

In the tree for MSC (32), however, the node currently under development has no formula value, which is provided from the copy of the major subject passed down the tree, step by step until this open node is projected. This process must be distinguished from the scrambling of an possessor argument to the sentence-initial position, which is ungrammatical as seen in the degraded status of sentence **Neko-no totemo karada-ga yawarakai* (here the adverb is inserted to cut the constituency between the possessor and possessee arguments) because the possessor argument is not subjectivized. The nominative marker requires expressions it marks to stand in a predication relation to predicative phrases (in MSCs, the latter must refer the former's permanent or stable attributes). Though the particle *GA* of the second subject fixes its tree node relation, as the ordinary GA or other case markers. However, the derivation suggested above requires multiple application of Local *Adjunction at the same *Ty*(*t*) node, and this is what Dynamic Syntax disallows, because more than one node with the same tree relation cannot be distinguished. In (32), there are two unfixed nodes, the major subject and the regular subject node, are both unfixed in a local type-*t*-requiring tree, and the derivation aborts by definition.

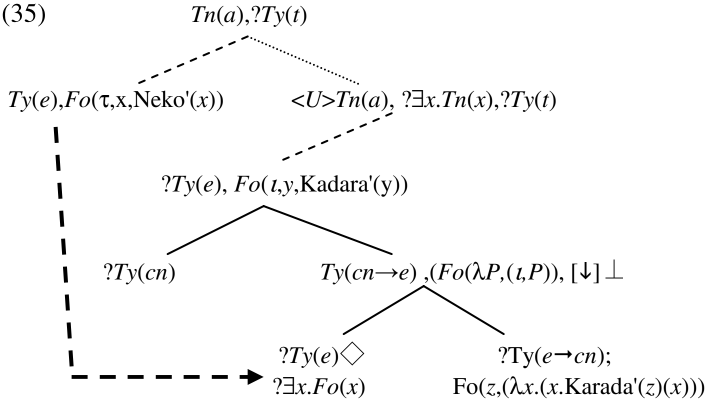
Another motivation to have recourse to a different computational rule, Generalized Adjunction, comes from our intuition that MSCs project complex structures, while non-MSCs like (32) do not. Finally, we hope to capture a parallelism between MSCs and its relativized counterparts we will discuss in the next section. First, the major subject is introduced, as before, but the requirement to find a copy is not imposed on the type-*t*-requiring node. The next step is to introduce a kind of embedded clause into the structure by Generalised Adjunction defined in (34):

(34) Generalised Adjunction (Cann, et. al 2005:242)

$$\frac{\{\ldots\{Tn(a),\ldots,?Ty(t),\Diamond\}\ldots\}}{\{\ldots\{Tn(a),\ldots,?Ty(t)\},\{\langle U\rangle Tn(a),?\exists x.Tn(x),\ldots,?Ty(t),\Diamond\}\ldots\}}$$

(34) is the rule to introduce a clause under the current type-*t*-requiring node. <U> is defined as the reflexive transitive closure of the union of the inverse($\langle L^{-1}\rangle$) and mother(<↑>) relation. In tree-diagrams, this tree relation is indicated by a dotted line, to distinguish it from the dashed line indicating the relation established by Local *Adjunction. After processing of the major and regular subject, (34) yields the interim transition as shown in (35):

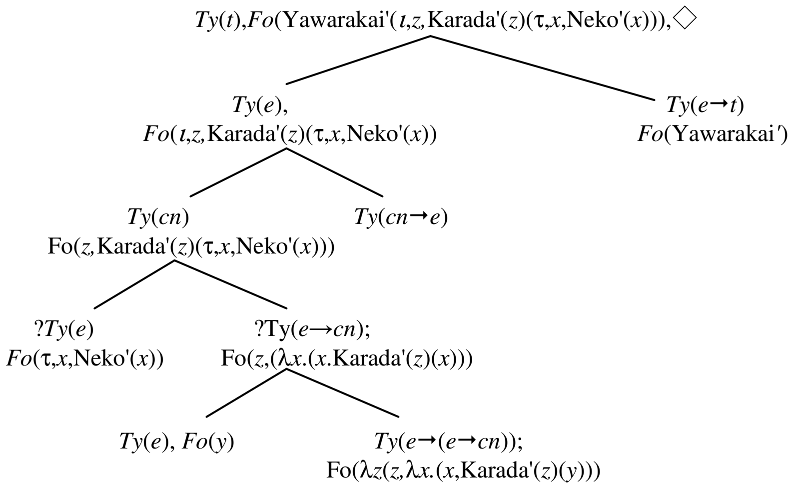
(35)



The partial structure is not ruled out by the prohibition of multiple application of the same Adjunction Rule at one time because one unfixed node is constructed by Local *Adjunction, while the other (type-*t*-requiring) node by Generalised Adjunction. Local *Adjunction may apply to construct another unfixed node for the following subject *karada* 'body', as shown in (31). The major subject node and the possessor node of the following subject is identified by the step of Merge (indicated by the heavy dashed line in (31)), which is here a step of structural abduction which is required as a meta-level process of reasoning (see Cann, et al. 2005:256 for discussion).

Because this is a pragmatic and system-external step, its application may be rejected.[7] After the predicate *yawarakai* 'pliable' is processed, the higher *Ty*(*t*)-requiring and adjoined *Ty*(*t*)-requiring nodes are identified because they are eventually interpreted to refer to one and the same node. In effect, the application of Generalized Adjunction makes a vacuous contribution to the semantic representation. Finally, the complete semantic tree for MSC (26b) should be something like (36):

(36)



It should be noticed that the construction process proposed here can be repeatedly applied. We can easily build the semantic representations for MSCs with more than two subjects in a simple clause, as in (3), which reflect the intuition of native speakers concerning the presence of the layers of predication in MSCs in the parsing process.

4 Relative Clause Formation of MSCs

In this section, we discuss relativization from MSCs where preceding major subjects can be extracted, while following subjects cannot, as shown in (5) and (7). In Japanese, any argument, adjunct or possessor can be relativized even in non-stative sentences. Note that the argument structures of the embedded predicates are fully saturated in these examples. Such unbounded dependency must be problematic for any syntactic theory proposed so far. In our analysis of MSCs in the preceding section suggests that major subjects are licensed by open propositions with unfixed nodes, which can in turn license the construction of relative clauses.

Another fact to be explained is the asymmetry in extractablity between major and regular subjects. Once subjectivization is invoked to raise a possessor to the major subject position to form the layers of predication, the remaining second or third

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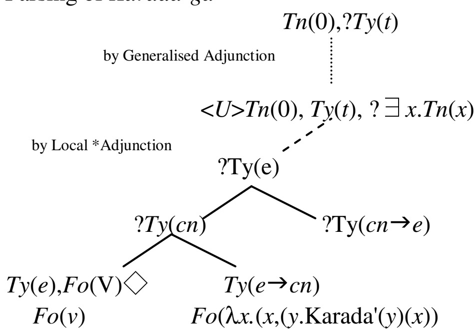
[7] For instance, observe the difference in acceptability of (ib) and (28a):

(i) a. Tanaka-sensei-no aiken-ga makkuro-da.
Tanaka-Mr.-Gen pet-dog-Nom inky-black-Be-Pres
'Mr. Tanaka's pet dog is inky black.'
b.*Tanaka-sensei-ga aiken-ga makkuro-da.
Tanaka-Mr.-Nom pet-dog-Nom inky-black-Be-Pres

subject must be stuck in a kind of 'island' formed by possessor extraction. How can our analysis account for the difference in grammaticality between (6a, 7a) and (6b, 7b)? First, let us consider how to build a semantic representation for a relative clause of a MSC. In parsing sentence (26b), the propositional node of the relative clause is introduced by Generalized Adjunction in (34). This weak rule merely introduce a type-*t*-requiring node (which may be an embedded clause or a relative clause) into the emergent structure. Then Local Adjunction constructs another kind of unfixed (type-*e*-requiring) node. The lexical specification of the relational noun *karada-ga* 'body' projects the structure with its possessor node open:

(39) Parsing of *Karada-ga*



The metavariable decorating the open type-*e*-requiring (possessor) node of the relational noun in (39) cannot be replaced with any formula. Hence, a fresh variable is constructed by the step of abduction to instantiate the metavariable, satisfying its formula requirement. The abduction process allows the propositional formula to be projected, and Completion and Elimination pass up this fresh variable to the local type-*t*-requiring node, and this variable is copied over to the new structure into which the head noun is introduced by the LINK Adjunction rule for Japanese in (40).

(40) LINK Adjunction (Japanese) (Cann, et al. 2005:274)

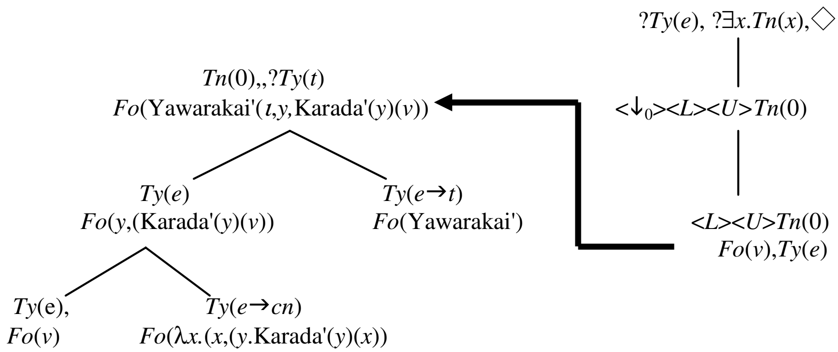
$$\frac{\{\ldots\{Tn(n), Ty(t), \ldots, \Diamond\}\ldots\{\langle\uparrow_*\rangle Tn(n), Fo(x), Ty(e)\ldots\}\ \}}{\begin{array}{l}\{\ldots\{Tn(n), Ty(t),\ldots\}\ldots\{\ \langle\uparrow_*\rangle Tn(n), Fo(x), Ty(e), \ldots\}\ \}, \\ \quad \{\{\langle L\rangle Tn(n), Fo(x), Ty(e)\}, \{\langle\downarrow_0\rangle\langle L\rangle Tn(n)\}, \\ \quad \{\langle\downarrow_0\rangle\langle\downarrow_0\rangle\langle L\rangle Tn(n), \langle U\rangle Tn(n), ?\exists x.Tn(x), \Diamond\}\}\end{array}}$$

Due to lack of space, we show only the tree resulting from the parsing of the relative clause *Karada-ga yawarakai neko* 'cats whose bodies are pliant' in (41) on the next page.

If the second subject is extracted from the relative clause in an MSC as in (7), there is no fresh variable left within the LINKed structure, the copy of which should be carried over, and (40) cannot apply to construct a term corresponding to the head noun. On the other hand, in successful parsing of the relative clause with the major subject extracted, as in (41), the evaluation rule can derive the proper interpretation like λx.(*x*, λ*y*.(*y*, Neko(*x*) ∧(Pliant'(Body'(*y*)(*x*)).

Finally, let us turn to the general issue of what role subjectivization plays in Japanese grammar. Recall that an MSC only carries an kind-level or individual-level interpretation, referring to the predication of an enduring inherent property of entity/entities denoted by a major subject. We, therefore, posit the presence of a generic operator, indicated by Gen, in MSCs. Observe the examples below.

(41)



(42) a. [$_{NP}$ Neko-no karada-ga] yawarakai.
cat-Gen body-Nom pliable-Be-Pres
b. [$_{NP}$ Neko-ga]$_i$ [e_i karada-ga] yawarakai.
cat-Nom body-Nom pliable-Be-Pres
c. [$_{NP}$ [$_S$ e_i karada-ga yawarakai] neko$_i$]-ga ...
body-Nom pliable-Be-Pres cat-Nom

As mentioned above, the value of *karada* 'body' must co-vary with the value of *neko* 'cat' in all the examples in (42). However, we should form different restrictors from quantified nouns of these sentences:

(43) a. *Gen* $x(\exists y(\text{Cat}'(x) \wedge \text{Body}'(x,y)) \rightarrow \text{Pliable}'(y))$
b. *Gen* $x(\text{Cat}'(x) \rightarrow \exists y(\text{Body}'(x,y) \wedge \text{Pliable}'(y)))$
c. $\lambda P.Gen\ x(\exists y\ (\text{Cat}'(x) \wedge \text{Pliable}'(\text{Body}'(x,y)) \rightarrow P(x))$

As for quantification concerning MSCs, we speculate that subjectivization is the device to take some predicate out of the restrictor to make it a new restrictor, and assemble the remaining elements into a new nuclear scope probably with internal structure, while relativization is the device to expand the restorictor, as can be seen from the analysis so far, but we do not discuss the interesting interaction between subjectivization and quantification any further.

5 Conclusion

In this paper, we explored an incremental parsing device building up semantic structures for multiple subject constructions in Japanese which are represented by the logic of finite trees. In Japanese stative sentences, argument structures (propositional templates) of predicates do not play any role for licensing of major subjects. Subjectivization of an arbitrary element in a stative clause is licensed by establishing a predication relation between a major subject and an open proposition, where pragmatic contexts should be taken into account. We have also shown how the layers of predication is constructed in a MSC projected from a single predicate, focusing on the semantic property of relational nouns which introduces an extra argument node into the structure. This construction process is not reflected in the semantic representation itself, but in sequences of transitions. The semantic properties of following subjects also provide an account to the asymmetry in applicability of relative clause formation in MSCs. Possibilities of establishing predication and relativization for MSCs have also given compelling evidence for our proposal. Many striking typological properties of MSCs have been clarified from a dynamic processing perspective following from general principles of left-to-right parsing and monotonic tree growth assumed in the Dynamic Syntax framework.

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