Japanese Scrambling as Growth of Semantic Representation*

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Abstract

In this paper I shall show how with syntax defined as the progressive projection of semantic representations along the left-right dimension provided by the sequence of words, natural explanations can be provided for scrambling of NPs in Japanese which follows from general principles of tree growth, retaining an integrated characterisation of local and nonlocal scrambling, which nevertheless captures the differences between them. In place of concepts of movement, concepts of structural underspecification representing partial semantic representations are invoked, with growth of such structure within a derivation following the time-linear dynamics of parsing. The explanation of scrambling will involve linear order irreducibly.

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1 The Challenge of Japanese

While it is universally assumed that people process language input in real time and on a broadly sequential basis, the dynamics of this process is very generally not reflected in the underlying grammar formalism.[1] Syntactic systems are, in all orthodox formalisms, neutral with respect to any applications which they are taken to underpin. In this paper, I argue to the contrary that natural language syntax should transparently reflect the process of parsing in real time, taking as a case study the phenomenon of scrambling in Japanese.[2] What I shall demonstrate is that the various syntactic puzzles posed by Japanese scrambling can be solved by shifting into this more dynamic parsing-oriented perspective. Central to the explanation will be the concept of structural underspecification associated with early stages in a parsing process, and the subsequent resolution of such underspecified aspects during the process of constructing an interpretation for a string: these two concepts in combination will replace altogether syntactic movement devices. The result will be a non-movement account of syntax which directly reflects the dynamics of language processing - an analysis in the strong competence tradition (see Fodor et al 1974, Phillips forthcoming).

1.1 Scrambling

Despite having been the focus of a great deal of attention over an extended period, including Saito 1985, 1992, 2003, Boškovič and Takahashi 1998, Saito and Fukui 1998, Karimi(ed.) 2003, scrambling remains something of an enigma.[3] The term 'scrambling', which goes back to Ross 1972, is a cover term for a range of word-order variation effects. It is perhaps most strikingly displayed in verb-final languages such as Japanese, where all noun phrases must precede the verbal complex;[4] and, at first glance, there is apparent freedom in the order of these noun

[1] Hausser 1989 is a notable exception, from whom the term *time-linear* is due, as are Phillips 1995, Kempson et al 2001, Schneider 2001.

[2] The incremental nature of Japanese processing (confirmed experimentally by Kamide and Mitchell 1998, Ferreira and Yoshita 2003) is hard to model, given standard assumptions, since the head-driven parsers which reflect orthodox grammar formalisms, would suggest, contrary to fact, that hearers should be forced to wait until the end of a sentence before being able to project any structure, making these languages relatively hard to process (See Mazuka 1990, Pritchett 1992, Inoue and Fodor 1995, Berwick and Fong 1995, Schneider 2001 for ongoing attempts to reconcile the self-evident lack of difficulty experienced by speakers in parsing Japanese with orthodox assumptions about Japanese syntax.)

[3] In this paper, I shall consider only Japanese scrambling; but the general style of analysis will apply in other languages also.

[4] In conversation, NPs and other constituents can follow the verb, but as argued by Sells 1998, these are elliptical fragments, and not part of the core sentence.

phrases. The problem is that some forms of interpretation from some positions are constrained by word order; and other forms of interpretation from other positions are not. Yet these two forms of interpretation are not complementary. In simple clauses, anaphoric expressions might initially appear to have to be preceded by their antecedent. The reciprocal *otagai* as used in possessive constructions, for example, can, in simple sentences, be associated with some antecedent apparently irrespective of the thematic role of either its containing expression or its antecedent as long as the antecedent precedes:[5] [6]

(1) *Taroo to Hiroto-ga otagai-no sensei-o hihansita (koto)*
Taro and Hiroto$_{NOM}$ each-other$_{GEN}$ teacher$_{ACC}$ criticised fact
'Taro and Hiroto criticised each other's teachers.'

(2) *?Taroo to Hiroto-o otagai-no sensei-ga hihansita (koto)*
Taro and Hiroto$_{ACC}$ each-other$_{GEN}$ teacher$_{NOM}$ criticised (fact)
Taro and Hiroto, each other's teachers criticised.

(3) *Taroo to Hiroto kara otagai-no hahaoya-ga hon-o*
Taro and Hiroto from each-other$_{GEN}$ mother$_{NOM}$ book$_{ACC}$
karita (koto)
borrow
From Taro and Hiroto, each other's mother borrowed books.

(4) *?*otagai-no sensei-ga Taroo to Hiroto-o hihansita (koto)*
Each other$_{GEN}$ teacher$_{NOM}$ Taro and Hiroto$_{ACC}$ criticised fact
'*Each other's teachers criticised Taro and Hiroto.'

(5) *John ga Taroo to Hiroto-ni otagai-o syookaisita*
John$_{NOM}$ Taro and Hiroto$_{DATIVE}$ each other$_{ACC}$ introduced
John introduced Taro and Hiroto to each other.

(6) **John ga otagai-o Taroo to Hiroto-ni syookaisita*
John$_{NOM}$ each other$_{ACC}$ Taro and Hiroto$_{DATIVE}$ introduced
John introduced Taro and Hiroto to each other.

[5] For some speakers, a wellformed antecedent for *otagai* must (like *zibunzisin*) be construed as subject). However, for those for whom the data reported here are wellformed, there is no distinction between argument and adjunct antecedent (as Saito 2003 points out).

[6] Throughout this paper, I adopt the Saitu methodology of setting aside all consideration of *-wa* marking, which I take to involve an anaphoric relation between the interpretation of the topic-marked expression and one argument in the interpretation of the sequence that follows. So, in general, the examples are presented with *koto* following each sequence to ensure an embedding environment.

This can't be dismissed as an idiosyncratic quirk of *otagai*, as the pattern extends to the pronominal *sono*:[7]

(7) *Dono hon-ni-mo sono tyosya-ga keti-o tuketa*
Which book-to-even its author$_{NOM}$ criticism$_{ACC}$ gave
Every book, its author criticised

(8) *?*Sono tyosya-ga dono hon-ni-mo keti-o tuketa*
Its author$_{NOM}$ which book-to-even$_{DATIVE}$ criticism$_{ACC}$ gave
'Its author criticised every book.'

In these cases, the linear order appears to matter: the antecedent of the anaphoric expression needs to precede the pronominal.

Yet, apparently contradicting this, interpretation appears NOT to be imposed by linear order, for any anaphoric expression occurring in a left-dislocated position.[8] From such a position, an anaphoric expression CAN be interpreted as dependent on some expression that follows. The data again include *otagai*:

(9) *Otagai-o John to Mary-ga hihansita (koto)*
each other$_{ACC}$ John and Mary$_{NOM}$ criticised fact
Each other John and Mary criticised

(10) *zibunzisin-o John-ga hihansita (koto)*
self$_{ACC}$ John$_{NOM}$ criticised fact
John criticised himself

Indeed we might also include (11), extending the first set of data (1)-(4):

(11) *Otagai-no sensei-o Taroo to Hiroto-ga hihansita (koto)*
Each other$_{GEN}$ teacher$_{ACC}$ Taro and Hiroto$_{NOM}$ criticised (fact)
'Each other's teacher, Taro and Hiroto criticised'

This is not just a problem of how anaphoric expressions are construed from a left-peripheral position: there are restrictions even on non-anaphoric expressions occurring in this left-initial position. No expression can provide an antecedent for an occurrence of *otagai* within some immediately following subject, if this left-initial expression is construed as an argument of some embedded structure.

[7]These data and translations are taken from Saito 2003. They might also be translated as 'No matter which book, its author criticised it.'

[8]This term is used without commitment to a specific analysis. In the event, the analysis to be given will not involve movement at all, so there is no dislocating or removal of any expression out of anywhere.

For example, if the sequence initiating (2) is continued so that the left-peripheral expression has to be construed within an embedded structure across two subject expressions, the result is not wellformed:[9]

(12) *?*Taroo to Hiroto-o otagai-no sensei-ga Tanaka-ga*
Taro and Hiroto$_{ACC}$ each other$_{GEN}$ teacher$_{NOM}$ Tanaka$_{NOM}$
hihansita to itta (koto)
criticised COMP said (fact)
*Taro and Hiroto, each other's teachers said that Tanaka criticised.

Likewise, quantifiers can, from this position, only be taken to bind a pronoun in some immediately following subject if they are construed as in the same clause as that subject, and not if they are construed in a subordinate clause, again across two intervening subject expressions:

(13) *Dono hon-ni-mo sono tyosya-ga keti-o tuketa*
which book-to-even its author$_{NOM}$ criticism$_{ACC}$ gave
Every book$_i$ its$_i$ author criticised

(14) **Dono hon-ni-mo sono tyosya-ga Hanaka-ga keti-o*
Which book-to-even its author$_{NOM}$ Hanaka$_{NOM}$ criticism$_{ACC}$
tuketa to itta
gave that said
*Every book$_i$ its$_i$ author said that Hanaka criticised

(14) cannot have the interpretation in which for every book its author said that Hanaka criticised it.

These facts have been taken to buttress the Saito analysis of left-dislocation structures in Japanese as involving so-called radical reconstruction whereby the interpretation of the left peripheral constituent, in these left-dislocated structures, are interpreted as though not in this left-peripheral position but in some clause-internal position. Saito's original evidence for this was the observation that *wh* expressions in Japanese are licensed by being associated with a clause final Q particle *ka* (or *no*). They may however occur in some left-peripheral position apparently outside the domain licensed by its associated Q particle as long as the construal is taken to be that of an embedded question:

(15) *John-ga Mary-ga dono hon-o yonda ka siritagatteiru*
John$_{NOM}$ Mary$_{NOM}$ which book$_{ACC}$ read Q want-to-know
(koto)
(fact)

[9]It is these data which are problematic for the purportedly uniform analysis of Tada 1990, as noted in Saito 2003.

John wants to know which book Mary read

(16) *?Dono* *hono-o* *John-ga* *Mary-ga* *yonda* *ka* *siritagatteiru*
which book$_{ACC}$ John$_{NOM}$ Mary$_{NOM}$ read Q want-to-know
(koto)
(fact)
John wants to know which book Mary read

So the overall problem is that in some sentence-types, expressions MUST be interpreted as reconstructed into some distinct site. Yet in others, no such "reordering" is available, and the expressions must be interpreted strictly according to the linear order in which they are presented.

The puzzles posed by scrambling have been worried over throughout the last twenty years, with no obvious signs of coming to any resolution. A central debate has been whether these languages are as configurational in their structural properties as more familiar languages such as English, given the apparent flat sequence of noun phrases preceding the verb with multiple possibilities for the ordering of these NPs (Hale 1983, Speas, Diesing 1992, and others). Can they, that is, be taken to project a VP node in any regular sense, if the NPs can occur in an order which makes the assignment of such a constituent impossible? The debate still rumbles on, with different versions in different frameworks.[10]

Even within (movement) frameworks in which a VP node is postulated in the syntax as holding at some level of abstraction, the analysis of these data remains controversial (see Saito 1985, 1992, 2003, Fukui 1993, Boskovic and Takahasi 1998, Saito and Fukui 1998, Bailyn 2001, 2003, Miyagaya 2003, Nemoto 1999, Kitahara 2002). The problem is that the form of movement apparently needed has never fitted well with assumptions of movement that have been articulated in the theory. It has been known for some time (since Mahajan's 1990 analysis of scrambling in Hindi) that so-called scrambling displays some of the properties of A movement, but also, contrarily, some properties of A' movement. Accordingly, many analyses invoke more than one process of scrambling, but there are equally many which attempt to provide a unitary account of the phenomena. The problem has taken on new urgency with the minimalist assumption that movement opera-

[10]LFG analyses distinguish a c-structure level (at which scrambled sentences are analysed with a non-binary flat structure) and other semantically related levels at which their thematic and semantic predicate-argument properties are projected (see Bresnan 2001). HPSG analyses too project such sequences as flat at the level of the string, separating out configurational principles from linearity, with superimposed linearisation principles. Reape 1994 defines discrete domains with relations between domains defined hierarchically, order internal to any one domain (roughly that of a clause) being unspecified. Kathol 2000 in addition defines a topological concept of fields (eg vorfeld and mittelfeld), internally to which idiosyncratic ordering statements are definable).

tions should be obligatory, for scrambling is transparently optional, with change of word order in some cases, but by no means all, being associated with change of interpretation.[11] In the original *wh* data cited by Saito 1992 (15)-(16), there is no change of meaning and the correspondence between the two is said to involve "radical reconstruction"; but in mixed quantification sentences, the order in which expressions occur does matter. (17) is unambiguous, but (18) is ambiguous:

(17) *dareka-ga* *hotondo-no* *uta-o* *utatta*
someone$_{NOM}$ most$_{GEN}$ song$_{ACC}$ sang
' Someone sang most of the songs' (unambiguous)

(18) *hotondo-no* *uta-o* *dareka-ga* *utatta*
most$_{GEN}$ song$_{ACC}$ someone$_{NOM}$ sang
'Most of the songs, someone sang
(ambiguous: indefinite narrow/wide scope)

The standard analysis of such reversed scope effects invokes covert A' movement to induce the appropriate LF configuration (Saito 1985), rather than any radical reconstruction. Thus covert and overt A' movement, both feature-driven, may be invoked as well as free application of Merge and obligatory reconstruction for meaning-preserving word order variation (Saito 2003). Alternative analyses are also proposed in terms of base generation of the scrambled strings, with LF lowering (Boskovic and Takahashi 1998). Yet others invoke concepts of information-restructuring (Bailyn 2003), though the status of such discourse-based explanations within a grammar formalism which eschews all reference to phenomena of use, is unclear. In sum, the situation remains in flux, with no agreement as to the preferred analysis. Because the working methodology disallows explanation in terms of linear order (see for example Mahajan 1997), linguists within minimalism have to address the problem by invoking hierarchical structures of varying complexity with associated movement operations subject to a range of restrictions in order even to describe the data.

For example, Saito's 2003 analysis involves a copy and delete mechanism. with P, D and O features as in Chomsky 1995;[12] and an additional A feature (A for anaphoric expressions) that gets argued for along the way. For cases necessitating binding at LF, both P and D features will be deleted from the foot of the chain

[11]The problem of optionality can be side-stepped of course, by invoking features specific to the task of enforcing the requisite movement (Kiss forthcoming, Miyagawa forthcoming, Maki and Ochi 1998). But invoking such features solely in order to trigger scrambling equally threatens the content of the minimalist claim.

[12](P features are phonological, D features are categorial features associated with binding relations, O features identify operators).

(17)-(18). For cases involving radical reconstruction (16), it will be only P features that are retained at the head of the chain. And in A chains, with local movement from an underlying SVO configuration, it is the head which selects the argument, and the D features will be retained at the head of the chain (not the foot), leaving no equivalent of trace. Saito assumes that with clause internal scrambling (2), both P and D features are copied, so that the D feature can be said to occupy a site c-commanding the anaphor at some point in the derivation, to wit LF, even though it is subsequently deleted at that level. In long-distance scrambling as in (14) , given the intervening movement site to which features are copied and then being an intervening site all deleted, there is no point at which the anaphor in matrix subject position is c-commanded by the D features of the left-dislocated antecedent, hence no possibility of the antecedent-anaphor relation between the front-placed *karare* and the immediately following occurrence of *otagai*.

As Saito himself points out, any minimalist account has problems capturing the "proper binding" effect (Saito 1992), in which the restriction, descriptively put, is that once an expression is moved out of a constituent, that constituent itself becomes frozen, and cannot itself be moved:

(19) *[*Hanako-ga* t_i *iru to]*$_j$ *Sooru-ni*$_i$ *Taroo-ga* t_j *omotteiru*
Hanako$_{NOM}$ be that Seoul-in Taroo$_{NOM}$ think
[That Hanako is t_i]$_j$ in Seoul$_i$ Taroo thinks t_j

(20) *Hanako-ga Sooru-ni iru to Taroo-ga omotteiru*
Hanako$_{NOM}$ Seoul$_{LOC}$ be that Taroo$_{NOM}$ thinks
Hanako is in Seoul, Taroo thinks.

In its original formulation (Saito 1992), this was an s-structure condition, a form of explanation in principle unavailable in minimalist explanations. In order to get the right result, he notes in passing that one solution would be to retain the full scrambling chain at LF, but, observing that this would necessitate the occurrence of P features at LF, he redefines Merge to apply only to "complete" constituents where this is a constraint preventing merge of an object that contains a trace but not its antecedent. But this, transparently, is no more than a description of the problem.

This machinery is still insufficient to handle the distribution of *zibunzisin*, the localised variant of *zibun*, which takes a range of subject antecedents, apparently along a movement chain:

(21) *Taroo-ga*$_i$ *Hanako-ga*$_j$ *Jiroo-ga*$_k$ *zibunzisin-o*$_{*i,*j,k}$ *hihansita* *to*
Taroo$_{NOM}$ Hanako$_{NOM}$ Jiroo$_{NOM}$ self$_{ACC}$ criticized that
itta *to* *omotteiru* *(koto)*
said that think fact
Taroo$_i$ thinks that Hanako$_j$ said that Ziroo$_k$ criticised self$_{*i,*j,k}$

(22) *Taroo-ga*$_i$ *Hanako-ga*$_j$ *zibunzisin-o*$_{*i,j,k}$ *Jiroo-ga*$_k$ *hihansita* *to*
Taroo$_{NOM}$ Hanako$_{NOM}$ self$_{ACC}$ Jiroo$_{NOM}$ criticized that
itta *to* *omotteiru* *(koto)*
said that think fact
Taroo$_i$ thinks that Hanako$_j$ said that Ziroo$_k$ criticised self$_{*i,j,k}$

(23) *Taroo-ga*$_i$ *zibunzisin-o*$_{i,j,k}$ *Hanako-ga*$_j$ *Jiroo-ga*$_k$ *hihansita* *to*
Taroo$_{NOM}$ self$_{ACC}$ Hanako$_{NOM}$ Jiroo$_{NOM}$ criticized that
itta *to* *omotteiru* *(koto)*
said that think fact
Taroo$_i$ thinks that Hanako$_j$ said that Ziroo$_k$ criticised self$_{i,j,k}$

To express this range of interpretations, Saito invokes an additional A feature, defined to allow checking at any intermediate movement site, hence optionally heading a chain, but also possibly discharged at intermediate sites, again no more than a descriptive device. Finally, with local scrambling of VP-internal arguments as yet unaccounted for, he defines such short scrambling to be like A-movement involving having the head of the chain preserve appropriate D features, hence not leaving a trace and not licensing reconstruction. Even this additional licence requires an ordering stipulation to prevent inappropriate interaction with the subject. So the overall picture is a list of heterogeneous phenomena, awaiting integration in a more explanatory account.

In this paper, I show how these puzzles can be solved if we shift into a perspective in which grammar formalisms induce structure reflecting the way in which semantic interpretation for a natural language sentence is built up in real time. The central concept is that of structural underspecification, replacing the concept of syntactic movement altogether. Interpretation is said to involve building up a tree structure representation of content on a left to right basis from the words. The form of under-specification which will be our primary focus is one in which nodes may be introduced into some partial tree which are in some sense not properly fixed in the tree. Working out where in the emergent tree such initially unfixed nodes are to end up is part of the construction process. Throughout any such overall tree building process, local units of propositional structure are introduced and then compiled; and each such sub-structure may involve the introduction and then

updating of such initially unfixed nodes. The result is an incremental account of how interpretation is built up in Japanese, in which the account itself constitutes a grammar formalism.

2 Dynamic Syntax

2.1 Preliminaries - The Representationalist Background

The grammar formalism in which these informal statements are to be made formally precise is Dynamic Syntax (DS: Kempson et al 2001). In Dynamic Syntax, the sole concept of syntax is given through expressing the monotonic growth of semantic representations along the time-linear dimension of natural language processing. [13] The original impetus for developing Dynamic Syntax as a framework was to provide a formal base from which other people, notably those working in pragmatics, could address such issues as the lexicon/pragmatics interface, disambiguation and the selection task of assigning a contextually appropriate interpretation to a string. Thus a formal space of tree structure representations of contextually established content is set out, together with a defined architecture through which such tree representations can be incrementally built up. There was no attempt within the Dynamic Syntax model itself to address the task of which out of a set of putative competing interpretations, a language processor might select; this is taken to be the central remit of pragmatic theory (Sperber and Wilson 1986).[14] What is central to the account however is the assumption that, as a general property of the cognitive system, the information directly derived from some input stimulus yields relatively weak/under-specified information compared with the interpretation to be assigned to it: interpreting a signal involves enriching that initially derived information in ways specific to the context of the task in hand. The enrichment processes that have then to be brought into play to define appropriate pairings of signal plus interpretation are in part determined by system-internal constraints, but they are also subject to whatever additional general cognitive constraints may play a role in determining interpretation. As we shall see, this becomes critical in addressing the puzzle of the borderline status of long-distance scrambling.

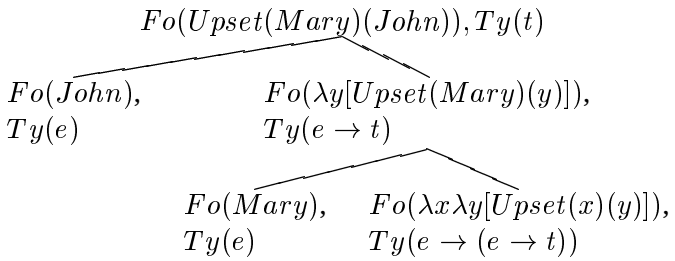
[13] This framework is a contribution in the tradition of representationalist theories of mind (Fodor 1981); but as we shall see, this system, though modular, is not encapsulated.

[14] For purposes of discussion, we may presume that this task is driven by some constraint such as the Sperber and Wilson presumption of optimal relevance in which factors of cognitive cost are weighted against the inferential benefits of the choice made (see section 6), but nothing turns on the particular form of such general cognitive constraints.

2.2 The Dynamic Syntax Architecture

The process of building up an interpretation is modelled as the goal-directed projection of logical form, where the logical form corresponding to an interpretation is represented as a tree.

The first thing to note is how different the concept of tree is from other frameworks. Tree structure configurations represent interpretations of a string, not the string itself. The logical form representing one such interpretation is a formula $Fo(\alpha)$ of propositional type, $Ty(t)$, which decorates the root node of the tree, Tn(0). The formula (Fo) decorations on all other nodes are subterms of this propositional formula:



As is evident from this display, trees are nothing more than lambda terms which happen to be represented in a tree format. The advantage of representing them in this way is that we can articulate fine-grained concepts of what it means for interpretation to unfold, expressed as the growth of a tree across sequences of partial trees.

2.3 Requirements and tree growth

All steps of tree growth that reflect the growth of interpretation follow the dynamics of parsing some linear sequence of words as though in real time. As diagrammatically set out in Figure 1, central to the concept of tree growth to be articulated is the concept of requirement. The input to all processes of interpretation – see tree 1 in figure 1 – is the goal of establishing some such propositional structure. This is specified as the introduction of a root node of some tree, decorated with a "requirement" $?Ty(t)$, this requirement being the specification that some formula of type t is the goal to be achieved.[15] All that follows are steps getting progressively closer to this goal (in figure 1, trees 2-6). More precisely, from this initial introduction of a root node decorated with this one requirement, a tree structure is progressively induced by an unfolding of tree-structure on a top-down basis as driven by requirements, and then compiling interpretation for the introduced structure on a

[15]Requirements invariably take the form $?X$ for some specification X.

bottom-up basis by type-deduction/functional application defined on those nodes as the features on the individual nodes dictates.[16]

The concept of partial tree, and the concept of requirement that drives the process of developing such trees, are articulated using a modal tree logic (Blackburn and Meyer-Viol 1994), in which $\langle\downarrow\rangle X$ holds at some node when some decoration X holds at its daughter node, and $\langle\uparrow\rangle X$ holds at some current node when X holds at its mother.[17] The opening step of development from the root node, with its decoration $?Ty(t)$, is to introduce requirements of the form $?\langle\downarrow_0\rangle Ty(e)$,$?\langle\downarrow_1\rangle Ty(e \rightarrow t)$, imposing the constraint that the tree develop into a predicate-argument structure, through the development of appropriate daughter nodes. These requirements then lead to the construction of the two daughter nodes with non modal forms of $?Ty(e)$, $?Ty(e \rightarrow t)$ respectively (see the transition from tree 1 to tree 2 in figure 1).[18] There is always one node under development, indicated by $\Diamond$, the pointer; and the general idea is that from the overall goal, computational actions and lexical actions progressively develop the tree, lexical actions determining the more idiosyncratic properties of growth.[19] So in figure 1, general computational actions dictate the transition from step 1-2, lexical actions associated with the word *John* dictate the transition from 2-3, lexical actions of *upset* dictate the step 3-4, those of *Mary* the step 4-5.[20]

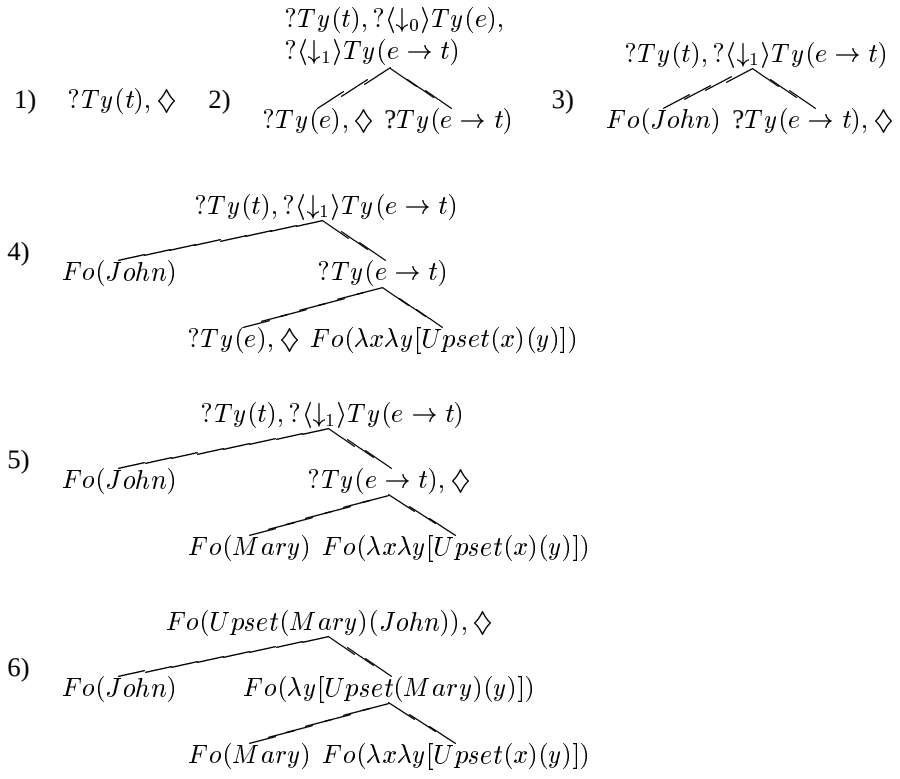
[16]The system is constraint-based (see Pullum and Scholz 2001). All rules are optional, and it is the interaction between them and the update actions provided by lexical items which determine individual language variation. Throughout this paper, general computational rules will be characterised only through tree display of their effect.

[17]Within this, we may distinguish $\langle\downarrow_0\rangle X$ and $\langle\downarrow_1\rangle X$, with the former holding if X holds at a daughter node whose decorations are to act as argument, and the latter holding if X holds at a daughter node whose decorations provide some functor. The notation is superficially similar to that of LFG, but in this system $\uparrow, \downarrow$ indicate mother and daughter relations respectively, not any more composite notion.

[18]This unfolding of local requirements from nonlocal, modal, requirements is a logical consequence of adopting a modal propositional logic as the basis of the tree formalism. Providing a general Kripkean semantics for modal logics involves articulating accessibility relations between worlds. These can be displayed as a "Kripke frame", a tree in which nodes represent worlds, relations between nodes in the tree represent accessibility relations, and the truth of $\Diamond P$ is established by constructing a relation from the current world to an introduced node representing an accessible world at which P must be established. So the semantics of modal propositional logic and the logic of finite trees go hand in hand, by definition, with an elegance that is not matched by tree-description logics defined using predicate logic (see Rogers 1994).

[19]Lexical actions take the form $IF..., THEN...., ELSE...$, with action predicates of the form make(...), go(...), put(...).

[20]Throughout, the characterisation of linguistic names will be over simple, as though there were a one to one correspondence between linguistic names and logical proper names. In a more detailed account, this would be replaced by an analysis in which the linguistic name provides instructions on the construction of some new name into the structure under development. Note the principle C effect of this assumption: the analogue of Binding principle C is not a property of the names in the logical



Note $Ty(e)$ the semantic type of DP
$Ty(e \rightarrow t)$ the semantic type of VP.

Figure 1: Parsing *John upset Mary*

In this simple development, all decoration of nonterminal nodes is indicated as taking place after all terminal nodes have had their requirements met, in a single transition from tree 5 to tree 6.[21] But this is by no means the only pattern. Nonterminal nodes are decorated by functional application/type deduction as and when the pairs of daughter nodes are assigned an interpretation satisfying their requirements, with accompanying steps of pointer movement back up the tree as

representation, but only of the process of constructing such names from linguistic input.

[21] A number of steps are conflated in the transition from tree 5 to tree 6. Decoration of non-terminal nodes is progressively bottom-up, not a global operation.

the requirements on each nonterminal node get established. With this progressive compilation of the tree, the variously introduced modal requirements can be met, until, as Figure 1 displays, the initially imposed goal, $?Ty(t)$, can be established.[22]

With the concept of requirement as the central driving force of the system, wellformedness is defined as the availability of at least one logical form derived by some sequence of computational, lexical or pragmatic actions using all information provided by the presented words in sequence, satisfying whatever requirements are imposed. Requirements, as we shall see, range over all decorations that are defined in the system: $?Ty(y), ?Fo(\alpha), ?\exists xFo(x), ?\exists xTn(x)$, etc.

2.4 Linked trees and relative clause construal

Not all tree relations are taken to be mother-daughter relations. Pairs of trees may also be induced, for which by definition there has to be an encoded sharing of at least one term in the pair of structures, as in:

(24) John, who I like, smokes.

(25) I saw John, which annoyed him.

As the interpretation of these examples suggests, the relative pronoun provides a fixed anaphoric device for correlating what are otherwise independent structures. Accordingly, relative clauses are defined to involve projection of paired partial structures across a so-called LINK relation (using an additional modal operator $\langle L \rangle$ and its inverse $\langle L^{-1} \rangle$). The extra complexity associated with building such partial trees in tandem, used to express adjunction and coordination, I shall leave on one side (see Kempson et al 2001, Kempson and Meyer-Viol 2002, Marten forthcoming, Cann et al forthcoming).

2.5 Underspecification and concepts of tree growth

As so far introduced, the system may seem indistinguishable from a simple phrase-structure or categorial grammar. But being a tree description language, LOFT enables a range of concepts of under-specification to be expressed - each with an associated process of update.

First, formula decorations may be under-specified to match the way pronouns under-determine the content they are assigned in context, with general procedures determining their interpretation. This is modelled as the lexical projection of place-holding meta-variables, $Fo(\mathbf{U})$, $Fo(\mathbf{V})$, etc to be provided some term as value,

[22] All noun phrases are taken to project terms of type e, both non-quantified and quantified. See section 2.6.

either by a general pragmatic process of substitution, relative to whatever locality constraint the particular expression imposes, or by other computational processes as available.[23]

2.5.1 Structural Underspecification

The concept of underspecification and update is generalised to structural concepts of under-specification, where the potential which LOFT provides comes into its own. Taking the concept of the relation from mother to daughter, $\langle\downarrow\rangle$, the relation of domination for an individual tree is defined from some node n as:
$\langle\downarrow_*\rangle X$ holds iff X holds at a node along some sequence of daughter relations (including the possibly empty sequence).[24] This is then extended by combining the concept of requirement to describe nodes as contained within a tree but unfixed within it. The node dominated by n is so described without further specification of what that relation consists in, merely with an accompanying requirement for a fixed value:

$$\langle\uparrow_*\rangle Tn(n), ?\exists x Tn(x)$$

We can then define a construction process that introduces such a node, a process we call *Adjunction:

$$\begin{array}{c} Tn(n), ?Ty(t) \\ \vdots \\ ?Ty(e), \Diamond \\ ?\exists x.Tn(x) \\ \langle\uparrow_*\rangle Tn(n) \end{array}$$

The effect of such a construction process is to introduce such an "unfixed" node to a node requiring $?Ty(t)$ which dominates no other nodes,[25] and to move the

[23]To drive the replacement of such meta-variables by some fixed value, all such variables are accompanied by a requirement for a fixed value of the form $?\exists x.Fo(x)$, thereby forcing their update in all wellformed completions. See Kamp and Reyle 1993, Ranta 1994, Fernando 1999, Kempson 1988, Sperber and Wilson 1995, Wilson and Sperber 1986, amongst others for similar analyses of anaphoric expressions.

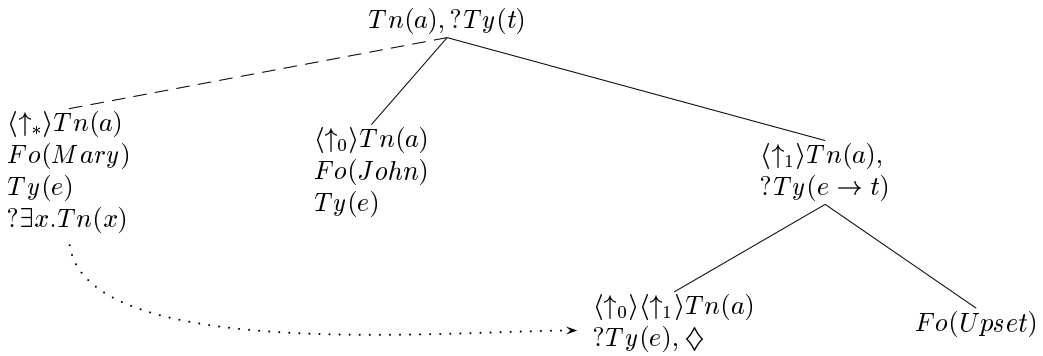
[24]This definition of *dominate* is standard in such tree description languages: see Blackburn and Meyer-Viol 1994, Rogers 1998. It should be noted that if such a relation holds between dominating node n and dominated node, the inverse relation of $\langle\uparrow_*\rangle Tn(n)$ will hold at that dominated node. The use of such relatively weak tree relations is in the tradition of D-tree grammar formalisms as devised for parsing algorithms (Marcus 1980), but here taken as the basis of a natural language grammar formalism.

[25]This condition will ensure that this rule cannot apply recursively to yield a sequence of unfixed nodes.

pointer to this node, requiring that it be immediately developed. Once this node is developed, a process of pointer movement returns the pointer from its tree node position indicated as $\langle\uparrow_*\rangle Tn(a)$ to the node $Tn(a)$, so that the construction process can proceed in the normal way from the type t-requiring node.[26]

Like all other aspects of underspecification, this underspecification of node position must be resolved during the construction process; and it must be an enrichment, i.e. with the assigned value entailing the weaker initial specification. To reach the resolution site, the information about the unfixed node is evaluated down through the emergent tree, step by step until a node is reached at which the appropriate update can be achieved. The fixing of the appropriate tree relation is then determined by a process which unifies the fixed node with some independently introduced node, thereby providing it with a fixed tree position.[27] For example, in the construal of (26) a left-dislocated object is taken to decorate an unfixed node along a sequence of daughter relations as its initial description, merging with the object node projected by some verb when that is parsed, since $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(a)$ entails $\langle\uparrow_*\rangle Tn(a)$:[28]

(26) Mary, John upset.



[26] I assume a general process moving the pointer back along a relation once the introduced node has its type requirement satisfied.

[27] The process, called *Merge*, can take place if the pointer is positioned at a node providing the putative update site, subject to the constraint that the tree node address of that site entails the input address of the unfixed node being merged (following the general monotonicity constraint on tree growth processes). Other general node admissibility conditions include the restriction that no node may have more thane one logically independent *Formula* value, no node may have more than one type value, etc. I assume a general process of moving the pointer back along a relation, once the introduced node has its type requirement satisfied.

[28] $\langle\uparrow_0\rangle Tn(a)$ indicates that the formula decorating the node is an argument in some formula; $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(a)$ indicates that the formula decorating the node is an argument in some formula which is itself a functor (here to be a one-place predicate).

Nodes that are introduced as unfixed in this way may also have further lexically imposed constraints on their resolution, eg as introduced by case specifications, NOMINATIVE indicating a requirement that immediately dominating it be a type t decorated node – $?\langle\uparrow_0\rangle Ty(t)$ – ACCUSATIVE indicating a requirement of the form $?\langle\uparrow_0\rangle Ty(e \rightarrow t)$, etc.

This process of seeking to establish a fixed position for the unfixed node takes place across an arbitrary sequence of daughter relations, hence also into complement structures. It is precluded from being resolved within the structure associated with relative clauses (or coordination/adjunct structures), since these are defined to project pairs of trees involving a LINK relation which relates an arbitrary node of one tree to the root node of a second tree. (see Kempson et al 2001, Kempson and Meyer-Viol 2002, Kempson, Meyer-Viol and Otsuka 2003).

When extended to *wh* questions, analysis of long-distance dependency will have the consequence that long-distance dependency associated with *wh* expressions is classed with radical reconstruction effects, occurring as an in-situ argument when the tree representing some logical form is completed. This may seem surprising given the standard assumption that *wh* expressions are propositional variable-binding operators with operator features to be checked under adjacency to some node associated with semantic evaluation as a proposition, particularly since it is generally assumed that construal of *wh* structures is distinct from the semantically empty process of scrambling for which radical reconstruction is motivated. However core arguments for movement such as those concerning the *wh* criterion (Rizzi 1990) centre on the concept of clause-typing, and there are reasons to distinguish clause-typing from the concept of scope. Particularly striking evidence of the independence of clause-typing and quantifier-scoping is available from German. In German, an expletive form of *wh* expression is used to convey information clause-typing the whole string as a *wh*-question. In (27) for example, the successive *was* forms mark the sequence as an overall *wh* question, and it is the lower full *wh* form *wen*, which provides the appropriate morphological form for the question that is being asked (the verb *lieben* requires the accusative):

(27) *Was glaubst du, was Hans meint, wen Jakob liebt?*
What think you what Hans said whom Jacob loved
'Who do you think Hans said Jacob loved?' [German]

Despite claims that this *was*-chaining device is a marker of semantic scope (eg McDaniel 1999), when this device is combined with an intervening quantifying subject, by far the most natural interpretation is that in which the associated full *wh* expression narrow scope with respect to the other quantifying expression. So the only natural interpretation of (28) is one in which *wohin* takes narrower scope

than *jeder* (Pafel 2000), a fact which is hard to explain under the operator-variable binding account of *wh* expressions:

(28) *Was glaubt jeder$_i$, wohin er$_i$ geht?* [German]
what thinks everyone where he went
'Where does everyone think he went?'

In the type of analysis proposed here, *wh*- expressions are simply defined to project a specialised very weak term,[29] with a clause-typing property, when decorating an unfixed node, to annotate the dominating type t-requiring node with an appropriate +Q feature. The analysis of examples such as (28) then involves explicit separation of clause-typing and quantifier-binding properties.

What this means, when we turn to Japanese, is that the radical reconstruction phenomenon, seen by Saito and others following him as an exceptional property of Japanese, is in fact a core process of the grammar – the introduction of an unfixed node early on in the parse process. The distinguishing feature of languages with *wh*-fronting is that the indefinite expression associated with *wh* questions also projects clause-typing information. Languages such as Japanese use an independent particle for this purpose. Thus in Japanese, the *wh* expression itself solely introduces an indefinite term, defined, in some uses, as requiring a dominating $Ty(t)$ node clause-typed with some feature $+Q$.[30] Though nothing prevents a *wh* expression in these languages decorating an unfixed node, nothing enforces their occurrence early on in the parse process. All that they impose is a requirement that they be dominated by a type t node which is suitably clause-typed with a $+Q$ feature. Hence the radical reconstruction phenomenon observed in Saito 1985, 2002.

2.6 Quantifier construal

It might seem that an account of *wh* expressions as of type e drives an unwanted wedge between *wh* expressions and quantifying expressions. However, in DS, ALL noun phrases are analysed as being assigned a logical form of type e, following the pattern of arbitrary names in predicate logic proofs. The framework, that is, adopts the epsilon calculus.[31] In the epsilon calculus, quantified expressions are analysed as a complex form of name - variable-binding term operators - whose syntax is

[29] In Kempson et al 2001, this was assumed to be a specialised meta-variable, not associated with a requirement forcing any update, however in languages such as Japanese it is arguably some form of epsilon term.

[30] As a quantifying term, it will have an associated scope statement (see section 2.6); and arguably this is lexically constrained to achieve a locality effect (see section 5.2). The functions of clause typing and scope determination are nevertheless independent.

[31] The epsilon calculus constituted the formal study of arbitrary names in predicate logic natural-deduction style proofs. See Hilbert and Bernays 1939 for the setting out of the epsilon calculus, and

simple as in predicate logic proofs, and the complexity is hidden in the semantics. Their interpretation is the arbitrary witness which makes the associated formula true, which the arbitrary name denotes.

This choice of analysis has the advantage of keeping the syntactic and semantic properties of noun phrases in correspondence, as in the Montague system, but without the lifting of types. The internal structure of such terms is then constructed across the determiner...nominal sequence. In a language such as English, the determiner introduces a daughter node which it decorates with a binding operator, and the noun projects both a fresh-variable for that operator to bind, and the nominal which constitutes its restrictor. Since scope in this system is not expressed in the tree by definition (since the NPs project names), scope statements are collected at a local type-t-requiring node, and feed an algorithm which determines the resulting semantics for the constructed names.

The detailed justification for this analysis would take us too far afield (see Kempson et al 2001, Kempson and Meyer-Viol 2003) but it is notable that there are lexical idiosyncracies associated with scope effects, a property impossible to square with any general account of quantifiers.[32] Indefinites, for example, may take arbitrarily wider scope than any other term in the structure in which they are contained

(29) Each professor insisted that three students carry out an assignment which involved evaluating two recent papers of Chomsky's.

Though many analyses have advocated lexical ambiguity,[33] such analyses cannot express the range of interpretations available for examples such as (29). The final indefinite in (29) can be interpreted as taking widest scope of all, or narrow scope with respect to each of the three quantifiying expressions preceding it, with no sensitivity to the structural configuration in which the quantifying expression is contained. With indefinite construal apparently not sensitive to islands, an analysis in terms of movement isn't appropriate, but nor is there a binary distinction to be drawn as one would expect on a referential/nonreferential ambiguity. Furthermore, there is parallelism between anaphora and indefinite construal. Languages which encode linearity sensitivity to anaphoric resolution also encode linearity sensitivity to indefinite construal, eg Chinese.

Meyer-Viol 1995 for recent development. See Kempson et al 2001 for a formal sketch of an account of natural-language quantification in these terms.

[32]The problem applies equally to generalised quantifier analyses of quantifying expressions, and to analyses in terms of covert movement.

[33]Fodor and Sag (1981) were the first to posit a lexical ambiguity, with many others following them. For evidence against this claim, see Farkas 1981, Cormack and Kempson 1990, amongst others.

Though inexpressible upon any account of indefinites either as names or as generalised quantifiers, this property is straightforward to express, given the characterisation of scope as the imposition of a lexical constraint on collecting scope statements at some suitably locally dominating type t-requiring node. We simply define indefinites as taking narrow scope with respect to some term to be chosen pragmatically out of what is made available during the construction process (this set including terms denoting times and indices of evaluation).[34] The default case where its scope appears to be widest of all constitutes a dependency on the index of evaluation associated with the assertion as a whole. This characterisation of scope reflects exactly the phenomenon of indefinite scope ambiguity, and it leads us to expect that selection of scope choice may involve a range of pragmatic factors including contingent knowledge.[35] This anaphora-style account of indefinite scoping has an immediate consequence: scope choice will not be reflected in the tree configuration – it cannot be, since there is no discrete operator binding at a propositional level. Rather, the logical form, once constructed, will have an accompanying scope statement which determines how the quantifying terms are to be evaluated; and, with all information available to fix the resulting interpretation, an algorithm evaluating pairs of scope-statement plus logical-form determines its final form.

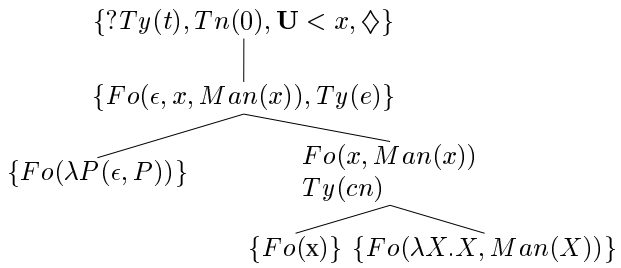
What needs to be added, to give the full Dynamic Syntax flavour, is the articulation of how the process of building up the input to the evaluation of such scope statements is incremental, like all other aspects of the process of constructing interpretation. This can illustrated with an account of the mechanisms involved in establishing the interpretation of (30):

(30) A man smokes

[34] See Perrett 2000 and Gregoromichelaki in preparation, for accounts of tense in Dynamic Syntax terms.

[35] For example, this flexibility of interpretation relative to pragmatic constraints provides a natural basis for explaining the prevailing cross-linguistic tendency for indefinites to the LEFT of some subsequent NP to be interpreted with the attendant scope choice made online PRECLUDING any dependency on some following quantifying term, but choice of scope for the indefinite FOLLOWING some such term invariably ALLOWING ambiguity of scope. This phenomenon is, I suggest, also a contributory factor in the varying ambiguity observed in mixed quantification sentences discussed by Sauerland and Elbourne 2002. On this basis, we expect that where such linearity considerations conflict with contingent knowledge of the situation described threatening to yield an inconsistent interpretation, they can be set aside, as in (i):
(i) kangofu-ga subete-no kanjya-o monsin-sita
nurse$_{NOM}$ every$_{GEN}$ patient$_{ACC}$ interview-did
'A nurse interviewed every patient'.
Moreover we would expect interaction between choice of interpretation for indefinites and scrambling (see sections 4, 5.3 for some preliminary statements).

Processing the sequence of determiner plus noun in English involves the introduction of internal structure at a constructed subject node, with the determiner providing the binder, the noun the restrictive predicate and a fresh variable. A scope statement concerning the introduced variable x is then added to the locally dominating $?Ty(t)$ node:



The fact that there is a scope choice to be made in the case of an indefinite is reflected in the representation of the first argument of the scope relation as a metavariable. In (30), the only possible value for the first argument of the scope statement is the temporal variable, but should there be another quantified expression, there will be a choice available, the value selected determining the form of scope dependency. With the subsequent construction and decoration of the predicate node, and in its turn the rootnode, the result is a pair of a logical form decorating the rootnode of a tree and an associated set of scope statements (the scope statement $S_i < x$ indicates that S_i, the index of evaluation, has scope over the term containing x):[36]

A man smokes $\rightsquigarrow$ $\quad S_i < x \;\; Fo(Smoke(\epsilon, x, Man(x)))$

Such pairs of scope statement and logical form feed into an algorithmic process of scope evaluation, all information to provide the requisite semantics being at this point fully articulated.[37] In a sequence of such scope statements, the index of evaluation projected by tense is the last to be evaluated.

[36] In this simplest case, there is only one scope statement but in principle there is a sequence of scope statements imposing an ordering on the way these constructed quantificational terms are to be evaluated. All terms, $\mathbf{x}$, each of which has a corresponding scope statement added to this sequence determining how $\mathbf{x}$ is to be understood in relation to other such terms, are described as $DOM(\mathbf{x})$. Names too are assigned a scope statement, ensuring widest scope with respect to other constructed terms. The predicate DOM enables us to pick out a full set of terms within some defined local domain.

[37] For example, from the logical form for (30) the resulting evaluation is:

$Fo(S_i : Man(a) \wedge Smoke(a))$
$a \;=\; \epsilon, x, Man(x) \wedge Smoke(x)$

where a represents the witness of the truth of the formula constructed from *A man smokes*.

The rule which yields this effect dictates that for each term under evaluation, a compound formula is introduced containing:

3 Varieties of structural underspecification

In turning now towards the challenge of capturing structural properties of Japanese, the question is how can we use the concept of having unfixed nodes early on in the parse process to characterise the information which a sequence of noun phrases conveys to a hearer. It might look as though we shall need several concepts of underspecification; and LOFT can certainly express several such concepts, just as it can express different concepts of locality for constraining anaphora construal. We start from the regular process of *Adjunction, and modify it in two directions, with deliberate echoes of the binding principles.

3.1 Generalised Adjunction

To take the broader concept first, we can express what it means to be contained within an overall configuration of linked trees without further itemisation of the particular relation involved: such a relation to some topnode $Tn(a)$ would be $\langle U\rangle Tn(a), ?\exists x.Tn(x)$.[38] To introduce such a node, we define a generalised adjunction process whereby a node can be introduced that matches in type the node from which the relation is induced, but which can hold across any arbitrary relation to the input node.

$$\{Tn(a), ?Ty(t)\}$$
$$\vdots$$
$$\{Tn(n), \langle U\rangle Tn(a), ?Ty(t), \Diamond\}$$

The process is one which allows a node to be, as it were, pulled apart from the place in the tree from which it was introduced for further modification. There are

(i) a first conjunct which contains the predicate of the restrictor of the term under evaluation predicated of a newly constructed name,
(ii) a connective appropriate to the quantifier internal to the term, $\wedge$ in the existential case, $\rightarrow$ in the universal case,
(iii) a second conjunct which contains the logical form as projected at the topnode of the tree predicated of the same new name, where
(iv) this new name is defined as the term making true the constructed (compound) formula. The internal structure of the name by definition reflects the propositional formula to whose truth it will serve as a witness. The details of this rule will not play an important role in what follows, but see Kempson et al forthcoming for an account of Japanese head-internal relatives in which the construction of such terms plays a central part (see also Kempson et al 2001, Kempson and Meyer-Viol 2003).

[38] U is defined as the reflexive transitive closure of the union of the inverse-LINK and mother relations, so $\langle U\rangle X$ holds at some node n if somewhere along a sequence of relations including either $\langle\uparrow\rangle$ or $\langle L^{-1}\rangle$, X holds.

at least two structure types in English which appear to motivate such a process, the so-called preposed clausal adjuncts, and genitive constructions:

(31) Having once had a fright by drinking too much, I am sure Tom will be careful not to do so at his party this time.

(32) The King of England's mother's brother's wife has disappeared.

Though these are very different constructions, they both pose the problem that the local projection of structure may need to be nested at arbitrary levels of embedding with respect to the root.

In Japanese, as we shall see, structure is quite generally developed without any indication of its contribution to the overall structure:

(33) *Hiroto-ga* *muita* *to* *itta*
Hiroto$_{NOM}$ peeled $COMP$ said
Hiroto said that he peeled it

(34) *Hiroto-ga* *muita* *ringo-o* *tabeta*
Hiroto$_{NOM}$ peeled apple$_{ACC}$ ate
Hiroto ate an apple he peeled

So once having introduced the general goal-driven requirement that Japanese, as every other language, is driven by the overall goal of establishing a propositional structure, we shall need to make use of some step of Generalised Adjunction in all cases where subordination needs to be induced. The effect of this step is that subordinate structure can be locally constructed without any prior identification of whether in the end result it will turn out to be that of a complement structure or as part of some relative-clause construal.

3.2 Local *Adjunction

At the other extreme, we might wish to express what it means to be a node introduced locally relative to some $Tn(a)$, without yet the projection of the tree within which its position is fully determined. Indeed such a form of *Adjunction seems to be well-suited for capturing Japanese local scrambling, as long as we provide appropriate modification of the rule to allow repeated application with an apparent sequence of unfixed nodes:

(35) *Hiroto-ga* *ringo-o* *tabeta*
Hiroto$_{NOM}$ apple$_{ACC}$ ate
'Hiroto ate an apple.'

(36) *Ringo-o* *Hiroto-ga* *tabeta*
apple$_{ACC}$ Hiroto$_{NOM}$ ate
'Hiroto ate an apple.'

This is straightforward to do. We simply implement the regular process of *Adjunction, loosening the requirement that the node to be introduced is the sole node dominated by the $?Ty(t)$ node, and yet impose the constraint that there must be no intervening dominating node between the input node and the introduced node bearing the same type t-requiring property:[39][40]

$\langle\uparrow_*\rangle(Tn(a)\wedge ?Ty(t) \wedge \neg\exists x(Tn(x)\wedge ?Ty(t) \wedge \langle\uparrow_*\rangle Tn(a) \wedge a \neq x))$.

Application of such a rule would seem to yield the tree as in Figure 2.

Sticking to this intuition as a basis for Japanese local scrambling just for the moment, notice what inducing the configuration in figure 2 also involves. Both the noun *ringo* and the verb *tabeta* are taken to project a template of structure, considerably more, that is, than the mere decoration of a single node. This separation of surface form and decoration on the semantic tree is unproblematic in this framework, again unlike more orthodox frameworks. Expressing the pro-drop intuition is straightforward. The verb does more than provide a logical predicate; it has a macro of actions that introduce a template of propositional structure, introducing nodes for each of its arguments as well as the node for the predicate, each such argument-node being decorated with a meta-variable requiring substitution. In like manner, the noun projects more than the nominal predicate. It may, in the face

[39]This characterisation of locality notably allows Merge to apply into structure projected from a noun, which data from Hoshi 2002 suggest is correct (on the assumption that one sub-use of *-no* is to project argument nodes of predicates internal to type e constituents):
(i) John-ga Mary kara hooseki-o ryakudatu sita
John$_{NOM}$ Mary from jewelry$_{ACC}$ plunderage did
(ii) John-ga Mary kara hooseki-no ryakudatu-o sita
John$_{NOM}$ Mary from jewelry$_{GEN}$ plunderage$_{ACC}$ did
(iii) ?John-ga Mary kara hooseki-o ryakudatu-o sita
John$_{NOM}$ Mary from jewelry$_{ACC}$ plunderage$_{ACC}$ did
In this connection, the characterisation of case may need to be made more abstract to allow the relative position imposed by case specifications to be met within such substructure. But since this involves consideration of how the sub-parts of quantificational terms should be typed, I leave this on one side, merely noting the general pattern.

[40]Several more finely based characterisations of locality are available. One characterisation might involve a concept of finiteness, holding exclusively at the requisite dominating node with no intervener, i.e. the presence of an index of evaluation; another might be defined solely over the distinction between functor and argument relations, eg as $?\langle\uparrow_0\rangle\langle\uparrow_*\rangle Ty(t)$, as in Kempson et al 2001. But this preliminary characterisation is sufficient to provide an indication that, being a tree description language, LOFT can express any of the familiar concepts of locality. See section 4 for locality constraints on *zibunzisin* and *otagai*.

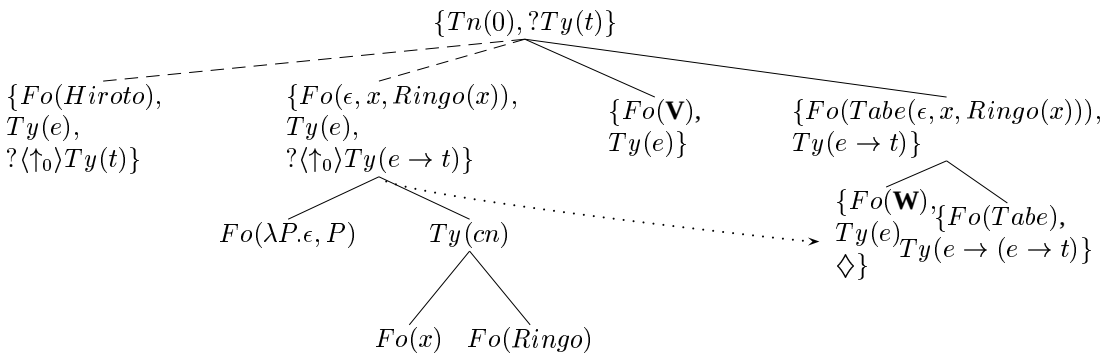


Figure 2: Local Scrambling as Multiple *Adjunction?

of there being no other quantifying form, induce an existential operator, enabling the construction of a full term of type e, also introducing a new variable for such an operator to bind.[41] So from a minimal sequence of words, a full propositional template may be induced with fully quantificational terms.

There is, however, a problem in assuming the particular degree of underspecification displayed in figure 2. Given that the tree node address of an unfixed node is by definition under-specified (the relation between the node in question and the root being not yet established), whenever two such nodes are introduced, relative to the same dominating node, they will have the same tree node address, $\langle\uparrow_*\rangle Tn(a)$, and cannot be kept properly distinct.[42] So, despite the apparent strength of the empirical evidence, such a solution involving multiple introduction of unfixed nodes cannot be right. Whatever process of *Adjunction it is that introduces such nodes must in some way be restricted so that no more than one unfixed node at a time is retained in the tree, even while allowing it to apply several times over from a given node.

[41]This analysis is inconsistent with Chierchia 1998, who analyses quantification in languages such as Japanese as semantically distinct from the basis for quantification in languages such as English. In this framework, the different is merely one of how much of the containing logical structure is projected by the word itself, a point of variation straightforwardly available in even a single language, eg in the English indefinite plural.

[42]In particular, this is problematic for the evaluation of two such nodes down through the tree, as required for all such introduced unfixed nodes (see Kempson et al 2001, ch.9), as at each step a possibly inconsistent set of properties will be being evaluated at each such intermediate node.

3.2.1 Case and Locality Effects

There is, fortunately, a simple solution - provided by case. Each node for such argument is indeed introduced as unfixed relative to some tree node $Tn(a)$ with a $?Ty(t)$ requirement; but suppose we assume that the effect of case is then to specify the tree node relation with that dominating $Tn(a)$, removing the underspecification, and adding an appropriate modal type requirement on its mother. For example, the update for a *ga*-marked NP is from $\langle\uparrow_*\rangle Tn(a)$ to $\langle\uparrow_0\rangle Tn(a)$, adding also the requirement $?\langle\uparrow_0\rangle Ty(t)$. The updating of an *-o*-marked NP is to $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(a)$, with modal type requirement $?\langle\uparrow_0\rangle Ty(e \rightarrow t)$. Each such update is an update on the $\uparrow_*$ relation and returns the pointer to the dominating node:[43]

-ga:

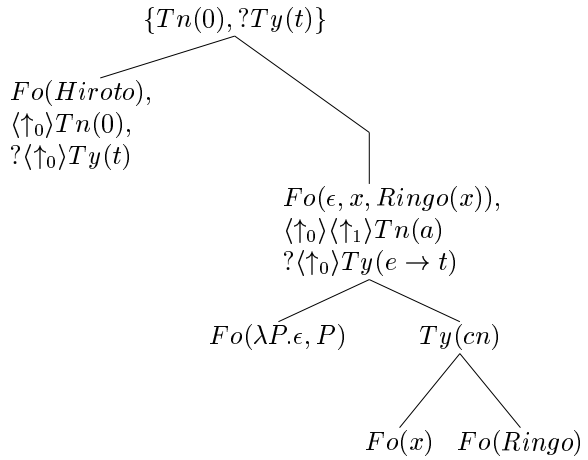
IF	$Ty(e)$	
THEN	IF	$\langle\uparrow_*\rangle(Tn(a) \wedge ?Ty(t))$
	THEN	$\mathtt{put}(\langle\uparrow_0\rangle Tn(a))$
	ELSE	Abort
ELSE	Abort	

By actions such as this, the appropriate set of tree relations can be incrementally established.[44] With this construal of case, this process of Local*Adjunction can

[43]There are uses of *-ga* which appear not to mark subject position. They fall into two classes, those which involve a concept of subject at a suitable level of abstraction, indicating predication on the first *-ga* marked term to be constructed from the remaining string, (i), and particular stative verbs which have to be itemised as taking a particular, idiosyncratic use of *ga*-marking, (ii):
(i) Usagi-ga mimi-ga nagai
Rabbit$_{NOM}$ ear$_{NOM}$ long.
'Rabbits' ears are long.'
(ii) John-ga nihongo-ga wakaru.
John$_{NOM}$ Japanese$_{NOM}$ understands
'John understands Japanese.'
It is arguable that the first type can be expressed while retaining the characterisation of $-ga$ suggested here, by presuming on variable adicity of nominal-internal predicates (*mimi* ('ear') in (i) functioning as a two-place predicate 'ear -of'), following the direction of Marten 2002. The use of *-ga* as in (ii) would require lexical stipulation specific to the verbs that require such use of *-ga*, a very restricted set.

[44]It might seem that an additional locality restriction needs to be imposed on the triggering condition, to prevent some case-specification applying to fix an immediate domination relation to some arbitrarily higher node in the tree. But in Japanese, *Adjunction introduces a node $\langle\uparrow_*\rangle Tn(a)$, with requirement $?Ty(e)$, and application of Generalised Adjunction introduces a radically underspecified relation, $\langle U\rangle Tn(a)$, with requirement $?Ty(t)$. So while a step of Generalised Adjunction may feed a step of *Adjunction, *Adjunction itself will not apply recursively to its own output, to yield a node requiring $Ty(t)$ unfixed but dominated by another type t-requiring node. Furthermore, supposing from $Tn(0)$ a step of Generalised Adjunction creates an intermediate radically unfixed node, a relationship which is then by enrichment determined to be one of immediate subordination, $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0)$,

be applied as many times as is needed by the various case markers, because in no such sequence of multiple applications is the created node left unfixed. It can even take place by parsing either object or indirect object argument first. We might have *Ringo-o* introduced first as unfixed, as in (36), the $\langle\uparrow_*\rangle Tn(a)$ relation enriched to $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(a)$, with the subject expression processed immediately subsequently:



Nothing forces the argument nodes to be introduced in a particular order. In every case, the node is introduced by constructing an unfixed node, and the local relation to the dominating type t-requiring node is fixed following the action dictated by the case specification.[45][46]

The projection by the verb of a full propositional template of predicate node and array of argument nodes remains unproblematic. If any of the argument nodes of this template have already been introduced, they will simply vacuously be duplicated by the associated argument node of the predicate - indeed it could not be otherwise, as two nodes with the same tree-node address decorate one and the same node; but once the verb is introduced, each argument node will have an assigned fixed tree-node address. No application of Merge is required to be externally imposed - the two actions simply create one and the same tree-relation. Thus in the parsing of (35)-(36), the case-marking on the two noun phrases preceding the verb

from which an unfixed node is constructed, such an unfixed node still couldn't be updated by free enrichment to yield, say, $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0)$ enforcing vacuous application of *Adjunction, because the output of Generalised Adjunction and *Adjunction impose incompatible type requirements. Hence the additional locality constraint emerges from the interaction of other processes, and isn't needed as a stipulated condition on the lexical action for the case suffix.

[45]For the moment, we leave the status of this process unspecified. As we shall see in section 4, we take this process to be one of structural abduction, the case marking of *ga* aside.

[46]There is an additional complication that, at any point, there is the option of building an adjunct structure by Generalised Adjunction, an option we take up in section 4.1.

does indeed induce fixed tree relations, and in the wake of these created relations, the macro of actions provided by the verb duplicates the building of the subject, predicate, and object node relations, but nontrivially provides the remainder of the template structure, viz. the functor node which it decorates with the formula $Fo(Tabe)$. With these actions completing the outline of structure, decoration of all nonterminal nodes duly takes place.

As we shall see in addressing long-distance scrambling, it isn't quite this simple, as the update to a fixed relation can be delayed in all non-subject cases, leaving one tree node unfixed; but the essential dynamics of short scrambling is to introduce an unfixed node, decorate it and then fix its tree relation to the locally dominating type t-requiring node.[47]

3.3 Suffixes and Constituency Boundary Marking

One property of case suffixes remains to be brought out; and it is indeed a property shared by both case and tense suffixes - arguably a property definitive of suffixes in general. What the case suffixes ensure, as (35)-(36) show, is the progressive build-up of interpretation for the constituent that it marks. Each suffix indicates that all that is needed to interpret the constituent whose end it marks is already presented. The action defined by a suffix, that is, takes some decorated node, WITH TYPE-REQUIREMENTS SATISFIED, and adds some additional specification. It is this form of the input condition that is critical. It is the simple mechanism of fixing a type specification as the input condition which ensures that all non-terminal nodes dominated by the node in question must have already been decorated with a type and formula specification. Hence the effect of case to determine the completed assignment of interpretation to the noun phrase sequence, and its "sealing-off" function.[48] [49]

This suffixal property extends directly to tense. The processing of a tense suffix in Japanese indicates that all elements needed to establish a propositional structure are already in hand. The specifying of its lexical actions as taking place in the presence of a formula of type t drives the compilation of all non-terminal nodes in

[47]The dynamics of this is identical to the parser of Schneider 2001, here construed as intrinsic to the grammar formalism itself.

[48]We take following quantifiers to be a "quantifier-float" phenomenon, which provides a specification that is superimposed upon an already-constructed term. The essential property of such postposed quantifiers is that their construal contributes solely to the final proposition-level process of scope evaluation.

[49]Once the node is decorated with the case requirement, the pointer will return to its locally-dominating type-t-requiring node, in preparation either for application of some further instance of *Adjunction as input to decorating nodes introduced by some subsequent nominal or for the processing of some subsequent verb.

a propositional structure. Reflecting this, the suffix *-ta* is specified in the following terms:[50]

ta

IF	$\{Fo(\psi), Ty(t)\}$
THEN	$\mathtt{put}(Fo(S_i : \psi), PAST(S_i, S_{\mathbf{U}}))$
ELSE	ABORT

This account, notably, requires the tense suffix to be processed last. The tense suffix is defined to take as trigger a completed propositional formula of type t, with no requirements. Furthermore, the propositional formula which it projects, with temporal specification added, signals the end of the scope evaluation process.[51] Buttressing this, the tense particles are projected as suffixes on the verb. Verb-final ordering is a consequence.

4 Local Scrambling, anaphora and quantifier construal

Putting the specification of case-marking as a tree-update action together with the suffixal property of both case and tense as completing construal of structural boundaries that they mark, we have to hand an account of local scrambling and the restrictions it imposes on anaphor and quantifier construal. The NP-sequences, with their case-marked suffixes, may lead to the introduction of unfixed nodes which are successively updated to a fixed tree relation in any order of introduction.[52] Clause-internal scrambling effects are thereby expected (Saito 1985 etc).[53] Leaving aside for the moment the long-distance scrambling data, the anaphor *ota-*

[50] S_i is some temporal variable, $\mathbf{S_U}$ a meta-variable over temporal variables. Japanese tense-marking is explicitly anaphoric, and the past tense construal may be relative to some point in time established in the discourse, not necessarily related to some time indexically fixed as prior to the time of utterance. See Kurosawa 2003 for discussion; and Gregoromichelaki (in preparation) for argument of tense/modality as projecting a super-structure denoting the witness that makes true the propositional structure constructed.

[51] The scope evaluation algorithm dictates that the term indicating the index of evaluation is evaluated last in the sequence of evaluation steps.

[52] These suffixes are optional, and, if omitted, necessitate other ways of determining construal. One strategy is to use computational actions to induce subject predicate structure (see Kempson et al 2001), as SVO ordering, in any case generally taken as the canonical ordering, will match such top down actions. Any variation from this without case-marking will rely solely on pragmatic considerations or contingent knowledge of individuals and events described.

[53] We leave on one side all detailed consideration of noun-phrase adjuncts. See Marten 2002 for arguments that these be treated as optional arguments, with the type-specification of verbs in consequence lexically under-determining the final type assignment. An alternative would be to define adjuncts as introducing their content into the tree across a LINK relation, hence their islandhood properties. As these alternatives suggest, we can express in DS the ambivalent status of NP-adjuncts as both argument-like and nonargument-like, much as in other frameworks.

gai, if taken to decorate a node whose case specification determines a FIXED tree relation, must have its interpretation determined from some antecedent within the same local domain (though this need not necessarily be the subject); and this antecedent must be selected at the point of parsing *otagai*.[54] This is because the case-marking will determine that its type specification is fully determined, and, with type and tree-node specification fixed, and the tense marking suffixed on the verb determining that all nodes in the propositional structure are complete, reflecting compositionality, the pointer will not return to any argument node within that structure to further develop it. Hence (1), (3)-(6) ((6) is repeated here):

(6) **John ga* *otagai-o* *Taroo* *to* *Hiroto-ni* *syookaisita*
John$_{NOM}$ each other$_{ACC}$ Taro and Hiroto$_{DATIVE}$ introduced
John introduced Taro and Hiroto to each other.

Quantifier scoping, too, is generally fixed in a way that reflects linear order (see footnote 34). Hence (17) repeated here:

(17) *dareka-ga* *hotondo-no* *uta-o* *utatta*
someone$_{NOM}$ most$_{GEN}$ song$_{ACC}$ sang
' Someone sang most of the songs' (unambiguous)

Only an indefinite can be an exception to this direct reflection of linear order; and even in such cases, the choice of term on which it is to be construed as dependent has to made from other terms already constructed at that point in the interpretation process. So there may be ambiguity, but it is not unrestricted. Hence (18):

(18) *hotondo-no* *uta-o* *dareka-ga* *utatta*
most$_{GEN}$ song$_{ACC}$ someone$_{NOM}$ sang
'Most of the songs, someone sang
(ambiguous: indefinite narrow/wide scope)

These linearity restrictions on *otagai* and quantifier-scoping, when the term in question decorates a fixed node, do not require special stipulation. They are a consequence of the fact that once a node has its decorations completed and all requirements met including the specification of tree-node position, the pointer will not subsequently return to further develop that node. Hence, from a hierarchically fixed position in the configuration, all aspects of underspecification must be resolved.

[54] I return to a more detailed specification of *otagai*'s locality condition in section 5.2.

4.1 Complement clause construal

The next step in developing a full account of scrambling is to see how the structure induced from simple clausal sequences is nested in some larger structure.

In setting out putative variations in the building of nodes without a fixed position in the resulting restructure, I distinguished Generalised Adjunction from *Adjunction, the former being a much more general process with no constraint at all imposed on the relation of the local structure to be developed to the whole. This transition underpins the parsing of (37) and (38):

(37) *Hiroto ga* *muita* *to* *itta*
Hiroto$_{NOM}$ peeled COMP said
'Hiroto (or someone else) said Hiroto peeled it'

(38) *Hiroto ga* *muita* *ringo o* *tabeta*
Hiroto$_{NOM}$ peeled apple$_{ACC}$ ate
'Hiroto (or someone else) ate the apple Hiroto peeled'

Once such an intermediate type-t-requiring node has been introduced by Generalised Adjunction, the sequence of actions for projecting some simple propositional structure is otherwise identical to that of processing a simple clausal sequence:

(39) *Hiroto ga* *ringo o* *tabeta* *to* *itta*
Hiroto$_{SUBJ}$ apple$_{OBJ}$ ate COMP said
'Hiroto said he ate an apple'

It is the obligatory presence of *-to* in standard Japanese which determines the nesting of the propositional structure. The subordinating particle *-to* is accordingly defined to ensure this. The nesting can be done in one of two ways, as reflected in the following disjunctive lexical set of actions: either by making use of structure already induced and returning the pointer there, or by adding a further intermediate node locally dominating the node just completed:[55]

[55]The disjunctive characterisation provides a straightforward way of expressing dialectal variation in the use of *-to*. In some dialects, eg the Osaka dialect, use of *-to*, like case, is optional. On this analysis, the dialect difference lies in whether the updating of the tree is by lexical or computational action. In standard Japanese, there is no generalised convention of return of the pointer from any node: such a computational action is only applicable to nodes of $Ty(e)$. In the Osaka dialect, this is generalised to apply to nodes with formulae of type t. In this dialect also, the action of introducing an additional intermediate node locally dominating the decorated type t node is also generalised from the more restrictive pattern of standard Japanese, for which the rule is restricted to nodes of type e for the parsing of relative-clause modified nouns.

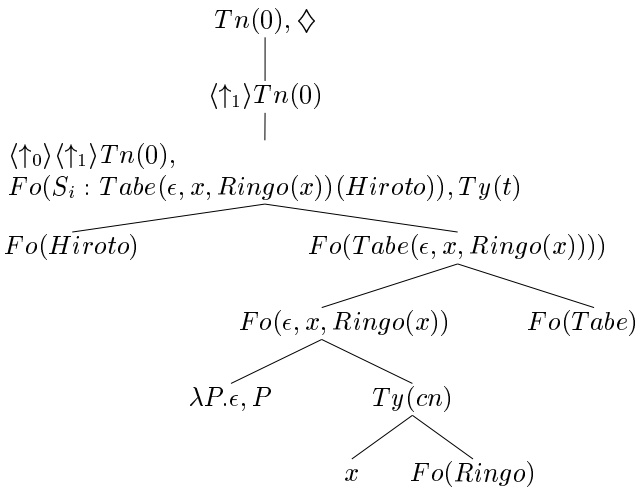
	IF	$\langle U\rangle Tn(a), Fo(\alpha), Ty(t)$
	THEN	$(\mathtt{put}(\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(a));$
		$\mathtt{go}(\langle\uparrow_0\rangle\langle\uparrow_1\rangle))$
-to		$\bigvee$
		$(\mathtt{make}(\langle\uparrow_*\rangle); \mathtt{go}(\langle\uparrow_*\rangle);$
		$\mathtt{put}(?Ty(t), \langle\downarrow_1\rangle\langle\downarrow_0\rangle Fo(\alpha)))$
	ELSE	ABORT

Following the regular pattern of suffixes, a completed type specification, here a type t formula, is the condition necessary for the update given by *-to* to be carried out. What *-to* imposes, as a result, is obligatory local subordination.

If there were several levels of embedding, as in (40), we would need the second form of action provided in the specification of *-to*:

(40)	*Hiroto ga*	*ringo o*	*tabeta*	*to*	*itta*	*to*	*omotteiru*
	Hiroto$_{NOM}$	apple$_{ACC}$	ate	COMP	said	COMP	think
	Hiroto ate an apple, he said, he thinks						

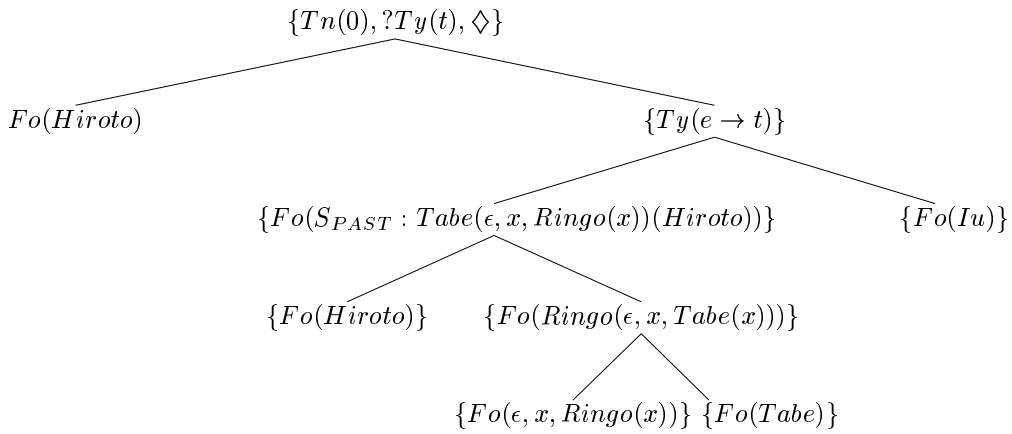
However, for (39), we need only the first alternative of returning to the root, in so doing determining the local relation between it and the node initially introduced by Generalised Adjunction:[56]



The result of carrying out the actions induced by *-to*, on either alternative, is that the pointer will be at a node from which the subsequent verb *itta* will be able to project its propositional template. From this node, the verb *Iu* can be processed

[56] I leave the propositional formula here in its unevaluated form for simplicity, ignoring the scope statement $S_i < x$ with which it must be evaluated.

as projecting its propositional template of structure, and in this derivation the constructed propositional structure provides the object argument node, with the subject argument being identified anaphorically as $Fo(Hiroto)$:[57]



The completed decoration on the topnode of the tree, when all requirements are fulfilled is:[58]

[57]The anaphoric identification of the subject term as $Fo(Hiroto)$ is in virtue of the presence of the term in the partial representation already constructed. Note that this choice is not any reflection of some analogue to any c-command relation: it is solely a consequence of linear order. In particular a constraint analogous to the Binding Principle C filtering out putative occurrences of the term $Fo(Hiroto)$ within the tree would not be appropriate, as the binding constraints determine the locality from within which some appropriate substituend for the natural language name may selected. They do not apply to the output form.

[58]This derivation, though a natural means of interpretation since locally incremental, is by no means the only possible interpretation that can be assigned to (39). An analysis closer to that assumed in current syntactic accounts might be to assume as a first hypothesis that the subject-marked noun phrase was to be projected as the matrix subject at the early stage at which the noun phrase itself is parsed. Such choices are always available. At each step, there is choice as to whether to interpret all noun phrases in the sequence as arguments of the subordinate clause, or whether by making alternative selections of the nested arguments from some independent context, interpret the presented expressions as providing arguments of the matrix predicate. In Japanese, any argument of a predicate may be identifiable from context. Uttering (ii) in a context of identifying who has eaten some cake might well mean that Akiko said to Halimah that some contextually identified person had eaten the cake:
(ii) Akiko-ga Halimah-ni tabeta to itta.
Akiko$_{SUBJ}$ Halimah$_{INDIR-OBJ}$ ate COMP said
‘ Akiko said to Halimah that Tom ate the apple.’
If Generalised Adjunction is taken to have applied FOLLOWING the processing of the first *-ga* marked expression in (39), the following object-marked node would then be constructed relative to a lower level of embedding, and the subordinate subject be identified anaphorically. Given that *-wa* is characteristically used to indicate which expression is to be construed as surface subject, this is not the natural interpretation. Nevertheless, this possibility gives a glimpse of the large numbers of sequences of actions available for an individual string, with variability even for one possible outcome.

$$Fo(S_{PAST} : Iu(S_{PAST} : Tabe(\epsilon, x, Ringo(x)(Hiroto))(Hiroto)$$

Notice that we are building up semantic structure, subpart by subpart, with each suffix, whether case, tense, or complementiser, determining the full compilation of semantic interpretation that is possible at that stage in the interpretation process prior to the subsequent structure-building step. So syntax and semantics are inseparable.

4.2 Locality Constraints on Noun Phrase Construal

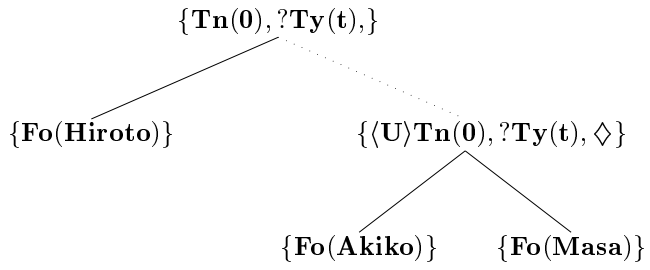
Confirmation of this analysis comes from its immediate application to variability in dative construal. Though scrambling of preverbal nonquantified nonanaphoric noun phrases is noted to be relatively unconstrained, a dative-marked noun phrase sometimes gives rise to ambiguous construals, sometimes not. When the dative-marked noun phrase occurs between two subject-marked phrases, it is ambiguous:

(41) *Hiroto ga* *Masa ni* *Akiko ga* *ringo o* *muita* *to* *itta*
Hiroto$_{NOM}$ Masa$_{DAT}$ Akiko$_{NOM}$ apple$_{ACC}$ peeled COMP said
'Hiroto said that Akiko peeled an apple for Masa.'
OR 'Hiroto said to Masa that Akiko peeled an apple.'

However what is not possible is the interpretation of a dative relative to some superordinate node in the structure once a certain level of embedding has been introduced. (42), in which there are two *-ga-* marked phrases is unambiguous:

(42) *Hiroto ga* *Akiko ga* *Masa ni* *ringo o* *muita* *to* *itta*
Hiroto$_{NOM}$ Akiko$_{NOM}$ Masa$_{DAT}$ apple$_{ACC}$ peeled COMP said
Hiroto said that Akiko peeled an apple for Masa
$\neq$ Hiroto said to Masa that Akiko peeled an apple.

Given application of Generalised Adjunction intermediate between the processing of *Hiroto ga* and the processing of *Akiko ga*, this is as we would expect:



We return to this issue in section 7.

Given that two NPs both marked with *-ga* as in (42) cannot be resolved in the same local domain,[59], the only possible sequence of transitions is one in which Generalised Adjunction applies following the parsing of the expression *Hiroto ga*. But on such a transition, the expression *Masa ni* following *Akiko ga* can only lead to interpretations in which either the two NPs are interpreted as co-arguments of some lower predicate, or *Masa ni* is interpreted as contributing to some structure at yet a further level of embedding. What is excluded is its projection as co-argument with the node decorated by the actions of *Hiroto ga*, for there is no pointer movement back to arbitrary nodes already introduced.

So far the predictions match those of other frameworks. However, with the occurrence of the matrix subject after the embedded clausal sequence, movement analyses lead to different predictions. On the present analysis, the occurrence of the dative-marked NP following *-to* as in (43)-(44), must be interpreted relative to the matrix subject, and not as contributing a term in the subordinate structure:

(43) *Akiko ga* *ringo o* *muita* *to* *Hiroto ga* *Masa ni* *itta*
Akiko$_{NOM}$ apple$_{ACC}$ peeled COMP Hiroto$_{NOM}$ Masa$_{DAT}$ said
Hiroto said to Masa that Akiko peeled an apple.
$\neq$ Hiroto said that Akiko peeled an apple for Masa

(44) *Akiko ga* *ringo o* *muita* *to* *Masa ni* *Hiroto ga* *itta*
Akiko$_{N}$ apple$_{A}$ peeled COMP Masa$_{DAT}$ Hiroto$_{N}$ said
Hiroto said to Masa that Akiko peeled an apple.
$\neq$ Hiroto said that Akiko peeled an apple for Masa

As we have already seen, once the pointer has moved down to some subordinate structure, there is no return to a higher point in the tree until that intermediate tree is completed. Yet once that intermediate tree is completed, the pointer moves on to a dominating node. The pointer is at that later point placed at whatever node locally dominates the node decorated by *Hiroto ga*. Hence the only interpretation for either (43) or (44) is one in which the term decorated by *Masa ni* modifies the predicate applied to $Fo(Hiroto)$ (either as third argument, or as adjunct, depending on the analysis attributed to the dative).[60]

[59] Apart from the pairs of *-ga* marked expressions which dictate a more abstract subject-predication relation. See footnote 42.

[60] In all of (42)-(44), the fixing of the subject relation in processing *-ga* means that the construction of the full template of structure projected by the verb will involve reconstructing the subject relation nondistinctly, as in the simpler cases, assigning the subject node a meta-variable as *Formula* decoration emptily, given the presence of an already determined *Formula* value.

4.2.1 Proper Binding Effect

This result is not predicted by movement accounts. To the contrary, (44) ought on the face of it to allow an interpretation in which the dative-marked *Masa-ni* is understood as an argument in the subordinate structure, since there is a possible sequence of movement steps first moving the dative NP from the complement clause to left-adjoin to the containing structure followed by a second extraction step moving the complement structure itself from its subordinate position to a left-adjoined one. Such cases constitute the problematic "proper binding constraint" (Saito 1985), which has to be superimposed on a movement analysis, as an additional constraint. It is these data further which remain problematic for minimalist accounts, since the level at which the proper binding constraint was defined in Saito 1985, s-structure, cannot be invoked. On the Dynamic Syntax account, there is simply no question of any such sequence of operations. The pattern repeats itself across a broad range of constructions:

(19) *[*Hanako-ga* t_i *iru to]*$_j$ *Sooru-ni*$_i$ *Taroo-ga* t_j *omotteiru*
Hanako$_{NOM}$ be that Seoul-in Taroo$_{NOM}$ think
[That Hanako is t_i]$_j$ in Seoul$_i$ Taroo thinks t_j

(20) *Hanako-ga Sooru-ni iru to Taroo-ga omotteiru*
Hanako$_{NOM}$ Seoul$_{LOC}$ be that Taroo$_{NOM}$ thinks
Hanako is in Seoul, Taroo thinks.

On the present account, all such cases are automatically precluded. The parsing of the sequence ending with *-to* in (19) has to have been construed as a completed propositional formula in order to license the update provided by *-to*, so would have to have the argument of *iru* provided in context. The provision of *Sooru-ni* following the parsing of *to* but to be understood as modifying the mebedded structure, is precluded. There is no going back of the pointer: once that structure is completed, the only possibility would be to construe *Sooru-ni* as a dative argument to *omotteiru* but this is independently excluded. In (20), by way of contrast, the full sequence of expressions needed to interpret the clausal sequence ending with *-to* allows a propositional structure to be routinely completed, and this then serves as the internal argument of *omotteiru* - all exactly as expected. The explanation follows directly from general properties of tree growth as driven by the suffixes. The processing of *to* demands the prior completion of a propositional structure and an associated formula of type t. No expression contributing to that structure can occur after it:

(45) **Mary ga* *yonda* *to* *sono* *hono* *John* *ga* *itta*
Mary$_{NOM}$ read COMP that book$_{ACC}$ John$_{NOM}$ said fact
(koto)

Mary read that book, John said

We can see, from the conflicting dynamics of movement and Dynamic Syntax accounts, how the data which provide such a problem for the former melt away in the latter. The problem arises in frameworks in which the projection of structure is defined exclusively bottom up, with chains or coindexing as so projected being said to provide the basis for defining relations between some propositional template of structure and some left-dislocated expression. In the present framework, the dynamics is the other way about. Partial structures are induced from the left as various forms of underspecification with subsequent enrichment, with the morphological suffixes indicating when any substructure is completed. The analogue of a leftward movement process from out of some overall structure, from which the remainder must not also be allowed to move, simply never arises.[61]

5 Long-distance scrambling

Despite the simplicity of the account so far, the sensitivity to linear order appears to be jeopardised by the reconstruction effects showing that the left-peripheral expression may be in some sense delayed:

(46) *zibunzisin-o* *Taroo-ga* *semeta* *(koto)*
self$_{ACC}$ Taroo$_{NOM}$ blamed
'Himself, Taro blamed.'

(47) *Otagai-o* *John* *to* *Mary-ga* *hihansita* *(koto)*
each other$_{ACC}$ John and Mary criticised
John and Mary criticised each other

[61]The apparent mirror image effect in (i), which is well-formed, can be explained by introducing either linked structures or unfixed nodes in the latter stages of the interpretation process, analogous to (ii):
(i)Taroo-ga omotteiru-(yo) Hanako-ga t(i) iru to Sooru-ni.
(ii) She talks too fast, Ruth Kempson.
Given that this paper does not explore the concept of linked structures in any depth, all right dislocation effects are left on one side. See Cann et al forthcoming b for an account of the asymmetry between left and right dislocation effects in terms of how these processes apply in early and late stages of the construction process.

The first problem about these is how case specifications, if an update mechanism, can be delayed at all. We have so far only given the lexical characterisation of *-ga* by way of illustration. And this we said provided a fixed relation as an immediate parse step. So how can these other cases fail to enforce any such update? The second problem is that long-distance scrambling data are commonly reported by informants not to occur in normal Japanese usage, no matter how formal the style:

(48) *?Ringo o* *Hiroto ga* *Akiko ga* *tabeta to* *itta*
Apple$_{ACC}$ Hiroto$_{NOM}$ Akiko$_{NOM}$ ate$_{COMP}$ said
'An apple, Hiroto said that Akiko ate.'

Given the central status of *Adjunction in the grammar formalism as the primary parsing tool for introducing unfixed nodes, this seems an odd source of cross-linguistic variation.

The processing perspective can provide a basis for explaining both these problems. The first problem is easy enough to solve *pro tem* at least. We define all nonsubject case markings as imposing only a requirement for update, a filter on output, dropping the fixing of the tree relation, allowing possible delay in assignment of the fixed relation that they express:[62]

The object marker *-o*:

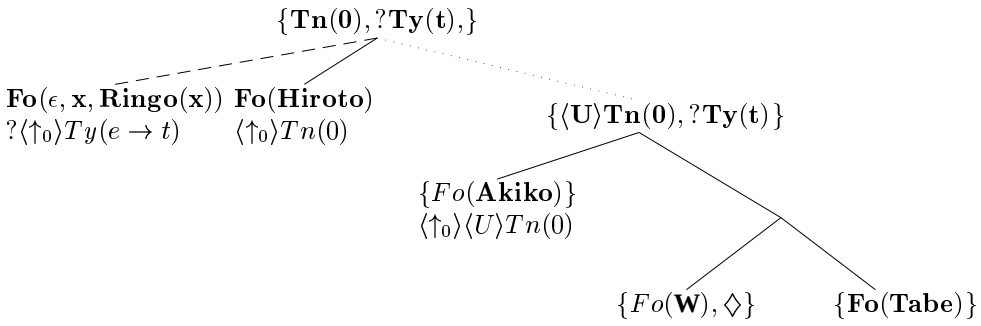
IF	$Ty(e)$	
THEN	IF	$\langle\uparrow_*\rangle(Tn(a)\wedge ?Ty(t))$
	THEN	$\mathtt{put}(?\langle\uparrow_0\rangle Ty(e \rightarrow t))$
	ELSE	Abort
ELSE	Abort	

Like the earlier specification of *-ga* the trigger for this update is an established Ty value. The only difference is the imposition of the weaker update, that of a requirement. Some subsequent update action will then have to provide the necessary value, either through Merge or some other enrichment process, a matter we now turn to.

In the case of cross-clausal scrambling phenomena such as (48), the problem imposed by the delay in fixing the tree position of such unfixed nodes across two specified subject relations is that all wellformed applications of *Adjunction must be associated with some subsequent application of Merge unifying the unfixed node with some other node with a fixed position in some emergent structure. With (48), however, *Adjunction cannot apply to license the introduction of a second unfixed node to the matrix type t-requiring node, at least on the assumption that

[62] As with *-ga*, the need for imposing a locality condition on the input condition is not necessary, given the particular characterisation of *Adjunction and Generalised Adjunction.

only one unfixed node can be introduced relative to a single node within any emergent partial tree. But this means that the transition from main clause structure to subordinate structure between the parsing of *Hiroto ga* and the parsing of *Akiko ga* has to be constructed by application of Generalised Adjunction. This in its turn creates a further hurdle, as the resulting structure is too weak to license Merge of the unfixed node originally introduced by **-Adjunction*:



The step of Merge cannot be applied to unify the node decorated with $Fo(\epsilon, x, Ringo(x))$ and the object node for *tabe*, because the application of *Merge* depends on a process of evaluating the unfixed node successively down some tree under construction across a succession of daughter relations. Generalised Adjunction does not provide the structural environment to allow this: what it defines is a transition which is a disjunction across LINK or daughter relations.

This may seem to enforce a characterisation of all such strings as incapable of yielding a logical form as a result, hence ungrammatical. Yet there is a simple and monotonic repair process. Given that the formal system allows interspersing of pragmatic enrichment processes with the mechanisms which encode the building of partial structures, all that is required to achieve a parsable string is to assume that pragmatic enrichment, as a generally available cognitive process, can apply not only to formula enrichment as for anaphora resolution, but also to structural enrichment.[63] What is required to yield a well-formed derivation is to introduce the requisite weak tree relation by Generalised Adjunction but, having done so, to enrich it to a fixed relation:

$$\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0)$$

The problem about such a step is that it is not morphologically triggered: it is an abduction step that is triggered solely by recognition that without it, no successful derivation will result - hence a meta-level step of reasoning. Indeed it is not

[63]This is hardly contentious, since enrichment of stimuli is a general cognitive phenomenon, not one specific to a certain mode of representation.

pointer-driven, and may only occur when the verb is processed. Being a pragmatic and optional process, any such choices should be expected to be associated with general cognitive constraints.[64] So pragmatic assumptions put together with the *Adjunction analysis of long-distance scrambling lead us to expect its commonly observed reduced acceptability, which can be improved with a particular form of stress, and focus-type interpretation.[65]

5.1 Why don't subjects scramble?

This account of long-distance scrambling presumes on the interaction of pragmatic and structural constraints, analogous to anaphora resolution. One critical detail remains unclear - the specification of the update provided by case. What was initially introduced as an update from unfixed node position to fixed node in the configuration got weakened for all non-subject case-marking to allow long-distance scrambling, these case specifications being said to be no more than filters on the output. With structural abduction providing a general cognitive basis for enriching unfixed nodes to some fixed relation, we now return to the status of case specifications, for all cases of structural underspecification will in principle also allow such free enrichment. The account of so-called local scrambling now becomes that of intro-

[64] If we follow relevance-theoretic assumptions, we should expect judgements of reduced acceptability if either processing/production costs fail to be minimised or if the interpretation cannot be made sufficiently salient to be recoverable. Since the quickest way to check for inferential effects in the construction of a putative parse sequence is to construct proposition-sized units in as few moves as possible, localised construction of propositional structures will invariably be preferred. It is notable in this connection that a minor ordering change, in which the matrix subject occurs immediately before the main verb *itta* transforms its acceptability:
(i) ringo o Akiko ga tabe to Hiroto ga itta
apple$_{ACC}$ Akiko$_{NOM}$ ate COMP Hiroto$_{NOM}$ said
' Akiko ate an apple, Hiroto said'.
In processing (i), all structural relations are locally induced once a type-t-requiring node has been introduced, and the result is fully acceptable. Acceptability of a string such as (48) is however reported to be improved if the left-dislocated expression is modified with a relative clause, the left-peripheral positioning then enhancing the identifiability of the constituent structure:
(ii) Watashi ga muita ringo o Hiroto ga Akiko ga tabe to itta
'The apple which I peeled Hiroto said Akiko ate.'

[65] Assigning separate lexical specifications for a verb and its tense suffix is essential to the analysis, as application of the step of Merge has to take place subsequent to the processing of the verb (which introduces the template of propositional structure), and prior to the steps of compiling up the decorations on non-terminal nodes of this structure as required by the update given by *-ta*. The need for such a Merge step (together with the attendant structural enrichment to enable Merge to take place) is thus driven by the presence of the verbal suffix and the condition it imposes that a completed propositional structure of type t be established. This result should extend to all verb-final languages; and casual but persistent enquiries indicate that this is overwhelmingly the general pattern (Turkic, Polynesian, Japanese and Korean).

ducing unfixed nodes by Local*Adjunction which are then successively enriched to a fixed tree configuration by what is a freely available enrichment process, with the case-marking itself not dictating the immediate fixing of the tree relation.

This account, though compatible with non-subject case marking, would yield too weak a characterisation of subject specifications, for a sequence of *ga* marked expressions is completely irreversible:

(49) *Hiroto ga* *Akiko ga* *ringo o* *tabe* *to* *itta*
Hiroto$_{NOM}$ Akiko$_{NOM}$ apple$_{ACC}$ peeled COMP said
$\neq$ Akiko said that Hiroto ate an apple.

(50) **sono kodomo-ga* *kouchou sensei-ga* *jugyouni* *sankashitewa* *ikenai-to*
the-kid teacher$_{NOM}$ class participate not allowed
kimata.
decided
'The child, the head-teacher decided should not attend school.'

If unfixed nodes could be spontaneously enriched, and all case specifications were just a filter not enforcing any immediate fixing of the node they decorate, then in principle the subject case marking on the first expression in a sequence of NPs, like any other case specification, should be able to decorate an unfixed node without imposing a fixed subject relation at that point in the parse, allowing a possible subsequent sequence of actions as in long-distance dependency effects. Following the analysis already set up, these would take the second *-ga*-marked expression to decorate the matrix subject, allow a step of Generalised Adjunction and a step of structural abduction to create a nested type-t-requiring node, and the unfixed node would then provide the embedded subject through application of Merge in the presence of the subject node introduced in parsing the verb. Indeed such an interpretation should be natural, if suitable choice of lexical items strongly buttresses such an interpretation. Yet this is contrary to the reported illformedness of (50) and the lack of ambiguity of (49).

However, at this juncture, there are interesting cross-linguistic differences. In Korean, suitable choice of predicate DOES lead to an entirely acceptable sentence

(51) *Ku* *Haksayng-i* *kyojangsensengnim-i* *hakkyo-e* *teisang* *oci-malla*
the student$_{NOM}$ head-teacher$_{NOM}$ school-at no longer come-not
ko *khyelcienghay-ss-ta*
COMP decide-PST-DEC
'The child, the head-teacher decided should not attend school.'

Paradoxically, this buttresses the proposed analysis, despite the need for lexical stipulation, since it provides a natural basis for cross-linguistic variation. Notwithstanding the availability of pragmatic explanations of why long-distance scrambling may or may not be sufficiently easy to construct to be acceptable in object or indirect-object cases, *-ga* marked expressions immediately induce a subject node within the partial structure under construction. The solution to this is to retain BOTH the earlier lexical specifications of *-ga* and *-o*, allowing difference in status for subject-marking in Japanese and all other case specifications. *Ga* marking is associated with a stipulated update of the unfixed node it decorates with a fixed relation.[66] All other case specifications merely impose a constraint on the update to be provided; and these can be taken as triggering an enrichment of the structural relation whose value they constrain.[67]

[66]The only type of case which will not fall within this characterisation are the uses of *-ga* to mark the object relation. All such cases require special lexical stipulation.

[67]It might be suggested that this account of why there is no subject scrambling cannot be the sole answer, as the sequencing of *ni-* marked expressions is similar, with the interpretation of the first member of such a pair construed as the embedded subject, the second as the dative. However, as this analysis would expect, it appears that pragmatic considerations are operative here, as in Korean, since speakers variously report that (i) is wellformed and unambiguous, and (ii)-(iii) are both ambiguous, though with the first *-ni* marked expression much preferred as the understood embedded subject (the reversed interpretation is possible if said in a context in which it is presumed that John made Taro kiss someone):
(i) Taroo-no apaato-ni Mary-ni John-ga denwa-s-ase-ta.
Taroo$_{GEN}$ apartment$_{DAT}$ Mary$_{DAT}$ John$_{NOM}$ phone-caused.
'John made Mary phone Taro's apartment.
(ii) Akiko ni Taroo ni John ga kiss-sase-ta
Akiko$_{DAT}$ Taro$_{DAT}$ John$_{NOM}$ kiss-cause-PAST
John caused/let Akiko kiss Taro (preferred)
or
John caused/let Taro kiss Akiko
(iii) John ga Akiko ni Taroo ni kiss-sase-ta
JOhn$_{NOM}$ Akiko$_{DAT}$ Taro$_{DAT}$ kiss-cause-PAST
John caused/let Akiko kiss Taro (preferred)
or John caused/let Taro kiss Akiko
Of these (iii) is the most natural, on an interpretation in which the first *ni* marked expression marks the embedded subject. A step of Generalised Adjunction is required subsequent to the parsing of the *-ga* marked expression to enable the two *-ni* marked expressions to be parsed, but the parsing reflects the way the semantic tree can be unfolded. In (i)-(ii), both of which are reported to be somewhat odd, there is only one possible way of constructing a logical form; and this involves a step of abduction, much as in long-distance scrambling. It involves assuming an initial step of Generalised Adjunction introducing an intermediate type-t-requiring node: this constructed node is then used as the node from which the two *-ni* marked expressions are sequentially parsed as unfixed nodes, each immediately updated to yield a fixed decorated node. It is then this type-t-requiring node whose relation to the root has to be enriched into a regular domination relation, so that, with its two argument nodes already constructed, it can be unified with the object argument node for the complex

While this enrichment process updating unfixed nodes marked by non-subject case marking is optional, it turns out in effect to be obligatory. No possible derivation will be successful for any sequence of NPs occurring between a subject expression and its associated verb whose nodes are not taken as immediately enriched; for should such an update fail to take place, the result would be mutually incompatible decorations of just one single node, as two such nodes would have the same treenode address, and nodes with the same treenode address cannot be distinguished from one another. All such sequence of actions would thus get filtered out, leaving only the sequences in which a node, once introduced by Local*Adjunction and then decorated is updated to yield some fixed tree position in the emergent propositional structure. [68] The difference between Korean and Japanese subject marking thus boils down to a difference in the status of the case specification – an encoding of a structural relation as a stipulated action in the one language, and as a filter on the output in the other.[69] Furthermore, expressed as a constraint on the output, we predict that in principle case specifications should allow delay in their implementation, exactly analogous to antecedent choice for anaphoric expressions, as long as they decorate a node introduced by *Adjunction.

Though construal of long-distance scrambling is constructed via application of Generalised Adjunction, the account nevertheless explains the observed sensitivity of long-distance scrambling to strong island restrictions, which constituted an argument for its syntactic status (Saito 1985):

(52)	*?*Ano*	*hon-o*	*John-ga*	*katta*	*hito-ni*	*aitagatteiru*	*rasii*
	That	book$_{ACC}$	John$_{NOM}$	bought	person$_{DAT}$	want-to-see	seem

'It seems that that book, John wants to meet the person who bought'

structure induced from *kiss-sase* to provide the arguments of *kiss*, once the *ga* marked expression and the compound verb are parsed. The resulting interpretation for both (i) and (ii) takes the form of presenting an ordered pair 'As for the pair of Akiko and Taro, John forced the former to kiss the latter' This is indeed just as is reported. Indeed (ii) fits well as an answer to the echoic question 'John made WHO kiss WHOM?' (thanks to Hiroyuki Uchida for this observation). With marked intonation, the reversed interpretation of the two *-ni* marked expressions will be available, with introduction of an unfixed node from that intermediate node as the basis for construing the first *-ni*-marked expression). (i)-(ii) are of special interest, as they indicate that "extraction from subject position" is not itself precluded in Japanese. All that is precluded is such a decoration IF the subject position is marked by *-ga*. This is exactly what this analysis would anticipate, though detailed specifications of light verbs such as *sase* remain to be given.

[68] In proposing an abduction style of analysis for case specifications in addition to the rescue strategy needed to render acceptable long-distance scrambling sequences, this analysis has much in common with the abduction+deduction account of sentence processing of Vasishth and Kruijff 2001.

[69] On this view of cross-linguistic case differences, we would expect differences in the subject specification of the two languages and, more generally, greater freedom of word order variation in Korean than Japanese. These differences are as reported, but need further detailed study. For this, and further development of an account of focus in Dynamic Syntax, see Kiaer in preparation.

The use of Generalised Adjunction prior to the projection of structure for the relative clause sequence is essential to the characterisation of relative clause construal. Enriching that relation to one of domination at an intermediate step in the construction process in the presence of a node to be construed as unfixed is indeed licensed, allowing a process of Merge to unify the node associated with the left-peripheral expression and an argument node for the verb *katta*. But making this move would then debar the resulting structure from functioning as a LINKed structure to some subsequent head. Hence the islandhood restriction.

5.2 Radical Reconstruction

This account of long-distance scrambling gives us a natural basis for explaining *wh-* questions such as (15)-(16), with suitable lexical definitions of *-ka* and *dono*:[70]

(15) *John-ga* *Mary-ga* *dono* *hon-o* *yonda* *ka* *siritagatteiru*
John$_{NOM}$ Mary$_{NOM}$ which book$_{ACC}$ read Q want-to-know
(koto)

John wants to know which book Mary read

(16) *?Dono* *hono-o* *John-ga* *Mary-ga* *yonda* *ka* *siritagatteiru*
which book$_{ACC}$ John$_{NOM}$ Mary$_{NOM}$ read Q want-to-know
(koto)

John wants to know which book Mary read

-Ka is simply defined as adding a $+Q$ typing feature and, if not the root, inducing a dominating relation (following the pattern of *-to*):

	IF	$Fo(\alpha), Ty(t)$	
	THEN	IF	$Tn(0)$
		THEN	$\mathtt{put}(+Q)$;
		ELSE	$\mathtt{put}(+Q, \langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0))$;
-ka			$\mathtt{go}(\langle\uparrow_0\rangle\langle\uparrow_1\rangle)$
			$\bigvee$
			$\mathtt{put}(+Q); \mathtt{make}(\langle\uparrow_*\rangle); \mathtt{go}(\langle\uparrow_*\rangle);$
			$\mathtt{put}(?Ty(t), \langle\downarrow_1\rangle\langle\downarrow_0\rangle Fo(\alpha))$
	ELSE	Abort	

[70]The lexical specification of *dono* will not be given here. It involves the complication of specifying not merely the requirement of being dominated by a node decorated with a +Q feature to ensure questionhood, but also its availability as a general indefinite licensed by a suitable range of NPI environments.

The mechanism of merging the initially unfixed node (which in (16) is the unfixed node decorated by *dono hono*) with the embedded object argument node will be driven by the combination of the clause-typing property of *-ka* and a requirement imposed on indefinites such as *dono hono* that to be interpreted as a questioned expression, they must decorate a node dominated by a +Q typing feature. So the presence of *-ka* as a suffix on *yonda* in (16) determines the interpretation of *dono hono* as an argument of *yonda*, as this is the only way to satisfy the +Q requirement imposed on it.[71] The analysis of long-distance scrambling is otherwise like the long-distance dependency effect displayed in English: both involve updating an unfixed node at a level at which the semantic structure is constructed. It is in this respect that the radical reconstruction phenomenon of Japanese is not a surprising language-particular phenomenon, but a reflex of an entirely general structural principle.[72] The parallelism with non-subject case-marking is expected, as both

[71] As Jun Abe points out to me, apparently problematic for the DS style of analysis is the observation of Takahashi 1993 that given two Q-markers, a preposed *wh* expression is identified as a matrix question rather than embedded one (to which in processing terms, it is closer):
(i) Nani-o John-ga Mary-ga tabeta ka siritagatteiru no
What$_{ACC}$ John$_{NOM}$ Mary$_{NOM}$ are Q want-to-know Q
'What does John want to know whether Mary ate?'
While a detailed lexical specification of *nani* remains to be given, the required interpretation of (i) suggests that *wh*-expressions in Japanese are constrained to take narrow scope with respect to some most local scope-inducing operator (unlike the English indefinite which has no such restriction), a constraint which would enforce their left-peripheral position if the interpretation to be conveyed is one in which their scope is not that of the complement structure. (Technically, to achieve this result, the very first step in the construction process needs to introduce a variable representing the index of evaluation associated with the root structure, this then allowing the introduction of a scope statement for the term constructed from the initially placed *wh* expression.) It is notable that, by such means, what are expressible within Minimalism as economy conditions on derivations (see Abe 2003 for an account of scrambling in these terms) can be reconstructed in terms of locality constraints on construal, whose application to intermediate partial structures in the construction process is immediate (see section 5.3).

[72] There is one difference from long-distance dependence in head-initial languages such as English, independent of the distinct means of clause-typing. The relation between matrix node and the subordinate propositional type *t* node is established in Japanese long-distance scrambling by introducing an extremely weak tree relation and enriching it by assumption to some fixed value. Accordingly, we would expect double embeddings to be severely degraded, as in these cases, no fixed relation can be established:
(i) ??Sono hon-o John-ga Mary-ga katta to Bill ga itta to omotte iru (koto)
That book$_{ACC}$ John$_{NOM}$ Mary$_{NOM}$ bought COMP Bill$_{NOM}$ said COMP think (fact)
'That book, John thinks that Bill said that Mary bought that book.'
(ii) ??Sono hon-o John-ga minna-ga Mary-ga katta to omotte iru to itta (koto) That book$_{ACC}$, John$_{NOM}$ all$_{NOM}$ Mary$_{NOM}$ bought COMP think COMP said (fact)
'That book, John said that everyone thinks Mary bought.'
In the more deeply embedded instances of complement embedding, the enrichment has to be from one underspecified relation to another rather than providing a fixed value. But this leaves application

constraints are expressed as an output filter.

5.3 Long-Distance Scrambling and Binding effects

Confirmation of all three processes of Adjunction comes from the interaction of these processes and anaphor construal.

First, we expect the "reconstruction" effects for non-*ga* marked anaphoric expressions occurring left-peripherally in any clausal sequence, whereby they can be construed as picking up their interpretation from some following expression. On the analysis of these expressions as decorating an unfixed node, these data are licensed because any node whose tree node relation isn't fixed will be associated with a subsequent update process. The fact that there has to be such a subsequent process means that there will be a distinct point in the construction process at which any aspects of underspecification left without update at the earlier step of constructing the unfixed node can be resolved at this second stage:

(46) *zibunzisin-o* *Taroo-ga* *semeta*
self$_{ACC}$ Taroo$_{NOM}$ blamed
'Himself, Taro blamed.'

Because all rules are optional, nothing forces the substitution of a term to update the meta-variable projected by the anaphor in (46) at the point at which the unfixed node is decorated. The pointer can be moved on from this node without any such process, given the provision of a type specification for the meta-variable, as it is this that is critical to successful processing of the case-marker *-o*. At the later stage, once this incompletely decorated node has merged with the internal argument node projected by the verb *semeta*, the substitution of this meta-variable will however become essential, as otherwise with an open requirement remaining, its immediately dominating predicate node will fail to be assigned a formula node, and so there will be no wellformed outcome overall.

It might seem from (46) that the identification of appropriate construal *zibunzisin* is identified off the fixed structure, once the initially unfixed node is updated - agreeing in this with the radical reconstruction account. But things aren't quite this simple. As is wellknown, *zibun* is a subject controlled anaphoric device, restricting identification of its antecedents to terms that decorate a subject node. *zibunzisin* is the local analogue of this, requiring as its antecedent a suitably local subject node, that is the CLOSEST subject in some sense to be made precise. The problem is that, given the range of interpretations available in (21)-(23) it is not sufficient to define

of Merge unavailable, and the overall interpretability of the string relying on global procedures not provided by the parse mechanism. (Saito reports these as degraded (1985), but he deems them to be grammatical, their unacceptability due to the displayed center-embedding.)

locality either off the predicate relative to which the anaphor has to be construed, or off the subject expression closest to it in the linear sequence, for there is the third type of reading to express, as in (23):[73]

(21) *Taroo-ga*$_i$ *Hanako-ga*$_j$ *Jiroo-ga*$_k$ *zibunzisin-o*$_{*i,*j,k}$ *hihansita* *to*
Taroo$_{NOM}$ Hanako$_{NOM}$ Jiroo$_{NOM}$ self$_{ACC}$ criticized that
itta *to* *omotteiru* *(koto)*
said that think fact
Taroo$_i$ thinks that Hanako$_j$ said that Ziroo$_k$ criticised self$_{*i,*j,k}$

(22) *Taroo-ga*$_i$ *Hanako-ga*$_j$ *zibunzisin-o*$_{*i,j,k}$ *Jiroo-ga*$_k$ *hihansita* *to*
Taroo$_{NOM}$ Hanako$_{NOM}$ self$_{ACC}$ Jiroo$_{NOM}$ criticized that
itta *to* *omotteiru* *(koto)*
said that think fact
Taroo$_i$ thinks that Hanako$_j$ said that Ziroo$_k$ criticised self$_{*i,j,k}$

(23) *Taroo-ga*$_i$ *zibunzisin-o*$_{i,j,k}$ *Hanako-ga*$_j$ *Jiroo-ga*$_k$ *hihansita* *to*
Taroo$_{NOM}$ self$_{ACC}$ Hanako$_{NOM}$ Jiroo$_{NOM}$ criticized that
itta *to* *omotteiru* *(koto)*
said that think fact
Taroo$_i$ thinks that Hanako$_j$ said that Ziroo$_k$ criticised self$_{i,j,k}$

This is expressible in this framework with no structure-specific stipulation (the locality constraint on the subject-seeking *zibunzisin* aside. Informally, given that an unfixed node is evaluated progressively down through a sequence of daughter relations, there is the possibility of updating any underspecification associated with the formula in question at each successive node that is passed through en route to the point at which *Merge* can take place. The lexical specification of *zibunzisin* is simple. It projects an itemised meta-variable, $\mathbf{U}_{anaph}$, defined to be associated with a local substitution process:

IF	$?Ty(e)$
THEN	$\mathtt{put}(Fo(\mathbf{U}_{anaph}, Ty(e)))$;
ELSE	Abort

The restriction on this local substitution process then merely has to refer to some closest subject relative to some point in the construction process (i.e. some dominating type t-requiring node which immediately dominates a subject node with no intervening type-t-requiring node node which itself dominates a subject node):[74]

[73] These are the cases for which Saito defined an additional A feature, stipulated to be satisfied at intermediate points in the chain construction.

[74] Notice how the concept of *subject* is again determining a locality domain.

Local Substitution:

IF	$Fo(\mathbf{U_{anaph}}), Ty(e)$;	
THEN	IF	$\langle U\rangle \exists x(Tn(x) \wedge ?Ty(t) \wedge \downarrow_0 Fo(\alpha) \wedge$ $\neg(\exists y(Tn(y) \wedge ?Ty(t) \wedge \langle U\rangle Tn(x) \wedge x \neq y \wedge \downarrow_0 \top))$
	THEN	$\mathtt{put}(Fo(\alpha))$
	ELSE	Abort
ELSE	Abort	

The significance of this characterisation is that it isn't specific to any fixed position in a tree. First, the substitution defined will trivially apply in the case of (21) since the node which *zibunzisin* decorates is a node which is locally dominated by a type-t-requiring node with a fixed term as subject; and this can function as its antecedent – there is no putative intervening type-t-requiring node. The substitution process can also apply in a derivation in which, following the parsing of some *ga* marked expression to serve as antecedent, a presumed step of Generalised Adjunction introduces an intermediate type-t-requiring node across a very weak structural relation and then a new unfixed node is introduced for the anaphor to decorate. As long as there is no intervening subject between this unfixed node and that of the putative antecedent, the *ga* marked expression immediately preceding the anaphor in the string will remain the closest subject as defined on the tree even though it isn't structurally local. So in (22), *Hanako* will be available as an antecedent for *zibunzisin*. Yet, because this node which the anaphor decorates is on this analysis unfixed, its decorations have to be passed down through the emergent tree as it is constructed until the point at which Merge can take place to unify that node with some fixed position. Hence in (22) *zibunzisin* can be identified as taking *Hanako* as antecedent, but nevertheless be object of *hihansita*. Nothing, however, forces such an interpretation of *zibunzisin* as the process of substitution is a computational action, hence optional. So should the substitution option not be taken up, the unfixed node with its metavariable as Fo value can be evaluated down through the tree as it unfolds until the point at which it can be merged - in (22) as the object of *hihansita* as before. Hence the ambiguity of (22). As we would expect, these two interpretations are reported to be equally natural: no step of structural abduction was necessary in the derivation of either interpretation. Finally we get to (23), and here, with its three possible interpretations, an intervening step of abduction becomes essential. As in (22), a step of Generalised Adjunction can be presumed to apply following the parsing of the matrix subject, and the immediately succeeding anaphor can be construed as sharing the Fo value of that matrix subject. There is also the interpretation in which the meta-variable projected by the anaphor isn't identified until the node it decorates is merged with the object argument node of *hihansita* when it can be identified relative to the most deeply embedded subject.

However, there is, in addition, the possibility of identifying *zibunzisin* as picking out *Hanako-ga*, which follows it in the string. This is because in the evaluation of the unfixed node decorated by the anaphor down through the tree, there will be an interim transition step in which the structural description provided by the locality specification will be specified as picking out *Hanako-ga* as the "closest" subject. In all three interpretations, unlike (21)-(22), structural abduction will be essential: without such an enrichment step, exactly as in the cases of long-distance scrambling already seen, the unfixed node which *zibunzisin* decorates will not be able to be merged with the object node of the complement structure provided by *hihansita*. So we get some basis for anticipating both the left-right asymmetry displayed in (21)-(23), and the reported reduced acceptability of (23).

It is notable that this analysis emerges from the dynamics of introducing a left-dislocated term as decorating a node without a fixed tree node which itself has an underspecified *Formula* value. The distribution of the different forms of construal of *zibunzisin* is simply a reflex of the interaction between the resolutions of the structural underspecification intrinsic to Generalised Adjunction and *Adjunction on the one hand and the content underspecification expressed with a meta-variable as *Formula* on the other.[75]

Confirming this style of analysis is the distribution of the non-subject-seeking anaphor *otagai*.[76] Unlike *zibun* or its variants, there is no restriction to *otagai* being interpreted only relative to a term that functions as a subject.[77] In an environment in which *otagai* must be construed as decorating a fixed node, the antecedent for *otagai* must precede it (see section 1):

(5) *John ga* *Taroo* *to* *Hiroto-ni* *otagai-o* *syookaisita*
John$_{NOM}$ Taro and Hiroto$_{DATIVE}$ each other$_{ACC}$ introduced
John introduced Taro and Hiroto to each other.

(6) **John ga* *otagai-o* *Taroo* *to* *Hiroto-ni* *syookaisita*
John$_{NOM}$ each other$_{ACC}$ Taro and Hiroto$_{DATIVE}$ introduced
John introduced Taro and Hiroto to each other.

Yet like *zibun* it can occur initially and be interpreted by some subsequent antecedent:

[75]This is in contrast to the Saito form of analysis, for which an additional A feature needs to be defined just in order to allow the facts to be expressible within the general movement account. The feature may seem reasonably well motivated, but it is a stipulation none the less.

[76]Without a fixed characterisation of plurals, some uncertainties inevitably remain.

[77]For those speakers who preclude any non-subject antecedent for *otagai*, the antecedent is presumably identified on a similar basis to *zibunzisin*.

(9) *Otagai-o* *John* *to* *Mary-ga* *hihansita* *(koto)*
each other$_{ACC}$ John and Mary$_{NOM}$ criticised fact
Each other John and Mary criticised

As we saw earlier, *otagai* itself cannot occur as a subject, but it can occur within a subject; and within a single clausal sequence, and only within a single clausal sequence, it can occur as a subpart of a subject with its antecedent being some non-subject-marked expression:

(2) *?Taroo* *to* *Hiroto-o* *otagai-no* *sensei-ga* *hihansita* *(koto)*
Taro and Hiroto$_{NOM}$ each other$_{GEN}$ teacher$_{ACC}$ criticised fact
'Taro and Hiroto criticised each other's teachers'

(12) *?*Taroo* *to* *Hiroto-o* *otagai-no* *sensei-ga* *Tanaka-ga*
Taro and Hiroto$_{ACC}$ each other$_{GEN}$ teacher$_{NOM}$ Tanaka$_{NOM}$
hihansita *to* *itta* *(koto)*
criticised COMP said (fact)
*Taro and Hiroto, each other's teachers said that Tanaka criticised.

Like *zibunzisin*, there is clearly some form of locality restriction at work, but for *otagai* there is no reference to subject as such, and, given the asymmetry between (2) and (12), it looks as though the restriction needs to be one which can preclude an unfixed node as a site for a putative antecedent. In this connection, recall that scope statements for terms as constructed from noun phrase sequences are entered incrementally into a tree structure, compiled at some local type t-requiring node. Technically this will mean that not only do all such terms α enter into such a scope statement, but they are also described as $DOM(\alpha)$.[78] It is this predicate DOM that we use to express the range of antecedents available to *otagai*, given the assumption that whereas short-scrambling involves constructing fixed tree relations immediately, long-scrambling involves leaving this underspecified relation and proceeding with the parsing of other expressions. We can then discriminate between an initial expression interpreted within some local structure, and one that is interpreted as decorating an unfixed node which is not immediately updated. The former will have an entry among the set of scope statements, describable as $DOM(\alpha)$: the latter will not. So we can say that *otagai* has to be assigned an antecedent α meeting the condition $DOM(\alpha)$.

While this analysis remains informal, pending a full account of plurals, a first approximation to the restriction on the substitution process associated with *otagai*

[78]We assume that such scope statements are constructed for all NPs, extending the assignment of scope statement to a proper name and assuming they involve the construction of terms which are assigned widest scope, an assumption which is uncontroversial.

might take the form:

IF	$Fo(\mathbf{U}_{otagai}), Ty(e)$	
THEN	IF	$\langle U\rangle(\exists x(Tn(x)\wedge ?Ty(t) \wedge DOM(\alpha)\wedge$ $\neg\exists y(Tn(y)\wedge ?Ty(t) \wedge \langle U\rangle Tn(x) \wedge x \neq y$ $\wedge\exists z DOM(z))))$.
	THEN	$\mathtt{put}(Fo(\alpha))$
	ELSE	Abort
ELSE	Abort	

Again we invoke a concept of most local, here attributed to the set describable by the predicate DOM. The fact that ANY term amongst the locally collected set of scoped terms will count as a possible antecedent is captured, hence the well-formedness of (5), and also the relative acceptability of (2) and (3):[79][80]

(3) *Taroo to Hanako kara otagai-no hahaoya-ga hon-o*
Taroo and Hanako from each-other$_{GEN}$ mother$_{NOM}$ book$_{ACC}$

[79]This analysis depends on the analysis of *no* as genitive marker as projecting argument nodes internal to the type e constituent. There is independent evidence of this analysis: see Saito and Hoshi 2002.

[80]It might be argued that this characterisation of the locality restriction on *otagai*, in being dependent solely on the presence of some term in some propositional structure, fails to characterise the illformedness of (i), for why can't *otagai* in (i) be taken to decorate an unfixed node, both the coordinate *Hiroto to Akiko ni* and the subject-marked expression *John ga* be taken to decorate fixed nodes, thus allowing the identification of *otagai* as the object of *syookaisita*, which would THEN allow *Hiroto to Akiko ni* to be identified as the antecedent of *otagai*:
(i) *Otagai-o Hiroto to Akiko-ni John-ga syookaisita.
Each-other$_{ACC}$ Hiroto and Akiko$_{DATIVE}$ John$_{NOM}$ introduced.
Two possible solutions suggest themselves, while retaining the relatively weak concept of locality proposed here. First, assigning an interpretation to (i) by the route of building both *otagai* and *Hiroto to Akiko ni* as locally unfixed nodes is precluded, and with all *-ni* marked nodes having to be introduced as unfixed and enriched only by abduction, this is sufficient to determine the ungrammaticality of (i). In effect, any node taken to be unfixed but not immediately updated must be followed by a subject-marked constituent. This condition isn't met by (i) if *otagai* and *Hiroto to Akiko* are interpreted as two nodes which are independently unfixed; hence its ungrammaticality. The alternative is to construct an interpretation for the sequence of *otagai o Hiroto to Akiko ni* as though they were together – a pair of argument creating nodes to an intervening type t-requiring node – and to consider that intervening node as the sole unfixed node, which is subject to a later step of *Merge*. However, unlike the use of this strategy to capture the possibility of two *-ni* marked expressions preceding a *-ga* marked subject in (i) of footnote 67, here, it will not yield a well-formed result. Such a move would require the interpretation of *otagai* to be selected from some antecedent term already in the set of terms describable at that intermediate node as already in a set of scope statements for that node, and this condition isn't met as *otagai* is parsed. Since by both possible interpretation strategies, (i) will fail to get a logical form with all requirements met, (i) is not wellformed. As Hiroto Hoshi pointed out to me, this example is problematic for Saito's 2003 analysis, since the explanation that renders (9) grammatical would equally apply to (i). I am grateful to him for bringing this example to my attention, and for alerting me to its significance.

karita (koto)
borrow
From Taroo and Hanako, each other's mother borrowed books.

Furthermore, as long as we distinguish *Adjunction and Local*Adjunction, this characterisation of *otagai* will also exclude construal of *otagai* from some following antecedent within some sequence of NPs providing arguments for a single propositional structure, as in (6). Once one fixed node is constructed from a type-t-requiring node, *Adjunction is inapplicable. Local*Adjunction, on the other hand, despite allowing multiple applications, requires each such application to be immediately enriched as indicated by the case marking to identify a fixed tree relation: otherwise, with two competing descriptions of unfixed nodes dominated by the same type t-requiring node, the derivation will be filtered out as providing inconsistent node decorations. Thus, with incremental fixing of the interpretation of each such node, all decisions about aspects of underspecification have to be made as the expressions are parsed, reflecting the strict incrementality of the interpretation process for any node that is fixed.

This analysis of *otagai* in terms of its putative antecedent having to be available in some set of scope statements provides a reason to expect the asymmetry between the single-clause and cross-clausal cases as in (2) and (12), for scope statements must be constructed locally.[81] Any expression interpreted as decorating an initially unfixed node which is accordingly not updated to be construed as locally dominated by a type t-requiring node will not provide any entry into the set of scope statements collecting at that node, hence will be precluded from serving as an antecedent for the subject-contained *otagai*. Hence the difference in acceptability of (2) and (12).

As noted initially, the type of asymmetry displayed in (2) and (12) pertains also to quantifier binding, confirming the general direction of the analysis, and the distinctness of Local*Adjunction and *Adjunction. Quantified expressions must be construed as entering a term into some set of scope statements. Without having done so, they are not wellformed as terms in the tree (they will have a scope requirement that isn't fulfilled). However, a scope statement can only be entered into from a fixed position in some local domain – the construal of quantified expressions thus cannot be licensed from an unfixed node. Hence, a regular pronoun, even though it itself may have no restriction requiring its construal to be identified locally, cannot have its interpretation provided by a quantifier that isn't yet assigned a fixed position. So (14) is illformed:[82]

[81] More accurately, scope statements are collected at the closest tense-marked type-t-requiring node to the node at which the quantifying term is constructed.

[82] As quite generally observed, though quantifiers may be construed as focussed through phono-

(14) *Dono$_i$ *hon-ni-mo* *sono$_i$* *tyosya-ga* *Hanako-ga* *ket-o*
Book every its author$_{NOM}$ Hanako$_{NOM}$ criticism$_{ACC}$
tuketa *to* *itta*
gave that said
*Every book$_i$ its$_i$ author said that Hanaka criticised

By contrast, (13) allows a bound-variable interpretation to *sono*, as the quantifying term decorates a fixed node. The object node which it decorates may have been introduced into the structure as an unfixed node, but in order to assign it some scope relation to other terms in the structure under construction, it must have been immediately enriched:

(13) *Dono* *hon-ni-mo* *sono* *tyosya-ga* *ket-o* *tuketa*
which book-to-even its author$_{NOM}$ criticism$_{ACC}$ gave
Every book$_i$ its$_i$ author criticised

So overall, the binding interaction between anaphor resolution, quantifier binding and scrambling is expected, given certain assumptions about appropriate concepts of locality for anaphor and quantifier construal and for the resolution of the unfixed nodes which the terms are taken to decorate. The whole story is about the interaction of different but related concepts of locality, both on the actions that induce the structure, and on the formulae that decorate them.[83]

6 Comparing Grammar Formalisms

Stepping back from the details, we can now see to what extent we have been successful in providing an account of Japanese scrambling. Using a family of underspecified tree relations and processes of tree growth defined over them, we have provided a basis for capturing core properties of the language, while reflecting remarkably faithfully the dynamics of processing in real time. We have characterised the asymmetry between the flat sequence of nodes whereby the structure is initiated and the fully configurational property of the output structure. We have

logical stress, they cannot occur in left-dislocated positions (see Anagnastopoulou 1995):
(i) John saw EVERYONE.
(ii) *Everyone, John saw.

[83]Technically, Local*Adjunction can be reduced to *Adjunction, but, to achieve the same data coverage, such a move imposes on each non-subject case specification a disjunction forcing the required update in the presence of a discrete fixed daughter relation. But this loses the cross-linguistic generality of both *Adjunction and the format of case specifications, making cross-linguistic comparisons harder.

characterised variability of word-order effects, and the limits on that flexibility, giving at least provisional specifications of the different locality restrictions associated with the anaphors *zibunzisin* and *otagai*. In all cases, processes of interpretation growth are driven by the suffixes, which determine that interpretation is built up locally, and incrementally. An account of long-distance scrambling has also been expressible within the framework, with some explanation of its peripheral status.

The parallelism between this account of scrambling and Saito's radical reconstruction form of analysis shines through, despite major differences of approach. Both analyses purport to provide an integrated account of the phenomena, here defined over a family of concepts of structural underspecification and their processes of update. In both styles of analysis, the interpretation of the expression in question is in some sense "reconstructed" into a configurational position from which the interpretation it provides can contribute to the whole. Yet, in Saito's analysis, the process of radical reconstruction is an idiosyncracy unique to Japanese needing special stipulation within the grammar of the language. In the present analysis to the contrary, the reconstruction effect of long-distance scrambling is explained as an immediate consequence of the general language architecture: all long-distance dependency is characterised in these terms. From a general perspective, what is novel about the approach adopted here is that the grammar directly provides an architecture for incremental left-to-right language processing. Rather than take correspondence between word order and interpretation to be indicative of how structure and interpretation determine the order of expressions, we take the linear order of expressions to provide the input from which structure and interpretation are projected.

6.1 Parametric variation?

One might ask what this framework has to say about parameters of cross-linguistic variation. Given its parsing commitment, the only basis for variation is the balance between lexical and general computational actions, as to whether a given form of update constitutes a general strategy in some language (possibly with varying conditions allowing cross-linguistic differences in range of its applicability), or is defined to occur solely as lexically triggered. So even Local*Adjunction would be expected to be applicable in principle in any language, possibly in a lexically restricted form.[84] This leads us to expect a considerably broader spectrum of languages to display scrambling than a parametric, head-driven approach (Fukui 1993,

[84]The correspondence between heavy NP Shift and scrambling is already noted (Saito and Fukui 1998), and it is notable that it is such structures as double-object constructions which impose linear order restrictions on quantifier construal (see Kempson and Meyer-Viol 2003).

Saito and Fukui 1998).[85]

According to the analysis provided here, it might seem that scrambling of argument NPs is twinned with the projection by the verb of a full propositional template of structure, to wit being fully pro-drop. Indeed, if in a language the verb bears the major role of projecting propositional structure, whether verb-final, verb-initial, or verb-medial,[86] we would expect this to be associated with relatively free ordering of NPs, since, with the trigger for projecting the update provided by the verb being that of the top type-t-requiring node, and its update actions relatively rich, the decorations provided by NPs themselves merely provide the decorations for argument nodes which have been provided by the parsing of the verb, and this can be achieved by any of the available strategies (either by direct decoration, or by the projection of unfixed nodes).[87] Hence the freedom of ordering for NPs in full pro-drop languages. But this cannot be the full picture, as it is well known that non pro-drop languages may also make widespread use of scrambling devices, notably the Germanic languages.[88] Yet these languages are, in the main, notably rich in the alternative lexical means of inducing propositional structure, namely case specifications. These languages too do not need to use general computational actions to induce structure, since the burden of doing so is carried by individual morphological specifications associated with the other major category associated with projection of predicate-argument structure – namely the argument providing expressions.

This leads us to expect a mixed situation, while sustaining a relatively stringent universalist position. All languages whose lexical specifications, either verbal or nominal, induce appropriate partial structures do not need to use general computational devices to unfold the requisite tree structure. In consequence, word order variation can be used for indications of relative dependency of eg scope and other aspects of context-dependency in interpretation. But those languages which do not contain either verbal or nominal specifications that induce such structure will of

[85]Bailyn 2003 argues that scrambling in languages may apply to constituents other than noun phrases, including adjective fronting. While there are arguments that adjunct placement forms part of the same phenomenon, possibly of optional argument status, the phenomenon of adjective fronting is arguably a distinct phenomenon. It is notable that with adjective fronting, the bare adjective, as well as the nominal with which it has to be construed are case-marked. From a DS perspective, this might suggests a relation more like apposition, as in:
(i) A friend of my mother's, someone she hasn't seen for years, is coming to stay.

[86]Given the role of tense in the construal of Japanese, we would expect the determination of a language as verb-final, verb-initial, or verb-medial would turn on properties of tense specification. In this connection, it is notable that verb-initial languages characteristically display auxiliary fronting. See Turner 2003.

[87]If some NP is not case-marked to indicate relative position in the resulting tree, the analysis can involve the projection of anaphorically correlated pairs of linked structures - as with *-wa* marking.

[88]For a DS characterisation of German word order, see Klein 2003.

necessity be relying on the computational top-down unfolding of subject-predicate relations, and maybe also predicate-object relations. And with order of expressions carrying the weight of triggering the processes that induce such branching in the semantic tree, linearity considerations cannot also be used to convey other order-sensitive projection of aspects of interpretation.

7 Coda: The Grammar-Parser Correspondence

It might seem that in advocating a parsing-directed grammar formalism, we have missed the point of the difficulties which parsing of Japanese poses. In all explanations set out, we have followed a single sequence of transitions, merely noting in passing that there are many alternative possibilities in the processing of a Japanese string almost every step of the way. Yet the problem of disambiguation is particularly acute in Japanese, and so, one might argue, cannot be set aside. In one sense, this is true. But the formalism is not itself a model of parsing in that it does NOT provide a model of the actual parsing mechanism used to establish how choices are made relative to context. To do this would involve modelling how stored information is retrieved for determining interpretations in a given context, what determines relative accessibility of stored information, and so on – in short an essentially pragmatic account.[89] The present model, to the contrary, merely defines an architecture of tree growth reflecting how information as processed is built up: what it provides is a set of constraints to be implemented in a theory of parsing in conjunction with whatever general cognitive constraints apply to cognitive processing in general. And the interest of the present account is that the step of leaving on one side the disambiguation task as a problem for a pragmatic theory to address has opened up the possibility of developing a grammar formalism in much closer correspondence to what is required by parsing models than has hitherto been possible.

That this characterisation of Japanese structure re-instates a closeness of correspondence between parsing and structure-projection provides a final buttressing of the proposed re-interpretation of a grammar formalism. In Japanese, as we've seen, individual propositional structures are progressively built up, and then are taken as units in some larger emergent structure. Far from requiring a puzzling asymmetry

[89]In following this up, we might pursue a relevance-theoretic basis for modelling the selection mechanism according to which processing choices are made relative to balancing cognitive cost with inferential effect (Sperber and Wilson 1995). On this assumption, one would expect that alternative sequences – even though requiring an implementation of some choice process as soon as possible to minimise cognitive cost – would have to be constructed in parallel until evaluation of inferential effect can be determined for any propositional unit. Thus we would expect possible choices to be selected clause by clause, rather than sentence by sentence, markedly reducing the combinatorial explosion of alternative derivations to be considered.

between the grammatical description of the language and its parsing implementation, the grammar formalism and processes of parsing are defined in synchrony. Japanese no longer seems such an exotic language for a child to acquire.

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