INTERNALLY HEADED RELATIVE CLAUSES IN JAPANESE

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ABSTRACT

Two influential accounts of Japanese internally headed relative clauses, that of Hoshi (1995, 1996) and that of Shimoyama (1999), give very similar analyses of this construction based on the mechanism of e-type pronouns. The e-type pronoun mechanism in question is a discourse-semantic/pragmatic mechanism, which has the consequence that on these analyses, the construction under discussion is not really a relative clause construction. In this paper we argue that Japanese internally headed relatives clauses show several syntactic and semantic properties that are unexpected on an e-type pronoun account and that in fact point in the direction of an analysis not in terms of discourse semantics/pragmatics, but in terms of sentence grammar, i.e. semantically interpreted syntax. We propose an analysis that postulates inside the relative clause a null functional projection **max** which introduces a relativization variable (open to the normal syntactic and semantic constraints) and has the semantics of role-maximalization. On this analysis, the e-type pronoun effects are in essence made part of the semantics of a true relative clause construction. We show how this analysis accounts for the problems discussed.

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We are especially grateful to Akira Watanabe for his extensive and generous help with the Japanese examples, and for his insightful comments on the syntax/semantics of the examples involved, and to Regina Pustet, for enabling us to understand the conditions under which negative concord operates in Lakhota. We also wish to thank Pamela Munro, Susan Rothstein, Junko Shimoyama, and Janis Williamson for help than enabled us to get a better grip on various aspects of the data.

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ABSTRACT

Two influential accounts of Japanese internally headed relative clauses, that of Hoshi (1995, 1996) and that of Shimoyama (1999), give very similar analyses of this construction based on the mechanism of e-type pronouns. The e-type pronoun mechanism in question is a discourse-semantic/pragmatic mechanism, which has the consequence that on these analyses, the construction under discussion is not really a relative clause construction. In this paper we argue that Japanese internally headed relatives clauses show several syntactic and semantic properties that are unexpected on an e-type pronoun account and that in fact point in the direction of an analysis not in terms of discourse semantics/pragmatics, but in terms of sentence grammar, i.e. semantically interpreted syntax. We propose an analysis that postulates inside the relative clause a null functional projection **max** which introduces a relativization variable (open to the normal syntactic and semantic constraints) and has the semantics of role-maximalization. On this analysis, the e-type pronoun effects are in essence made part of the semantics of a true relative clause construction. We show how this analysis accounts for the problems discussed.

This paper is concerned with Japanese internally headed relative clauses. We take a relative clause to be a clausal structure, a CP, with a predicative meaning, based on an operator which abstracts over a semantic variable which is (part of) the interpretation of a grammatically realized element inside the IP (a gap, a resumptive pronoun, an internal head, etc.). This, we assume, is pretty much standard.

Two influential accounts of Japanese internally headed relative clauses, that of Hoshi (1995, 1996) and that of Shimoyama (1999), give analyses of these constructions based on the mechanism of e-type pronouns. Since the latter interpretative mechanism does not involve 'abstraction over a semantic variable which is the interpretation of a grammatically realized element inside the IP', on Hoshi and Shimoyama's accounts, the construction known as the Japanese Internally Headed Relative Clause is not a relative clause in the sense defined above.

In this paper we want to argue that this is problematic: there are problems with the accounts of Hoshi and Shimoyama, and these problems suggest that the clauses involved are after all better regarded as true relative clauses in the sense defined above. We will provide a new account of their semantics which addresses the problems raised.

The paper is organized as follows. We start in section one with some background distinguishing the properties of two major types of internally headed relative clauses discussed in the literature: the Lakhota type (NP-headed) versus the Japanese type (DP headed). In section two we introduce the Hoshi and Shimoyama's accounts of the semantics of Japanese internally headed relatives; we criticize these accounts in section three. In section four we present our own proposal, and in section five we extend it to cases where the internal head is scopally dependent upon a quantifier inside the relative clause.

1. NP versus DP-headed internally-headed relatives.

We will focus in this paper on Japanese internally-headed relative clauses. The terms 'internally-headed' and 'externally-headed' are pre-theoretical labels in the sense that the object referred to as 'head' is not a *lexical* item (as in the X-bar theory of phrase structure), but a *phrase*. In the case of internally-headed constructions, the terminology is also vague with respect to the more precise nature of the phrase at issue. Thus, while the 'internal head' is typically a nominal (extended) projection of some kind, it is in some cases an NP (more precisely, a category that includes weak – but not strong determiners), and in some cases a DP (which includes strong determiners as well). There are then two subclasses of internally headed relative clauses with, as we will see, very different characteristic properties, we call them: 'NP-headed' versus 'DP-headed' relatives.

For externally-headed relative clauses, a consensus that emerges from the earlier literature is that **non-appositive externally-headed relative clauses** are NP-headed. This means what we see in [1]: the relative clause and the head NP *book* both have a predicative interpretation and combine with predicate conjunction. The resulting complex NP *book that Mary bought* is the argument of the strong determiner *the*:

[1] [$_{DP}$ the [[$_{NP}$ book] [$_{CP}$ that Mary bought __]]]
$\lambda x.\text{BOOK}(x)$ $\lambda x\text{BOUGHT}(m,x)$
$\lambda x.[\text{BOOK}(x) \wedge \text{BOUGHT}(m,x)]$
$\sigma(\lambda x.[\text{BOOK}(x) \wedge \text{BOUGHT}(m,x)])$

Despite structural differences, the internal head of internally-headed relatives as they are found, for example, in Lakhota (Williamson 1987), are similarly analyzed as NPs, thus these are **internally-NP-headed relatives**, as illustrated in [2] (= Williamson's *(4a)*).

[2] [$_{DP}$ [$_{CP}$ Mary [$_{NP}$owíža wą] kağe] ki]
Mary quilt a make the
'The quilt that Mary made.'
σ(λx. QUILT(x) ∧ MADE(m,x))

Note that in [2a], the strong determiner is external to the relative clause, just as in [1a], but NP *a quilt* is internal to CP, instead of being a distinct constituent. Nonetheless, the NP and the remainder of the CP are semantically combined just as in [1a], that is, as conjoined predicates, resulting in the same kind of semantic representation, as can be seen by comparing the representations in [1] and [2].

Williamson gets two predicates which can be conjoined by assuming an operation of head raising at LF: she assumes that the internal head is semantically raised out of the relative clause. This analysis is problematic, because it is not consistent with another property possessed by Lakhota relatives, and which is also found with other internally NP-headed relatives, e.g., Mojave (see Munro 1976, Basilico 1996): the internal head may be contained within a syntactic island, e.g., within a complex DP. Thus, the relation between where the head occurs and where it is interpreted does not show island-sensitivity, and it should, if the relation were produced by head-raising.

Now, Williamson provides one seemingly strong piece of evidence for a head raising account: Lakhota has negative concord, and Williamson claims that negative internal heads shows negative concord with a negation outside the relative clause:

The examples in [3] show that Lakhota has clause bound negative concord:

[3] a. *Šųka wąžini* ophewathų **šni**
dog a-not bought.I Neg
'I bought no dog.'
b. **Šųka wąžini* ophewathų –
dog a-not bought.I
[Purported reading: same as [4a]]
c. *[*Tuweni* u pi] ki imuge **šni**
someone-Neg come Pl whether I-ask not
[Purported reading: I did not ask whether anyone came]

The examples in [4] show negative concord in relative clauses, according to Williamson:

[4] a.*[*Šųka wąžini* ophewathų **šni**] cha he sape
dog a-not bought.I Neg Ind that black
'*The/a dog such that I did not buy any is black.'
b. [*Šųka wąžini* ophewathų] cha sape **šni**
dog a-not bought.I Ind black Neg
'No dog that I bought is black.'

The contrast in (4) can be explained, according to Williamson, if we assume that in Lakhota negative concord is checked at LF and the internal head raises out of the relative clause at LF.

However, Regina Pustet (p.c.) kindly informs us that the extensive field work she has done on Lakhota unmistakably points to the conclusion that negative concord applies on surface structures in Lakhota, as it does in other negative concord languages, and that the kind of cases that Williamson cites as evidence (i.e. 4b) are unhesitatingly rejected by reliable native informants.

A number of writers have addressed the issue of how to get the correct semantic interpretation for Lakhota relative clauses, without relying on head movement (e.g. Bonneau 1992, Watanabe 2002), and propose accounts in terms of operations that are not island-sensitive, like unselective binding. We will not pursue this matter here: what matters in the present context is that Lakhota relatives receive the semantics of English externally-headed relatives.

Japanese internally-headed relatives, which were discussed in some detail in Hoshi (1995, 1996) and Shimoyama (1999), pattern quite differently from those of Lakhota (as well as Mojave and Digueño). Illustrations are provided in [5]-[7] (= Shimoyama's *(9), (4)* and *(2)* respectively), with the internal heads boldfaced (we comment on the English translations of these examples below). Following Shimoyama, we gloss the morpheme *–no*, which is suffixed to these constructions just before Case markers, as 'NM' (nominalizer), but will reconsider its status below.

[5] Taro-wa [$_{DP}$[$_{CP}$Yoko-ga reezooko-ni [$_{DP}$ **kukkii-o** **hotondo**] irete-oita]-no]-o
Taro-Top Yoko-Nom refrigerator-Loc cookie-Acc ***most*** *put-Aux-NM-Acc*
paatii-ni motte itta.
party-to brought
'Yoko put most cookies in the refrigerator and Taro brought {them, *some} to the party.'

[6] Hotondo-no gakusei-ga [$_{DP}$[$_{CP}$Taro-ga [$_{DP}$ **dono syukudai-mo**] sikenmae-ni
most-Gen student-Nom Taro-Nom ***every*** *homework before.exam-at*
dasita] -no] -o teisyutusita
assigned-NM-Acc turned.in

[7] Yoko-wa [$_{DP}$[$_{CP}$Taro-ga sara-no ue-ni [$_{DP}$**keeki-o**] oita]-no]-o tabeta.
Yoko-top Taro-nom plate on cake-acc put-NM-Acc ate
'Taro put a piece of cake on a plate and Yoko ate it.'

The DP-status of the internal head is explicitly illustrated by [5]-[7] where the (bold-faced) internal head has an overt strong determiners, like *hotondo* 'most' or *dono* 'every' (and may by extension be assumed for (7) where the indefinite meaning is not morphologically expressed). This contrasts with the situation found in Lakhota relatives, whose internal heads never exhibit strong determiners (for illustration, see *(13)* in Williamson 1987). Furthermore, in Lakhota the whole complex with the relative clause is an NP and hence can be itself the complement of any determiner, in particular, any overt strong determiner (Williamson 1987 and p.c.). This is not the case in Japanese: none of the overt strong

determiners can head the entire complex DP (only the definite determiner can, and that one is covert, unless we identify it with the suffix *–no*, as Shimoyama proposed to do).

Another important difference between the relevant constructions of Lakhota and Japanese is that the internal DP-heads in Japanese never take scope out of the relative, and thus never determine the quantificational force of the entire complex DP. The narrow scope of the internal head is brought out by the contrast in interpretation between [5] and [8] (= Shimoyama's *(5)*).

[8] Taro-wa [[Yoko-ga reezooko-ni *e* irete-oita] **kukkii-o hotondo**]
Taro-Top Yoko-Nom refrigerator-Loc put-Aux cookie-Acc most
paatii-ni motte itta.
party-to brought
'Taro brought to the party most cookies that Yoko had put in the refrigerator.'

[8] is an externally-headed relative clause, and its semantics is exactly as expected from the model for externally headed relative clauses in [1]. We saw above that Lakhota internally-headed are interpreted on the same model. But, as the paraphrases of the examples in [5]-[7] show, Japanese internally-headed relative clauses are not interpreted on this model at all.

This case is further strengthened by examples like [9] (Shimoyama's *(51a)*), where the (boldfaced) internal head is construed in the scope of a relative-internal distributive quantifier (in italics). What [9] says is not that Wasaburo read three papers, but that he read all the triples of papers submitted by the various students.

[9] Wasaburo-wa [[dono gakusei-mo **peepaa-o** **3-bon** dasita]-no]-o
Wasaburo-Top[*every student term-paper-Acc 3-Cl turned-in*]-*NM-Acc*
itiniti-de yonda.
one-day-in read
'Every student turned in three term papers and Wasaburo read them (= all the papers that all the students turned in) in one day.'

Finally, it is of importance to note that while Lakhota and other languages with internal NP-heads allow their internally-headed relatives to stack **with intersective import** much like the externally-headed relatives of other languages, Japanese and other languages with internal DP-heads do not allow this type of construal for stacked relatives.

Thus, compare stacking in English, Lakhota and Japanese:

[10] The books that Deloria wrote [that lie on this shelf] pleased me greatly
(but I don't care much about the other books he has written).
[11] [[[wowapi wą] Deloria owa *cha*] blawa {*cha,* ki}] …
book a Deloria wrote ? read.I ? the
'{A, the} book that Deloria wrote that I have read…'
[12] [John-ga [Mary-ga **nagai ronbum**-o kaita-no]-o yonda-no-ga] *LI*-ni notta
John-Nom Mary-Nom long paper-Acc wrote-NM-Acc read-NM-Nom *LI*-Loc appeared
'Mary wrote a long paper, John read it, and it appeared in *LI*.'

[10] is fully appropriate in a context in which it is assumed that Deloria wrote books **additional to** those that now lie on this shelf, the role of the bracketed relative being to narrow down the denotation of the complex DP to just the books on the shelf written by Deloria, i.e. stacking has an intersective interpretation. The same interpretation is found in the Lakhota example in [11], and with stacked internally NP-headed relatives of other languages, e.g., Mojave (Munro 1976 and p.c.).

In contrast, the Japanese example [12] is **not** appropriate in a context where it is assumed that Mary wrote several long papers (Watanabe p.c.). Rather, the implication of [12] is that Mary wrote just one contextually relevant long paper, that that paper was read by John, and that it appeared in *LI*.

[12] is interesting because it is similar to the cases in [10] and [11] in that the relative *[Mary-ga* ***nagai ronbum****-o kaita-no] (lit. Mary long paper wrote)* is embedded in, i.e. structurally part of the larger relative [*John-ga [Mary-ga* ***nagai ronbum****-o kaita-no]-o yonda-no]* (lit. *John read [Mary long paper wrote]]*), without, however, the intersective interpretation of [10] and [11]. Interpretatively it has certain similarities to stacking in appositives, free relatives or co-relatives, e.g. the examples in [13]-[15], without being interpretatively identical to any of them.

[13] Bill, who never went to a good school, who cannot in fact even read and write properly, wants to register in our PhD program!
[14] What Deloria wrote [what lies on this shelf] pleases me greatly.
[15] jo laRkii khaRii hai (jo laRkii ravii kii dost hai),
WH girl standing is WH girl Ravi Gen friend is
vo (laRkii) bahut lambii hai
Dem girl very tall is
'Which girl is standing (which girl is Ravi's friend), {she, that girl} is tall.'

In [13], *Bill*, which denotes an individual, cannot intersect with the relatives, which are of the type of propositions, and the relatives cannot intersect with each other, either, since conjoined propositions do not receive the construal of intersecting predicates. Rather, the leftmost relative provides information about John, and the rightmost relative reinforces the point made by it. [14] is acceptable only if the bracketed relative is flanked by heavy pauses, in which case it receives an appositive interpretation (in particular, one that provides an alternative characterization of what Deloria wrote), and, as pointed out by Rajesh Bhatt (p.c.), the Hindi example [15] is also acceptable only if the parenthesized correlative is pronounced and construed as an appositive. However, these cases **differ** from the Japanese example in [12] in that the stacked relatives in these examples are clearly (syndetically) co-ordinated, and not structurally embedded into each other.

The analysis we present in this paper will account for the reading of [12].

What we see in Japanese internally-headed relative clauses is the following: We have a CP with marker *no* which becomes a complex DP (receiving a case marker). One of the DPs inside the CP somehow manages to become semantically the head of the complex DP. But there is no obvious free variable involved that gets abstracted over, so these constructions don't look like they satisfy the requirements for relative clauses we started out with. How then are these constructions interpreted? Related answers to this question are provided by Hoshi (1995, 1996) and Shimoyama (1999). They assume basically that the

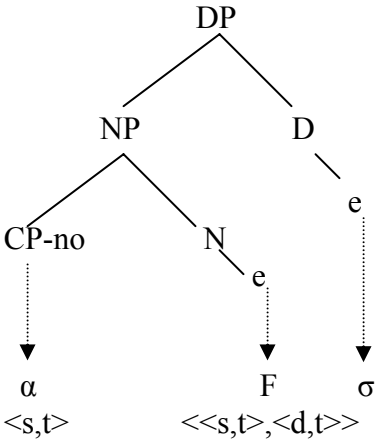
matrix of the complex DP which contains the CP with *no* contains a null e-type pronoun which is required to pick up its antecendent from inside the CP. How this works we will now explain.

2. The e-type pronoun analysis: Hoshi's and Shimoyama's proposals.

The accounts of Japanese internally headed relative clauses presented by Hoshi and Shimoyama are actually rather similar. To bring out these similarities, we will reformulate Hoshi's proposal in a format that is syntactically more similar to Shimoyama's.

Hoshi proposes the equivalent of the following syntactic structure for the internally headed relative:

[16]



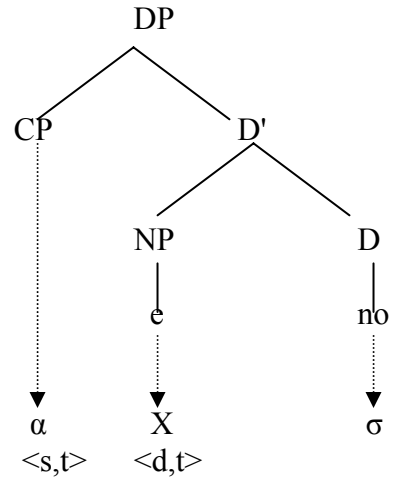
F, here, is a variable of the same type as propositional attitude verbs (a relation between individuals (type d) and propositions (type <s,t>). The semantics is just functional application following the constituent structure:

-The NP is interpreted as F(α) of type <d,t> (predicate of individuals.
-The DP is interpreted as σ(F(α)) of type d.

This, of course, doesn't give you the full interpretation: F is a variable free in σ(F(α)), a variable over relations between individuals and propositions, and the **context** must provide an appropriate relation between individuals and propositions as the interpretation of F.

Shimoyama's approach is slightly different: she assumes that *no* actually is the determiner, and that the CP is extraposed:

[17]



X, here, is a variable of type <d,t>.
-The interpretation of D' is σ(X) of type d.
-The interpretation of the DP is the result of **appropriately restricting** the interpretation of X in σ(X) by α. That is, the **context** must provide the appropriate interpretation of variable X, **derived from the CP interpretation.**

The CP is extraposed, in Shimoyama's account because it is a 'co-assertion'. This could be expressed more dir4ectly by assuming the following semantics for the DP:
-Interpretation of the DP: (with co-assertion)

$\lambda P.P(\sigma(X)) \wedge {}^{\vee}CP$ where the content of variable X derives from the CP-meaning.

The same co-assertion effect can be derived in Hosji's theory by assuming that his variable F is restricted to **factive** relations: relations between individuals and propositions that presuppose the truth of the proposition.

What we have sketched here is what Hoshi and Shimoyama assume the semantics for internally headed relative clauses specifies. The further selection of the content of the free variable is achieved by pragmatic, contextual restriction.
There are for our purposes two salient aspects to these approaches:

A. The DP containing the relative is an e-type pronoun.

As a noun phrase the internally headed relative is a definite expression(σ(F) or σ(X)). The restriction on the definite is derived **contextually** using in the context the content of the interpretation of the CP. The process deriving the restricted interpretation is not done by the grammar (by the semantics). In this sense, these accounts are modeled on Cooper (1984)'s analysis of e-type pronouns. On Cooper's account, e-type pronouns are 'concealed definites': e-type pronouns have interpretations of the form σ(X), with σ the definite operator an X a property variable, which gets its interpretation from the context. In other words, the e-type pronoun just looks for a **salient** property in the context as the interpretation of variable X. In discourse theories, the context includes the linguistic context, and the linguistic context may naturally provide an appropriate salient property, this is why such a property is often derived from the linguistic context. Crucially, though,

the relation between the interpretation of the e-type pronoun ($\sigma(X)$) and its antecedent (the property derived as the interpretation of X) is **indirect and pragmatically mediated**.

This is precisely what both Hoshi and Shimoyama propose for Japanese internally headed relatives.

In Hoshi's approach, determining the content of the DP is pragmatic, because it requires contextually determining F. Since F is a relation, the choice, though, can be regarded as **semantically restricted** by the content of the CP to which F applies (i.e. what proposition is expressed by the CP may restrict what relations one assumes are contextually natural).

. Shimoyama's approach is more radically pragmatic: the relation between the content of the definite and the content of the relative clause is relegated completely to the contextual interpretation of X.

Such pragmatic mediation is exactly what has been argued to exist for e-type pronouns, most strongly by Kadmon 1990. Kadmon argues that the relation between the restriction of the e-type pronoun and its indefinite antecedent is not provided by the grammar (as was assumed in Sells 1987 and others), but is mediated by the context.

In sum:

> Both on Hoshi and Shimoyama's account the relation between the semantically derived definite interpretation for the DP and the internal head inside the CP is identified with the relation between a discourse anaphor and a discourse antecendent.

B. The internally headed clause is not a relative clause.

In both Hoshi's and Shimoyama's account, the so-called relative clause is a CP with a propositional interpretation (type <s,t>). There is no semantic variable derived from the CP to be abstracted over: the construction doesn't involve abstraction at all.

For Hoshi, the CP is, if anything, the complement of the empty relational head noun of the definite noun phrase; for Shimoyama the CP is, in essence, appositive. In either case the CP is not a CP with a predicative meaning, based on an operator which abstracts over a semantic variable that is the interpretation of a grammatically realized element inside the IP, i.e. a relative clause.

3. Problems for the e-type pronoun analyses.

In this section we discuss three problems with the e-type analyses of Japanese internally headed relatives. The basis of these problems is the following: Japanese has e-type pronouns, and e-type pronouns in Japanese behave in relevant ways exactly like e-type pronouns behave in other languages like English. But the e-type pronoun postulated as the interpretation of the DP in the internally headed relative **does not** behave in relevant ways in that way. And the way in which the internally headed relatives differ from e-type pronouns point to a relation which is not just pragmatically mediated, but **grammatically,** semantically and syntactically, as it is in real relative clauses.

Problem one: pragmatically inappropriate antecedents.

With e-type pronouns in discourse, pragmatically inappropriate antecedents may undergo accommodation, as illustrated in [18b], where *they* is construable as denoting 'the typical students' in the context of the utterance. This option is not available to the Japanese constructions at issue, as illustrated by [19] (cited in an earlier version of Shimoyama 1999), which can only have the absurd reading that attributes to some group of students simultaneous presence at the party and at home. Look at the examples in [18]:

[18] a. John owns some sheep. Harry shaves them.
b. At the party, John saw **few students/no students**. They were at home, preparing for a test.

As is well known, out of the blue the most salient e-type antecedent in [18a] is *sheep that John owns* (meaning that the pronoun *them* is interpreted as *the sheep that John owns*).
In (18b) this strategy, which amounts to interpreting the e-type pronoun with *students that John saw* and assigning to *they* the interpretation: *the students that John saw*, is contextually problematic, since it **conflicts** with what the sentence tries to express. So, as is normal for e-type pronouns, the context looks for a different, more plausible antecendent, like the interpretation of the noun *students* (meaning *contextually salient students* or *typical students*, etc.). This is, of course, exactly what we expect of a pragmatically mediated relation like that between a discourse pronoun and its discourse antecedent.

However, when we test the same effect in internally headed relatives, the results are different. Look at [19] (from an earlier version of Shimoyama's paper):

[19] *[[Honno **suunin-no insee-sika** doyoobi-no party-ni ikanakatta] -no] -ga
only a-few-Gen grad-student Saturday-Gen party-to do-Neg-Past NM-Nom
jitsuwa uchi-de term paper-o kaite ita.
in-fact home-at term paper-Acc writing was

[19] ought to have the interpretation expressed by [20]:

[20] Honno suunin-no insee-sika doyoobi-no party-ni ikanakatta.
Only a-few-Gen grad-student-sika Saturday-Gen party-to go-Neg-Past
Karera-wa jitsuwa uchi-de term paper-o kaite ita.
They-Top in-fact home-at term paper-Acc writing were
'Only a few graduate students came to the party on Saturday. In fact, they were writing term papers at home.'

But it doesn't. [19] only has the absurd reading that attributes to some group of students simultaneous presence at the party and at home.

This is unexpected on Hoshi and Shimoyama's e-type pronoun accounts.

Problem two: *exactly* effects.

As has been argued by Kadmon 1990, out of the blue the most natural interpretation for the e-type pronoun *them* in the second sentence of (21a) uses the exactly implicature (*John has not more than three sheep*) and uses the antecendent:
sheep that John has to get the interpretation of the pronoun expressible as: *the three sheep that John has*.

[21] a. John has three sheep. Harry shaves them.
b. John has three children. They are communists. But he also has two other children, and these are not communists.
c. Jon-ni-wa kodomo-ga san-nin iru. So-no ko-tachi-wa kyousanshugisha-da.
John-loc-top child-nom 3-cl be that-gen child-pl-top communist-cop
'John has three children. Those children are communists.'
Daga, Jon-ni-wa hokani futa-ri kodomo-ga i-te ko-no ko-tachi-wa
but John-loc-top separately 2-cl child-nom be-conj this-gen child-pl-top
kyousanshugisha-de-wa nai.
communist-instr-top neg
'John has two other children, and these children are not communists.'

However, Kadmon argues extensively that this process is pragmatic and leads to pragmatic accommodation when the *exactly*-implicature is canceled. This is shown in (21b). Up to the end of the second sentence of the discourse (21b) there is an implicature that John has exactly three children, and this implicature has been used to provide the appropriate antecedent for the e-type pronoun in the second sentence. The implicature is canceled in the third sentence, which leads to a pragmatic re-interpretation of the antecedent of the original e-type pronoun in the second sentence: from *the children that John has* to, say, *the obedient children that John has*. Thus, Kadmon argues, while the e-type pronoun may use the exactly implicatures in context to construct the most plausible antecedent, **the e-type pronoun does not semanticize the exactly implicatures**: when the implicature is canceled, the e-type pronoun accommodates pragmatically to a different interpretation (rather than making the sentence infelicitous).

Japanese e-type pronouns do not differ in this respect (as in 21c), but the internally headed relative clauses do. If the internal head is a numerical phrase like *sanko-no ringo-o 'three apples'* it has an **exactly meaning**, rather than an exactly implicature: [22] is felt to be self-contradictory (Akira Watanabe p.c.):

[22] John-ga [Mary-ga sanko-no ringo-o muitekureta]-no-o tabeta.
John-Nom Mary-Nom three apple-Acc peeled-NM-Acc ate
#Atode, Bill-wa sono nokori-no ringo-o tabeta.
afterwards, Bill-Top the remainder-Gen apple-Acc ate
'Mary peeled three apples. John ate them. #After that, Bill ate the rest of the apples that Mary peeled'

In this respect the internal head patterns completely with the interpretation of numericals inside definite DPs, which, as argued in Landman 2004, have an exactly meaning, rather than an exactly implicature:

[23] The three children that John has are communists. #But he has two more children who are not communists.

This is unexpected on Hoshi and Shimoyama's account: inside the CP, the internal head in is argument position, where it receives an *at least*-interpretation with an *exactly*-implicature (as argued by Kadmon 1990). But as the internal head, it ends up having an *exactly*-meaning. It is not at all clear, on the e-type strategy how that could come about, because, as we have seen e-type pronouns do not semanticize the exactly effect, not in English, and not in Japanese.

Problem three: island sensitivity.

The relation between an e-type pronoun and its antecedent is not sensitive to syntactic island-boundaries. This almost goes without saying for a relation that is pragmatic, contextual, discourse based.

[24] a. John knows [$_{DP}$ a shepherd [$_{CP}$ who owns **three sheep**]]; *they* are fed by a servant.

b. Jon-wa hitsuji-o san-tou katteiru hitujikai-o shitteiru.
John-top sheep-acc 3-cl keep shepherd-acc know
'John knows a shepherd who owns three sheep.'
Sore-ni-wa meshitsukai-ga esa-o yatteiru.
that-dat-top servant-nom food-acc give
'The servant feeds them.'

c. John has **three sheep**. [$_{DP}$ The servant [$_{CP}$ who feeds *them*]] is now on holiday.

d. Jon-wa hitsuji-o san-tou katteiru.
John-top sheep-acc 3-cl-KA keep
'John has three sheep.'
Sore-ni yesa-o yaru meshitsukai-wa kyoo-wa yasumi-da.
that-dat food-acc give servant-top today-top holiday-cop
'The servant who feeds them is on holiday today.'

For the internally-headed relative clauses, Watanabe 2002 shows that the internal DP-head may not be contained in an island, in particular, not inside a relative construction itself (in contrast to the discourse antecedent in [24a]). In [25a] the internal head is inside an externally-headed relative, in [25b] it is inside an internally-headed relative. In both cases the examples are infelicitous. For perspicuousness we put the external/internal head **of the island** in italics, and the purported embedded internal DP head in boldface:

[25] a. *[John-ga [**subarashii ronbun**-o kaita *hito*]-o homete-ita –no]-ga
John-Nom excellent paper-Acc wrote person-Acc praised-had-C^{o}-Nom
shuppan-sareta.
publish-Pass
'The excellent paper which John had praised the person who wrote (it) was published.'

b. *[John ga [*MIT-no gakusei-ga* **subarashii ronbun**-o kaita- no]-o
John-Nom MIT-Gen student-Nom excellent paper-Acc wrote-C^{o}-Acc
posuto-docu-toshite saiyoushite-ita-no]-no shuppan-ga okureta.
post -doc -as adopted-had- C^{o}-Gen publish-Nom was-delayed]
'Publication of the excellent paper which John had hired as post-doc an MIT student who wrote (it) was delayed.'

Comparable data from internally-headed relative clauses in Quechua and Navajo may be found in Cole (1987) and Platero (1974) respectively.

These data are striking because, not only because they are completely unexpected on an e-type pronoun account, but also because they actually provide **strong** evidence that the Japanese internally-headed relative clause construction is, after all, a relative clause construction, involving a variable and an abstraction operator. After all, if there is evidence that subjacency is violated, there ought to be something, one would think, that does the violating. Syntactically, the thing that does the violating is a chain. Semantically, the chain corresponds to a variable-abstractor relation, which gives us a relative clause.

The earlier literature has a number of proposals on how to deal with the kind of dependency found in Japanese and comparable languages, and with its sensitivity to Subjacency. In particular, Watanabe (1992) proposes that a 'null operator' originating in the Specifier of the internal head undergoes cyclic movement to the relative's Specifier, an operation that is typically Subjacency-sensitive in numerous other languages. A somewhat different approach based on long-distance checking of (un-interpretable) features on the internal head is made in Watanabe (2002). Watanabe does not present a semantics, and for our semantic purposes a syntactic analysis closer to Watanabe (1992) is easier to work with.

Diagnosis.

We have discussed several problems with the e-type analyses of internally headed relatives of Hoshi and Shimoyama. These problems, we think, point in the same direction. The e-type pronoun mechanism involves the selection of a set uniquely or maximally satisfying a certain property. But, as Kadmon 1990 argues, in e-type pronouns, this property is selected pragmatically: the selection of the relevant property is mediated by things like contextual salience and pragmatic implicatures. We think that Hoshi and Shimoyama's e-type approach was on the right track: involved is indeed a mechanism for selecting a set maximally satisfying a certain property. But what the problems discussed here show is that **in the case of internally headed relative clauses, this property is not pragmatically selected, but semantically constructed, constructed by the grammar.**

In the next sections we will formalize this idea for simple cases like [5]; extend the analysis to complex cases like [9]; and illustrate both.

4. The analysis

We assume as semantic background a neo-Davidsonian theory of events and plurality, as in Landman 2000, 2004, with the following central types:
-d is the type of singular and plural individuals.
-e is the type of singular and plural of events.
-<e,d> is the type of roles like Agent, Theme, but also prepositions like WITH, FROM,…
-<e,t> is the type of sets of events, event types.
When all arguments are connected with the verb, the type of the interpretation derived by the grammar is assumed to be <e,t>. Adjunct modifiers like prepositional phrases and adverbs are semantically functions from type <e,t> into type <e,t>.
-At the IP-level default existential closure takes place over the event argument, deriving from event type α an interpretation of type t: $\exists e[\alpha(e)]$.
-Relativization-abstraction over an individual variable of type d at the CP-level, will create an abstract $\lambda x. \exists e[\alpha(e)]$ of type <d,t>, a predicate of individuals.

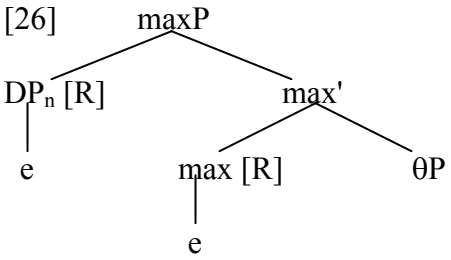
The theory of plurality assumes that the relevant semantic domains are complete atomic Boolean algebras ordered by part-of operation $\sqsubseteq$ and sum operation $\sqcup$. The central notions here are:
-Pluralization as closure under sum: $*P = \{x: \text{for some } X \subseteq P: x = \sqcup X\}$
-Definiteness as maximalization: $\sigma(P) = \sqcup P$ if $\sqcup P \in P$; undefined otherwise.
-Cardinality as counting atomic parts: $|x| = |\{a \in ATOM: a \sqsubseteq x\}|$
-$(a - b)$ as the relative complement of b in a, the maximal part of a such that $(a - b) \sqcup b = a$.

We come to our proposal. As expressed above, at some point of the derivation the arguments of the verb are in. At this point the interpretation of the phrase is of type <e,t>. Depending on your theoretical orientation you may think of this level as IP, or with an internal subject hypothesis as vP, or θP. For our purposes it doesn't actually matter which you choose, so, let's call it θP.

What we assume is that the grammar of Japanese allows θPs to function as complements of a null functional head that we will call 'max.' If the resulting maxP ends up contained within a CP with a suffixed *-no*, a construal of this construction as an internally headed relative is possible, assuming a compatible larger context (for completeness, we note in passing that a CP with a suffixed *-no*, but lacking an internal maxP, is interpretable as a propositional complement of a verb; see Comrie 1998, example (34) and the ensuing text).

MaxP is thus 'sandwiched' between θP, the level at which the type <e,t,> is reached, and IP, the level at which the event variable undergoes Existential Closure. Its null head is indexed by a feature R. We assume that [Spec, maxP] includes a null DP, in effect, a 'null operator', which undergoes cyclic A-bar movement to the relative clause's [Spec, CP]. This null DP (also indexed by R as a result of Spec-Head agreement) introduces the semantic relativization variable.

[26]



Feature R is a semantic feature. R is freely chosen, with the semantic requirement that it must be a **role** that is defined on the event type which is the interpretation of θP. Thus, it can be the Agent role, or the Theme role if that role is defined on the event type, or a role introduced by an adjunct or a prepositional phrase. The semantics of maxP will make whatever fills this role in the event type θP the internal head of the relative clause.

Note that, since we let maxP syntactically realize a relativization gap as the foot of a cyclically constructed A-bar chain, the island effects observed under problem three of the last section will automatically follow. The other effects will follow from the semantics of max, to which we now turn.

Semantically, max[R] and DP$_n$ [R] are modifiers, functions from <e,t> into <e,t>. Their interpretations are specified as follows:

[27] Let E be a variable of type <e,t> and e a variable of type e, R a role of type <e,d>:

$DP_n[R] = \quad \lambda E \lambda e.E(e) \wedge R(e)=x_n$

$max[R] = \quad \lambda E \lambda e.E(e) \wedge R(e) = R(\sqcup E)$

This, in essence, is all there is to the theory.

We see that the language is able to introduce a syntactic/semantic null variable [$_{DPn[R]}$ e] but only in a context where it also introduces a maximalization operation. This is similar to what we assumed happens in degree relatives in Grosu and Landman 1998 (where we find a degree variable paired with an individual variable plus maximalization over the resulting ordered pairs). We still don't know why these two factors - a non-standardly introduced individual variable and maximalization - must go together in so many constructions and so many languages, nor do we know why maximalization is sometimes found in conjunction with variables that appear to be introduced in a standard manner, e.g., in free relatives and correlatives, but we accept the fact that relative clause constructions of various sorts whose semantics involves maximalization exist. In the context of Japanese internally-headed relatives, maximalization will account for the properties of the construction we discussed in the previous section.

5. Examples showing how the problems are resolved.

Example one: how the maximalization analysis works.

We will show how the semantics works by analyzing sentence [5] repeated here:

[5] Taro-wa [$_{DP}$[$_{CP}$Yoko-ga reezooko-ni [$_{DP}$ **kukkii-o** **hotondo**] irete-oita]-no]-o
Taro-Top *Yoko-Nom refrigerator-Loc* *cookie-Acc* ***most*** *put-Aux-NM-Acc*
paatii-ni motte itta.
party-to brought
'Yoko put most cookies in the refrigerator and Taro brought the cookies that Yoko put in the fridge to the party.'

We start with the θP:

[$_{θP}$ Yoko-ga reezooko-ni [$_{DP}$ **kukkii-o** **hotondo**] irete]
'Yoko put most cookies in the refrigerator'

For ease of analysis we will assign to *most cookies* the semantics of more than half of the cookies. The interpretation of the θP is:

$\lambda e.PUT(e) \wedge Ag(e)=Yoko \wedge *COOKIE(Th(e)) \wedge IN(e)=FRIDGE \wedge$
$|Th(e)| > |\sqcup(*COOKIE) - Th(e)|$

The set of events e of Yoko putting a sum of cookies in the fridge where the theme of e (the sum of cookies put in the fridge in e) is more than half of the sum of all the (contextually given) cookies.
We come to the maxP. We choose index x and variable x_n, we choose the role. We decide that *most cookies* is going to be the internal head, so we specify the role feature as: Th(eme):

$DP_n[Th] = \lambda E \lambda e.E(e) \wedge Th(e)=x_n$
$max[Th] = \lambda E \lambda e.E(e) \wedge Th(e) = Th(\sqcup E)$

max[Th] applies to the interpretation of the θP and we get:

$\lambda E \lambda e.E(e) \wedge Th(e) = Th(\sqcup E)$
$(\lambda e.PUT(e) \wedge Ag(e)=Yoko \wedge *COOKIE(Th(e)) \wedge IN(e)=FRIDGE \wedge$
$|Th(e)| > |\sqcup(*COOKIE) - Th(e)|)$
=
$\lambda e.PUT(e) \wedge Ag(e)=Yoko \wedge *COOKIE(Th(e)) \wedge IN(e)=FRIDGE \wedge$
$|Th(e)| > |\sqcup(*COOKIE) - Th(e)| \wedge$
$Th(e) = Th(\sqcup \lambda e.PUT(e) \wedge Ag(e)=Yoko \wedge *COOKIE(Th(e)) \wedge IN(e)=FRIDGE \wedge$
$|Th(e)| > |\sqcup(*COOKIE) - Th(e)|))$

Now, assuming that Yoko did put most cookies in the fridge, the sum of all the events of Yoko putting a sum of more than half of the cookies in the fridge, has as theme exactly the sum of **all** the cookies that Yoko put in the fridge.
So the event type after maximalization is:

$\lambda e.PUT(e) \wedge Ag(e)=Yoko \wedge *COOKIE(Th(e)) \wedge IN(e)=FRIDGE \wedge$
$|Th(e)| > |\sqcup(*COOKIE) - Th(e)| \wedge$
$Th(e) = \sqcup\{x \in COOKIE: \exists e[PUT(e) \wedge Ag(e)=Yoko \wedge Th(e)=x \wedge IN(e)=FRIDGE]\}$

Let us define some abbreviating notation:

$\lambda e.\ PUTinF(e,Yoko,x) =$
$\lambda e[PUT(e) \wedge Ag(e)=Yoko \wedge Th(e)=x \wedge IN(e)=FRIDGE]$

So we can write:

$\lambda e.\ PUT(e) \wedge Ag(e)=Yoko \wedge *COOKIE(Th(e)) \wedge IN(e)=FRIDGE \wedge$
$|Th(e)| > |\sqcup(*COOKIE) - Th(e)| \wedge$
$Th(e) = \sqcup\{x \in COOKIE: \exists e[PUTinF\ (e,Yoko,x)]\}$

The set of sums of events of Yoko putting cookies in the fridge, where the theme is more than half of the cookies and the theme is all the cookies Yoko puts in the fridge.

Let us assume for simplicity a context in which the cookies are put in the fridge only once, and indeed, Yoko does put most of the cookies in the fridge, the event type derived is a **singleton event type**:

$\lambda e.e = \sqcup(\lambda e.\ \exists x \in *COOKIE:\ PUTinF(e,Yoko,x))$

The set containing the sum of the events of Yoko putting cookies in the fridge.

This event type is input for $DP_n[Th]$:

$\lambda E \lambda e.E(e) \wedge Th(e)=x_n$
$(\lambda e.e = \sqcup(\lambda e.\ \exists x \in *COOKIE:\ PUTinF(e,Yoko,x)))$
=
$\lambda e.e = e = \sqcup(\lambda e.\ \exists x \in *COOKIE:\ PUTinF(e,Yoko,x))) \wedge Th(e)=x_n$

Next what happens is the following:
-At the IP-level existential closure takes place; we derive:
$\exists e[e = \sqcup(\lambda e.\ \exists x \in *COOKIE:\ PUTinF(e,Yoko,x))) \wedge Th(e)=x_n]$

-At the CP-level abstraction takes place over the variable x_n; we derive:
$\lambda x_n.\ \exists e[e = \sqcup(\lambda e.\ \exists x \in *COOKIE:\ PUTinF(e,Yoko,x))) \wedge Th(e)=x_n]$
-At the DP-level, the definiteness operation σ derives a DP-interpretation at type d:

$\sigma(\lambda x_n.\ \exists e[e = \sqcup(\lambda e.\ \exists x \in *COOKIE:\ PUTinF(e,Yoko,x))) \wedge Th(e)=x_n])$
= $\sigma(\lambda x.*COOKIE(x) \wedge \exists e[PUTinF(e,Yoko,x)])$

The sum of the cookies for which there is an event of Yoko putting them in the fridge, i.e. the sum of the cookies that Yoko put in the fridge.

[5], thus, expresses that Taro brought this sum to the party.

We see that we derive the correct interpretation. But note that the interpretation of the internally headed relative as the sum of the cookies that Yoko put in the fridge is derived **semantically**, not pragmatically through e-type pronouns.
This means that the interpretation procedure is not open for the pragmatic accommodation that the e-type pronoun interpretation is. This leads to our resolution of the first problem:

Example two: no accommodation for inappropriate antecedents

Look at [19], repeated below:

[19] *[[Honno **suunin-no insee-sika** doyoobi-no party-ni ikanakatta] -no] -ga
only a-few-Gen grad-student Saturday-Gen party-to do-Neg-Past NM-Nom
jitsuwa uchi-de term paper-o kaite ita.
in-fact home-at term paper-Acc writing was

Now, first, we must at this point modify the semantic analysis, since we need to deal with the fact that in this example the internal head is not upward entailing. This requires modifications of the semantics. The issue of maximalization for non-upward entailing expressions is discussed extensively in Landman 2000 and Landman 2004. For simplicity we will here just assume that when the internal head is not upward entailing, the interpretation of the max-phrase is not intersective (following, in essence, Landman 2004):

[28] $DP_n[R] = \lambda E \lambda e.\ R(e)=x_n$
$max[R] = \lambda E \lambda e.\ R(e) = R(\sqcup E)$

The role feature in [19] is set to the role that **suunin-no insee-sika** receives in the θP, say role Th. The semantics will now tell us that that the sum of events of *only few students being at the party* is not required to be **itself** a sum events of only few students being at the party, which is appropriate for a non-upward entailing head. Apart from that, the semantics is the same. The crux of maximalization is that the theme role of that sum event is **still going to be the sum of all the students that were at the party**. With that, we predict the clash expressed in [19]: if the students were at the party, they couldn't be sitting at home writing term papers. As we see, the clash is not pragmatic, but semantic, derived from maximalization. This means that it is not resolved by pragmatics, and the example is infelicitous.

Example three: *exactly*-readings instead of *exactly*-implicatures

We come to the exactly-effects in example [22], repeated here:

[22] John-ga [Mary-ga **sanko-no ringo-o** muitekureta]-no-o tabeta.
John-Nom Mary-Nom three apple-Acc peeled-NM-Acc ate
'Mary peeled three apples. John ate them.'

We start out with the θP:

Mary-ga **sanko-no ringo-o** muitekureta]
Mary peeled three apples

$\lambda e.PEEL(e) \wedge Ag(e)=Mary \wedge *APPLE(Th(e)) \wedge |Th(e)|=3$
The set of (sums) of events of peeling with agent Mary and theme a sum of three apples.

Once again, we set the role feature to Th and we apply max[Th]::

$\lambda E \lambda e.\ E(e) \wedge Th(e) = Th(\sqcup E)$
$(\lambda e.PEEL(e) \wedge Ag(e)=Mary \wedge *APPLE(Th(e)) \wedge |Th(e)|=3)$
=
$\lambda e.PEEL(e) \wedge Ag(e)=Mary \wedge *APPLE(Th(e)) \wedge |Th(e)|=3 \wedge$
$Th(e) = Th(\sqcup \lambda e.PEEL(e) \wedge Ag(e)=Mary \wedge *APPLE(Th(e)) \wedge |Th(e)|=3)$

The set of events of Mary peeling three apples whose theme is the sum of the themes of all the events of Mary peeling three apples. This set of events is empty if Mary peels more than three apples or less than three apples. If Mary peels exactly three apples, and she doesn't peel the same apples more than once, then again, this set of events is a singleton set: the set containing the sum of the events of Mary cutting apples, and this sum has a sum of three apples as theme:

$\lambda e.e=\sqcup(\lambda e.PEEL(e) \wedge Ag(e)=m \wedge APPLE(Th(e))) \wedge |Th(e)|=3$

We appy DP_n[Th] and get:

$\lambda e.e=\sqcup(\lambda e.PEEL(e) \wedge Ag(e)=m \wedge APPLE(Th(e))) \wedge |Th(e)|=3 \wedge Th(e)=x_n$

With existential closure, abstraction over x_n and definiteness, we derive for the DP:

$\sigma(\lambda x_n.\exists e[e=\sqcup(\lambda e.PEEL(e) \wedge Ag(e)=m \wedge APPLE(Th(e))) \wedge |Th(e)|=3 \wedge Th(e)=x_n])$
=
$\sigma(\lambda x.*APPLE(x) \wedge |x|=3 \wedge \exists e[PEEL(e) \wedge Ag(e)=Mary \wedge Th(e)=x)$
'The three apples that Mary peeled'.

The effect is derived by maximalization and definiteness: σ requires the predicate it applies to not to be empty. This requires the above event type to be non-empty, and that means that it is the singleton set of the sum of events of Mary peeling apples, namely three. Thus maximalization has the effect of semanticizing the *exactly*-effect: the DP is the sum of the exactly three apples that Mary peeled, **not** of the at least three apples that Mary peeled. The prediction of the theory hence is that *sanko-no ringo-o 'three apples'* as the internal head of the relative clause means *exactly three apples*, and this, of course, is what we observe.

Example four: Stacking

Let us come back to example (12), which shows stacking.

[12] [John-ga [Mary-ga **nagai ronbum**-o kaita-no]-o yonda-no-ga]
John-Nom Mary-Nom long paper-Acc wrote-NM-Acc read-NM-Nom
LI-ni notta
LI-Loc appeared
'Mary wrote a long paper, John read it, and it appeared in *LI*.'

[12] involves two internally headed relatives. The most deeply embedded one is:

[Mary-ga **nagai ronbum**-o kaita-no]
Mary-Nom long paper-Acc wrote-NM-Acc

The role-feature is set to Agent, and we derive for the DP:

$\sigma(\lambda x.\text{LONG-PAPER}(x) \wedge \exists e[\text{WRITE}(e) \wedge \text{Ag}(e)=\text{Mary} \wedge \text{Th}(e)=x])$
The long paper that Mary wrote.

Let's abbreviate this as:

$\sigma(\lambda x.\text{LP}(x) \wedge \exists e[\text{WRITE}(e,M,x)])$

[12] [John-ga **[Mary-ga nagai ronbum-o kaita-no]-o** yonda-no-ga]
John-Nom Mary-Nom long paper-Acc wrote-NM-Acc read-NM-Nom
LI-ni notta
LI-Loc appeared
'Mary wrote a long paper, John read it, and it appeared in *LI*.'

In the higher internally headed relative **this very DP** is made the internal head. We have there as the interpretation of the θP:

$\lambda e.\text{READ}(e) \wedge \text{Ag}(e)=\text{John} \wedge \text{Th}(e)=\sigma(\lambda x.\text{LP}(x) \wedge \exists e[\text{WRITE}(e,M,x)])$

We set the role-feature to Theme, and derive as the interpretation of the higher DP:

σ(λx.∃e[READ(e) ∧ Ag(e)=John ∧ Th(e)=σ(λx.LP(x) ∧ ∃e[WRITE(e,M,x)]) ∧ Th(e)=x))
The object which is the theme of a reading event of John with the long paper that Mary wrote as theme.

This denotes the long paper that Mary wrote that John read, but also just the long paper that Mary wrote. That is, it is presupposed that Mary wrote one long paper. Thus indeed the sentence means: Mary wrote a long paper; John read it; and that paper was sent to *LI*.

A comment on problem three: island sensitivity

The semantics given here only deals with cases where the internal head occurs in a position where it is assigned a role in an event type, i.e. typically as an argument of a verb, or as the complement of a preposition adjoined to a verbal event type. If there are cases where the internal head can occur, say, inside a DP, we would need to extend the analysis (say, with maximalization at the NP level). However, we have not been able to find convinving felicitous cases which require this. In fact, Hoshi 1995 gives the following example (29) as infelicitous. Akira Watanabe p.c. confirms this judgement for this example and other similar ones.

[29] ??[John-ga [[*subarashii aburae-no* hyooban]-o kikituketa]no]-ga
John-nom magnificent oil.painting-gen rumor-acc heard C-nom
ima buzyututen-de tenzisareteiru sooda.
now art.exhibition-at is.displayed I-heard
'John heard a rumor *about a magnificant oilpainting*. I heard **it** is now displayed at an art-exhibition.'

6. Internal heads scopally dependent on quantifiers inside the relative clause.

We now come back to Shimoyama's [9]

[9] Wasaburo-wa [[dono gakusei-mo **peepaa-o** **3-bon** dasita]-no]-o
Wasaburo-Top[*every student term-paper-Acc 3-Cl turned-in*]-*NM-Acc*
itiniti-de yonda.
one-day-in read
'Every student turned in three term papers and Wasaburo read them (= all the papers that all the students turned in) in one day.'

Note that, while Shimoyama mentions [9], neither she nor Hoshi, nor as far as we are aware anybody else presents an analysis of this case.

We want to start by pointing out that the reading that Shimoyama points out is quite unlike what you find in the domain of relative clauses in other languages. For instance, as is well-known we do have 'under-quantification'-effects in English relative clauses, it's called functional readings. And there are several things you can express with functional readings:

[30] a. The two delegates that every district elected were its two richest inhabitants
b. The two delegates that every district elected were female.
c. The two delegates that every district elected met before the opening of parliament.

Thus, you can express with relative clauses with functional readings that every district elected its two richest inhabitants (identity of functions) [30a]; you can express that every district elected two delegates and each of them was female (distributive property distributing of the value of the function) [30b]; you can express that every district's two candidates met (collective property of the value of the function) [30c]. But what you cannot do with functional readings is collect all those values together:

[31] The two delegates that every district elected gathered in Parliament Hall for the opening ceremony.

It is very difficult, up to impossible to get for (31) the interpretation where it describes one gathering of the members of Parliament in the Hall. Rather what you get is a reading similar to [30c], which is funny, because gather is not a very natural property of groups of two.
In fact, we can stress the point by looking at [32]:

[32] #The one delegate that every district elected gathered in Parliament Hall for the opening ceremony.

This is completely out, since *gather* is not a property of singular individuals

However, the reading impossible in English in [31] is exactly what we can get for Japanese internally headed relatives as in [33] (Watanabe p.c.), and, as Akira Watanabe p.c. points out, the internally headed relative in [34] corresponding to the English infelicitous [32] is also fine in Japanese.

[33] [Dono toshi-mo futari-no daigiin-o senshutushita-no]-ga
which city-MO 2.cl-link delegate-acc elected-NM-nom
Kokkai-Gijidou-ni atumatta.
Parliament-Hall-loc gathered
'Every city elected two delegates. They gathered in Parliament-Hall.'

[34] [Dono toshi-mo daigiin-o hitori-zutu senshutushita-no]-ga
which city-MO delegate-acc one.cl-each elected-NM-nom
Kokkai-Gijidou-ni atumatta.
'Every city elected one delegate. They gathered in Parliament-Hall'

We come to example [9]:

[9] Wasaburo-wa [[dono gakusei-mo **peepaa-o** **3-bon** dasita]-no]-o
Wasaburo-Top[*every student* *term-paper-Acc 3-Cl* *turned-in*]-*NM-Acc*
itiniti-de yonda.
one-day-in *read*
'Every student turned in three term papers and Wasaburo read them (= all the papers that all the students turned in) in one day.'

We will follow the derivation of [9] and specify the semantics along the way.
First we assume that on the reading in question, the scope mechanism applies to the DP *dono gakusei-mo 'every student'*, its meaning is stored and will be retrieved later, after event-existential closure (see Landman 2000). The internal head is *peepaa-o 3-bon*, hence the role-feature is set to the theme role. This means that we derive as the interpretation after max[Th] and DP_n[Th] have been applied:

$\lambda e.\text{TURN-IN}(e) \wedge \text{Ag}(e)=a_k \wedge \text{PAPER}(\text{Th}(e)) \wedge |\text{Th}(e)|=3 \wedge \text{Th}(e) = x_n \wedge$
$\text{Th}(e) = \sqcup(\lambda e.\text{TURN-IN}(e) \wedge \text{Ag}(e)=a_k \wedge \text{PAPER}(\text{Th}(e)) \wedge |\text{Th}(e)|=3)$
STORE: $<a_k, \lambda P.\text{EVERY}[\text{STUDENT},P]>$
where EVERY[STUDENT,P] is equivalent to $\forall z[\text{STUDENT}(z) \rightarrow P(z)]$

Next existential closure takes place:
$\exists e[\text{TURN-IN}(e) \wedge \text{Ag}(e)=a_k \wedge \text{PAPER}(\text{Th}(e)) \wedge |\text{Th}(e)|=3 \wedge \text{Th}(e) = x_n \wedge$
$\text{Th}(e) = \sqcup(\lambda e.\text{TURN-IN}(e) \wedge \text{Ag}(e)=a_k \wedge \text{PAPER}(\text{Th}(e)) \wedge |\text{Th}(e)|=3)\ ]$
STORE: $<a_k, \lambda P.\text{EVERY}[\text{STUDENT},P]>$

Now, we will assume that for the interpretation we are after, quantifying-in will take place **after** relativization-abstraction. Thus, next we abstract over the relativization variable x_n::

$\lambda x_n \exists e[\text{TURN-IN}(e) \wedge \text{Ag}(e)=a_k \wedge \text{PAPER}(\text{Th}(e)) \wedge |\text{Th}(e)|=3 \wedge \text{Th}(e) = x_n \wedge$
$\text{Th}(e) = \sqcup(\lambda e.\text{TURN-IN}(e) \wedge \text{Ag}(e)=a_k \wedge \text{PAPER}(\text{Th}(e))) \wedge |\text{Th}(e)|=3)\ ]$
STORE: $<a_k, \lambda P.\text{EVERY}[\text{STUDENT},P]>$

This is equivalent to:

$\lambda x.x = \sqcup(\lambda y.\text{PAPER}(y) \wedge \exists e[\text{T-I}(e) \wedge \text{Ag}(e)=a_k \wedge \text{Th}(e)=y])) \wedge |x|=3$ type <d,t>.
STORE: $<a_k, \lambda P.\text{EVERY}[\text{STUDENT},P]>$

-Let us call the meaning of type <d,t> derived so far **β**,
and let us call the stored element $\mathbf{<a_k, \alpha>}$.

So far we have derived as interpretation:

β: per assignment to a_k: the singleton set containing the sum of papers (three) that a_k turned in.

$\mathbf{<a_k, \alpha>}$**:** we have stored under a_k the generalized quantifier *every student*.

The quantifying-in operation that we will define is complex, and we will break it down into composing operations.
First, it involves, as usual, abstraction over variable a_k in β. The spectific abstraction operation we assume stays at the type <d,t>, in the following way:

[35] abstract$_k$(β)

abstract$_k$(β) = λa_k.[σ(β)≠ ⊥] of type <d,t>

-σ(β) is, per assignment to a_k the sum of three papers that a_k turned in (when defined).
- σ(β)≠ ⊥ - σ(β) is not undefined - expresses that the sum of three papers that a_k turned in is not undefined, i.e, it expresses that a_k turned in exactly three papers.
- λa_k.[σ(β)≠ ⊥] is the set of individuals that turned in exactly three papers:

abstract$_k$(β) = λz.|⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3
the set of individuals that turned in exactly three papers

We are involved in defining a quantifying-in operation. In standard quantifying-in this involves just giving the stored quantifier wide scope. This is **not** what happens in this case: the scope taking quantifier will be a **distributive operator** (i.e. a universal quantifier), and the stored noun phrase meaning will enter into **defining the domain of the distributive operator**.

To understand what we are going to do here, it is best to keep the parallel with e-type pronouns in mind. Look at [36]:

[36] a. Some students
b. Three students
turned in three papers. Wasaburo read **them**.
c. Most students
d. All students

The antecedent sentence provides in each of the cases in [36] out of the blue (ignoring e-type pragmatics) a set of papers, which in each of the cases a-d can be described **in the very same way**, namely as:

> The set of sums of three papers each of which was turned in by **a student who turned in three papers.**

This means – and this is the central e-type insight – that, **regardless of the determiner**, the relevant **domain** to be constructed is:

> The set of all students that turned in three papers.

From this set, the relevant set of papers that Wasaburo read can be constructed.

This means, then, that for every determiner DET, from the relative clause:

DET students turned in three papers

we construct the set:

The students that turned in three papers.

But, of course, the meaning of the determiner must play its role too, the sentences in (36a-e) do not all have the same meaning. Though semantically the same set is constructed, **what this set is** obviously varies with what the relative clause expresses, and hence with the meaning of the determiner. The way we will encode this here is that this part of the meaning is encoded **presuppositionally** in the construction of the set expressions. Informally:

From relative clause

DET students turned in three papers

we let the grammar derive an expression α such that:

α denotes *the students that turned in three papers* if DET students turned in three papers, and α is undefined otherwise.

This means in essence that the cases in (36) are analyzed as in (37):

[37] Wasaburo read all papers turned in by students that turned in three papers
a. presupposing that **some** students turned in three papers.
b. presupposing that **three** students turned in three papers.
c. presupposing that **most** students turned in three papers.
d. presupposing that **all** students turned in three papers.

We now formalize this idea, by defining the relevant domain of the distributive quantifier:

[38] domain[α,abstract$_k$(β)]

We define this notion by successively defining the following notions:

a. **proposition**[α,**abstract$_k$**(β)]
b. **noun**[α]
c. **property**[α, **abstract$_k$**(β)]
d. **domain[α,abstract$_k$(β)]**

a. **proposition**(α, **abstract$_k$(β)**) = α(**abstract$_k$**(β)) of type t

proposition(α, **abstract$_k$(β)**) =
EVERY[STUDENT, λz.|⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3]
Every student turned in exactly three papers

b. Let α = (DET(NOUN)).
noun[α] = NOUN
The operation **noun** extracts from the generalized quantifier meaning the meaning of the noun that it is based on.

In the case of our example *every student* this is simple:

noun(*every student*) = ∩(*every student*) = STUDENT

In other cases (in particular downward entailing noun phrases) such an operation is complex, or even impossible (see Landman ms. for discussion). That is hardly a problem in this particular case, because cases dependent on a downward entailing noun phrase are, according to our informants, degraded.

c. **property**(α, **abstract$_k$(β)**) = **noun**[α] ∩ **abstract$_k$(β)**

property(α, **abstract$_k$(β)**) =
λz.STUDENT(z) ∧ |⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3]
The set of students who turned in exactly three papers

d. **domain[α,abstract$_k$(β)]**

$$\textbf{Domain}(\alpha, \textbf{abstract}_k(\beta)) = \begin{cases} \textbf{Property}(\alpha, \textbf{abstract}_k(\beta)) & \text{if } \textbf{Proposition}(\alpha, \textbf{abstract}_k(\beta)) \\ \text{undefined otherwise} & \end{cases}$$

In our example, this means that the domain of the distributive quantifier is, when defined, the set of students who turned in exactly three papers. But this domain is only defined if every student turned in exactly three papers. This means that the quantification over this domain will **presuppose** that the content of the relative clause, *every student turned in exactly three papers* is true.

Had the stored noun phrase interpretation been, say, *some students*, then the domain of quantification would **also** have been the set of students who turned in exactly three papers. But in that case the defining condition would have been that some students turned in exactly three papers, and the quantification over that domain would presuppose only that *some students turned in exactly three papers*.

Thus we have:

domain[α,**abstract**$_k$**(**β**)]** =

λz.STUDENT(z) ∧ |⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3]

The set of students who turned in exactly three papers

Presupposition:

EVERY[STUDENT, λz.|⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3]

Every student turned in exactly three papers

Next we put all this together in the quantifying-in operation:

[39] quantify-in[<a_k,α>,β>

quantify-in[<a_k,α>,β> = *∩λP.∀z ∈ **domain**[α,**abstract**$_k$[β]]: P(σ(**abstract**$_k$[β](z)))

-σ(**abstract**$_k$[β](z)) = the sum of exactly three papers that z handed in, if there is such a set.
domain[α,**abstract**$_k$[β]] = the set of students who turned in exactly three papers, presupposing that every student turned in eactly three papers.

-The generalized quantifier λP.∀z∈**domain**[α,**abstract**$_k$[β]]: P(σ(**abstract**$_k$[β](z)))
denotes the set of all sets P such that for every student who turned in exactly three papers, the sum of the three papers that that student turned in is in P, presupposing that every student turned in exactly three papers.

-The intersection ∩(λP.∀z ∈ **domain**[α, **abstract**$_k$[β]]: P(σ(**abstract**$_k$[β] (z)))) containts precisely, for each student that turned in exactly three papers, the sum of the three papers that that student turned in, presupposing again that every student turned in three papers.

∩(λP.∀z ∈ **domain**[α, **abstract**$_k$[β]]: P(σ(**abstract**$_k$[β] (z)))) =

{ ⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y]):

STUDENT(z) ∧ |⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3 }

The set of sums of papers that z turned in, for each student z that turned in exactly three papers.

Presupposition:

EVERY[STUDENT, λz.|⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3]

Every student turned in exactly three papers

-Quantify-in, finally, gives us the closure under sum of this set:

*∩(λP.∀z ∈ **domain**[α, **abstract**$_k$[β]]: P(**abstract**$_k$[β] (z)))) =

*{ ⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y]):

STUDENT(z) ∧ |⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3 }

The closure under sum of the set of sums of papers that z turned in, for each student z that turned in exactly three papers.

Presupposition:

EVERY[STUDENT, λz.|⊔(λy.PAPER(y) ∧ ∃e[T-I(e) ∧ Ag(e)=z ∧ Th(e)=y])|=3]

Every student turned in exactly three papers

This is the interpretation derived at the CP level. Note that it is, as it should be, of type <d,t>. Next, inplicit definiteness applies at the DP level and we get as the interpretation of the full noun phrase:

$\sigma(*\cap(\ \lambda P.\forall z \in$ **domain**$[\alpha,$ **abstract**$_k[\beta]]$: $P(\sigma($**abstract**$_k[\beta]\ (z)))))$ =

$\sigma(*\{\ \sqcup(\lambda y.PAPER(y) \wedge \exists e[T\text{-}I(e) \wedge Ag(e)=z \wedge Th(e)=y]):$

$STUDENT(z) \wedge |\sqcup(\lambda y.PAPER(y) \wedge \exists e[T\text{-}I(e) \wedge Ag(e)=z \wedge Th(e)=y])|=3\ \})$

The sum of the set of sums of papers that z turned in, for each student z that turned in exactly three papers.

Presupposition:

$EVERY[STUDENT, \lambda z.|\sqcup(\lambda y.PAPER(y) \wedge \exists e[T\text{-}I(e) \wedge Ag(e)=z \wedge Th(e)=y])|=3\ ]$

Every student turned in exactly three papers

This is:

$\sqcup\{\ \sqcup(\lambda y.PAPER(y) \wedge \exists e[T\text{-}I(e) \wedge Ag(e)=z \wedge Th(e)=y]):$

$STUDENT(z) \wedge |\sqcup(\lambda y.PAPER(y) \wedge \exists e[T\text{-}I(e) \wedge Ag(e)=z \wedge Th(e)=y])|=3\ \})$

The sum of the set of sums of papers that z turned in, for each student z that turned in exactly three papers.

Presupposition:

$EVERY[STUDENT, \lambda z.|\sqcup(\lambda y.PAPER(y) \wedge \exists e[T\text{-}I(e) \wedge Ag(e)=z \wedge Th(e)=y])|=3\ ]$

Every student turned in exactly three papers

We repeat example [9]:

[9] Wasaburo-wa [[dono gakusei-mo **peepaa-o** **3-bon** dasita]-no]-o
Wasaburo-Top[*every student* *term-paper-Acc 3-Cl* *turned-in*]-*NM-Acc*
itiniti-de yonda.
one-day-in *read*
'Every student turned in three term papers and Wasaburo read them (= all the papers that all the students turned in) in one day.'

On our analysis, [9] presupposes that every student turned in three term papers, and [9] expresses that if we sum together, for all the students, the three papers that each of them turned in, we get what Wasaburo read in a day.

Changing the determiner in the quantifier *dono gakusei-mo/every student* to will change the presupposition, but not the content: thus, if we change *every student* to *two students*, the sentence will presuppose that two students turned in exactly three papers, and the sentence will express that Wasaburo read all the papers that every student who wrote exactly three papers turned in (i.e. the papers that those two students wrote). And this seems to be correct.

This concludes our analysis of the complex case in [9]. Admittedly, it is not a simple analysis. There are some good reasons why this is so.

In the first place, we think – as already noted in the conclusion to section 3 – that in an important sense Hoshi's and Shimoyama's analyses were on the right track: there are very strong parallels between what goes on in e-type pronouns and Japanese internally-

headed relative clauses. The parallels extend in fact to grabbing-together interpretations: these are also possible with discourse anaphora in English, as in [40]:

[40] {Every, two, most} student turned in three term papers, and Wasaburo read *them* in one day.

The relevant reading of [40] (and many more cases) have been analyzed for discourse anaphora in Krifka (1996), using parametrized sum individuals. As far as complexity is concerned, one cannot really claim that Krifka's analysis of the relevant e-type pronoun case is really simpler than what we have done here. Thus a first reason for complexity is that grabbing-together is already complex for e-type pronouns. We cannot expect grabbing-together for relative clauses to be simpler than that.

But, as we have argued, the phenomenon in Japanese internally-head relative clauses is parallel, but not identical to e-type pronouns. (The phenomenon is, by the way, not restricted to Japanese, we find the construction in Korean as well and the facts seem to be analogous (Soyoung-Yun Roger p.c.).) What seems to be the case is that a process that relies on pragmatic-discourse operations in some languages and/or in some constructions (i.e. discourse anaphora) **is part of the derivational grammar** of relative clauses in this case.

This means first of all that, what Kadmon 1990 calls the 'maximal set determined by the antecendent' in discourse anaphora needs to be constructed by the semantics. In the simple cases this is done by **max** inside the relative clause. In the quantificationally dependent cases like [9] this is not enough. There we need to construct this 'maximal set' with the **domain-construction** operation.

To make the point we're after the other way round: while what above we called the (presuppositional) domain of the distributive quantifier is in essence freely contextually determined in e-type pronouns (fixed by the pragmatics), this domain is fixed by the **semantics** in the case of relative clauses. That is, while, as Kadmon 1990 shows, what the actual set picked up by a discourse anaphor can be contextually and pragmatically varied, this is not so in relative clauses like [9]: [9] is about papers turned in by *students who turned in exactly three papers*, and that is **not** open for contextual negotiation in pragmatic domain selection. And this means that the content of the domain must be derived by the semantics.

The situation is not unique to this particular case. Landman ms. argues that the very same operation of semantic presuppositional domain construction is used also in relative clauses with functional readings and relative clauses with intensional readings (in particular the type discussed in Grose and Krifka 2008), and he argues that these cases are essentially similar, in that the relevant domain of quantification involved is semantically, rather than pragmatically determined.

7. Summary and conclusions

We have presented in this paper an explicit compositional semantic analysis of Japanese internally-headed relative clause constructions, both with respect to 'simple' cases and with respect to more complex 'collecting' or 'grab-together' cases. We have placed our discussions in the broader framework of a syntactico-semantic binary typology of internally-headed relatives, the internally NP-headed and DP-headed ones (Japanese belonging to the latter type), noting and accounting for accompanying constellations of distinguishing properties.

Our semantic analysis was contrasted with the far more pragmatic approach of two earlier writers, Hoshi and Shimoyama, who proposed to reduce – in part and in whole respectively – the interpretation of Japanese internally-headed relatives to the e-type strategy found in discourses. While there are undeniable similarities between the e-type strategy and the semantics of internally DP-headed relative constructions, we have discussed several differences which force a different analysis, in which the interpretational connections are encoded in the grammar

The semantics we provided not only replaces Hoshi's and Shimoyama's proposals, it also extends to an analysis of the grab-together cases, which these earlier writers did not provide. We hope that our analysis of the Japanese internally-headed relatives will be naturally extendable to the internally DP-headed relatives of other languages. To forestall possible misunderstandings, we do not maintain that the internally DP-headed relatives of all languages share all (interesting) properties, e.g., those of Japanese exhibit a pragmatic 'relevancy constraint' (Kuroda 1976), which is shared by the Korean counterparts (Soyoung-Yun Roger, p.c.), but has never, to our knowledge, been signaled in relation to Navajo or Quechua. We do, however, believe that internally DP-headed relatives share a core of semantic properties, and it is these properties we have attempted to capture in this paper.

REFERENCES

Basilico, David (1996). Head position and internally headed relative clauses. *Language* 72, 498-532.

Bonneau, José (1992). *The structure of internally headed relative clauses*. Doctoral dissertation, McGill University, Montreal.

Cole, Peter (1987). The structure of internally headed relative clauses. *Natural Language and Linguistic Theory* 5, 277-302.

Cooper, Robin (1984). *Quantification and Syntactic Theory*. Kluwer, Dordrecht.

Grosu, Alexander and Manfred Krifka, 2008, '*The gifted mathematician that you claim to be:*Equational intensional 'reconstruction' relatives', in *Linguistics and Philosophy* 30.

Hoshi, Koji (1995) *Structural and interpretive aspects of Head-Internal and Head-External relative clauses*, PhD dissertation, University of Rochester.

Hoshi, Koji (1996) On the necessity of a 'Cooperian' treatment of e-type pronouns: Evidence from head-internal relative clauses in Japanese, *ESCOL* '95, Proceedings of the 12th Eastern States Conference on Linguistics, Dartmouth College, 1995, pp. 77-88.

Kadmon, Nirit (1990), Uniqueness. *Linguistics and Philosophy* 13, pp. 273-324.

Kuroda, Sige-Yuki (1976). Headless relative clauses in modern Japanese and the relevancy condition. *Proceedings of the Second Annual Meeting of the Berkeley Linguistic Society*, edited by H. Thompson *et al.*, 269-279. Berkeley: University of California.

Landman, Fred (2000). *Events and Plurality,* Kluwer, Dordrecht

Landman, Fred (2004), *Indefinites and the Type of Sets*, Blackwell, Oxford.

Landman, Fred, ms, 'Two-tier semantics for relative clause constructions,' ms. Tel Aviv University.

Munro, Pamela (1976). *Mojave syntax.* New York: Garland.

Platero, Paul R. (1974). The Navajo relative clause. *International Journal of American Linguistics* 40, 365-424.

Sells, Peter (1987), Restrictive and non-restrictive modification. Report, CSLI, Stanford.

Shimoyama, Junko (1999) Internally headed relative clauses in Japanese and e-type anaphora. *Journal of East Asian Linguistics* 8, 147-182.

Williamson, Janis (1987) An indefiniteness restriction for relative clauses in Lakhota. In: Eric Reuland and Alice ter Meulen (eds.), *The representation of (in)definiteness.* The MIT Press: Cambridge, Mass, 168-190.

Watanabe, Akira (1992). WH in situ, Subjacency and chain formation. *MIT occasional papers in linguistics* 2.

Watanabe, Akira (2002). Parametrization of Quantificational Determiners and Head-Internal Relatives. Paper presented at GLOW in Asia 2002, National Tsing Hua University, Taiwan.