Unifying Japanese relative clauses: copies in context

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Abstract: We offer a new, unified approach to the derivation and interpretation of head-external, head-internal, and heretofore understudied doubly-headed relative clauses in Japanese. Our proposal is motivated by new data on the interpretation of these different forms of relative clauses with quantificational heads, in different contexts. Head-internal and doubly-headed relative clauses are interpreted as definite descriptions with their quantificational head interpreted in their surface, relative-clause-internal positions. We show that the complex patterns of possible interpretations, as well as the shape of observed inter-speaker variation, are derived by interpreting definite descriptions using a maximal informativeness semantics and a simple assumption regarding the role of contextual information, which we call the *Salient Sets Restriction*.

Syntactically, we propose a novel DP head-raising derivation for relative clauses that takes advantage of the Copy Theory of movement and the late-merger of relative clauses. This allows for the unification of head-internal and doubly-headed relativization strategies with the familiar head-external form, which would otherwise not be possible. We believe this approach is suitable for head-raising relative clauses in other languages as well, including English. Our proposal avoids some complications of previous head-raising derivations, instead taking advantage of independently motivated mechanisms of copy-chain resolution at LF.

Keywords: Japanese, relativization, head-internal relative clause, doubly-headed relative clause, Copy Theory, maximal informativeness, Salient Sets Restriction

1. Introduction

Japanese is known for having a rich inventory of relative clause constructions (see e.g. Kuno 1973; Kuroda 1975–76; among many others). In this paper we focus on three of these, which we claim are derivationally related to one another. Two of these are among the most well studied in Japanese: the first is the head-external relative clause (HERC), in which the head noun appears *outside* the relative clause (1a) and the second is the head-internal relative clause (HIRC), in which the head noun appears *inside* the relative clause (1b). There is a third variety, which has received very little previous attention in the literature (see brief mentions in Inada 2009 and Tomioka 2012): this is what we will refer to as a *doubly-headed* relative clause (DHRC). In the DHRC in (1c), the head noun 'apples' appears both *inside* and *outside* the relative. Superficially, then, a DHRC appears to be a synthesis of both a head-internal and head-external relative. Heads of relative clauses will be italicized in examples throughout.

(1) **Three types of Japanese relatives and their head positions:**

a. + external, – internal (head-external):
Junya-wa [$_{\text{HERC}}$ [Ayaka-ga mui-ta] *ringo*]-o tabe-ta.
Junya-TOP Ayaka-NOM peel-PAST apple-ACC eat-PAST
'Junya ate the *apples* that Ayaka peeled.'

b. – external, + internal (head-internal):
Junya-wa [$_{\text{HIRC}}$ [Ayaka-ga *ringo*-o mui-ta] -no]-o tabe-ta.
Junya-TOP Ayaka-NOM apple-ACC peel-PAST -NO-ACC eat-PAST
literally 'Junya ate [that Ayaka peeled *apples*].'

c. + external, + internal (doubly-headed):
Junya-wa [$_{\text{DHRC}}$ [A.-ga *ringo*-o mui-ta] *sono-ringo*]-o tabe-ta.
Junya-TOP A.-NOM apple-ACC peel-PAST those-apples-ACC eat-PAST
literally 'Junya ate [*those apples* [that Ayaka peeled *apples*]].'

In this paper we offer a unified framework for the syntax and semantics of the three types of relative clauses exemplified in (1). Building on Itô's (1986) discussion of head-internal and head-external relatives, we propose that the internal and external head positions are related by

movement in the narrow syntax in all three relative clauses in (1), with differences in how these chains are pronounced at PF and interpreted at LF. We present a concrete implementation of this idea using the Copy Theory of movement and associated work on the interpretation of copy chains (Chomsky 1993, 1995; *inter alios*). We demonstrate that our core proposal is also a valuable revision to previous head-raising derivations for English head-external relative clauses.

In support of our proposal, in Section 2 we present two related pieces of novel empirical evidence. First, we discuss the semantics of HIRCs and HERCs with quantified heads. In particular, the interpretation of relative clauses with a proportional quantifier modifying the head exhibits an interesting dependence on the context of evaluation. Second, we shine a light for the first time on the semantics of DHRCs. We show how their interpretation patterns with those of their more familiar head-internal counterparts and provides support for our copy-theoretic analysis. Our proposal accounts for these interpretations and the systematic nature of their context-sensitivity, as well as differences between the interpretations of HIRCs and HERCs.

Our approach contrasts sharply with the influential proposal of Shimoyama (1999), which interprets Japanese head-internal relative clauses (HIRC) through E-type anaphora. Shimoyama shares with her predecessor Hoshi (1995) the intuition that HIRCs are interpreted as if they are independent clauses, with an anaphoric element similar to a cross-sentential anaphor interpreted in the HIRC's position. We can illustrate this approach explicitly through the Japanese paraphrase in (2) and its English translation:

(2) **A paraphrase for (1b) in the spirit of Hoshi (1995) and Shimoyama (1999):**

Ayaka-wa *ringo*-o mui-ta. Junya-wa *sore/sono-ringo*-o tabe-ta.
Ayaka-TOP apple-ACC peel-PAST Junya-TOP that/that-apple-ACC eat-PAST
'Ayaka peeled *apples*. Junya ate *them/those apples*.'
⇒ *them/those apples* = the apples that Ayaka peeled

The evidence we present in Section 2 shows that this E-type approach is in general untenable for both head-internal and doubly-headed relative clauses. When we consider the interpretation of

HIRCs and DHRCs with quantificational heads, we see that there are examples for which paraphrases using cross-sentential anaphora do not derive the correct interpretations.

Later we will also discuss the proposal of Grosu (2010) and Grosu & Landman (2012), who also argue against an E-type analysis on independent grounds. Our analysis shares with Grosu & Landman the idea that HIRCs are truly relative clauses that are interpreted as definite descriptions, but otherwise differs substantially. We will argue that our approach is superior both empirically and theoretically, with the new data we propose in Section 2 being problematic for the Grosu & Landman proposal, and our unified syntactic analysis being preferable from the point of view of theoretical parsimony.

Section 3 presents our syntactic proposal, and Section 4 discusses the semantic interpretation of the different types of relative clauses. There we will adopt a recent proposal to model definiteness as maximal informativeness (von Fintel, Fox, and Iatridou, 2014) and we introduce the *Salient Sets Restriction* which formalizes the effect of context in definite description evaluation, which will be crucial for the interpretation of HIRCs and DHRCs with quantificational heads. We show that the one main form of inter-speaker variation that we observe in the interpretation of Japanese relatives is easily explained by differences in the willingness of speakers to invoke the Salient Sets Restriction in our judgment tasks. We conclude in Section 5.

2. Three relatives and their interpretations

In this section we present new data that focus on the interpretive similarities and differences that cut across the three relative constructions in (1). In basic cases, all three relative clauses will yield the same extension, but systematic differences emerge depending on the context, and with the addition of quantifiers inside or outside the relative clause.[1]

[1] Various differences have been claimed to exist between HERCs and HIRCs—for discussion, see e.g. Itô (1986), Hoshi (1995), and Shimoyama (1999). Among these differences, perhaps most well known is the observation that HIRCs but not HERCs are sensitive to what has been called a *Relevancy Condition* following Kuroda (1976–77),

A few methodological points are in order. First, as we will see, the interpretation of these relative clauses will be sensitive to the organization of entities in the discourse context, and therefore their interpretations will be discussed in relation to explicit contexts. We consider first the straightforward context in (3). There are twelve apples; our friend Ayaka has peeled three and the others are unpeeled.

(3) **Context with three peeled apples and nine unpeeled apples:**

The second point concerns the source of our data. What we are interested in here is the extension of these different types of relative clauses in a context such as (3). The data we present will be entailment judgments that make this extension clear: which apples do we know to be eaten in this context, given a sentence such as those in (1) above? The results that we present here aggregate responses from over a dozen Japanese speakers who were consulted individually in person and/or completed a written survey that asked the participant to read test sentences in illustrated contexts such as (3) and to circle the apples that would be eaten, as well as those who responded to our earlier presentations of preliminary findings. In this section we present the dominant pattern of judgments; another, distinct pattern of judgments is discussed later in section 4.3.

The third point is a consideration related to the lack of definiteness marking in Japanese. Consider the head-external relative clause example from (1a), repeated below in (4). This example evaluated in context (3) does *not* entail that Junya ate all three of the apples that Ayaka peeled, but simply that Junya ate *some* of the apples that Ayaka peeled. The availability of such a

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which seems to place semantic-pragmatic constraints on what can be a HIRC head vis-à-vis properties of the surrounding relative clause and the matrix clause. See Nishigauchi (2004), Kim (2007, 2008), Grosu (2010), and citations therein for discussion. We will not discuss this Relevancy Condition in this paper, and instead concentrate on examples where corresponding HERCs, HIRCs, and DHRCs are all possible. Space limitations prevent us from discussing all the differences that have been reported between the types of relatives, but we believe that our basic proposal is in principle compatible with a full account of this range of phenomena.

non-maximal reading makes it difficult to identify the precise extension of the relative clause itself.

(4) **Basic head-external relative clause, repeated from (1a):**

Junya-wa [$_{\text{HERC}}$ [Ayaka-ga mui-ta] *ringo*]-o tabe-ta.
Junya-TOP Ayaka-NOM peel-PAST apple-ACC eat-PAST
'Junya ate (one/some of) the apples that Ayaka peeled.'

We can block such non-maximal readings by adding the quantifier *zenbu* 'all' outside of the nominal expression in question. The addition of *zenbu* in (5), for example, makes the sentence entail that all three of the peeled apples in (3) were eaten. We will use this manipulation in all of our examples here, to facilitate the identification of the nominals' full extensions.[2]

(5) **Basic head-external relative clause (1a) with external *zenbu* 'all':**

Junya-wa [$_{\text{HERC}}$ [Ayaka-ga mui-ta] *ringo*]-o zenbu tabe-ta.
Junya-TOP Ayaka-NOM peel-PAST apple-ACC all eat-PAST
'Junya ate all of the apples that Ayaka peeled.'
Evaluated in context (3): ⇒ Junya ate all three of the apples Ayaka peeled.

These manipulations—the addition of *zenbu* 'all' and an explicit context—now allow us to compare the extension of this head-external relative with its corresponding head-internal and doubly-headed relatives in (1b–c). In this basic case, all three relatives denote the same extension of the three apples that Ayaka peeled in (3):

[2] In the case of HIRCs, Hoshi (1995, p. 132) and Shimoyama (1999, p. 150) claim that only such maximal readings exist. The addition of *zenbu* 'all' to HIRCs is then predicted to be redundant and not affect their interpretation. In our experience, the addition of *zenbu* 'all' makes judgments of the extensions of these relative clauses clearer for some speakers.

(6) **Basic head-internal relative clause (1b) with external *zenbu* 'all':**

Junya-wa [$_{\text{HIRC}}$ [Ayaka-ga *ringo*-o mui-ta] -no]-o zenbu tabe-ta.
Junya-TOP Ayaka-NOM apple-ACC peel-PAST -NO-ACC all eat-PAST
Evaluated in context (3): ⇒ Junya ate all three of the apples Ayaka peeled.

(7) **Basic doubly-headed relative clause (1c) with external *zenbu* 'all':**

Junya-wa [$_{\text{DHRC}}$ [A.-ga *ringo*-o mui-ta] *sono-ringo*]-o zenbu tabe-ta.
Junya-TOP A.-NOM apple-ACC peel-PAST those-apples-ACC all eat-PAST
Evaluated in context (3): ⇒ Junya ate all three of the apples Ayaka peeled.

In this paper we introduce new data on the interpretation of relative clauses involving quantifiers. We begin by considering relatives whose head is modified by the proportional quantifier *hanbun* 'half.'[3]

First, consider the HIRC in (8).[4] This example is infelicitous in the simple context in (3) where three of twelve apples have been peeled. However, we will also introduce an additional context in (9). In (9), twelve apples are presented in two groups of six. Ayaka peeled three of the apples in the first group (the white apples); in the second group, all apples are unpeeled. Evaluated in this context, the HIRC in (8) denotes the six apples in the first group, half of which Ayaka has peeled.

[3] Similar structures using the proportional quantifier *hotondo* have been discussed in the literature, especially by Shimoyama (1999) who gives the translation 'most.' Grosu (2010, p. 263) notes that *hotondo* is better translated as 'nearly all' or 'an overwhelming majority of,' and we agree with this. We use *hanbun* 'half' here as its meaning is very clear and facilitates crisper judgments for our present purposes.

[4] There is another type of reading possible with these examples using the quantifier *hanbun* 'half'; this reading refers to some apples being (individually) "half-peeled," i.e. with half of each apple's skin having been peeled. We do not consider such readings here.

(8) **HIRC with quantifier *hanbun* 'half':**

Junya-wa [$_{\text{HIRC}}$ [Ayaka-ga *ringo*-o *hanbun* mui-ta] -no]-o zenbu tabe-ta.

Junya-TOP Ayaka-NOM apple-ACC half peel-PAST -NO-ACC all eat-PAST

literally 'Junya ate all of [that Ayaka peeled *half of the apples*].'

Evaluated in context with no grouping (3): *infelicitous*

Evaluated in context with two groups (8): ⇒ Junya ate the six apples in the first group.

(9) **Context with two groups of apples:**

Examples of this form are problematic for previous approaches to Japanese HIRCs. Proponents of the E-type analysis, Hoshi (1995) and Shimoyama (1999), draw an explicit parallel between the interpretation of HIRCs and cross-sentential anaphora, as illustrated above in example (2). Consider the cross-sentential paraphrase for example (8) in (10) below:

(10) **A cross-sentential paraphrase for the HIRC with 'half' (8) is unavailable:**

Ayaka-wa *ringo*-o *hanbun* mui-ta.

Ayaka-TOP apple-ACC half peel-PAST

Junya-wa *sore/sono-ringo*-o zenbu tabe-ta.

Junya-TOP those/those-apples-ACC all eat-PAST

'Ayaka peeled half of the apples. Junya ate all of them/those apples.'

Evaluated in context with no grouping (3): *infelicitous*

Evaluated in context with two groups (9):

- For some speakers: *infelicitous*
- For other speakers: two possible readings
  - i. ⇒ Junya ate the three peeled apples.
  - ii.$^{\%}$⇒ Junya ate the six apples in the first group.

Example (10) is judged as infelicitous by all speakers in the context with no grouping, in (3). For the context with two groups in (9), speakers split into two patterns of judgments. Some speakers report that the entire utterance in (10) is also judged as infelicitous in the context in (9),

commenting that the first sentence in (10) is false as Ayaka did not peel half of the apples in the context. For these speakers, the second sentence is therefore unable to identify a referent for the cross-sententential anaphor 'those' or 'those apples.' Other speakers report that (10) has two readings—Junya could eat the three peeled apples or all six apples in the first group—apparently accommodating that the first sentence is referring to the first group of apples. Note that for both patterns of judgments, the interpretation of the cross-sentential paraphrase in (10) differs from the interpretation of the HIRC in (8). This suggests that HIRCs are not interpreted using E-type anaphora, contra Hoshi (1995) and Shimoyama (1999). Data such as (8) are also problematic for the "quantificational disclosure" approach of Grosu (2010) and Grosu & Landman (2012), which we will discuss in Section 4.4.

Next we consider example (11), which includes the doubly-headed version of the relative clause in (8). The DHRC involves an external head with an obligatory deictic *sono*, which at first glance may suggest the explicit use of an E-type anaphor, as in Hoshi and Shimoyama's E-type analysis for HIRCs. However, the DHRC in (11) is felicitous in the context in (9), and furthermore has the same interpretation as the HIRC (8) in this context. It is similarly infelicitous in the context with no groupings, in (3).

(11) **DHRC with quantifier *hanbun* 'half':**

Junya-wa [$_{\text{DHRC}}$ [Ayaka-ga *ringo*-o *hanbun* mui-ta] *sono-ringo*]-o
Junya-TOP Ayaka-NOM apple-ACC half peel-PAST those-apples-ACC
zenbu tabe-ta.
all eat-PAST
literally 'Junya ate all of [*those apples* [that Ayaka peeled *half of the apples*]].'
Evaluated in context with no grouping (3): *infelicitous*
Evaluated in context with two groups (9): ⇒ Junya ate the six apples in the first group.

The HIRC and DHRC with the proportional quantifier *hanbun* 'half' have the same interpretation and, unlike HIRCs and DHRCs without quantifiers inside the relative as in (6–7) above, are not amenable to paraphrases using cross-sentential anaphora. Their felicitous

interpretation is also dependent upon a richer context such as (9), which includes salient groupings.

The extension picked out by these relative clauses in (8) and (11) is intuitively *the salient set of apples, half of which Ayaka peeled*. We propose this as an accurate and informative paraphrase for these relative clauses. In a similar fashion to this English paraphrase, the same interpretation can also be obtained through a Japanese HERC with the quantifier *hanbun* 'half' stranded *inside* the relative clause, as in (12).[5]

(12) **HERC with internally stranded quantifier *hanbun* 'half':**

Junya-wa [$_{\text{HERC}}$ [Ayaka-ga *hanbun* mui-ta] *ringo*]-o zenbu tabe-ta.
Junya-TOP Ayaka-NOM half peel-PAST apples-ACC all eat-PAST
'Junya ate all of [*the apples* [that Ayaka peeled *half of*]].'
Evaluated in context with no grouping (3): *infelicitous*
Evaluated in context with two groups (9): ⇒ Junya ate the six apples in the first group.

Thus when evaluated in contexts (3) and (9), the HIRC, DHRC, and HERC with internal stranding have the same extension with the proportional quantifier *hanbun* 'half.' This observation will inform our analysis in subsequent sections.

The examples that we constructed above all use the proportional quantifier *hanbun* 'half.' Next we will consider a simple numeral, here 'three.' The numeral 'three' takes a numeral classifier *tsu* here, with the numeral and classifier together realized as *mit-tsu*. The HIRC and DHRC with 'three' are in (13) and (14), respectively. We also give the HERC with 'three' stranded internally in (15), parallel to our example (12) above. We will discuss their interpretations below.

[5] Again, there is also a reading that refers to apples that are half-peeled, which is quite salient in (12), but we leave aside this reading here.

(13) **HIRC with numeral *mit-tsu* 'three-CL':**

Junya-wa [$_{HIRC}$ [Ayaka-ga *ringo*-o *mit-tsu* mui-ta] -no]-o zenbu tabe-ta.
Junya-TOP Ayaka-NOM apple-ACC three-CL peel-PAST -NO-ACC all eat-PAST
literally 'Junya ate all of [that Ayaka peeled *three apples*].'

(14) **DHRC with numeral *mit-tsu* 'three-CL':**

Junya-wa [$_{DHRC}$ [Ayaka-ga *ringo*-o *mit-tsu* mui-ta] *sono-ringo*]-o
Junya-TOP Ayaka-NOM apple-ACC three-CL peel-PAST those-apples-ACC
zenbu tabe-ta.
all eat-PAST
literally 'Junya ate all of [*those apples* [that Ayaka peeled *three apples*]].'

(15) **HERC with internally stranded numeral *mit-tsu* 'three-CL':**

Junya-wa [$_{HERC}$ [Ayaka-ga *mit-tsu* mui-ta] *ringo*]-o zenbu tabe-ta.
Junya-TOP Ayaka-NOM three-CL peel-PAST apple-ACC all eat-PAST
'Junya ate all of [the *apples* [that Ayaka peeled *three of*]].'

As with the corresponding HIRC and DHRC with *hanbun* 'half' above in (8) and (11) and the HERC with internally stranded *hanbun* 'half' in (12), the HIRC in (13) and DHRC in (14) and the HERC with internally stranded 'three' in (15) all have the same interpretive possibilities for any particular context. We'll again consider the context with no grouping and the context with two groups, repeated from above.

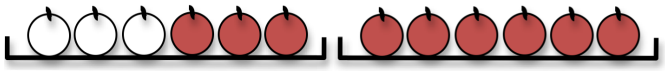
(16) **Interpretations of HIRC (13) and DHRC (14) with *mit-tsu* 'three-CL' and HERC with internally stranded *mit-tsu* 'three-CL' (15):**

a. Evaluated in context with no grouping, repeated from (3):

i. ⇒ Junya ate the three peeled apples.

ii. ⇒ Junya ate all twelve apples.

b. Evaluated in context with two groups, repeated from (9):



i. ⇒ Junya ate the three peeled apples.

ii. ⇒ Junya ate the six apples in the first group.

Examples (13), (14), and (15) are judged as felicitous in the context with no grouping (16a) and these relative clauses may refer to the three apples that Ayaka has peeled (16ai) or secondarily to all twelve apples (16aii). In the context with two groups in (16b), all three structures again have two possible readings: on one reading, the relative clause refers to the three apples that Ayaka peeled (16bi), just as in (16ai), and on the other reading, the relative clause denotes the salient set of six apples, three of which Ayaka peeled (16bii).

We again contrast the pattern of interpretation of the HIRC (13) and DHRC (14) in these contexts, illustrated in (16), with the interpretation of a cross-sentential paraphrase in (17). The utterance in (17) is felicitous in both the context without salient groupings and with groupings, and in either case the relative clause unambiguously refers to the three apples that Ayaka peeled. The context with two groups does not allow for the reading, available with the HIRC (13) and DHRC (14) in (16bii), that picks out the salient set of apples that Ayaka peeled three of.

(17) **Cross-sentential paraphrase for the HIRC (13) and DHRC (14) with 'three':**

Ayaka-wa *ringo*-o *mit-tsu* mui-ta.

Ayaka-TOP apple-ACC three-CL peel-PAST

Junya-wa *sore/sono-ringo*-o zenbu tabe-ta.

Junya-TOP those/those-apples-ACC all eat-PAST

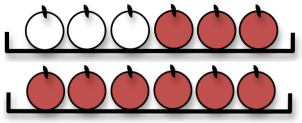
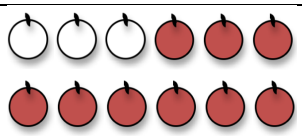
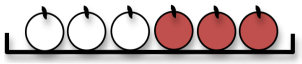
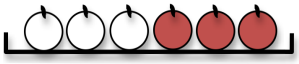
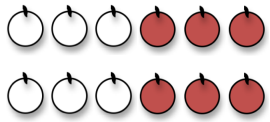
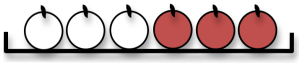
'Ayaka peeled three apples. Junya ate all of them/those apples.'

Evaluated in context with no grouping (3/15a): ⇒ Junya ate the three peeled apples.

Evaluated in context with two groups (9/15b): ⇒ Junya ate the three peeled apples.

Let us take stock of the patterns documented in this section. We summarize the different denotations of the different relative clause constructions as well as the corresponding cross-sentential anaphora, in the two contexts we consider, in the table in (18).

(18) **Summary of denotations in different contexts:**

Context:		
HIRC (8), DHRC (11), and HERC (12) with internal 'half':		#
HIRC (13), DHRC (14), and HERC (15) with internal 'three':	i.  ii. 	i.  ii. 
Cross-sentential anaphor for 'half' (10):	# -or- for some speakers: i.  ii. 	#
Cross-sentential anaphor for 'three' (17):		

The table in (18) collapses the interpretations of HIRCs, corresponding DHRCs, and corresponding HERCs with the numeral or quantifier stranded internally, as supported by the data presented in this section. The complex pattern of interpretation of the HIRC examples above is consistently mirrored by the interpretation of parallel DHRC constructions in the same contexts, the interpretation of which has never been described before.

One point that the table (18) highlights is the strong context-sensitivity of these judgments. In particular, the HIRCs and DHRCs with 'half' and 'three' are able to refer to the six apples on the left in the context with two group of apples, but not in the context without such groups.

Intuitively, the addition of salient sets allows for the first group of apples to be referenced, which satisfies the descriptions "λX . Ayaka peeled half of the apples in X" or "λX . Ayaka peeled three of the apples in X." It is these *salient set* readings that distinguish the behavior of the HIRC and DHRC from their corresponding paraphrases with cross-sentential anaphora. These readings presented here make clear that the interpretation of HIRCs and DHRCs with quantifiers cannot be straightforwardly explained by an E-type account as in Hoshi (1995) and Shimoyama (1999), which retrieve the denotation of the HIRC through an E-type anaphor akin to a cross-sentential anaphor.

In the remainder of this paper, we will present our account for these relative clause constructions in Japanese. In Section 3, we will present our syntactic account, which unifies the underlying syntax of HERCs, HIRCs, and DHRCs, using the Copy Theory of movement and related work on the interpretation of copy chains. In Section 4, we will then present our semantic analysis for these constructions, which offers a principled explanation for the patterns of readings presented in this section, including their context sensitivity. We discuss the E-type analysis and Grosu & Landman's alternative proposal at the end of Section 4.

3. A unified syntax for relativization

In this section we present our analysis of the structure of the three relative clause constructions under consideration. We propose that in each of these relatives there is movement in the narrow syntax of the head DP from a position within the relative clause CP to a position outside of it. Furthermore, we assume that this movement results in there being multiple *copies* of the head DP (cf. Chomsky 1993, 1995). Support for this proposal comes from the various systematic options that exist for the pronunciation and interpretation of these copies. If only the highest copy is pronounced, the result is a head-external relative, and if only the lowest copy is pronounced, what results is a head-internal relative. Crucially, it is also possible for both high and low copies to be pronounced, resulting in a doubly-headed relative. Yet another option is for the NP of only one of the copies to be pronounced, while the quantificational material is pronounced on the other copy. Importantly, the quantificational force of only one copy is interpreted, and the quantifier is interpreted in the position where it is pronounced.

We begin by reviewing in Section 3.1 how Chomsky's Copy Theory proposal has been refined to account for the semantic consequences of movement. In Section 3.2 we present a novel derivation for head-external relatives, involving head-raising of a DP. This derivation takes advantage of the Copy Theory and the idea from Lebeaux (1988, 1991) that relative clauses may be "Late Merged" into the structure. In Section 3.3, we then show how this proposal allows for a natural unification of the range of relative clause structures observed in Japanese. In Section 4, we will then present our account for the interpretation of these Japanese relative clauses.

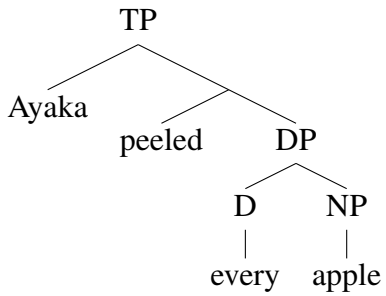
3.1. Background: Copy Theory and the interpretation of chains

We begin with a brief introduction to the Copy Theory of movement (Chomsky 1993, 1995). The Copy Theory of movement proposes that syntactic movement of X from position A to B results in two copies of X, one at A and one at B, rather than leaving a "trace" in position A as in earlier conceptions of movement. In most instances of movement, only one of the copies within a chain will be pronounced at PF. See Chomsky (1993, 1995), Sauerland (1998), and Fox (1999, 2002), among others, for various arguments for the Copy Theory of movement.

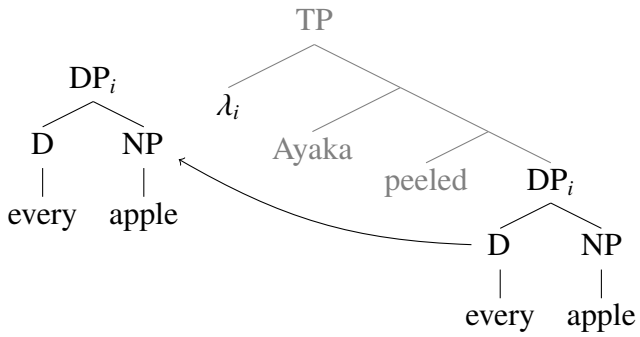
We can conceive of the process of movement more granularly as the result of two elementary operations, Copy and Merge (Chomsky 1995). Suppose we begin with the structure in (19a), which is a simple English TP clause. Details of the internal structure of TP are not illustrated here, as they are not relevant for our discussion. We will demonstrate the process of "moving" the DP *every apple* to a higher position. We first Copy the DP into the workspace in Step 1, resulting in two separate objects in the workspace, with root nodes labeled DP and TP. A corresponding λ-binder is adjoined to the TP at this point to bind the position of the original *every apple*; we will discuss its interpretation below. We then Merge this new root DP with the original TP in Step 2.

(19) **Movement as Copy and Merge:**

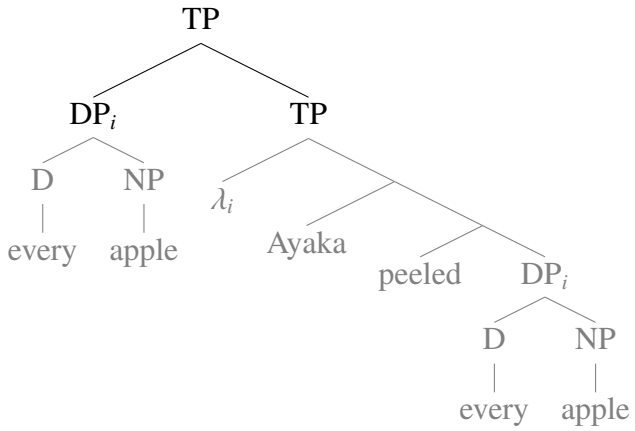
a. Step 0: Build TP



b. Step 1: Copy DP, adjoin corresponding λ-binder to TP



c. Step 2: Merge the new DP with TP



It has been hypothesized that quantificational DPs in object position are required to move in this way—to undergo Quantifier Raising (QR; May 1977, 1985)—for reasons of semantic interpretation. This movement is normally covert in English. Under the Copy Theory, the correct word order can be obtained by choosing to pronounce only the lower copy of movement at PF.

We now turn to the interpretation of the movement in (19). In considering how DP movement can be interpreted within a compositional semantics, we first review the standard approach in a framework with movement that does not leave copies. Such DP movement is hypothesized to leave a "trace" in the lower position of movement and this trace is interpreted as a variable of type *e*. Movement triggers λ-abstraction that binds the variable left behind. This is illustrated schematically in (20). The end result is that the quantifier *every* will scope higher while binding a variable in the object position of the verb. See e.g. Heim & Kratzer (1998) for further discussion of this widely-adopted approach.

(20) **Interpreting movement as in (19), without copies:**
LF: [every apple] λx . Ayaka peeled x

The question, then, is how to reconcile this basic semantics of movement with a theory of movement that leaves copies. Specifically, how is the lower copy to be interpreted? To address this question, Fox (2002) introduces a procedure called *Trace Conversion*, which converts the lower copy into a definite description (see also Rullmann & Beck 1998; Sauerland 1998; Fox 1999). For example, in (19), the lower copy of *every apple* will be interpreted as "the apple x," meaning the unique apple that is x, and the higher λ-binder will abstract over this value of x. The truth conditions of (21b) is identical to that of the non-copy-theoretic LF in (20).

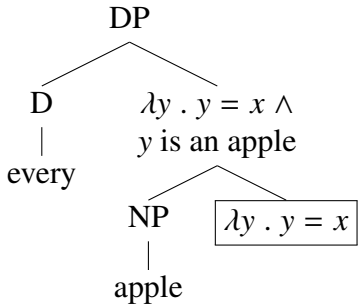
(21) **Interpreting movement (QR) with copies:**
a. Narrow syntax (19c): [every apple]$_i$ λ_i Ayaka peeled [every apple]$_i$
b. LF after Trace Conversion: [every apple] λx . Ayaka peeled [the apple x]

Fox (2002) presents Trace Conversion as the combination of two elementary operations. The first operation is Variable Insertion (22a): the original NP "apple" is modified intersectively by the predicate λy . $y = x$, resulting in the modified domain "the apples that are x," where x is a variable. The higher λ-binder λ_i is now interpreted as λx to abstract over this variable. The second operation is Determiner Replacement (22b), which replaces the quantifier of the lower copy—here, *every*—with the definite determiner THE. The end result is as in (21b), where the lower copy of movement is interpreted as a definite description variable that is abstracted over by the λ-

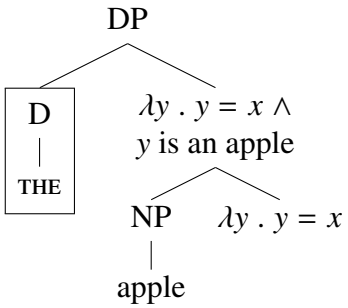
binder, whereas the highest copy will be interpreted with the quantificational force of the original determiner. If there are more than two copies in the chain, all lower copies can be converted in this fashion.

(22) **Trace Conversion of the lower copy, in detail:**

a. Step 1: Variable Insertion



b. Step 2: Determiner Replacement



The discussion thus far has illustrated how a quantifier such as *every* will be interpreted in the position of the highest copy of the DP. It is also possible for the quantifier in a lower copy position to be interpreted instead, resulting in lower quantificational scope, which is referred to as syntactic reconstruction. A common approach to syntactic reconstruction is to suppose that at LF the merger of the higher copy is "undone" or "ignored" (see Chomsky 1993; Hornstein 1995; Fox 1999). An alternative conception of syntactic reconstruction, which will be relevant for our proposal later, is the *Inverse Trace Conversion* proposal of Erlewine (2014). Under this approach, both the higher and lower copies are interpreted at LF, but now the quantifier of the *lower* copy is interpreted, and the *higher* copy is interpreted as a definite description.

We illustrate this approach in (23), where Inverse Trace Conversion is used to reconstruct the subject *every apple* into the *v*P-internal position in *Every apple isn't rotten* with its inverse scope interpretation, meaning "not every apple is rotten." Following Inverse Trace Conversion in (23b), the higher copy is interpreted as the plural individual "the apples," and the lower copy is interpreted as "every apple in [that higher plural individual *the apples*]." In this simple case, this is equivalent to interpreting the lower copy as simply "every apple," under the scope of negation.

(23) **Interpreting the lower copy quantifier through syntactic reconstruction:**

Inverse scope reading (not > every) of "Every apple isn't rotten."

a. Narrow syntax:

[every apple]$_i$ NEG [$_{v\text{P}}$ [every apple]$_i$ is rotten]

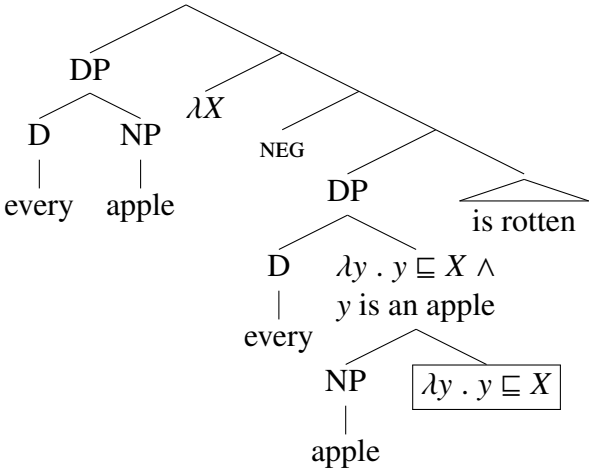
b. LF after Inverse Trace Conversion:

[THE apples] λX . NEG [$_{v\text{P}}$ [every [apple in X]] is rotten]

Inverse Trace Conversion derives this result through a different application of the Variable Insertion and Determiner Replacement operations of standard Trace Conversion, with slight modifications. First, we apply a version of Variable Insertion to the lower copy (24a) to change the restrictor "apple" to "apple in X." Formally, here we use the $\sqsubseteq$ part-of relation. The higher λ-binder abstracts over this (possibly plural) type e individual variable X. Second, Determiner Replacement targets the *higher* copy (24b).[6]

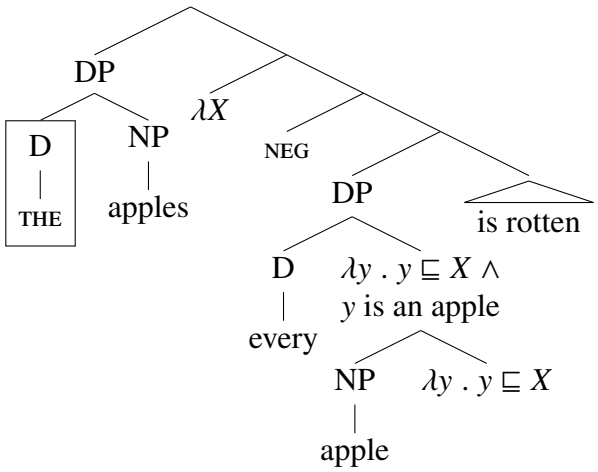
(24) **Inverse Trace Conversion, in detail:**

a. Step 1: Variable Insertion of the lower copy, with the part-of relation $\sqsubseteq$



[6] Because the higher copy will denote the plural individual "the apples," for illustration purposes we change the higher noun "apple" to be plural. Note that this complication will not arise in Japanese, which has no number marking.

b. Step 2: Determiner Replacement of the higher copy



Erlewine (2014) motivates Inverse Trace Conversion through the interaction of reconstruction and focus association in English and demonstrates its utility for the interpretation of quantifier float. In section 3.3 below, we will show that Inverse Trace Conversion offers a natural derivation for Japanese HIRCs, DHRCs, and HERCs with internally stranded quantifiers. See Chapter 7 of Erlewine (2014) for further discussion of Inverse Trace Conversion, including how Inverse Trace Conversion can be made compatible with the binding reconstruction facts discussed in Fox (1999).

3.2. Head-raising through late-merger into a copy

In this section, we will present a unique approach to the derivation of head-external relative clauses for English and Japanese, which takes advantage of the Copy Theory of movement, reviewed above. Our approach builds on the idea, first developed by Lebeaux (1988, 1991), that relative clauses can be *Late Merged* into a DP in a derived position. Together with the Copy Theory reviewed above, this now widely-accepted proposal has successfully explained a range of DP scope, ellipsis, extraposition, and binding facts (see e.g. Sauerland 1998; Fox 1999, 2002; Fox & Nissenbaum 2000; Takahashi & Hulsey 2009).

To illustrate late-merger, consider the following contrast from Freidin (1986). Example (25a) is ungrammatical with coreference between *John* and the pronoun *he*. This is explained as a

Condition C violation at LF, as the pronoun *he* c-commands the coreferential *John* in its base position of movement. In contrast, *John* in the relative clause in (25b) does not trigger a Condition C violation.

(25) **Condition C obviation with late-merger of the relative clause:**

a. * Which report that $John_i$ was incompetent did he_i submit?
   Narrow syntax: * [Which report [that $John_i$ was incompetent]] did he_i
   submit [which report [that $John_i$ was incompetent]]?

b. Which report that $John_i$ revised did he_i submit?
   Narrow syntax: [Which report [$_{late\text{-}merged}$ that $John_i$ revised]] did he_i
   submit [which report]?

Lebeaux proposes that adjuncts such as relative clauses can be attached after their host DPs have undergone movement. Thus, the DP *which report* is base-generated within the VP in (25b) and undergoes *wh*-movement, after which the relative containing *John* adjoins within the *wh*-DP. There is thus no instance of *John* that is c-commanded by *he* in (25b). The option for late-merger is not available to complements; consequently *he* must c-command the lower copy of the complement clause containing *John* in (25a), resulting in the familiar Condition C effect.

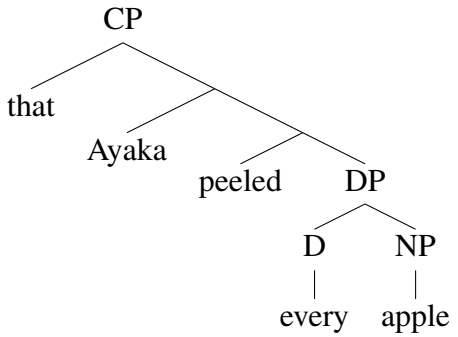
Our proposal for the derivation of relative clauses is as follows. First, build a CP via successive applications of Merge (26a). Next, Copy into the workspace the DP that will be the head of the relative (26b). At this point, copying the DP triggers the adjunction of a λ-binder to the root of the tree that contains the original DP being copied. Finally, the CP is Late Merged with that copy of the DP in the workspace (26c). We represent this late-merger as adjunction of the CP to the NP of the relative's head.[7] For the sake of convenience, we will refer to this structure in (26c) as

[7] This late-merge of the CP containing the lower copy of DP *into* the higher copy of DP seems to be a "movement" that violates the Proper Binding Condition (Fiengo 1977). However, if the spirit of the Proper Binding Condition is instead best stated as a semantic condition requiring the lower copy to have a c-commanding binder, the λ-binder introduced in Step 1 above may satisfy this requirement. Note also that both instances of the DP will be in case-positions. We will leave open questions of case and DP licensing for future work.

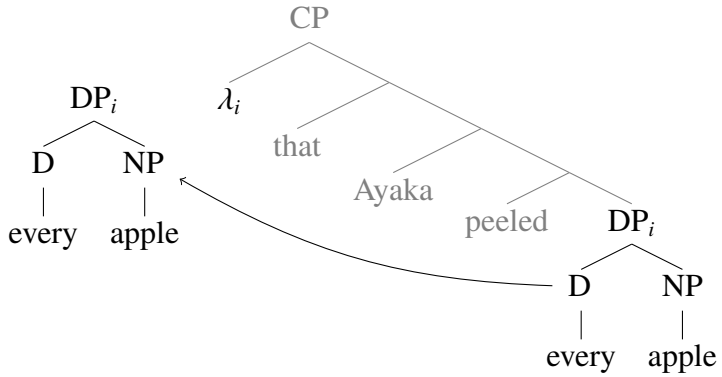
that of a *proto-relative*, the common core of all of the relative clause derivations that we will discuss.

(26) **Derivation of a proto-relative:**

a. Step 0: Build CP

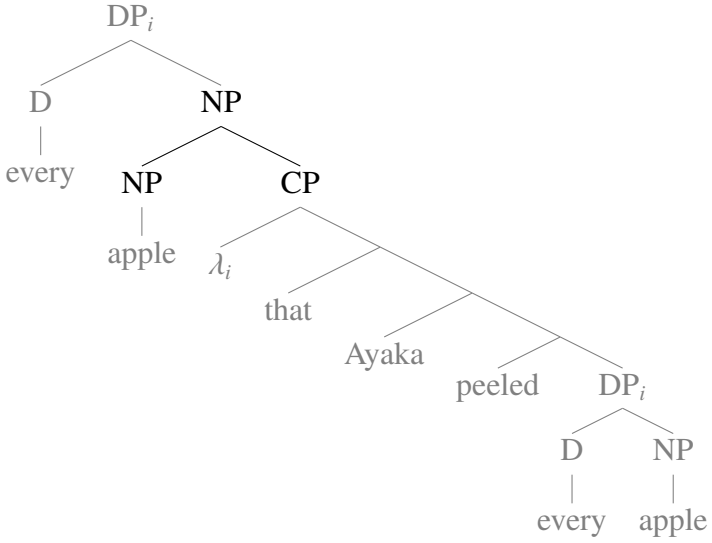


b. Step 1: Copy DP, adjoin corresponding λ-binder to CP



c. Step 2: Merge root CP to NP *apple* under the copied DP

i.e. "Late Merge" (Lebeaux's "late Adjoin-α") CP *into* the restrictor of DP



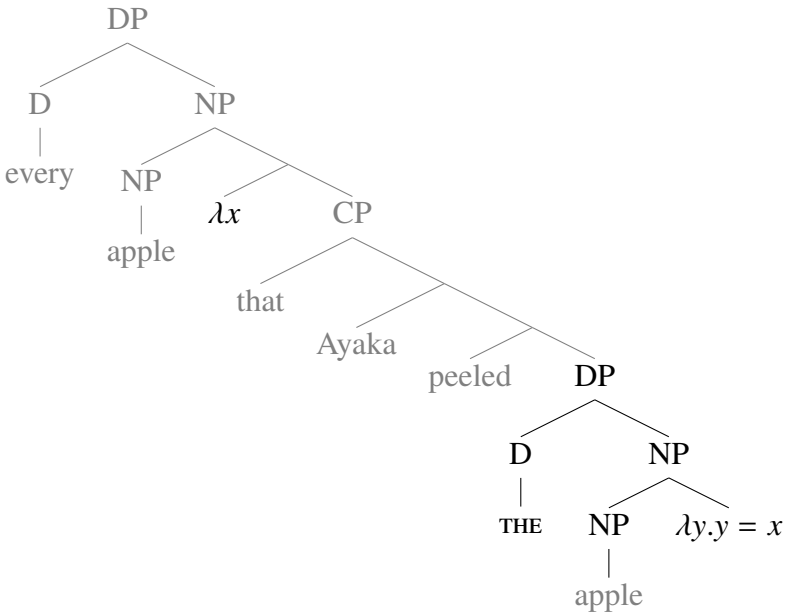
We propose that the structure in (26c) is the common core of all relative clause structures that we are studying here. The representation in (26c) shows the two copies of 'every apple' co-indexed with each other. As discussed above, the Copy Theory makes available different options for interpreting these copies at LF and at PF. For expository purposes, we will first demonstrate how the structure in (26c) can form a familiar English head-external relative clause. We discuss the application of this approach for the various relative clause strategies in Japanese in the following section.

For an English head-external relative, we propose that the higher copy of *every apple* in (26c) is pronounced and the lower instance is unpronounced. This results in the PF representation in (27). At LF, we apply Trace Conversion to the lower copy in (26c) to give us the structure in (28). The nominal domain "apple" and the CP relative clause interpreted intersectively to form the domain "λx . x is an apple and Ayaka peeled [the apple x]" for the quantifier "every" (see e.g. Partee 1975).

(27) **A HERC at PF: pronounce the higher copy**

"every apple that Ayaka peeled"

(28) **A HERC at LF: Trace Convert the lower copy**



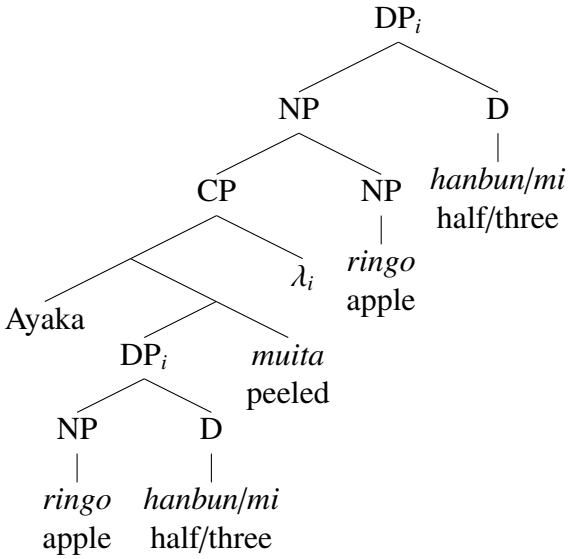
A precursor to this derivation of relative clauses is Henderson (2007), who similarly conceives of movement as Copy and Merge. Henderson proposes Copying the head noun NP of the relative clause and later late-merging the relative clause to an instance of that head noun. Our proposal differs from Henderson's in that we copy the DP, which allows for the possibility of pronouncing and interpreting the DP's quantifier in either the lower or the higher position. DP movement will play an important role in the compositional semantics we propose for Japanese relatives, as well as in the spell-out of copies at PF, in particular the higher copy in DHRCs which requires the deictic *sono*. We now turn to our account of the various relative clause structures in Japanese.

3.3. The derivation of the three Japanese relatives

In this section we show how the approach to the syntax of relative clauses introduced above can derive the three relative clauses under consideration in Japanese, as well as their variations. We begin by following the Copy and Late Merge approach outlined in (26) above for Japanese relative clauses with the head DPs 'half apples' and 'three apples.' This results in the structure in (29), which we propose to be the common core of the three Japanese relative clause strategies.[8]

[8] The internal structure of the CP clause is again not illustrated. Also not illustrated here is the internal structure of the Japanese DPs *ringo hanbun* 'half apple' and *ringo mit-tsu* 'three apple.' We believe our proposal for the derivation of Japanese relative clauses is compatible with different options for the internal composition of Japanese DPs and in particular the position of quantifiers, numerals, and classifiers; see for example Watanabe (2006) and references therein for previous proposals. What is important for our purposes is that all material outside of the NP will be targeted by the Determiner Replacement step of Trace Conversion and Inverse Trace Conversion, not simply the D layer, narrowly-defined. We therefore illustrate both the quantifier *hanbun* 'half' and the numeral and classifier *mit-tsu* 'three-CL' under the D head in (29) and subsequent structures, but this should be taken as standing in for a potentially richer DP-internal representation. See also footnote 13 below on the position of demonstratives.

(29) **Japanese proto-relative structure after Copy and Late Merge (cf. 26):**

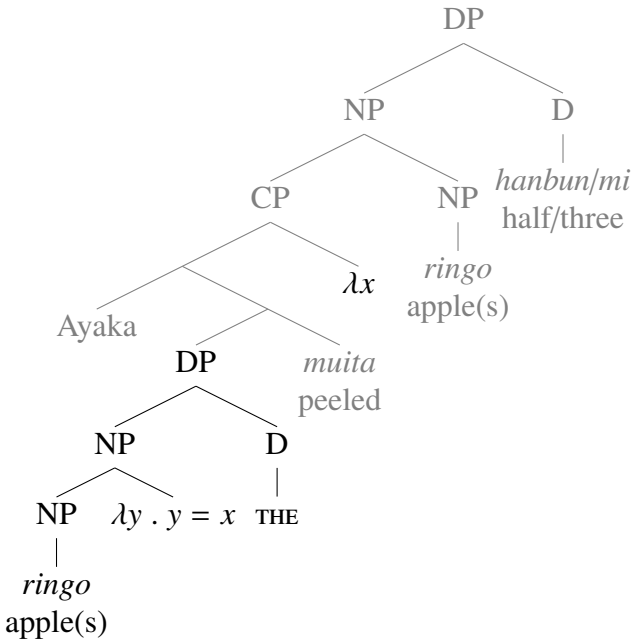


We propose that Japanese HERCs, HIRCs, and DHRCs all involve this underlying proto-relative derivation, which involves movement of the head DP. Evidence from island constraints shows that Japanese HERCs involve movement of the head (see e.g. Inoue 1976; Hasegawa 1981; and Ishizuka 2009 for a recent review). Watanabe (1992, 2003) similarly present evidence that the head inside a HIRC cannot be embedded inside a syntactic island; see also Watanabe (p.c.) island data presented in Grosu (2010). Watanabe (1992) and subsequently Grosu (2010) and Grosu & Landman (2012) have used this evidence to motivate the movement of a null operator from the position of the internal head in HIRCs.[9] Our own analysis here is best thought of as a modern reincarnation of Itô (1986), which proposes that the head of a HIRC moves to an external position at a level of representation that does not feed the surface form, drawing a direct parallel to the derivation of HERCs in Japanese. In contrast to Itô, our proposal involves movement in the narrow syntax and also includes an explicit semantic proposal, which we present in the remainder of this section and in Section 4.

[9] Technically, for Grosu and Grosu & Landman, this null operator moves from the position of the associated ChooseRole head, which is in a local relationship with the internal head, taking the head-containing VP as its complement. See Section 4.4 for further discussion.

For the proto-relative structure in (29) to be interpretable, we will have to apply Trace Conversion or Inverse Trace Conversion to the movement chain of the head DP. We note here that we assume that in Japanese these operations apply in the narrow syntax, which then feeds both LF and PF. This predicts a tight correspondence between the final PF and LF representations of these copy chains.[10] As illustrated for English in (28), Trace Conversion of the lower copy yields an LF appropriate for a HERC:

(30) **Trace Conversion for HERC:**

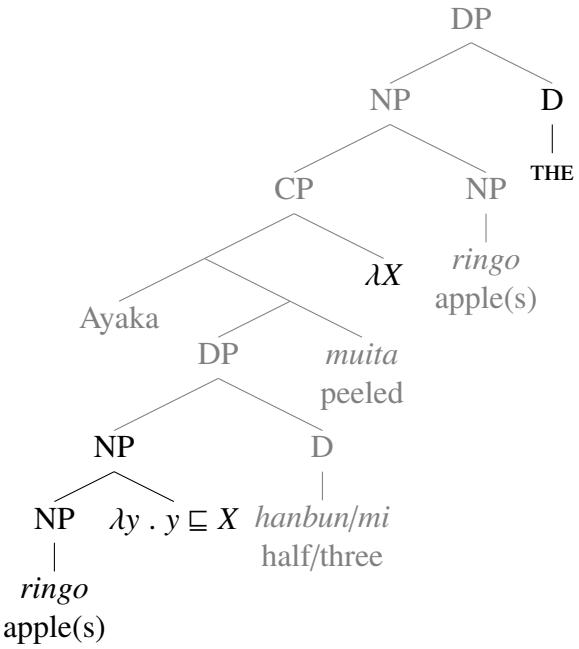


The other option for resolving the copy chain is the use of Inverse Trace Conversion, giving us the structure in (31) below. This allows the quantificational material (here, 'half' or 'three') to be interpreted in the lower copy inside the relative clause at LF, with the entire structure interpreted

[10] It is tempting to relate this generalization regarding the timing of Trace Conversion and Inverse Trace Conversion to the traditional description of Japanese as a scope-rigid language (see e.g. Hoji 1985). However, a growing body of work suggests that many configurations in Japanese *do* lead to scope ambiguities, including those that are best analyzed in terms of varying LF resolution strategies of copy chains—see e.g. Shibata (2015) and references therein. Here we therefore claim that copy chains involved in relative clause formation are resolved using Trace Conversion or Inverse Trace Conversion in the narrow syntax, feeding PF, without making a more general claim regarding the timing of such operations in Japanese.

as a definite description. We propose that this option represents the structure of both HIRCs and DHRCs in Japanese, which we saw in Section 2 to consistently have the same interpretation. The interpretation of this structure in (31) in Japanese will be discussed in detail in Section 4.

(31) **Inverse Trace Conversion for HIRC/DHRC:**



A precursor to this LF in (31) is Bhatt's (2002) mechanism for the interpretation of quantificational material on a lower copy of the head (there, superlatives) in an English head-external relative, with the higher λ-binder preserved. See Bhatt's Section 5.1. Note that Bhatt's syntactic proposal involves disregarding the higher copy of movement at LF, but not undoing the corresponding λ-binder of movement, which does not correspond to any independent syntactic reconstruction procedure. The approach we illustrate in (31) instead involves the straightforward application of the independently motivated operation of Inverse Trace Conversion.

The demonstration above shows how the proto-relative clause structure in (29) can result in two distinct types of LFs. The quantificational material of the relative's head DP can be interpreted outside the relative with Trace Conversion (30) or inside the relative with Inverse Trace Conversion (31).

Let us now turn to how the copies of the head DP in (29) are treated at PF. Recall that we propose that one of the strategies for the semantic resolution of the copy-chain (Trace Conversion or Inverse Trace Conversion) will apply in the narrow syntax and therefore feed the PF representation. This predicts that at PF, only one of the copies will include its quantificational material, such as 'half' or 'three,' with the other copy having been converted into a definite description. We will therefore consider the PF options for the two logical relative clause structures—(30) and (31) above—in turn.

We first consider the structure in (30), where the lower copy of the head DP has been Trace Converted. As noted above and also in the previous section's discussion of English relatives, this yields the expected LF for a HERC. Pronunciation of the higher copy DP, which includes the remaining quantifier, with no pronunciation of the lower copy at PF, yields the familiar HERC structure in (32a).

(32) **PF options after Trace Conversion of the lower copy (30):**

a. Pronouncing the higher copy only = HERC:

[$_{DP}$ [$_{CP}$ Ayaka-ga mui-ta] *ringo hanbun/mit-tsu*]

Ayaka-NOM peel-PAST apple half/three-CL

b. Pronouncing the noun lower and quantifier higher:

[$_{DP}$ [$_{CP}$ Ayaka-ga *ringo*-o mui-ta] -no *hanbun/mit-tsu*]

Ayaka-NOM apple-ACC peel-PAST -NO half/three-CL

c. Pronouncing both copies:

* [$_{DP}$ [$_{CP}$ Ayaka-ga *sono-ringo*-o mui-ta] *ringo hanbun/mit-tsu*]

Ayaka-NOM that-apple-ACC peel-PAST apple half/three-CL

The canonical HERC structure in (32a) is, however, not the only possibility. The head noun could be pronounced in the lower position with the quantifier higher, resulting in the structure in (32b).[11] This too is a possible relative clause, with the same interpretation as the corresponding

[11] One prominent difference between HERCs and DHRCs on the one hand and HIRCs on the other is that the relative clause is followed by the morpheme *–no* in the latter. This morpheme has been treated variously as, for

HERC. One ungrammatical option is (32c), where we pronounce the Trace Converted lower copy definite using a deictic *sono*; we will discuss the ungrammaticality of this option below. We do not consider options where the quantifier in the higher copy is not pronounced, as the intended quantification would then be unrecoverable (cf. Fiengo & Lasnik, 1972).

Now consider the PF options for a relative clause after Inverse Trace Conversion has applied, i.e. for the structure illustrated above in (31). Pronunciation of the lower copy yields the HIRC in (33a); pronunciation of the quantifier low and the noun high yields the HERC with an internally stranded quantifier in (33b); and pronunciation of both higher and lower copies yields the DHRC in (33c).[12] Recall that the three different relative clause forms in (33) were shown to all have the same interpretational profile in Section 2. This is exactly what we predict under our account, where all three forms in (33) necessarily correspond to the same narrow syntax derivation involving Inverse Trace Conversion (31) and therefore the same LF.

(33) **PF options after Inverse Trace Conversion (31):**

a. Pronouncing the lower copy only = HIRC:

[$_{DP}$ [$_{CP}$ Ayaka-ga *ringo-o* *hanbun/mit-tsu* mui-ta] -no]

Ayaka-NOM apple-ACC half/three-CL peel-PAST -NO

---

example, a complementizer in Itô (1986) and a definite determiner in Shimoyama (1999). Here we remain agnostic as to the exact status of *–no* in relative clauses, but we note the following descriptive generalizations: (i) *–no* never occurs when the higher copy of the head's NP is pronounced; and (ii) *–no* must occur if the morpheme immediately following the relative is a postposition/case-marker. How these generalizations should be properly accounted for remains an issue of further research, but we believe an explanation lies at the interface with PF and with considerations of Case licensing. Indeed, as regards generalization (i), Itô proposes a PF constraint, which is a version of Chomsky and Lasnik's (1977) doubly-filled COMP filter.

[12] We suggested in the previous section that this general Copy and Late Merge approach may also apply for English relative clauses. A natural question is then why head-internal and doubly-headed relativization are not available in English. The lack of head-internal relativization is explained by the generalization for English that the highest copy in chains derived in narrow syntax must be pronounced at PF, with covert movement being movement at LF. We furthermore suggest that Inverse Trace Conversion (and reconstruction operations in general) apply only at LF in English, which means that doubly-headed relativization of the Japanese form—where both higher and lower copies of the structure in (31) are pronounced after Inverse Trace Conversion—would never surface in English.

b. Pronouncing the quantifier low and noun high = HERC with stranding:

[$_{DP}$ [$_{CP}$ Ayaka-ga *hanbun/mit-tsu* mui-ta] *ringo*]
Ayaka-NOM half/three-CL peel-PAST apples

c. Pronouncing both the lower and higher copies = DHRC:

[$_{DP}$ [$_{CP}$ Ayaka-ga *ringo-o* *hanbun/mit-tsu* mui-ta] *sono-ringo*]
Ayaka-NOM apple-ACC half/three-CL peel-PAST those-apples

In the DHRC (33c), we propose that the medial deictic *sono* here is the conventionalized strategy for spelling-out the definite determiner introduced by Inverse Trace Conversion in this configuration.[13] Evidence for this view comes from the fact that proximal and distal demonstratives cannot be used in the same position (34), even if the event of Ayaka peeling the apples or the resultant apples are construed as very close to or far from the speaker.

(34) **Doubly-headed relative clauses must use *sono* (33c), not other demonstratives:**
* [$_{DP}$ [$_{CP}$ Ayaka-ga *ringo-o* *hanbun/mit-tsu* mui-ta] *kono/ano-ringo*]
Ayaka-NOM apple-ACC half/three-CL peel-PAST PROXIMAL/DISTAL-apples

This obligatory *sono* deictic on the higher head in DHRCs supports our DP-movement analysis for relative clauses, in this case with the higher copy pronounced following Inverse Trace Conversion. If relative clauses instead involved movement of only the head NP (restrictor), the choice of demonstrative at the outside edge of the entire relative clause construction should be completely independent of the internal derivation of the relative clause, and therefore allow any demonstrative marker.

One contrast between the PF options in (32) and (33) is the conspicuous ungrammaticality of option (32c), where the entire higher and lower copies are pronounced. What we predict in (32c) is in a sense the reverse of the DHRC in (33c), which is grammatical. The availability of the

[13] In the trees given above, the higher layers of the DP are illustrated as a single left-branching DP. Note, though, that demonstratives are necessarily prenominal. As mentioned in footnote 8 above, there is internal structure in the DP that we do not illustrate here. We assume the *sono* demonstrative is prenominal and the relative clause preposes to yield the observed RC-*sono*-NP order.

DHRC in (33c) shows that the ungrammaticality of (32c) cannot be explained by some general economy principle that prohibits the redundant pronunciation of multiple full heads in a chain. We hypothesize that this asymmetry is due to linear processing: as relative clauses are pre-nominal in Japanese, if the linearly first instance appears with a deictic, it would be interpreted not as a lower copy, but as referring to another entity.

We note, however, that relative clauses of this form have been attested. Kuno (1973) gives the example in (35), which he describes as "awkward, but not ungrammatical". Kuno (1973) and Haig (1976) point out that overt internal heads of this form are disallowed in argument positions; it is grammatical in (35) because it is a possessor. This contrast is reminiscent of the grammaticality of resumptive pronouns in gaps of island-violating movement in English. We will leave open here the precise conditions that govern this option of pronouncing the entire copy in the Trace Converted lower position.

(35) **Doubly-headed relative with *sono* on lower copy, from Kuno (1973: p. 237):**

[$_{\text{DHRC}}$ [watakusi-ga *sono-okyakusan*-no namae-o wasurete-sima-tta] *okyakusan*]

I-NOM that-guest-GEN name-ACC forget-SIMA-PAST guest

'a guest whose name I have (unfortunately) forgotten'

In this section we presented our syntax for the three Japanese relative clause types considered here—head-external, head-initial, and doubly-headed—as well as their quantifier stranding variants. In particular, the doubly-headed relatives provided strong evidence for an analysis involving DP movement. Using our proposal from Section 3.2, which introduced a Copy and Late Merge approach to head-raising relative clause derivations, we were able to account for the diverse range of Japanese relativization strategies.

4. Interpreting relative clauses

Our proposal for the unified syntax of Japanese relativization presented in Section 3 predicts there to be two different LFs for Japanese relative clauses, corresponding to the choice of semantic chain resolution strategy. These two options are repeated below in (36) with their basic

semantic denotations. The LF in (36b) resolves the copy chain in (36a) using Trace Conversion, leaving the higher copy's quantifier interpreted. We propose that (36b) exemplifies the LF of Japanese HERCs. The LF in (36c) instead uses Inverse Trace Conversion, leaving the lower copy's quantifier interpreted and instead interpreting the entire DP as a definite description. As discussed above, we propose that (36c) represents the LF for Japanese HIRCs and DHRCs, as well as HERCs that have internally stranded their quantificational material.

(36) **Two LFs for Japanese relative clauses:**

a. Proto-relative structure, after Late Merge of CP into the head DP (=29):

$[_{DP_i}\ [_{NP}\ [_{CP}\ [\text{Ayaka}\ [_{DP_i}\ \text{apple half/three}]\ \text{peeled}]\ \lambda_i\ ]\ \text{apple}]\ \text{half/three}]$

b. LF after Trace Conversion (=30) = HERC:

$[_{DP}\ [_{NP}\ [_{CP}\ [\text{Ayaka}\ [_{DP}\ [\text{apple}\ \boldsymbol{x}]\ \textbf{THE}]\ \text{peeled}]\ \boldsymbol{\lambda x}\ ]\ \text{apple}]\ \text{half/three}]$

$[\![\text{DP}]\!] = [\![\text{half/three}]\!](\lambda x\ .\ x \text{ is an apple and Ayaka peeled the apple } x)$

$= \lambda P\ .$ half/three of $\{x \mid x$ is an apple and Ayaka peeled $x\}$ satisfy P

c. LF after Inverse Trace Conversion (=31) = HIRC/DHRC:

$[_{DP}\ [_{NP}\ [_{CP}\ [\text{Ayaka}\ [_{DP}\ [\text{apples} \sqsubseteq \boldsymbol{X}]\ \text{half/three}]\ \text{peeled}]\ \boldsymbol{\lambda X}\ ]\ \text{apple}]\ \textbf{THE}]$

$[\![\text{DP}]\!] = [\![\text{THE}]\!](\lambda X\ .\ X$ apple(s) and Ayaka peeled half/three [apple parts of X])

In this section we will focus on the interpretation of this denotation in (36c). We will show how this denotation, together with a maximal informativeness semantics for definiteness (von Fintel, Fox, and Iatridou 2014), is able to account for the interpretations of Japanese HIRCs and DHRCs documented in Section 2. A simple assumption regarding the role of context on the interpretation of definite descriptions will explain the context-sensitivity observed in Section 2 and one major point of inter-speaker variation.

4.1. Background: Definiteness as maximal informativeness

In this paper we will adopt a proposal by von Fintel, Fox, and Iatridou (2014) for modeling definiteness as *maximal informativeness*. As we will see in the next section, the adoption of a maximal informativeness semantics for the definite determiner is crucial for computing the correct interpretation for some Japanese relatives with quantificational heads.

Traditionally the definite determiner THE has been described as a *maximality* operator which returns the unique maximal individual satisfying the restriction (see e.g. Sharvy 1980; Link 1983). Consider the interpretation of the definite description *the number of children that John has* in (37) below. We assume that the domain of the predicate N = "λn . John has n-many children" is restricted to positive integers. The definite description is interpreted as the maximal value that satisfies this predicate in the context. In this case, the positive integers 1, 2, 3, and 4 satisfy the predicate N. [[THE]](N) returns the maximal value, 4.

(37) **Maximality semantics for *the number of children that John has*:**
Context: John has exactly four children.
$1 < 2 < 3 < \mathbf{4} < \cancel{5} < \cancel{6} < \cancel{7} < \ldots$

In contrast, von Fintel, Fox, and Iatridou (2014) propose a new, intensional semantics for THE which returns the unique individual corresponding to the *maximally informative* true description. The denotation of the definite determiner THE is defined as follows:

(38) **Definiteness as maximal informativeness (von Fintel, Fox, & Iatridou 2014):**
a. [[THE]](φ) is defined in w only if there is a uniquely maximal object x, based on the ordering $\geq_\varphi$, such that $\varphi(w)(x)$ is true. The reference of "the φ" (when defined) is this maximal element.
b. For all x, y of type α and property φ of type $\langle s, \langle \alpha, t \rangle\rangle$, $x \geq_\varphi y$ iff λw . $\varphi(w)(x)$ entails λw . $\varphi(w)(y)$.

In many cases, the maximal informativeness semantics in (38) yields the same result as the traditional maximality semantics for THE. For example, consider the interpretation of *the number of children that John has* using the maximal informativeness semantics for THE in (38). In this case we consider the intensional property φ = "λw . λn . John has n-many children in w" for different values of n. We discard the values of n where $\varphi(w^*)(n)$ is false, where w^* is the world of evaluation, and order the remaining values by $\geq_\varphi$. The φ-proposition "λw . John has 4 children in w" entails all other φ-propositions that are true in the context, and therefore it will be the

maximally informative true φ-proposition. $[\![\text{THE}]\!](\varphi)$ returns the value of n corresponding to this maximally informative true proposition: 4.

(39) **Maximal informativeness semantics for *the number of children that John has*:**

Context: John has exactly four children.

Ordering of φ-propositions by entailment:	Resulting partial order $\geq_\varphi$:
$\ldots \Leftarrow \lambda w$. John has 3 children in w	
$\Leftarrow$ **λw . John has 4 children in w**	$1 \leq_\varphi 2 \leq_\varphi 3 \leq_\varphi \mathbf{4} \leq_\varphi \sout{5} \leq_\varphi \sout{6} \leq_\varphi \ldots$
$\Leftarrow$ ~~λw . John has 5 children in w~~ $\Leftarrow \ldots$	

The difference between maximality and maximal informativeness lies in the ordering used over the values that satisfy the restriction. In the case of *the number of children that John has*, both the natural ordering over numbers and the ordering $\geq_\varphi$ based on the entailment of corresponding φ-propositions yield the same result.

There are other cases, however, where only the maximal informativeness semantics yields the correct interpretation. For example, consider the definite description *the amount of flour sufficient to bake a cake*, beginning with the maximal informativeness approach from (38). We consider the intensional property φ = "λw . λn . n-much flour is sufficient to bake a cake in w" with different values of n, ordered by propositional strength. Note that if the proposition "λw . n-much flour is sufficient to bake a cake in w" is true, the corresponding proposition for any greater amount of flour, $m > n$, will also be true: "λw . m-much flour is sufficient to bake a cake in w." Therefore, φ-propositions corresponding to *smaller* values of n will be stronger. Of those φ-propositions that are true in the context in (40), the maximally informative proposition is "λw . 150g of flour is sufficient to bake a cake in w." $[\![\text{THE}]\!](\varphi)$ returns the corresponding value: 150g.

(40) **Maximal informativeness semantics for *the amount of flour sufficient to bake a cake*:**

Context: 150g of flour is sufficient to bake a cake.

Ordering of φ-propositions by entailment:

$\ldots \Leftarrow \lambda w$. 160g of flour is sufficient to bake a cake in w

$\Leftarrow$ **λw . 150g of flour is sufficient to bake a cake in w**

$\Leftarrow$ ~~λw . 140g of flour is sufficient to bake a cake in w~~ $\Leftarrow \ldots$

Resulting partial order $\geq_\varphi$:

$\ldots \leq_\varphi$ 170g $\leq_\varphi$ 160g $\leq_\varphi$ **150g** $\leq_\varphi$ ~~140g~~ $\leq_\varphi$ ~~130g~~ $\leq_\varphi \ldots$

(41) **Maximality semantics for *the amount of flour sufficient to bake a cake*:**

Context: 150g of flour is sufficient to bake a cake.

$\ldots <$ ~~130g~~ $<$ ~~140g~~ $<$ 150g $<$ 160g $<$ 170g $< \ldots$ *there is no maximal value!*

In contrast, we are unable to model this definite description accurately using the traditional maximality semantics. In the context in (41), 150g of flour is sufficient to bake a cake, but so is *any greater amount of flour*. Using the natural ordering over these values, there will be no unique maximal value.

4.2. Interpreting relatives and the effect of context

We are now in a position to compute the denotation of the HIRCs and DHRCs, as schematized in (36c), repeated here as (42). Consider first the denotation in (42) with the numeral 'three', in the simple context with no groupings, repeated in (43) below with the apples numbered.

(42) **Proposed denotation for HIRCs and DHRCs (=36c):**

[[DP]] = [[THE]] (λX . X apples and Ayaka peeled half/three [apple parts of X])

(43) **Context with no salient subgroups (=3):**

1 2 3 4 5 6 7 8 9 10 11 12

We will use the maximal informativeness semantics for THE introduced above, with φ_{three} = "λw . λX . X apples and Ayaka peeled three [apple parts of X] in w". The following entailment pattern holds of φ_{three}-propositions: the statement "λw . Ayaka peeled three apple parts in X in w" entails "λw . Ayaka peeled three apple parts in Y in w" if and only if X is a part of Y. We use this entailment pattern to induce a partial order over the set of apples in (43) closed under sum formation, using the definition in (38b): $X \geq_{\varphi three} Y$ if and only if $X \sqsubseteq Y$. Based on this ordering, the $\geq_{\varphi three}$-maximal individual that satisfies φ_{three} is the sum of the apples 1+2+3 in (43) above: the proposition "λw . Ayaka peeled three apple parts in 1+2+3 in w" entails "λw . Ayaka peeled three apple parts in Y in w" for all Y which satisfy φ_{three} in the context. The denotation of the DP in (42) with 'three' will be $[\![\text{THE}]\!](\varphi_{three})$ = 1+2+3.[14]

Now consider (42) with the quantifier 'half' evaluated in (43). φ_{half} = "λw . λX . X apples and Ayaka peeled half of the [atomic apple parts of X]." Notice that there is no productive entailment pattern between φ_{half}-propositions corresponding to different apple sums; that is, there is no general relation between X and Y such that peeling half of the apples in X entails that half of the apples in Y will also be peeled, except equality. We therefore result in the (trivial) partial order $X \geq_{\varphi half} Y$ iff $X = Y$. Next, we note that there are multiple apple sums of the same size that satisfy φ_{half} in the context: for example, 1+2+3+4+5+6 and 1+2+3+7+8+9. Therefore there is no unique $\geq_{\varphi half}$-maximal apple sum that satisfies φ_{half} in the context, and therefore based on the definition in (38), $[\![\text{THE}]\!](\varphi_{half})$ is predicted to be undefined in context (43). This explains the infelicity of the HIRC and DHRC with *hanbun* 'half' in this context without any grouping (43).

Of course, the HIRC and DHRC with the quantifier *hanbun* 'half' can be used felicitously in the richer context with two salient groups that we have considered, repeated here as (44). We propose that this effect is due to a more general effect of salient sets in the interpretation of definite descriptions, which we call the *Salient Sets Restriction*, given in (45).

[14] In Section 2, we reported the HIRC and DHRC corresponding to (42) has another reading, referring to the entire set of 12 apples. We return to this reading below.

(44) **Context with two groups of apples (=9):**

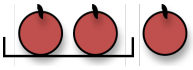
1 2 3 4 5 6 7 8 9 10 11 12

(45) **Salient Sets Restriction (SSR):**

The existence of salient sets in the context allows for limiting the set of possible outputs of [[THE]] to those salient sets (represented as plural sums).

The effect of the Salient Sets Restriction is easily observable beyond our Japanese relative clause examples. For example, consider the context in (46) with three apples, two of which form an observable group, to the exclusion of the third. A sentence such as the English *Junya will eat the two apples* in this context is unambiguously interpreted to mean that Junya will eat apples 1 and 2. This reading is possible because of the SSR in (45): without the SSR, there are three possible referents satisfying the description "two apples"—1+2, 1+3, and 2+3—with no way of ordering them based on this description.[15] The SSR introduces the option of considering only 1+2 versus 3 as possible referents, of which only 1+2 satisfies the description "two apples," giving us our unique referent.

(46) **Context with three apples, two of which form a group:**



1 2 3

Returning now to the context in (44), there are two salient sets of objects. Electing to use the SSR, we limit the possible referents for definite descriptions to just two plural individuals: 1+2+3+4+5+6 and 7+8+9+10+11+12. Only one of these individuals satisfies φ_{half} in the context: 1+2+3+4+5+6. Therefore the denotation in (42) with 'half' will have a referent in the context in (44), explaining the felicity of the HIRC and DHRC with *hanbun* 'half' in this context with unambiguous reference to the entire first group of apples, 1+2+3+4+5+6.

[15] Here we adopt the maximal informativeness semantics for definite descriptions, but this argument for the SSR still holds even if a maximality semantics for the definite is adopted.

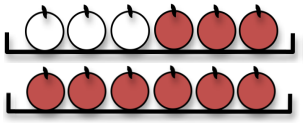
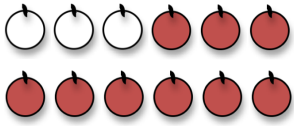
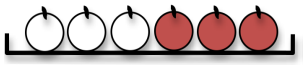
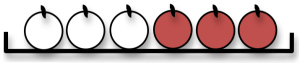
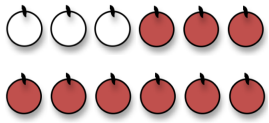
Let us now return to the interpretation of the HIRC and DHRC with the numeral 'three.' We showed above that we predict [[THE]](φ_{three}) to refer to the peeled apples 1+2+3 in the context with no groupings in (43) above. This same interpretation will be possible in the context with two groups in (44), ignoring its salient set information. However, The Salient Sets Restriction introduces additional possible readings for the HIRC and DHRC with 'three' in these contexts.

We first consider the context (43) with no groupings: if we consider the entire group of twelve apples in the context to be a salient set—perhaps in opposition to other apples which may exist outside of the relevant context—then electing to use the SSR allows us to consider only the entire group of twelve apples as a possible output for [[THE]](φ_{three}). This sum of all twelve apples does satisfy φ_{three} in the context, as Ayaka has peeled three apple parts thereof, explaining the possibility of interpreting [[THE]](φ_{three}) as all twelve apples in (43).

In the context with two groups, (44), electing to use the SSR will give us a different result. The two possible referents will be 1+2+3+4+5+6 and 7+8+9+10+11+12, and only the former satisfies φ_{three}. Therefore [[THE]](φ_{three}) = 1+2+3+4+5+6, the first group of apples.

As documented in Section 2 above, the interpretation of Japanese HIRCs and DHRCs is complex and context-sensitive. These patterns are summarized in the table in (47) below, which reproduces part of the summary table (18) from Section 2 above. In this section we showed how the simple definite description denotations we propose for these HIRCs and DHRCs in (42) accurately captures this pattern of judgments.

(47) **Summary of denotations in different contexts (=18):**

Context:		
HIRC (8), DHRC (11), and HERC (12) with internal 'half':		#
HIRC (13), DHRC (14), and HERC (15) with internal 'three':	i.  ii. 	i.  ii. 

In the simpler context with no grouping, (42) with 'half' will be undefined, and (42) with 'three' will refer to the three peeled apples or—if the SSR is used with the entire set of twelve apples considered—the entire group of twelve apples. In the context with two groups, (42) with 'half' will now be able to find a referent, the first group of six apples, using the SSR. (42) with 'three' is again ambiguous, referring to the three peeled apples or—if the SSR is invoked—the group of six apples in which three are peeled.

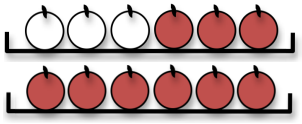
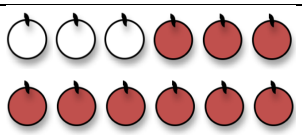
We note finally that the adoption of definiteness as maximal informativeness (von Fintel, Fox, and Iatridou 2014) is crucial for our analysis. Using a more traditional maximality semantics for the definite, [[THE]](φ_{three}) will refer to the maximal plural individual which satisfies φ_{three}. In the case where the SSR is not used, this will necessarily be the sum of all the apples in the context, because it too satisfies the description of Ayaka having peeled three of its apple parts. Thus, maximal informativeness semantics is essential for deriving the reading of [[THE]](φ_{three}) that denotes the three peeled apples.

4.3. Another pattern of judgments

As mentioned at the beginning of Section 2, the denotations for Japanese HIRCs and DHRCs summarized in (47) reflect the judgments of the majority of speakers that we consulted with.

However, three of our survey participants responded with a very different, internally consistent pattern of judgments. This pattern is summarized in the table in (48) below.

(48) **A different pattern of judgments, by some speakers (cf. 47):**

Context:		
HIRC (8), DHRC (11), and HERC (12) with internal 'half':	#	#
HIRC (13), DHRC (14), and HERC (15) with internal 'three':		

The pattern of judgments reported by these speakers varies greatly from what we have reported above. The HIRC, DHRC, and HERC with internally stranded quantifier 'half' are all judged as infelicitous in both types of contexts, whereas the HIRC, DHRC, and HERC with internally stranded numeral 'three' are all judged as referring unambiguously to the three peeled apples.[16]

Two things are striking here. First, the pattern we summarize in (48) to represent responses from a minority of speakers is drastically different from the pattern we reported in Section 2 above and summarized in (47). Second, there is strong inter-speaker consistency within each of these groups of responses.

Fortunately, our proposal above offers a natural account for this difference. The interpretations for some speakers, summarized in (48), are precisely what we predict if the Salient Sets Restriction (SSR) in (45) is consistently not used by these speakers. Recall from the discussion in the previous section that the context with two groups allows for a reading where the six apples in

[16] As noted above in Section 2, there is also a different reading available with the 'half' examples, referring to apples that have individually been half-peeled; we will leave such readings aside here.

the first group is picked out if the SSR is used; the first group satisfies the descriptions of Ayaka having peeled half or three of its apple parts, but it is not the unique maximal possible referent of this form without the SSR. Furthermore, without the SSR, there is no option in the context with no groupings to consider just the entire group of twelve apples as a salient set, which satisfies the description of Ayaka having peeled three of its apple parts. Following the discussion in the previous section, using the maximal informativeness semantics for definiteness, what remains without the SSR is then precisely what we observe as the behavior reported by these speakers in (48).

At this point we cannot say whether the availability of the SSR is a true point of inter-speaker variability or an artifact of the survey task that speakers responded to. We suspect that the answer is the latter. This survey used the same schematic illustrations that we use here to represent different configurations of apples, with or without grouping. We suspect that the speakers described in this section did not perceive the schematic grouping information as salient enough when participating in the written survey, but would use the SSR for definite description reference in a real world context.[17]

4.4. Alternative approaches

In this section we will expand our discussion of alternative proposals in the literature. There are broadly two previous approaches to the compositional syntax/semantics of Japanese HIRCs: the E-type analysis of Hoshi (1995) and Shimoyama (1999) and the quantificational disclosure approach of Grosu (2010) and Grosu & Landman (2012).

We already noted in Section 2 that the denotations of Japanese HIRCs and DHRCs do not straightforwardly correlate with the interpretations of their paraphrases with cross-sentential

[17] The directional light noun *hoo* is often used when salient sets are referred to or contrasted. Therefore another possibility for the speakers described in this section is that the use of the SSR is lexically tied more closely to the use of *hoo* for these speakers than for others. We leave further study of the light noun *hoo* and its connection to the SSR for future work.

anaphora, casting doubt on the E-type analysis of Hoshi (1995) and Shimoyama (1999). The HIRCs and DHRCs with the numeral 'three' can refer to the three apples peeled, but also has a salient set reading available, denoting a salient set within which Ayaka peeled three apples (16). In the context with two groups, this will be the first set of six apples; in the context with no grouping, this will be all twelve apples in the context. This contrasts with the cross-sentential paraphrase in (17), which all speakers interpreted as unambiguously referring to the three apples that were peeled, in either context. The HIRCs and DHRCs with 'half' also shows this reliance on salient set information, referring to the first group of apples, half of which have been peeled, in the context with two groups (8, 11). This too differs from the corresponding cross-sentential paraphrase, which is judged as either infelicitous or ambiguous between the first group of apples or the three apples that were peeled (10). See the table in (18) above for a summary of these differences.

These readings where HIRCs and DHRCs refer to a salient set—specifically here, a salient set of apples that satisfies the description of Ayaka having peeled three or half of them, rather than simply those apples that have been peeled—are also problematic for the event-semantic "quantificational disclosure" approach of Grosu (2010) and Grosu & Landman (2012). Grosu and Grosu & Landman propose a null functional head, *Choose Role*, that modifies the event-description-denoting VP and "reopens" a designated role of that event description so that the extension of that argument can be abstracted over. The semantics for Choose Role is given in (49) below.

(49) **Choose Role (Grosu & Landman 2012, p. 169):**

[[Choose Role]] = $\lambda E . \lambda x . \lambda e . E(e) \wedge \boldsymbol{C}_E(e) = x$

where e is an event, E is an event description, and $\boldsymbol{C}_E$ stands in for the appropriate role to be "reopened," based on the context

The variable x introduced by Choose Role in (49) is abstracted over, after existential closure of the event variable e, to form the domain of a definite description. This approach predicts HIRCs to refer strictly to the (maximal) individual that satisfies the $\boldsymbol{C}_E$ role of the event in question. For the HIRCs we considered in Section 2, for example, $\boldsymbol{C}_E$ will be the *Theme* role and our HIRCs

from Section 2 will therefore be predicted to consistently denote *the apples that Ayaka peeled*, the theme of the peeling event. As noted above, this is not in general what these HIRCs denote.

Here we note that there were two speakers that we consulted whose responses did not line up cleanly with any other speakers, and whose behavior was not included in the discussion of the dominant patterns in Sections 2 and 4.3 above. One speaker consistently interpreted all relative clauses considered above as denoting the three apples that Ayaka peeled; except for the HIRC, DHRC, and HERC with internally stranded 'half' (8, 11, 12) in the context with no groups, which were judged as infelicitous. This speaker's behavior could be consistent with the quantificational disclosure approach, but could also be the result of an E-type approach, given that they also interpreted the cross-sentential paraphrases in (10) and (17) as referring unambiguously to the three peeled apples. Another speaker gave a more complex pattern of judgments: their responses to some examples are incompatible with our approach and compatible with the alternatives, but their responses to other examples are only compatible with our approach. We consider these two speakers to be outliers, given the otherwise strongly uniform patterns of judgments across speakers, described in Sections 2 and 4.3 above. Nevertheless, their judgments lead us to conclude that it is possible that this is a point of ideolectal variation, with the E-type approach or the quantificational disclosure approach active for some speakers.

In addition to the empirical difficulty faced by the theory of Grosu and Grosu & Landman for the behavior of most speakers, described in Section 2 above, our approach is also conceptually advantageous on a number of fronts. First, our copy-theoretic approach introduces a variable in the lower copy of the head DP through the independently motivated process of Variable Insertion (Fox, 2002). Grosu & Landman (2012) comment that this need to "reopen" an argument of the relative clause is the primary motivation for their Choose Role functional head and there is no independent motivation for its existence.[18] The existence of an alternative approach to "opening

[18] Grosu & Landman (2012, p. 166): "Although we do not have, at the moment, other cases where ChR [=Choose Role] is required, we think neither that ChR is an *ad hoc* stipulation nor that it is a *sui generis* mechanism. ChR constitutes a 'salvaging' mechanism whose primary *raison d'être* is to make available a suitable interpretation for an otherwise closed sentence…"

up" a variable in an apparently gapless clause, presented here, makes Choose Role an unnecessary theoretical construct.

Second, our approach explains why the entire HIRC is necessarily interpreted as a definite description, and similarly for DHRCs and HERCs with internal stranding, not considered together by other authors. In our approach, the process of Inverse Trace Conversion (Erlewine, 2014) applies Determiner Replacement (Fox, 2002) to the higher copy DP, replacing its quantificational material with a definite determiner. In contrast, Grosu (2010) section 6 stipulates that the HIRC CP has an uninterpretable [MAX] feature, which must be checked by the application of a definite (maximalizing) determiner.

Third and finally, as discussed in detail in Grosu & Landman (2012) section 5, the analysis of HIRCs with additional quantifiers becomes quite complicated in their approach, due to its heavy reliance on event semantics. Grosu & Landman state, "the standard mechanisms for creating scopal dependencies (like quantifying-in or QR) interact with the Choose Role mechanism with detrimental effects, giving wrong readings for examples where the internal head is in the scope of a quantifier" (p. 178). Grosu & Landman then offer a complex approach to such examples that involves translating nominal quantification into quantification over events and reference to the participants of event sums with cumulative interpretation; see Grosu & Landman section 5 for details. In contrast, our approach can handle such examples straightforwardly, using standard scope-taking mechanisms.

We will demonstrate how our approach handles such complex cases by briefly discussing two examples raised at the end of Shimoyama (1999), without an analysis, which Grosu & Landman analyze using their complex event quantification formalism in their sections 5.5 and 5.6. The first example is (51):

(50) **Three children, two apples each (Shimoyama, 1999, p. 176):**

Wasaburo-wa [$_{\text{HIRC}}$ [san-nin-no kodomo-ga sorezore
Wasaburo-TOP [[three-CL-GEN child-NOM each
ringo-o *futa-tsu-zutu* katte-ki-ta] -no]-o tana-ni oi-ta.
apple-ACC two-CL-each buy-come-PAST-NO-ACC shelf-on put-PAST

Shimoyama's translation: 'Three children bought two apples each and Wasaburo put *them* on the shelf.'

As Shimoyama notes, the HIRC in (50) denotes the *six* apples such that three children each bought two of them. Our analysis allows us to straightforwardly model the relationship between the higher quantifier 'three children' and the internal head 'apples two' in its scope.[19] The structure and interpretation we propose is sketched in (51) below:

(51) **Derivation and interpretation of HIRC in (50):**

a. Proto-relative after Copy and Late Merge (cf 29):

[$_{\text{DP}i}$ [$_{\text{NP}}$ [$_{\text{CP}}$ [[three children] [[$_{\text{DP}i}$ *apples two*] bought]] λ_i] *apples*] *two*]

b. HIRC after Inverse Trace Conversion (cf 31):

[$_{\text{DP}}$ [$_{\text{NP}}$ [$_{\text{CP}}$ [[three children] [[$_{\text{DP}}$ [*apples* $\sqsubseteq$ ***X***] *two*] bought]] $\boldsymbol{\lambda X}$] *apples*] **THE**]

c. Denotation of HIRC DP (cf 36c):

$[\![\text{DP}]\!] = [\![\text{THE}]\!](\lambda X$. X apples and there are three children Y, such that
for each child y in Y, y bought two apples in X)

Assuming that there is a context where indeed three children bought two apples each, that sum of six apples will satisfy the restrictor of (51c) here.[20] This sum of six apples will be identified as

[19] We do not illustrate the 'each' particles *sorezore* and *-zutu* here, which we take to have the function of ensuring that the head DP 'apples two' will take scope under the subject 'three children.'

[20] This HIRC is infelicitous if it is not *exactly* three children who brought *exactly* two apples each. This is predicted by our account: if there are additional children who brought two apples or if some of these children brought more than two apples, our semantics for definiteness as maximal informativeness will not be able to identify a maximally informative sum of six apples. Because definiteness is not simple Sharvy-Link maximality, it will also not return the sum of all apples (two or more each) that the three or more children brought.

the maximally informative true member, because any sum of apples satisfying this restrictor predicate entails that a superset of apples will satisfy the restrictor as well.

The second complex example given by Shimoyama is (52) below. Grosu & Landman describes such examples as "the most challenging examples for the analysis of internally headed relatives" (p. 178) and show that, under their Choose Role analysis of HIRCs, "if we apply a standard scope mechanism [in (52)], we will get a wrong interpretation" (p. 187). Again, under our proposal, the interpretation of this HIRC is completely straightforward using standard treatments for quantifier scope. This is illustrated in (53).

(52) **Every student, three papers (Shimoyama, 1999, p. 176):**

Wasaburo-wa [$_{\text{HIRC}}$ [dono-gakusei-mo *peepaa*-o *san-bon* dashi-ta] -no]-o
Wasaburo-TOP [[every student term paper-ACC three-CL submit-PAST -NO-ACC
ichi-nichi-de yon-da.
one-day-in read-PAST

Shimoyama's translation: 'Every student turned in three term papers and Wasaburo read *them* in one day.'

(53) **Derivation and interpretation of HIRC in (52):**

a. Proto-relative after Copy and Late Merge (cf 29):
[$_{\text{DP}i}$ [$_{\text{NP}}$ [$_{\text{CP}}$ [[every student] [[$_{\text{DP}i}$ *papers three*] submitted]] λ_i] *papers*] *three*]

b. HIRC after Inverse Trace Conversion (cf 31):
[$_{\text{DP}}$ [$_{\text{NP}}$ [$_{\text{CP}}$ [[every st.] [[$_{\text{DP}}$ [*papers* $\sqsubseteq$ ***X***] *three*] submitted]] $\boldsymbol{\lambda X}$] *papers*] **THE**]

c. Denotation of HIRC DP (cf 36c):
[[DP]] = [[THE]](λX . *X* papers and for every st. *y*, *y* submitted three papers in *X*)

Again, given a context where every student has submitted three papers each, our maximal informativeness semantics for the definite description in (53c) will pick out exactly those (3 * *n*) papers that the *n* students submitted, as is the interpretation described by Shimoyama. No special quantificational mechanisms are necessary for the interpretation of such examples with the internal head scoping under other quantifiers inside the relative clause.

5. Conclusion

In this paper we have investigated the interpretation of head-external, head-internal, and doubly-headed relative clauses in Japanese. By focusing on the subtle interplay between quantification and context, we introduced a rich set of data that reveals the underlying semantics of these types of relatives. These data are especially problematic for existing semantic analyses of HIRCs in Japanese. We accounted for the data by proposing a novel head-raising analysis of relative clauses, which combines the following independently motivated components: (i) the Copy Theory of movement and strategies for copy-chain interpretation; (ii) late-merger of relative clauses; (iii) a maximal informativeness semantics for definiteness; and (iv) a pragmatic constraint on interpretation, viz. the Salient Sets Restriction.

Our treatment of relative clauses is unique in that it exploits to a high degree both the interpretive and phonological possibilities made possible through the Copy Theory of movement (Chomsky 1993, 1995). This allows for a straightforward unification of the syntax of head-external, head-internal, and doubly-headed relative clauses in Japanese, including those with quantifier stranding. Taking the copy-chain resolution operations of Trace Conversion and Inverse Trace Conversion to feed both LF and PF, we derive the systematic correspondence observed between the interpreted and pronounced positions of quantificational material. We showed that the resulting LFs accurately derive the range of interpretations of these relative clauses in different contexts.

We hypothesize that the novel Copy and Late Merge derivation for read-raising relative clauses presented here is also applicable to relativization in other languages. The flexibility offered by this structure in both LF and PF interpretation brings certain questions to the fore—for example, why are head-internal or doubly-headed relatives unattested in so many languages?—while at the same time offering potential solutions to other puzzles. For example, derivationally relating the head DP, including its quantificational material, to a lower copy within the relative clause may offer a new approach to instances of relativization which have been analyzed as involving reconstruction of the head's quantificational material; see e.g. Bhatt (2002) and Aoun & Li

(2003). We hope to explore such questions and applications of this new framework for relativization in future work.

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