Relative Tense in Japanese: The Case of Multiply Embedded Relative Clauses*

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1 Introduction

'Relative tense' refers to the phenomenon where the meaning of a tense morpheme is evaluated based on some context-dependent time, not necessarily the speech time (Comrie 1985). This interpretation can be observed with Japanese subordinate clauses, and many descriptive and formal analyses of their behavior have been proposed (Mihara 1992, Ogihara 1996, Kusumoto 1999, Kaufmann & Miyachi 2011). However, most previous studies focused only on a single level of embedding, leaving unaddressed the systematic investigation of multiply embedded clauses.

Against this backdrop, this study investigates the temporal interpretation of Japanese multiply embedded relative clauses. We observe (i) that a multiply embedded relative clause can have a

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relative tense interpretation that depends on its nonimmediately higher clauses, and (ii) that this 'clause skipping' interpretation is constrained by the tense forms of the clauses. We then present a formal analysis of the meaning of the tense morphemes, deriving the attested interpretations in a compositional manner.

2 Relative Tense in Japanese

Before going into the details of relative tense in Japanese, we introduce some basic terminology for describing temporal interpretations. We use the term 'reference time' (RT) to refer to the time (or more formally, the time interval) that is related to the eventuality denoted by a predicate. Tense temporally locates the RT based on some other time, which is called its 'evaluation time' (EvT). To illustrate, we consider the temporal interpretation of (1) (in examples, the past and nonpast tense morphemes are glossed PST and NPST, respectively).

(1) gakusee-ga {(a) ki-**ta** / (b) ku-**ru**}
student-NOM {come-PST / come-NPST}
'A student {(a) came / (b) will come}.'

In both cases, the EvT is the 'speech time' (ST), the time of the utterance. With the past tense, the RT t_1 is before the ST ($t_1 <$ ST). With the nonpast tense, the relationship is the opposite ($t_1 >$ ST).[1] In what follows, we graphically indicate these temporal interpretations as in Figure 1.

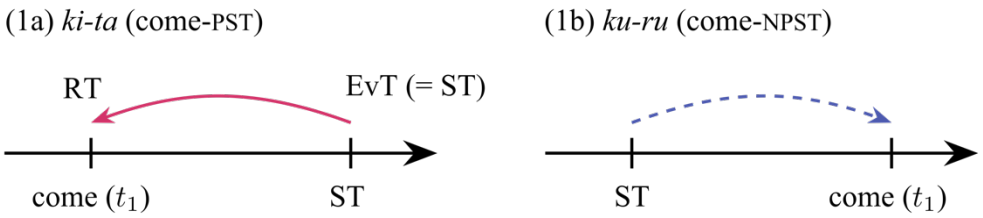

Figure 1: Temporal Interpretations of (1a) and (1b)

Each arrow corresponds to the tense of the clause, indicating how the RT is temporally located relative to the EvT (which is the ST in this case). We will use a solid line for the past tense and a dashed line for the nonpast tense.

Based on the property of the EvT, tense is classified into two types: 'absolute' and 'relative' (Comrie 1985). In absolute tense, the EvT is the ST, while in relative tense, it need not be. As the above examples show, main clauses in Japanese (as well as in many other languages like English) have absolute tense. In contrast, Japanese subordinate clauses generally involve relative tense. For example, consider how the relative clause in (2) is temporally interpreted. As a notational convention, we will henceforth annotate the RT of each clause next to the verb. Additionally, we will indicate relative clauses in brackets ('[ ]') in examples (note that Japanese has no overt relative pronouns).

[1] The meaning of the nonpast tense is $t_1 \geq$ ST, generally speaking. However, as this paper mainly focuses on dynamic predicates, which require that t_1 be disjoint from ST, we can identify the meaning of the nonpast tense as $t_1 >$ ST.

(2) [ryuugaku-{(a) si-**ta** / (b) su-**ru**} (t_2)] gakusee-ga happyoo-su-**ru** (t_1)
study.abroad-{do-PST / do-NPST} student-NOM presentation-do-NPST
'A student [who {(a) studied ($t_2 < t_1$) / (b) will study ($t_1 < t_2$)} abroad] will make a presentation.'

We can see that in both cases, the EvT of t_2 is t_1, namely the RT of the matrix clause (we remark that the same holds when the matrix clause has the past tense). Let us consider the interpretation in more detail with (2a). Here, the sentence has no implication about whether the action of studying abroad occurred in the past, so the EvT of t_2 is not ST. Rather, the only requirement is that the person's studying abroad be before the presentation, meaning that the EvT is t_1 (Figure 2).

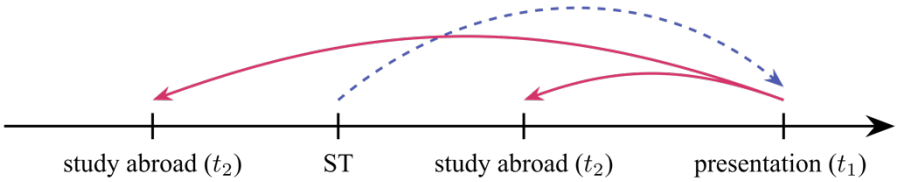

Figure 2: Temporal Interpretation of (2a)

The RT of the relative clause (t_2) can be either before or after the ST, as indicated by the branching solid arrow.

At this point, we need to remark that the EvT of a relative clause is not always the RT of the matrix clause. It has been pointed out that, in some cases, the tense of a relative clause can be evaluated from the ST (Mihara 1992, Ogihara 1996). To illustrate this, let us examine (3).

(3) [**sakki** ki-ta (t_2)] gakusee-ga **sen-getu** happyoo-si-ta (t_1)
just.now come-PST student-NOM last-month presentation-do-PST
'The student who came just now made a presentation last month.' ($t_1 < t_2$)

Here, the explicit usage of the temporal adverbials (*sakki* and *sen-getu*) forces us to interpret the sentence as indicating $t_1 < t_2$. Hence, the EvT of t_2 cannot be t_1 (if so, it would entail $t_2 < t_1$, leading to contradiction). Instead, t_2 is evaluated based on the ST.

However, it is unclear whether this type of 'absolute' interpretation is due to the semantic property of the tense morpheme itself. Rather, it seems to be more reasonable to assume that the absolute interpretation is driven by the definiteness/specificity of the noun phrase modified by the relative clause. To remove this effect, we can explicitly make the sentence generic with an adverbial like *mai-tosi* 'every year', as exemplified by (4). As expected, the sentence does not allow $t_1 < t_2$, even though this temporal relation is not pragmatically odd.

(4) kore-made **mai-tosi**, [happyoo-si-ta (t_2)] gakusee-ga ryuugaku-si-ta (t_1)
this-until every-year presentation-do-PST student-NOM study.abroad-do-PST
'Every year up to now, a student who had made a presentation studied abroad.' ($t_2 < t_1$)

For this reason, we set aside the absolute interpretation and focus on cases where the EvT of the relative clause depends on its higher clauses.

So far, we have briefly explained the phenomenon of relative tense in Japanese. While the relative tense interpretation of various kinds of subordinate clauses (including relative clauses) was investigated in the previous studies (Mihara 1992, Ogihara 1996, Kusumoto 1999, Kaufmann & Miyachi 2011), they did not present a systematic examination of multiply embedded clauses. The central aim of the present study is to fill this gap.

3 Observation

3.1 Temporal Interpretation of Doubly Embedded Relative Clauses

This section presents some observations of doubly embedded relative clauses. We start with the two examples shown together in (5).

(5) [Context: Due to a pandemic, hospitals need special care in cleaning rooms]
[[kansen-syoo-o hassyoo-si-ta (t_3)] hito-ga {(a) tuka-u / (b) tukat-ta} (t_2)]
infection-disease-ACC develop-do-PST person-NOM {use-NPST / use-PST}
heya-o syokuin-ga sooji-su-ru (t_1)
room-ACC employee-NOM clean-do-NPST
'An employee will clean a room [that a person [who developed the infectious disease] {(a) will use / (b) used}].'

For ease of exposition, we refer to complex sentences by listing the tense forms of their clauses from low to high (using P for 'past' and N for 'nonpast'). For instance, sentences like (5a) are referred to as '$P_3N_2N_1$', with the subscript numbers indicating the depth of embedding. With this notation, we illustrate the temporal interpretations of (5a) and (5b) in Figure 3.

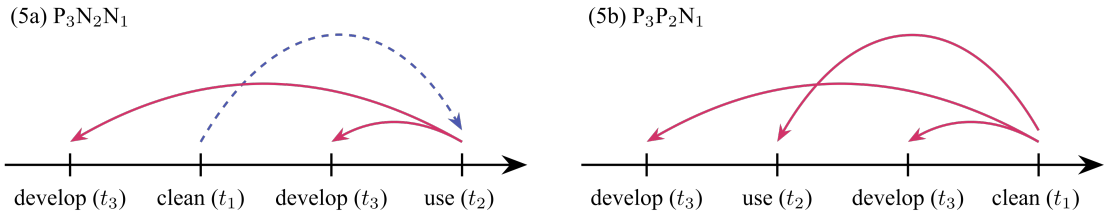

Figure 3: Temporal Interpretations of (5a) and (5b)

We omit ST (which obeys ST $< t_1$ here) for brevity.

The $P_3N_2N_1$ case (5a) is not surprising. The deepest clause is evaluated from its immediately higher clause ($t_3 < t_2$), which in turn is evaluated from the outermost clause ($t_2 > t_1$), in accordance with the basic pattern of relative tense that we described in Section 2. In contrast, (5b), which has the form $P_3P_2N_1$, exhibits something unexpected. As shown in Figure 3, the development of the infection can be either before or after the event of using the room. This means that the EvT of t_3 is t_1, rather than t_2. In other words, (5b) shows that the EvT of a doubly embedded relative clause may be the RT of a nonimmediately higher clause, with the intermediate clause being skipped.

Additionally, when we use the past tense in the outermost clause (*sooji-si-ta*), we do not find any change in the relationship between t_3 and t_2. That is, the only difference lies in whether t_1 is placed in the future or in the past, and the interpretations shown in Figure 3 are invariant.

Next, we turn to cases where the deepest clause has the nonpast tense. Consider (6), where the tense of each clause is the opposite of (5).

(6) [Context: A university is holding an information session for new students]
[[setumee-kai-o kesseki-su-ru (t_3)] hito-ga {(a) uketot-ta /
information-session-ACC absent-do-NPST person-NOM {receive-PST /
(b) uketor-u} (t_2)] siryoo-o syokuin-ga kakunin-si-ta (t_1)
receive-NPST} material-ACC employee-NOM clean-do-PST
'An employee checked a handout [that a person [who would absent themselves from the information session] {(a) had received / (b) would receive}].'

We illustrate the interpretations in Figure 4. We can see that the two subfigures are 'mirror images' of those in Figure 3. Namely, the EvT of t_3 is t_2 in (a), and t_1 in (b), with the directions of the arrows being reversed. We also report that the EvT patterns remain the same when the outermost clause has the nonpast tense (*kakunin-su-ru*).

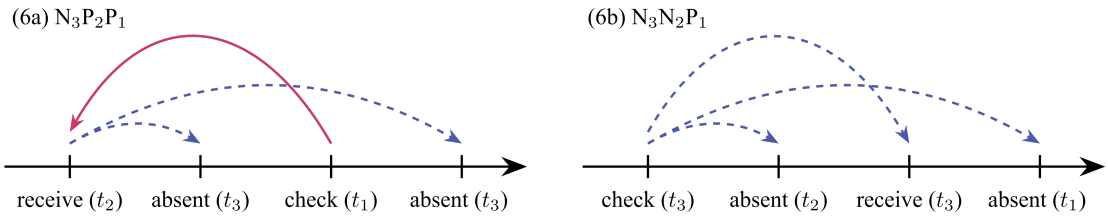

Figure 4: Temporal Interpretations of (6a) and (6b)

ST is omitted for brevity.

In summary, the EvT of a doubly embedded relative clause varies depending on whether the third and second clauses have the same tense form. If they have a different tense form (e.g. $P_3N_2N_1$ in (5a), and $N_3P_2P_1$ in (6a)), the deepest clause is temporally evaluated based on the immediately higher clause. In contrast, if they have the same tense form (e.g. $P_3P_2N_1$ in (5b), and $N_3N_2P_1$ in (6b)), the second clause is skipped and the EvT is provided by the outermost clause, which would not be expected from the common generalization given in the previous literature. With these results at hand, we proceed to form an empirical generalization that correctly describes the EvT patterns.

3.2 An Empirical Generalization

Given the observations made in the previous section, we propose the following generalization regarding the EvT of relative clauses in Japanese.

(7) The EvT of a relative clause in Japanese is
a. the RT of its nearest higher clause with the opposite tense form, or
b. if there is no such clause, the RT of the outermost clause.

We can easily check that (7) correctly describes the patterns observed above. We remark that the provision (7b) is necessary to capture the case where all the clauses involved have the same tense forms (e.g. $P_3P_2P_1$). We also point out that the behavior of single embedding we described in Section 2 can be regarded as a special case of (7).

Although we have obtained (7) as a descriptive generalization, further discussion is necessary in order to argue for its adequacy, because one can also summarize the data into a much simpler hypothesis, which can be stated as follows.

(8) Counterhypothesis (to be rejected): The EvT of a relative clause in Japanese can be the RT of any higher clause (and the choice is made based on pragmatic factors).

This alternative, as well as (7), is compatible with the observations so far. For each of the double embedding examples, we could have said that the EvT of the deepest clause can be given by either of the two higher clauses. Consider the $P_3N_2N_1$ case (5a) again, where $t_3 < t_2$ and $t_2 > t_1$. Here, even if we suppose that the EvT of t_3 can also be t_1 (i.e. $t_3 < t_1$), we merely obtain a logically stronger interpretation than the case of t_2, since $t_3 < t_1$ together with $t_2 > t_1$ entails $t_3 < t_2$. Then, one can consistently assume that such stronger readings can be ruled out pragmatically (e.g. as a violation of the maxim of quantity). With this counterhypothesis at hand, why should we adopt (7) instead?

To settle this question, we need to look into examples with a triply embedded relative clause. In particular, we inspect the configuration $P_4N_3N_2P_1$. The aim is to distinguish between the two generalizations by considering whether the deepest clause P_4 can be temporally evaluated based on the second clause N_2, skipping the third clause N_3 ((8) allows this possibility, while (7) does not). We examine (9) as a concrete example.

(9) [Context: The school is planning to exhibit an essay written by a brilliant student somewhere in the building next semester. The essay is to be written in the middle of the semester, and the grades of each student will be determined by the exams held at the end of the semester. Today (before the semester begins), the place for the essay was decided in a teachers' meeting. One of the teachers says]
[[[koo-seeseki-o osame-ta (t_4)] gakusee-ga kak-u (t_3)] sakubun-o tenji-su-ru (t_2)]
good-grade-ACC get-PST student-NOM write-NPST essay-ACC exhibit-do-NPST
basyo-o kettee-si-ta
place-ACC decide-do-PST
[Intended] 'We decided on a place [where we would exhibit an essay [that a student [who got good grades] wrote]].'

This sentence does not have the interpretation where t_4 is before t_2 but after t_3, which is visualized in Figure 5.

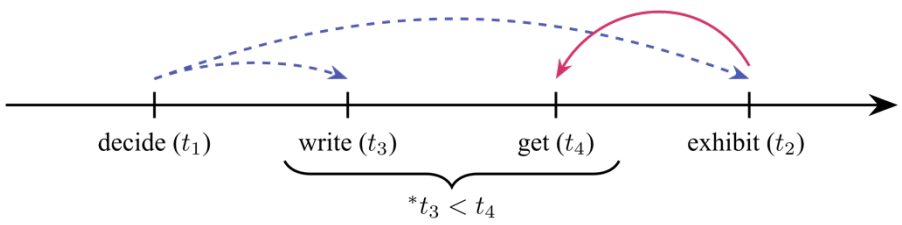

Figure 5: Temporal Interpretation of (9) That Would Be Available if the EvT of t_4 Were t_2

Since the event order is given by the context, there should be no lexical or knowledge-based effect that makes the interpretation in Figure 5 pragmatically odd. Hence, (8) allows this interpretation (by choosing t_2 as the EvT of t_4), contrary to the fact. In contrast, it follows from our proposed statement (7) that the EvT of t_4 is t_3, as it is the *nearest* nonpast-tensed clause. Thus, (7) correctly ensures that t_4 must be before t_3, ruling out the unavailable interpretation. Based on this argument, we reject the counterhypothesis (8) and adopt (7).

4 Formal Account

Having established an empirical generalization, we proceed to its formal analysis. The nontrivial question here is how to compositionally derive the clause skipping interpretations, which involve a dependency going over the boundary of a tensed clause. Moreover, we need to account for how those interpretations are constrained by the tense forms of the clauses. While we admit the possibility of formulating a syntactic account (cf. Ogihara 1996, Kusumoto 1999), we adopt a semantic approach here. Namely, our proposed account predicts the EvT of a relative clause as a result of semantic composition, with no special syntactic operations.

4.1 Time Interval List

At the core of our account is the idea of employing finite sequences of time intervals $[t_1; \ldots; t_n]$ (Kaufmann & Miyachi 2011), which we call 'time interval lists'. To motivate the introduction of this formal device, consider how the temporal interpretation of a relative clause can be derived in a bottom up manner. Following the generalization (7), we cannot determine the EvT of a relative clause independently from the surrounding environment; we need to 'wait' until the opposite tense form appears in a higher clause (7a) or the whole sentence is completed (7b). Thus, relative clauses need to have access to the RTs of all of their higher clauses, since each of them has the potential to provide the EvT.

This desideratum can be met by assuming that a relative clause can refer to the list of RTs. More concretely, we introduce the semantic type σ of time interval lists and analyze verb phrases as functions taking an argument of type σ. One additional assumption we make is that each element of a time interval list is associated with a feature indicating the tense form of the clause. Below, we illustrate the point via an abstract configuration with embeddings of depth n.

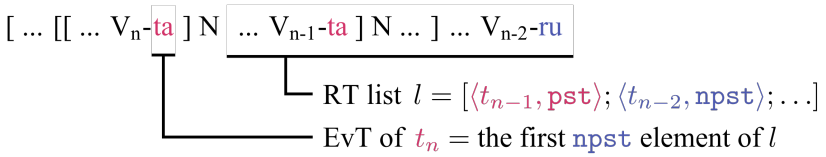

Figure 6: Illustration of a Time Interval List

Here, the time interval list for the past-tense morpheme of the deepest clause has $n-1$ elements (although the specific value of n is not specified until the whole sentence is formed). Each element has the form $\langle t_i, \alpha_i\rangle$, indicating that the i-th clause has the RT t_i and the tense α_i. Given this setting, the EvT of t_n here can be formalized as the time interval t_i with the largest i satisfying $\alpha_i =$ npst (in this case, $i = n-2$), which exactly amounts to the RT of the nearest higher clause with the opposite tense form.

Before presenting a precise formalization of this idea, let us give a preliminary sketch of how to incorporate time interval lists into the lexical semantics of verb stems. (10) shows a standard way of defining the meaning of a verb stem. x is the denotation of the subject, and t is the RT of the clause, which constrains the duration $\tau(e)$ of the event e. Following Champollion (2015), we introduce the event quantification $\exists e$ in the lexical entries of predicates (instead of using a covert operator) and use the variable f for adverbial modifiers, although this choice is only for concreteness and does not directly bear on the issue at hand.

(10) $[\![\text{ki}]\!] = \lambda x.\lambda t.\lambda f.\exists e.\big(\text{come}(e,x) \wedge \tau(e) \subseteq t \wedge f(e)\big)$

Now, we can simply replace the RT t with the list of RTs l, as shown in (11), where head is the function that takes the first RT of the list (i.e. the RT of the current clause).

(11) $[\![\text{ki}]\!] = \lambda x.\boldsymbol{\lambda l}.\lambda f.\exists e.\big(\text{come}(e,x) \wedge \tau(e) \subseteq \mathbf{head}(\boldsymbol{l}) \wedge f(e)\big)$

4.2 Deriving the Temporal Interpretations

We formalize the idea sketched above with categorial grammar, while the concept itself is independent of the choice of framework. Concretely, we adopt Combinatory Categorial Grammar (Steedman 2000), building on some previous studies of Japanese syntax and morphology (e.g. Bekki 2010). In this framework, a lexical entry associates form and meaning with a syntactic category. For example, the lexical entry of the verb stem *ki* 'come' is as below.

(12) $\text{ki} \coloneqq V \setminus NP_{ga} : \lambda x.\lambda l.\lambda \text{f}.\exists e.\big(\text{come}(e,x) \wedge \tau(e) \subseteq \text{head}(l) \wedge f(e)\big)$

Here, the category $V \setminus NP_{ga}$ indicates that *ki* combines with a noun phrase NP (with the feature for the nominative case) to its left and results in a verb phrase V. To put it more generally, the category of the form B/A (resp. $B \setminus A$) requires a constituent of category A to its right (resp. left) to form a constituent of category B. This behavior is specified in the function application rules shown in (13).

(13) a. $B / A : f \quad A : a \implies B : fa$ (forward application >)
b. $A : a \quad B \setminus A : f \implies B : fa$ (backward application <)

Note that these rules also specify how semantic representations are composed. In both cases, the function f is applied to the argument a. Thus, in this framework, syntactic formation and semantic composition proceed 'in tandem', making it easier to present a compositional analysis.

Given these preliminaries, we propose the lexical entries of the tense morphemes. In what follows, we assume that Japanese tense morphemes are ambiguous as to whether they form a relative clause or not. In the latter case, a tense morpheme is formalized as a function that turns a verb phrase V into a tense phrase S, as exemplified in (14).

(14) $\text{ta} \coloneqq S \setminus V : \lambda\varphi.\exists t.\big(t < \text{ST} \wedge \varphi([\langle t, \text{pst}\rangle])(\lambda e.\top)\big)$

In the semantic representation, *ta* existentially quantifies the RT t, which satisfies $t <$ ST, and passes two arguments to φ. The first one $[\langle t, \text{pst}\rangle]$ initializes the time interval list. The second one $\lambda e.\top$ specifies that no adverbial modification can apply to the event variable afterward. To illustrate how this works, consider the following derivation of *kaoru-ga ki-ta* 'Kaoru came'.

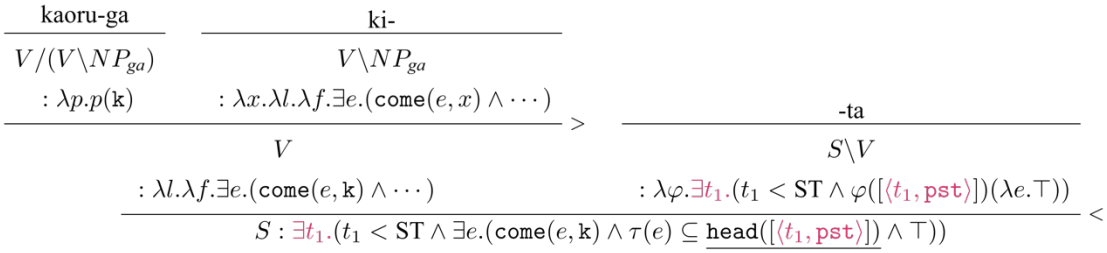

Figure 7: Derivation of *kaoru-ga ki-ta* 'Kaoru came'

Here, the subject and the verb stem are first combined (note that the subject is handled as a generalized quantifier). Then, the tense morpheme is applied to this V, resulting in a constituent of category S. In its semantic representation, the underlined part reduces to t_1, correctly deriving the interpretation of the sentence. We remark that the semantic feature pst is at work only during semantic composition, without affecting the interpretation itself.

Next, we turn to the lexical entries of the tense morphemes forming a relative clause. We assume that they turn $V \setminus NP$ (a verb phrase missing one NP argument) into N / N (a noun modifier). (15) shows a concrete lexical entry for the past-tense morpheme.

$$\text{(15)}\quad \text{ta} \coloneqq (N/N) \setminus (V \setminus NP) : \lambda p.\lambda n.\lambda x.\lambda l.\exists t.(t < \text{find}(l, \text{npst}) \wedge p(x)(\langle t, \text{pst}\rangle :: l)(\lambda e.\top) \wedge n(x)(\langle t, \text{pst}\rangle :: l))$$

There are two critical parts in the semantic representation. First, we introduce a function $\text{find}(l, \alpha)$, which returns t of the first element of l that has the form $\langle t, \alpha\rangle$ (if there is no such element, it returns the last element of l). Hence, the formula $t < \text{find}(l, \text{npst})$ in (15) directly reflects the generalization (7). Second, we pass $\langle t, \text{pst}\rangle :: l$ (the list l extended with $\langle t, \text{pst}\rangle$) to p and n, thereby ensuring that t is the RT of this relative clause. To examine these points, consider (2a), the P_2N_1 case. Below, we show the derivation in two parts.[2] We can see that the underlined part of the resultant semantic representation reduces to t_1, correctly predicting the EvT of t_2.

[2] Here are some remarks about the derivation. $\emptyset_\exists$ is an unpronounced operator for an indefinite article. For simplicity, we have omitted the case particle *ga* (see Bekki 2010 for a categorial grammatical analysis of case particles). We have also simplified the contribution of the nonpast tense as $t_1 >$ EvT, leaving the proper treatment of stative predicates for another occasion (see Kaufmann & Miyachi 2011 for a solution with time interval lists).

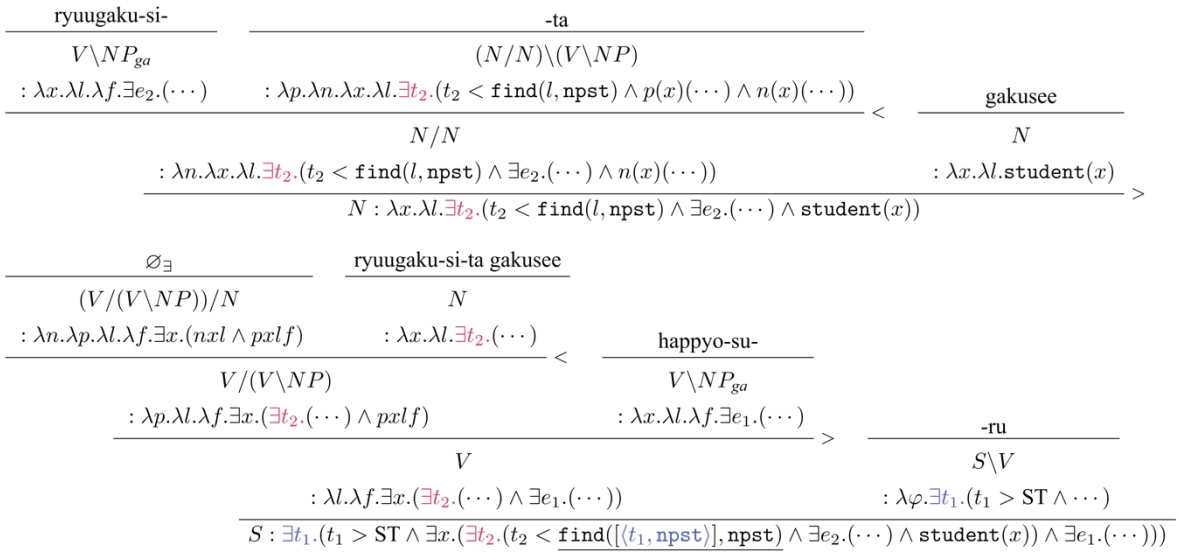

Figure 8: Derivation of (2a)

Notably, this analysis immediately extends to multiply embedded clauses. Below we show the semantic representation of the $P_3P_2N_1$ case, abstracting away the irrelevant details. The function find returns t_1, thereby yielding the clause skipping interpretation, as desired.

$$\exists t_1.\cdots\exists t_2.\cdots\exists t_3.\ (t_3 < \underline{\texttt{find}([\langle t_2, \texttt{pst}\rangle; \langle t_1, \texttt{npst}\rangle], \texttt{npst})}\cdots)$$

Figure 9: Outline of the Semantic Representation of the $P_3P_2N_1$ Case

5 Conclusion and Future Work

This article has presented a detailed investigation of relative tense in Japanese, focusing on multiply embedded relative clauses. The main finding is that a multiply embedded relative clause may be evaluated from the RT of a nonimmediately higher clause. We have demonstrated that this clause skipping interpretation is constrained by the tense forms of the clauses and proposed a novel empirical generalization (7). We have also presented a formal analysis of the observed temporal interpretations by employing time interval lists, which enable us to capture the proposed generalization in a compositional manner.

Future work should examine the validity of our proposed generalization in terms of other kinds of subordinate clauses and other languages with relative tense (e.g. Korean; Yoon 1996). In addition, detailed scrutiny is necessary in order to reveal the behavior of stative predicates in multiply embedded environments. It has often been stated that the state denoted by an embedded nonpast stative predicate must contain the EvT (e.g. Mihara 1992). However, this assumption can be challenged by the observation by Oshima (2009) with a doubly embedded stative predicate.

(16) 2-nen-mae, Ken-wa [[Kanbozia-de NGO-katudoo-o site-i-ru (t_3)] zyosee-ga
2-years-ago K-TOP Cambodia-LOC NGO-activity-ACC do-be-NPST woman-NOM
kai-ta (t_2)] hon-o yon-da (t_1)
write-PST book-ACC read-PST
'Two years ago, Ken read a book written by a woman working for an NGO in Cambodia.'
(adapted from Oshima, 2009: (21), glosses modified)

Oshima reported that (16) can be interpreted as locating the period of the woman's activity over Ken's reading event (t_1). Assuming that the EvT of t_3 is t_2 (based on the generalization (7)), this observation implies that the state can be 'shifted' to the future relative to the EvT. Because such a shifted future reading is possible for matrix stative predicates, embedded stative predicates may also allow this interpretation in general, contrary to the traditional assumption. A systematic study of this point is left for future work.

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