Relative Tense in Japanese: A Case of Multiply Embedded Relative Clauses

Relative tense locates the reference time (RT) based on some context-dependent time, not necessarily the speech time (ST) [1]. This phenomenon can be observed with Japanese subordinate clauses, and there have been many descriptive and formal analyses of their behavior [e.g., 2, 3, 4], most of which, however, focused only on a single level of embedding. We observe that Japanese multiply embedded relative clauses (RCs) can have a relative-tense interpretation that depends on their non-immediately higher clauses, which we then formally analyze.

Background (1) illustrates relative tense ($[\cdots]$ indicates the RC).

(1) [*ki-ta* (t_2)] *gakusei-ga* *hasir-u* (t_1)
come-PST student-NOM run-NPST

"A student who has come will run."

As Figure 1 shows, the time from which the past tense of the RC is evaluated (*evaluation time*; EvT) is the RT of its matrix clause (t_1), not ST.

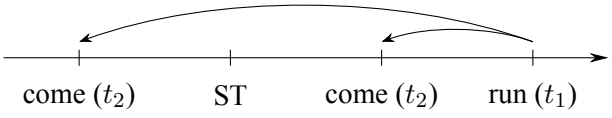


Figure 1: Temporal interpretation of (1).

Observation Consider (2) and Figure 2. With (a), the EvT of the deepest clause is the RT of its matrix clause (t_2). With (b), however, t_3 is not necessarily before t_2, meaning the EvT is t_1.

(2) [[*kansensyoo-o hassyoosi-ta* (t_3)] *hito-ga* {(a) *tuka-u* / (b) *tukat-ta*} (t_2)]
infection-ACC develop-PST person-NOM use-NPST use-PST
heya-o *syokuin-ga* *soojisu-ru* (t_1)
room-ACC employee-NOM clean-NPST

"An employee will clean a room that a person who has developed an infection {(a) has used / (b) will use}."

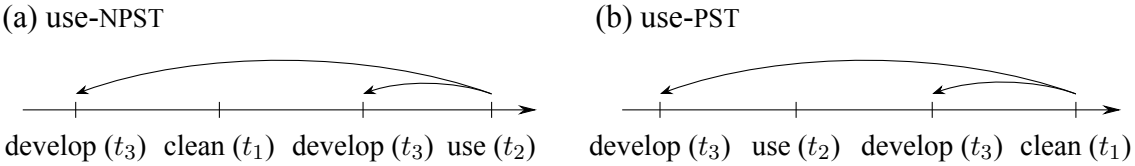


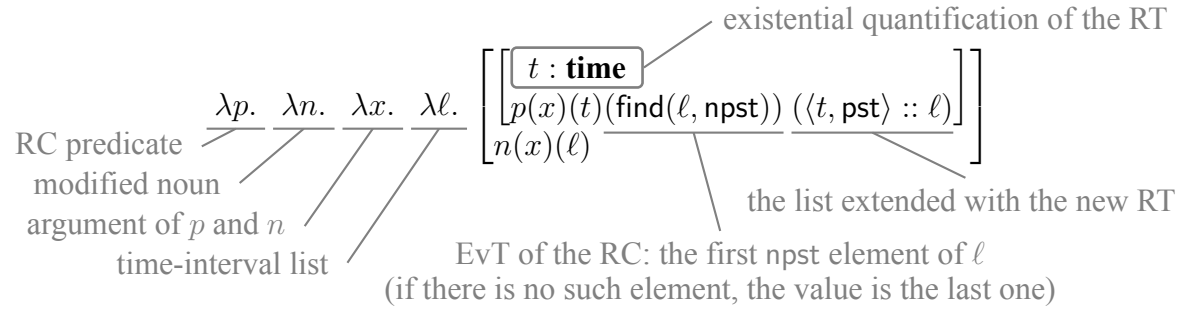
Figure 2: Temporal interpretation of (2). ST is omitted for brevity.

Therefore, the EvT of an RC may be the RT of a non-immediately higher clause as if the matrix clause were "skipped," which was not expected in previous studies. Given this evidence, we propose the following criterion.

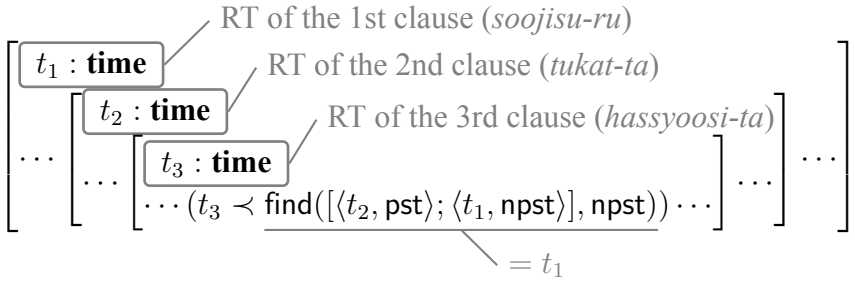
(i) The EvT of an RC is the RT of its nearest higher clause with the opposite tense form (unless the noun phrase with the RC is anaphoric or specific). If there is no such clause, the EvT is the RT of the outermost clause.

Analysis To formalize (i), we utilize *lists* of time intervals [4] with constants for tense forms (e.g., $[\langle t, \mathsf{pst}\rangle; \langle t', \mathsf{npst}\rangle, \ldots]$). Then, (i) amounts to searching a list for an appropriate pair $\langle t, F\rangle$ from head to tail. We implement this search with *dependent type theory* [5], which provides a computationally robust way to handle lists.

Concretely, adopting Dependent Type Semantics [6, 7], we define the following semantic representation for a null morpheme equivalent to the relative pronoun of a past-tensed RC (the non-past version is similarly defined).



Below is the outline of the semantic representation for (2b), where the EvT of t_3 is calculated as t_1, as required.



Thus, we can compositionally derive semantic representations even when the EvT of an RC is given over the boundary of its matrix clause.

References **[1]** B. Comrie. *Tense*. Cambridge University Press, 1985. **[2]** K. Mihara. *Jisei-kaisyaku to Toogo-gensyoo* [Temporal Interpretation and Syntactic phenomena]. Kuroshio, 1992. **[3]** T. Ogihara. *Tense, Attitudes, and Scope*. Kluwer Academic Publishers, Dordrecht, 1996. **[4]** S. Kaufmann and M. Miyachi. On the temporal interpretation of Japanese temporal clause. *Journal of East Asian Linguistics*, 20(1):33–76, 2011. **[5]** P. Martin-Löf. *Intuitionistic Type Theory*. Bibliopolis, Naples, 1984. **[6]** D. Bekki and K. Mineshima. Context-Passing and Underspecification in Dependent Type Semantics. In S. Chatzikyriakidis and Z. Luo, editors, *Modern Perspectives in Type-Theoretical Semantics*, pages 11–41. Springer International Publishing, Cham, 2017. **[7]** M. Utsugi. *Izongata-imiron ni yoru Nihongo no Tensu no Bunseki* [Analysis of Japanese Tense with Dependent Type Semantics]. Master's thesis, Ochanomizu University, 2017.