Japanese gapless relativization: The syntax-prosody interface to semantics

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This paper presents an analysis of Japanese gapless relativization (GR) in the framework of Lexical Functional Grammar. To this end, this study involves three proposals: (1) in GR, the relative clause (RC) involves an argument with the thematic role rel(ative) which represents some underspecified semantic relationship of the relativized argument with the event; (2) a gapless relative clause (and, possibly, gapped relative clauses in general) involves a non-subcategorizable grammatical function REL(ative) that shares the structure with the head noun; (3) in (Tokyo) Japanese, which lacks a morphosyntactic marking for relativization, the REL argument is introduced at the syntax-prosody interface instead. The semantic notation in this study follows Neo-Davidsonian event semantics. Note that we use the term "gapless" following the previous literature, though LFG does not postulate syntactic movement.

Overview of GR in Japanese. GR is a kind of relativization of NP where the gap for the head noun is not found in the modifying RC. In languages like Japanese, in addition to relativizing a subject (1 b), an object (1 c), and an oblique (1 d) all derived from (1 a), it is possible to relativize a noun that is not subcategorized by the embedded predicate as exemplified in (2). Nevertheless, GR is lexically restrictive and only selects a head noun related to the embedded event in some way; in (2), the expression implies that the sound was caused by the embedded event (i.e., the cat's catching of the mouse).

(1) (a) *neko=ga* *ie=de* *nezumi=o* *tukamaeta*
cat=NOM house=LOC mouse=ACC caught
'The cat caught the mouse in the house'

(b) [___$_i$ *ie=de* *nezumi=o* *tukamaeta*] *neko*$_i$
house=LOC mouse=ACC caught cat
'The cat that caught the mouse in the house'

(c) [*neko=ga ie=de* ___$_i$ *tukamaeta*] *nezumi*$_i$

(d) [*neko=ga* ___$_i$ *nezumi=o tukamaeta*] *ie*$_i$

(2) [*neko=ga* *nezumi=o* *tukamaeta*] *oto*
cat=NOM mouse=ACC caught sound
'The sound (that is caused by the event where) the cat caught the mouse'

Issues of GR in Semantics. In formal semantics, the semantic composition of a relativized NP with a gap can be computed by assuming the Predicate Modification (PM) rule expressed in (3) (Heim and Kratzer, 1998, p. 65). Therefore, in the Neo-Davidsonian representation, the semantics of (1 b) is derived as in (4), assuming that *neko* "cat" is of type $\langle e, t\rangle$. However, this generalization becomes problematic with GR like (2), because there is no free variable in the RC, and the PM rule is not applicable.

(3) If a branching node γ has only two nodes α and β as its daughters, $\alpha \rightsquigarrow \alpha'$, $\beta \rightsquigarrow \beta'$, and α' and β' are both of type $\langle e, t\rangle$, then $\gamma \rightsquigarrow \lambda x.\alpha'(x) \wedge \beta'(x)$.

(4) (a) *nezumi* "mouse" $\rightsquigarrow m$, *ie* "house" $\rightsquigarrow h$, *tukamaeta* "caught" $\rightsquigarrow \lambda e.\mathsf{catch}(e)$, *neko* "cat" $\rightsquigarrow \lambda x.\mathsf{cat}(x)$

(b) "x caught the mouse in the house" $\rightsquigarrow \lambda x \exists e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, x) \wedge \mathsf{theme}(e, m) \wedge \mathsf{loc}(e, h)$

(c) $\lambda x \exists e.\mathsf{cat}(x) \wedge \mathsf{catch}(e) \wedge \mathsf{agent}(e, x) \wedge \mathsf{theme}(e, \mathsf{m}) \wedge \mathsf{loc}(e, \mathsf{h})$ (by the PM rule)

Analysis by Cha (1999) and its problems. Cha (1999) proposes a solution to this problem for Korean GR, which has similar characteristics to Japanese GR. To represent the relationship between the embedded event and the head noun, Cha assumes a "special predicate" $\boldsymbol{P}(e, x)$ that takes an event of type v and an entity of type e as its arguments. In this approach, the GR in (2) would look like (5), where $\boldsymbol{P}$ follows the other Neo-Davidsonian conjuncts.

$\boldsymbol{P}$ only specifies that the event and the entity share some relationship reasonably inferred from the context and syntax, and it does not represent any specific relationship at the level of semantics. Cha further generalizes this claim and argues that canonical relativization with a gap also includes $\boldsymbol{P}$, where $\boldsymbol{P}$ is interpreted to be semantically vacuous. However, Cha (1999) does not demonstrate the detailed semantic derivation of the desired expression, and in particular, does not explicitly explain at which point in LF $\boldsymbol{P}$ is introduced and what semantic operations are involved to compute $\boldsymbol{P}$ as vacuous with a gap and as contentful with GR. It also fails to explain what allows GR in some languages but not in others.

(5) $\lambda x \exists e.\mathsf{sound}(x) \wedge \mathsf{catch}(e) \wedge \mathsf{agent}(e, \mathsf{c}) \wedge \mathsf{theme}(e, \mathsf{m}) \wedge \mathsf{loc}(e, \mathsf{h}) \wedge \boldsymbol{P}(e, x)$

Proposal 1: Thematic role rel**(ative).** Rather than depending on an underdefined predicate $\boldsymbol{P}$, we seek our solution in the fact that the head noun is semantically related to the event in some way but is not overtly subcategorized by the embedded predicate; to this end, we introduce the thematic role rel(ative). Suppose that the meaning constructors of each lexical entry are as defined in (6). We make an additional assumption that we have a thematic role REL in the lexicon, which will be supported later by the evidence from the syntax-prosody interface. Also, we assume here that the conjuncts of thematic roles for *tukamaeta* "caught" are lexically defined, while it is the meaning constructor of REL role θ_{REL} that specifies the conjunction of REL argument with the event predicate. Similarly to canonical RCs, the relativized argument in the RC (i.e., REL) is first introduced by a conditional proof assumption, which is to be abstracted before applying the PM rule with the head (relativized) noun. The process of derivation to obtain the meaning of (2) is shown in Figure 1. See also Coppock and Champollion (2022, p. 443–449) for a detailed discussion on the semantic representation of thematic roles.

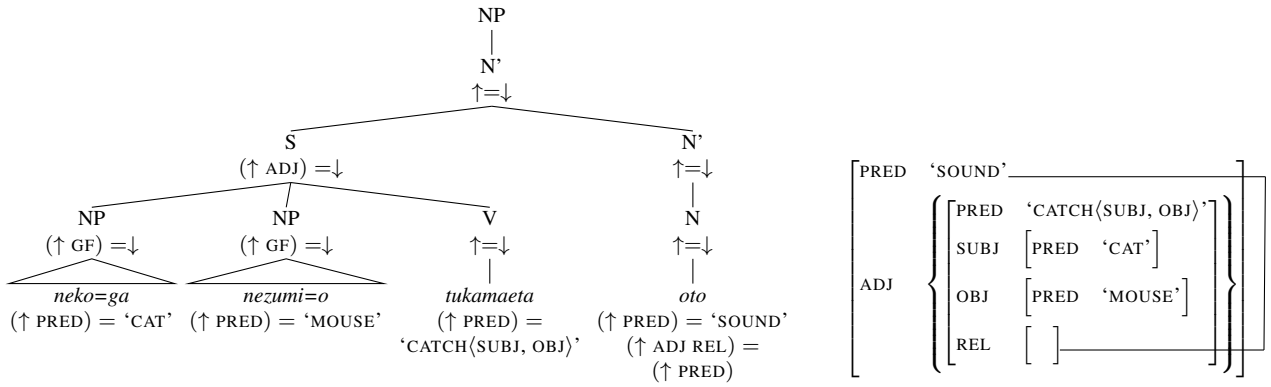
(6)

Lexicon	Meaning constructor
neko	$\mathsf{c} :\uparrow_\sigma$
nezumi	$\mathsf{m} :\uparrow_\sigma$
tukamaeta	$\lambda y \lambda x \lambda e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, x) \wedge \mathsf{theme}(e, y) : (\uparrow \text{OBJ})_\sigma \multimap (\uparrow \text{SUBJ})_\sigma \multimap (\uparrow \text{EV})_\sigma \multimap \uparrow_\sigma$
oto	$\iota x.\mathsf{sound}(x) :\uparrow_\sigma$
θ_{REL}	$\lambda x \lambda V \lambda f.V(\lambda x.\mathsf{rel}(e, x) \wedge f(e)) :$ $(\uparrow \text{ARG})_\sigma \multimap (((\uparrow \text{EV})_\sigma \multimap \uparrow_\sigma) \multimap \uparrow_\sigma) \multimap (((\uparrow \text{EV})_\sigma \multimap \uparrow_\sigma) \multimap \uparrow_\sigma)$

$$\dfrac{\dfrac{\dfrac{\dfrac{\lambda y \lambda x \lambda e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, x) \wedge \mathsf{theme}(e, y) \quad \mathsf{m}}{\lambda x \lambda e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, x) \wedge \mathsf{theme}(e, \mathsf{m})} \quad \mathsf{c}}{\text{EC}\ \dfrac{\lambda e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, \mathsf{c}) \wedge \mathsf{theme}(e, \mathsf{m})}{\exists e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, \mathsf{c}) \wedge \mathsf{theme}(e, \mathsf{m})} \qquad \dfrac{\lambda x \lambda V \lambda f.V(\lambda e.\mathsf{rel}(e, x) \wedge f(e)) \quad x_1}{\lambda V \lambda f.V(\lambda e.\mathsf{rel}(e, x_1) \wedge f(e))}\ \text{CPA}}}{\dfrac{\lambda f.\exists e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, \mathsf{c}) \wedge \mathsf{theme}(e, \mathsf{m}) \wedge \mathsf{rel}(e, x_1) \wedge f(e)}{\exists e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, \mathsf{c}) \wedge \mathsf{theme}(e, \mathsf{m}) \wedge \mathsf{rel}(e, x_1)}\ \text{QC}}}{\dfrac{\lambda x \exists e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, \mathsf{c}) \wedge \mathsf{theme}(e, \mathsf{m}) \wedge \mathsf{rel}(e, x)}{\exists e.\mathsf{catch}(e) \wedge \mathsf{agent}(e, \mathsf{c}) \wedge \mathsf{theme}(e, \mathsf{m}) \wedge \mathsf{rel}(e, \iota x.\mathsf{sound}(x))} \quad \iota x.\mathsf{sound}(x)}$$

Figure 1: Proof tree for (4 c) from the premises in (6). EC is an abbreviation for existential closure, QC for quantifier closure, and CPA for conditional proof assumption. Here *oto* is assumed to be an entity by the iota operator.

Proposal 2: Syntax of GR. This part discusses the REL argument in the c- and f-structures that are to be mapped to the semantic structure. As done in Proposal 1, gapless RCs are treated similarly to gapped RCs in the sense that the relativized head noun shares the structure with its corresponding argument in the RC. This structure sharing is expressed as the linking line in Figure 2b. Naturally, the information of the structure sharing is included in the lexical entry of *oto* "sound", as described in Figure 2a.



(a) c-structure (b) f-structure

Figure 2: c- and f-structures for (2). Other grammatical information such as tense is omitted for simplicity.

Proposal 3: Introducing REL at the syntax-prosody interface. Thus far our discussion has assumed that the REL argument exists in syntax, even though there is no syntactic word that directly expresses it.[1] This proposal argues that the REL argument is introduced at the level of syntax-prosody interface based on the evidence from pitch assimilation in Tokyo Japanese. Tokyo Japanese has a pitch accent system where either a high or low tone is assigned to each mora. As shown in (7), in a natural speech, the low pitch in the first mora of /ò.tó/ assimilates to the high pitch of the preceding word when *oto* is relativized; the pitch without the assimilation sounds unnatural, as noted with double question marks. This assimilation process has been reported in various studies (Uyeno et al., 1980; Jun and Koike, 2003). Following Jun (2003), these prosodic words (PW) form a unit as an accentual phrase (AP). Thus, Japanese relativization is marked by prosody, and the syntax–prosody interface gives rise to the f-description (↑ ADJ REL) = (↑ PRED) in the modified lexical entry. As for gapped RCs, since the relativized argument with a core grammatical function (e.g., the subject in (1 b)) is retrievable from syntax, the value of REL also shares the structure with the core grammatical function; in this case, REL can be ignored as it would be a redundant representation. Therefore, all the RCs (or possibly all the adnominal modifiers) in Japanese may involve REL essentially. Lastly, this analysis also explains why GR is not language-universal because the introduction of REL is constrained at the levels of prosody and syntax that show variability across languages. In sum, (Tokyo) Japanese introduces REL at the syntax–prosody interface, and the mapping propagates from the c- and f-structures to the semantic structure, where the semantic composition is well-formed with the proposed thematic role function rel.

(7)	Form	Hierarchy	Pitch (split by mora)	Translation
	tukamaeta	PW	/tù.ká.má.é.tá/	"caught"
	oto	PW	/**ò**.tó/	"sound"
	tukamaeta oto	AP	/tù.ká.má.é.tá.**ó**.tó/	"sound of (something's) catching (of something)"
			??/tù.ká.má.é.tá.ò.tó/	

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[1] Modern Japanese verbs have lost the inflectional distinction between the adnominal and finite forms.