Stativity and progressive: The case of Japanese '*tokoro-da*'[1]

Magdalena KAUFMANN — *University of Connecticut*
Stefan KAUFMANN — *University of Connecticut*

Abstract. The Japanese noun '*tokoro*' (lit. 'place') has a grammaticalized variant with a temporal interpretation (Takubo 2011). Syntactically, this variant behaves like a noun and is typically modified by a sentence (or a suitable proform). The resulting NP '*S-tokoro*' roughly means 'time at which S'. With the copula '*da/datta*' (Nonpast/Past) it can form a matrix sentence; but on its own it can also be used as a temporal adverbial. In these respects it is similar to other temporal expressions like '*S-mae*' ('time before S'), '*S-ato*' ('time after S), and '*S-toki*' ('time at which S'). But the acceptability and interpretation of '*S-tokoro*' interacts with the temporal and aspectual properties of '*S*' in puzzling ways. Focusing on matrix uses in this paper (embedded ones being similar), we develop an analysis that accounts for those interactions.

Keywords: tense, aspect, temporal adverbs, modality, counterfactuality, progressive, Japanese

1. Introduction

The Japanese noun '*tokoro*' (lit. 'place') has a grammaticalized variant as a "formal noun" (形式名詞), a dependent category taking a sentential complement to form a compound which behaves outwardly like a noun phrase. In this paper we focus on sentences formed of such an '*S-tokoro*' phrase and a tensed form of the copula '*da*', shown schematically in (1).[2]

(1) [[Sentence] tokoro] { da / datta }

Here Sentence stands for a tensed clause and '*da, datta*' are the Nonpast and Past forms of the copula. On the temporal interpretation of '*tokoro*' (other readings are possible, see below), (1) locates the matrix reference time relative to a time at which Sentence is or was true. The temporal and aspectual properties of Sentence play a crucial role in determining both whether the construction as a whole is well-formed, and if it is, how it is interpreted. Our goal in this paper is to give a semantic analysis which accounts for these interactions. The observation we are most interested in is that only non-stative and progressive Sentences are allowed under temporal '*tokoro*', whereas lexical statives and perfects are not.

[1]This paper is part of an extensive ongoing project with Yukinori Takubo, to whom we are grateful for much inspiration and discussion. However, the analysis presented here is our own and differs from his in important respects. We are also grateful to Setsuko Arita, Ikumi Imani, Yuya Okawa, Yukiko Atarashiya, the audiences the workshop on *Modality as a window on cognition* (19th International Congress of Linguistics, Geneva, 2013), the Meikai University Linguistics Colloquium (2015), Sinn und Bedeutung 21 (Edinburgh, 2016), and the Meaning Group at the University of Connecticut (2016), for comments and discussion. Part of this work was carried out during a semester at Kyoto University in Fall, 2015. We are grateful to Yukinori Takubo, the Japan Society for the Promotion of Science (Grant L-15504), and Kyoto University for their hospitality and support.

[2]'*S-tokoro*' can also occur in other environments, but its interpretation in such contexts does not differ significantly from that in (1), so we focus on the latter for the purposes of this paper.

1.1. Temporal '*tokoro*' with non-statives

Our analysis of the tenses follows Kaufmann and Miyachi (2011; henceforth KM11). Sentences denote binary relations between temporal intervals, i.e., sets of pairs $\langle i, j \rangle$. In a non-stative like (2a), the relation holds if and only if (i) j is the temporal trace of an event of Jon putting on a red jacket; and (ii) either $i < j$ (for Nonpast) or $j < i$ (for Past). In Reichenbachian terms, in matrix contexts i and j correspond to speech and reference time, respectively.

(2) a. Zyon-ga akai zyaketto-wo { ki-ru / ki-ta }
Jon-NOM red jacket-ACC put on-NONPAST put on-PAST
'Jon { will put on / put on } a red jacket'
b. [Zyon-ga akai zyaketto-wo ki-ru] tokoro { da / datta }
'Jon { is / was } just about to put on a red jacket'
c. [Zyon-ga akai zyaketto-wo ki-ta] tokoro { da / datta }
'Jon { has / had } just put on a red jacket'

In (2b), the Nonpast version of (2a) is embedded under '*tokoro*' and the tensed copula. We aim to give (2a) a uniform analysis for matrix and embedded contexts, thus we assume that, as in (2a), the embedded clause '*Zyon-ga akai zyaketto-wo ki-ru*' denotes a binary relation between intervals $\langle i, j \rangle$. Now, however, i and j correspond to the reference times of the matrix clause and the embedded clause, respectively. Thus for (2b) and (2c) to be true, the matrix reference time must **precede** and **follow** that of the embedded clause, respectively. In both of (2b,c), the relation between the speech time and the matrix reference time is constrained by the tense on the copula. The presence of '*tokoro da/datta*' means that (2b,c) are stative (in contrast to the non-stative (2a)). In this case, a co-temporal reading is available for Nonpast '*datta*' under which speech and reference time coincide.

Thus (2b,c) basically assert that the reference time is/was **before** or **after** the dressing event, respectively. One may wonder how they differ from their counterparts with '*mae*' and '*ato*', the more canonical Japanese counterparts of '*before*' and '*after*'. We discuss this relationship in some detail below. For now, suffice it to say that (2b,c) are indeed close in meaning to their counterparts in (3a,b), with the important difference that (2b,c) carry a connotation of **immediacy**, expressed in (2) in our gloss using English '*just*', which (3a,b) lack.

(3) a. [Zyon-ga akai zyaketto-wo ki-ru] { mae / *ato } { da / datta }
'Jon { is / was } just about to put on a red jacket'
b. [Zyon-ga akai zyaketto-wo ki-ta] { *mae / ato } { da / datta }
'Jon { has / had } just put on a red jacket'

1.2. Temporal '*tokoro*' with lexical statives

Stative clauses also denote binary relations between intervals but there are differences in detail which lead to markedly different patterns in well-formedness and interpretion under '*tokoro*'.

In matrix-level statives, the interpretation is similar to that of non-statives, except that Nonpast allows for speech and reference time to coincide. Thus in terms of the relationship between i, j, we have $j < i$ for Past (as with non-statives) and $i \leq j$ for Nonpast (cf. $i < j$ for non-statives). In embedded contexts, however, i must be contained in j; as a consequence, Past tense is disallowed (hence the ill-formedness of (4c)) and Nonpast lacks the futurate interpretation on which $i < j$. These facts are shared across a range of embedding contexts (see KM11 for data and discussion), but '*tokoro*' adds even more constraints: the embedded Nonpast in (4b) is also peculiar. Most informants judge it to be marginal and, if acceptable at all, restricted to the **counterfactual** reading indicated in the gloss.

(4) a. Ie-ni { i-ru / i-ta }
home-LOC be-NONPAST be-PAST
'I { {am/will be} / was } at home.'
b. ?[Ie-ni i-ru] tokoro { da / datta }
'I would { be / have been } at home.'
c. *Ie-ni i-ta tokoro { da / datta }

In this paper we aim to explain the absence of a temporal reading for (4b). We leave the analysis of the counterfactual reading for another occasion.

1.3. Temporal '*tokoro*' with derived statives

In addition to lexical statives, Japanese has aspectual operators which form **derived statives** from eventive complements. A well-studied expression of this kind is the suffix '*-tei-*', which combines with the stems of non-stative verbs[3,4] and can have either **progressive** or **perfect** readings, depending on the aspectual properties of the complement and contextual factors. This is illustrated by (5b), which has the two readings indicated in the translation.

(5) a. Zyon-ga akai zyaketto-wo { ki-tei-ru / ki-tei-ta }
Jon-NOM red jacket-ACC wear-TEI-NONPAST wear-TEI-PAST
Progressive: 'Jon { is / was } putting on a red jacket'
Perfect: 'Jon { is / was } wearing a red jacket'
b. [Zyon-ga akai zyaketto-wo ki-tei-ru] tokoro { da / datta }
Progressive: 'Jon { is / was } putting on a red jacket'
Perfect: 'Jon would { be / have been } wearing a red jacket'
c. *[Zyon-ga akai zyaketto-wo ki-tei-ta] tokoro { da / datta }

That one morpheme should have these two seemingly incompatible uses is puzzling and has made '*-tei-*' one of the most written-about expressions in the Japanese linguistic literature. We postpone further discussion to the analysis below. For now, we only point out that the sentences derived with '*-tei-*' exhibit an intriguing behavior when combined with '*tokoro*', as

[3]Certain other derivational morphemes can intervene between the verb stem and '*-tei-*', for instance Passive, Causative and Potentialis, but not Negation. The details are not relevant here.

[4]The claim that '*-tei-*' combines only with non-statives is widely accepted in the literature. Incompatibility with '*-tei-*' is Kindaichi's (1950; 1976) main diagnostic for the class of stative verbs in his taxonomy (jôtaidôsi).

shown in (5b): On the Progressive reading of '*-tei-*', '*tokoro*' adds a purely temporal interpretation meaning 'while/when', even though no such interpretation is available either with lexical statives, which force a counterfactual reading in this case (cf. (4b)), or with eventives, on which the temporal interpretation would be 'before' (cf. (2b)). On the Perfect reading of '*-tei-*', the sentence patterns with lexical statives in that only a counterfactual reading is available. Notice also that (5c) patterns with stative (4c) and not with eventive (2c) in that the string is ill-formed.

This is the main puzzle to be addressed in this paper: On the one hand, Progressive and Perfect are generally considered derived statives, and the Japanese examples exhibit some properties that are expected under this analysis (e.g., the ill-formedness of (5c) and the relationship between the matrix and embedded reference times in (5b)). On the other hand, under '*tokoro*' the Perfect is restricted to a counterfactual reading like other statives, while the Progressive has a temporal reading – which, however, is unlike that obtained with non-statives.

2. Theoretical background

We develop our analysis in a slightly simplified version of the framework introduced by KM11.[5] The major ingredients are shown in (6) along with their hierarchical structure in the sentence.

(6) [[[[Sentence Radical] Aspect] Tense] Environment]

Sentence radicals come in two major classes, stative and non-stative. We are not concerned here with the kind of sub-sentential aspectual composition that arises with quantification and distributivity, for instance, but we do need a formal representation of the stative/non-stative distinction. Aspectual operators impose temporal constraints on reference times and relate events to times. We assume that '*-tei-*' is such an operator. But even sentences without '*-tei-*' or other overt aspectual markers include a covert aspectual operator. In this we follow KM11. There are two tenses, Nonpast and Past, whose interpretation depends on the aspectual class of their complement as well as on the difference between matrix and embedded contexts. What we label as "Environment" in (6) is either the matrix context or one of a class of subordinating expressions which includes '*tokoro*'.

2.1. The model

Let $\langle T, \prec \rangle$ be a non-empty set of temporal instants ordered by the transitive, irreflexive and connected relation $\prec$. The **temporal period structure** induced by $\langle T, \prec \rangle$ is a triple $\langle I, \subseteq, < \rangle$, where I is the set of non-empty convex subsets of T,[6] $\subseteq$ is set-theoretic inclusion, and $<$ is the relation of strict precedence on $I \times I$. An **event structure** is a join-semilattice $\langle E, \sqsubseteq \rangle$, where E is a non-empty set of events and $\sqsubseteq$ is a partial order interpreted as the mereological "sub-event" relation. A **temporal model** is an octuple $\langle I, \subseteq, <, E, \sqsubseteq, \tau, s, V \rangle$, where $\langle I, \subseteq, < \rangle$ is a temporal period structure; $\langle E, \sqsubseteq \rangle$ is an event structure; $\tau : E \mapsto I$ maps events to their temporal traces, subject to the condition that for all $e, e' \in E$, if $e \sqsubseteq e'$ then $\tau(e) \subseteq \tau(e')$; $s \in I$ is a (short)

[5] The simplification concerns KM11's account of absolute tense under '*toki*', which is orthogonal to this paper.

[6] A set $T' \subseteq T$ is **convex** iff for all t, t', t'', if $t \prec t' \prec t''$ and $t, t'' \in T'$, then $t' \in T'$.

interval representing the speech time; and V is an interpretation function mapping non-stative and stative sentence radicals to (characteristic functions of) subsets of E and I, respectively.

We present our analysis as a compositional mapping from Japanese sentences to expressions in an extensional type-theoretical language which are then to be interpreted in temporal models. The basic types are i with $D_i = I$ (intervals), ϵ with $D_\epsilon = E$ (events) and t with $D_t = \{0, 1\}$ (truth values). We do not define the language or its interpretetion explicitly because both will be obvious. We do assume that it has variables $i, j, k, \ldots$ ranging over intervals and e ranging over events; and symbols for unary predicates of intervals and events (corresponding to sentence radicals). We overload the symbols $s, \tau, <, \subseteq$ (mapped to the speech time s, the temporal trace function, the precedence relation $<$, and the subinterval relation). We will define further symbols below.

2.2. Sentence radicals

Stative and non-stative sentence radicals denote properties of intervals and events, respectively.

(7) Zyon-ga Nihon-ni i-
Jon-NOM Japan-LOC be
'Jon be in Japan'
$\rightsquigarrow \lambda i \in I[\textsc{JonInJapan}(i)]$

(8) Zyon-ga Nihon-ni ik-
Jon-NOM Japan-LOC go
'Jon go to Japan'
$\rightsquigarrow \lambda e \in E[\textsc{JonToJapan}(e)]$

2.3. Aspectual operators

Next up in the structure in (6) is a slot for aspectual operators. The suffix '*-tei*' mentioned above is one of these operators; we also assume, following KM11, that sentences which do not have an overt operator in this location have a covert one.[7] Semantically, aspectual operators map properties of intervals or events to binary relations between intervals. We use the symbols in (9) for relations between intervals, in addition to the "strict precedence" relation already defined in the model (see also Allen, 1983).

(9) **Relations between intervals**
a. $i \oslash j \coloneqq i < j \vee j < i$ [non-overlap]
b. $i \Subset j \coloneqq \exists k, l[k \subseteq j \wedge l \subseteq j \wedge k < i < l]$ [non-initial, non-final subinterval]

These relations are used in the translations of the aspectual operators. We adopt from KM11 the convention of using the names φ and ρ for variables over properties of intervals and properties of events, respectively.[8]

[7] This simplifies the lexical entries of morphemes (such as tenses) that can combine with sentence radicals both directly and via the mediation of aspectual operators.

[8] We deviate slightly from KM11's definition of $\emptyset$ for non-statives: their $\tau(e) \subseteq j$, corresponds to our $j = \tau(e)$.

(10) **Aspectual operators**

a. $\emptyset \quad \rightsquigarrow \lambda\varphi_{\langle i,t\rangle}\lambda i\lambda j[\varphi(j) \wedge [i \neq s \rightarrow i \Subset j]] \cup$
$\lambda\rho_{\langle \epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge j = \tau(e)] \wedge i \varnothing j]$

b. '*-tei-*' $\rightsquigarrow \lambda\rho_{\langle \epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge \boxed{\textsc{tei}(e, j)}] \wedge [i \neq s \rightarrow i \Subset j]]$

At this point the expression "$\textsc{tei}(e, j)$" is just a placeholder. We return to this issue in Section 3, where we fill in the details that explain why '*tokoro*' can have a temporal interpretation with the Progressive reading but not with the Perfect reading of '*-tei-*'. For now, we are more interested in the last conjunct of the formula in (10b), which establishes the relationship between the two intervals i, j. If i is not the speech time (i.e., in embedded contexts), it must be contained in j, otherwise (i.e., in matrix contexts) it is not so constrained. This condition mirrors the one imposed by the covert aspectual operator for lexical statives (the upper line in (10a)). This is the sense in which we think it correct to say that clauses modified by '*-tei-*' are (derived) **statives**, regardless of whether the reading is Progressive or Perfect. The result of applying these aspectual operators to sentence radicals in (7) and (8) is given in (11).

(11) Zyon-ga nihon-ni { a. i-∅ / b. ik-∅ / c. it-tei }
Jon-NOM Japan-LOC be go go-TEI
Jon { be in / go to / go-TEI to } Japan

a. $\rightsquigarrow \lambda i\lambda j[\textsc{JonInJapan}(j) \wedge [i \neq s \rightarrow i \Subset j]]$

b. $\rightsquigarrow \lambda i\lambda j\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e) \wedge i \varnothing j]$

c. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge \boxed{\textsc{tei}(e, j)}] \wedge [i \neq s \rightarrow i \Subset j]]$

2.4. Tense

Next up in our structure (6) are the tenses. As mentioned above, there are two tenses in Japanese, Nonpast and Past, typically expressed on verbs with some allomorph of '*-ru*' and '*-ta*', respectively, except for the copula, whose forms are '*-da*' and '*-datta*'.[9]

(12) **Tenses**

a. $\textsc{nonpast} \rightsquigarrow \lambda i\lambda j[i \leq j]$ b. $\textsc{past} \rightsquigarrow \lambda i\lambda j[j < i]$

(13) Zyon-ga nihon-ni { a. i-ru / b. i-ta / c. ik-u / d. it-ta / e. it-tei-ru / f. it-tei-ta }
Jon-NOM Japan-LOC be-NP be-P go-NP go-P go-TEI-NP go-TEI-P
'Jon {is in / was in / is going to / went to / . . . } Japan'

a. $\rightsquigarrow \lambda i\lambda j[\textsc{JonInJapan}(j) \wedge i \leq j \wedge [i \neq s \rightarrow i \Subset j]]$

b. $\rightsquigarrow \lambda i\lambda j[\textsc{JonInJapan}(j) \wedge j < i \wedge [i \neq s \rightarrow i \Subset j]]$[10]

c. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e)] \wedge i < j]$

d. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e)] \wedge j < i]$

e. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge \boxed{\textsc{tei}(e, j)}] \wedge i \leq j \wedge [i \neq s \rightarrow i \Subset j]]$

f. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge \boxed{\textsc{tei}(e, j)}] \wedge j < i \wedge [i \neq s \rightarrow i \Subset j]]$[10]

[9] One class of adjectives also carries tense, expressed with '*-i*' and '*-katta*' for Nonpast and Past, respectively. The negative suffix '*-na*{*-i*/*-katta*}' belongs to this paradigm.

[10] Notice that (13b,f) imply that $i = s$, in line with the observation that Past statives only occur in matrix contexts.

2.5. Embedding environments

Next up we now reach the position filled by '*tokoro*' or other embedding temporal expressions, such as '*toki*' 'when', '*mae*' 'before', etc. It is instructive to compare several such items to '*tokoro*'. In (14) we give four examples along with their interpretations from KM11.

(14) a. mae 'before' $\leadsto \lambda\varphi_{\langle i,\langle i,t\rangle\rangle}\lambda h\lambda i\exists j[\varphi(i)(j) \wedge i < j]$
b. ato 'after' $\leadsto \lambda\varphi_{\langle i,\langle i,t\rangle\rangle}\lambda h\lambda i\exists j[\varphi(i)(j) \wedge j < i]$
c. uti 'while' $\leadsto \lambda\varphi_{\langle i,\langle i,t\rangle\rangle}\lambda h\lambda i\exists j[\varphi(i)(j) \wedge i \Subset j]$
d. toki 'when' $\leadsto \lambda\varphi_{\langle i,\langle i,t\rangle\rangle}\lambda h\lambda i\exists j[\varphi(i)(j)]$

All of these items are of the same type, viz. $\langle\langle i,\langle i,t\rangle\rangle,\langle i,\langle i,t\rangle\rangle\rangle$ (i.e., modifiers of binary relations between intervals). Their arguments are the denotations of tensed sentences – relations between intervals i, j which, in matrix sentences, are interpreted as the speech time and the reference time, respectively. In (14) we see that a new time is introduced when tensed sentences are embedded under temporal connectives. The idea is that now h, i are interpreted as the speech and reference time of the matrix sentence, and i anchors the temporal interpretation of the embedded clause. The relation that the embedded sentence imposes on i, j is now, in Reichenbachian terms, imposed on the reference time and event time of the embedded clause.

The semantic contribution of most of the items in (14) is an added condition on the temporal relation between i, j (an exception is '*toki*', which does not add any new constraint). This condition is conjoined with whatever the complement clause already requires of the two intervals. The result may be a contradiction, resulting in ill-formedness (e.g., in the case of '*mae*' 'before' with Past tense or '*ato*' 'after' with Nonpast). Some or the results are shown in (15) and (16).

(15) Zyon-ga nihon-ni { a. ik-u / b. *it-ta } mae
Jon-NOM Japan-LOC go-NPST go-PST before
'before Jon {goes / went} to Japan'
a. $\leadsto \lambda h\lambda i\exists j[\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e)] \wedge i < j \wedge i < j]$ ✓
b. $\leadsto \lambda h\lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e)] \wedge i < j \wedge j < i]$ ✗

(16) Zyon-ga nihon-ni i-ru { a. *mae / b. *ato / c. uti / d. toki }
Jon-NOM Japan-LOC be-NPST before after while when
'{before / after / while / when} Jon {is / was} in Japan'
a. $\leadsto \lambda h\lambda i\exists j[\textsc{JonInJapan}(j) \wedge i < j \wedge i \Subset j]$ ✗
b. $\leadsto \lambda h\lambda i\exists j[\textsc{JonInJapan}(j) \wedge j < i \wedge i \Subset j]$ ✗
c. $\leadsto \lambda h\lambda i\exists j[\textsc{JonInJapan}(j) \wedge i \Subset j \wedge i \Subset j]$ ✓
d. $\leadsto \lambda h\lambda i\exists j[\textsc{JonInJapan}(j) \wedge i \Subset j]$ ✓

Table 1 shows the overall pattern resulting from the interaction between the various temporal constraints. *iku* 'go' and *iru* 'be' are non-stative and stative, respectively. The rightmost column shows the data with '*tokoro*' that we outlined earlier. Our goal is to add a semantic entry for '*tokoro*', replacing the question marks in the top row.

Table 1: Temporal constraints contributed by temporal connectives (top row) and their clausal complements (left column), and the resulting well-/ill-formedness of the combinations.

		mae 'before' $i < j$	ato 'after' $j < i$	uti 'while' $i \Subset j$	toki 'when' ·	tokoro ???
ik-u	$i < j$	'before'	*	*	'before'	'right before'
it-ta	$j < i$	*	'after'	*	'after'	'right after'
it-tei-ru$_{\text{PROG}}$	$i \Subset j$	*	*	'while'	'while'	'while'
it-tei-ru$_{\text{PERF}}$	$i \Subset j$	*	*	'while'	'while'	*/cf
i-ru	$i \Subset j$	*	*	'while'	'while'	*/cf
i-ta	✗	*	*	*	*[11]	*

There are three major challenges to this project. First, as seen in the table, '*tokoro*' is sensitive to a distinction that the other particles do not track, distinguishing between the upper three rows (Nonstative *ik-u/it-ta* 'go'; Progressive reading of '*-teiru*') and the lower rows (Stative *i-ru/i-ta* 'to be', and Perfect reading of '*-teiru*'). None of the other connectives is sensitive to this distinction, nor is it expressed in the relation between the intervals i, j, which was sufficient to account for the patterns discussed so far. Secondly, '*tokoro*' adds a connotation of "immediacy" to the temporal relations in the top rows, which our rendering in English as 'right before' and 'right after' is intended to convey. Finally, '*tokoro*' alone has a counterfactual reading in cases in which a temporal reading is unavailable.

3. Analysis

We address the challenges just discussed in terms of an interaction between '*tokoro*''s aspectual properties and a certain notion of "immediacy." For instance, recall that with non-stative complements, '*tokoro*' comes to mean 'right before' or 'right after', depending on the embedded tense. We want to formalize this notion in such a way that the more peculiar properties of '*tokoro*' – its well-formedness with Progressive but not with Perfect '*-teiru*' and the availability of a counterfactual reading with Perfect '*-teiru*' and statives – also fall out.

One way to describe the peculiar behavior of '*tokoro*' in combination with '*-teiru*' is that on the Progressive reading of '*-teiru*' these sentences behave like non-statives, whereas on the Perfect reading they behave like statives. We need to explain, not only why one and the same morpheme, '*-tei-*', can have such disparate uses, but also why on the Progressive use it has a certain eventive "flavor" which is absent from the Perfect use.

What is this eventive "flavor," and how should it be represented? It is a widely held view that events involve **change** or **development** of some kind, and that their progress can be **measured**

[11] Past statives can in principle occur in embedding contexts, but only with an **absolute** reading of the Past tense (i.e., one anchored to the speech time rather than the matrix reference time). Whether such a reading is available depends on the embedding connective. It is not available under '*tokoro*', therefore we ignore it in this paper. It is available under '*toki*', hence the asterisk in the corresponding cell in our table is a simplification. See Kaufmann and Miyachi (2011) for details.

in various ways, whereas states have none of those properties. The stative/non-stative distinction is often taken to be an ontological fact about different kinds of enventualities (Smith, 1991; Bach, 1986[12]); the notion that events can be measured is discussed and formalized in various ways depending on whether the measurement draws on incremental themes, expressions of creation, changes of state or degree, paths, or yet some other notion (Dowty, 1991; Krifka, 1989, 1992; Tenny, 1994; Hay et al., 1999; Kennedy and Levin, 2008, *i.a.*).

In this paper we stop short of committing ourselves to a particular view on the origins of event measurement. We are more interested in the question of how, once such measurement is introduced, it can have repercussions throughout the compositional process. For recall that '*tokoro*' does not combine directly with event-denoting sentence radicals, and not even with '*radical+-tei*' compounds. Instead, it combines with tensed clauses, and we have been assuming throughout that tensed clauses denote binary relations between temporal intervals. Since there is no direct link to the underlying eventualities, the "eventive flavor" of the Progressive cannot be implemented straightforwardly in terms of the denotatum of '*tokoro*''s complement. Instead, we need a way to let the stative/non-stative distinction that is accessible lower in the derivation leave an "imprint" on the intervals higher up.

To implement this, we enrich our representation of temporal traces. We do this in two steps: in Section, 3.1, give '*-tei-*' access to different phases of an event (*viz.* its run-time and its result state, where available); in Section 3.2 we add a representation of event measurement.

3.1. The versatility of '*-tei-*'

While space does not permit us to do justice to the extensive literature on '*-tei-*', we do need to introduce the basic facts about its semantic versatility. Most discussions of '*-tei-*' distinguish at least three readings: Progressive, Resultative Perfect, and Experiential Perfect. Which of them are available for a particular sentence containing '*-tei-*' depends on the prejacent's aspectual properties (and possibly other factors). The clearest cases exhibiting all readings are accomplishments with an activity phase and a result state. The examples in (17) are from Igarashi and Gunji (1998), adjusted to our transliteration and glosses. (17a,b) illustrate the Progressive and Resultative Perfect readings, as highlighted by the English glosses. In (17c), the combination of the past adverbial '*sannen mae-ni*' 'three years ago' with Nonpast tense forces the Experiential Perfect reading (Fujii, 1976; Ogihara, 1998).

(17) a. Ken-wa ima tonari-no heya-de kimono-wo ki-tei-ru [PROG]
Ken-TOP now next-GEN room-LOC kimono-ACC put on-TEI-NPST
'Ken is now putting on a kimono in the next room'

b. Ken-wa kesa kara zutto ano kimono-wo ki-tei-ru [RESULT]
Ken-TOP this morning from always that kimono-ACC put on-TEI-NPST
'Ken has been wearing that kimono since this morning'

[12]Bach distinguishes states, processes and events, with the latter two being subsumed under the class of "non-states." We use the labels "non-stative" and "eventive" interchangeably.

c. Ken-wa ano kimono-wo sannen mae-ni ki-tei-ru [EXP]
Ken-TOP that kimono-ACC three years before-LOC put on-TEI-NPST
(i) 'Ken has the experience of putting on that kimono three years ago' [EXP I]
(ii) 'Ken has the experience of wearing that kimono three years ago' [EXP II]

Igarashi and Gunji (1998) argue that the Experiential (17c) can actually have two readings, depending on which of the two phases of the accomplishment – the putting on or the wearing of the kimono – is said to have taken place in the past. The two translations in (17c) are meant to bring out that difference. Gunji (2004) puts even more emphasis on this distinction, extending the traditional tripartite taxonomy by treating the two variants of the Experiential Perfect as distinct (though related) readings. This allows him to account for the full picture in terms of the interplay between two independent dimensions of variation: Activity vs. Result State reading of the prejacent, and Ongoing vs. Anterior reading of '*-tei-*'.[13] The competing view of the traditional tripartite taxonomy is that the distinction between Activity and Resultative reading of the prejacent is only relevant under the Ongoing reading of '*-tei-*', but neutralized under its Anterior reading (Ogihara, 1998).

We adopt (Igarashi and) Gunji's position that there is a major distinction between the Progressive and Resultative Perfect reading on the one hand, and the Experiential reading(s) on the other.[14] This distinction seems related to a grammatical difference, as shown by the ability of past adverbials to co-occur with Present tense only under the Experiential reading.[15] We stop short of postulating two distinct readings of the Experiential, however. This is in part because space is limited and a formal implementation which draws the distinction would require further modifications to the framework. Moreover, most informants report having a hard time seeing a clear semantic difference between the two readings. For the purposes of this paper, at least, we treat (17c) as one reading in which the Activity/Result State distinction is neutralized.

For our formal analysis, this means that we need to encode two distinctions: the Activity/Result State distinction for the prejacent, and the Ongoing/Anterior distinction for '*-tei-*'. Furthermore, we follow those who assume that the two distinctions are not independent: Activity and Result State are only distinguished under Ongoing '*-tei-*'. Finally, we want to account for the fact that past adverbials can occur with Nonpast tense under Anterior but not Ongoing '*-tei-*'.

[13] Gunji uses different terminology: at both levels, he distinguishes a **basic** view (基本視野; in our terminology, Activity at the level of the precedent and Ongoing at the level of '*-tei-*') from a **stative** view (状態視野, our Result State (prejacent) and Anterior ('*-tei-*')). We prefer our terminologoy for its mnenomic value (for us), but nothing hinges on this choice. Notice also that Gunji considers '*-tei-*' complex. He attributes the Ongoing/Anterior distinction to the semantics of '*-te-*' alone, while taking '*i*' to be semantically inert.

[14] A separate class of approaches, which we do not discuss in detail here, seeks to unify the Resultative Perfect and the Experiential Perfect reading, setting them apart from the Progressive. See Ogihara (1998) for discussion.

[15] Past adverbials **can** modify sentences with '*-tei-*' under the other readings, but only if the matrix tense is Past:

(i) Ken-wa ano kimono-wo sannen mae-ni ki-tei-ta
Ken-TOP that kimono-ACC three years before-LOC wear-TEI-PST
'Ken was { putting on / wearing } that kimono three years ago.'

These cases do not pose a problem for our analysis on the assumption that the adverb here has '*-tei-*' in its scope, rather than *vice versa*.

We start with Ongoing '*-tei-*' and the two readings it gives rise to. Our preliminary definition of '*-tei-*' from (10b) is repeated below.

(10b) (*preliminary*) $\lambda\rho_{\langle\epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge \boxed{\textsc{tei}(e, j)}] \wedge [i \neq s \rightarrow i \Subset j]]$

We now need to spell out the expression $\textsc{tei}(e, j)$ in the box in (10b). The idea is that '*-tei-*' makes the inner stages of an event available for linguistic reference. We could simply replace the the box with the condition that $j = \tau(e)$, thus locating i within the runtime of the event in embedded contexts. However, this would only make the Progressive interpretation available, not the Perfect.

To add the Perfect, we adapt from Igarashi and Gunji (1998); Gunji (2004) the main idea behind their classification. In principle, not one but two intervals can be associated with an event in the extension of a sentence radical: one is the familiar temporal trace of the event itself, the other is the interval over which its result state holds.[16] Whether both of these intervals are available depends on the aspectual class: activities have no lexically encoded result state, whereas achievements may have a result state but no temporal extension in the triggering change-of-state event (i.e., no interval corresponding to an Activity part). Consequently, under '*-tei-*', activities typically only have Progressive readings and achievements only Result state readings, whereas accomplishments can have both.

Formally, we define an **extended temporal trace** function τ^+ from events to sets of (one or two) intervals. The intention is that $\tau^+(e)$ is true of the conventional temporal trace $\tau(e)$ but also of the maximal interval of which e's result state holds, in case the latter is defined. In (18) we use the auxiliary notation *result* for the partial function mapping events to their result states.[17]

(18) **Extended temporal trace**
For all events e, $\tau^+(e) \coloneqq \lambda i[i = \tau(e) \vee \exists j[j = \mathit{result}(e) \wedge i = j]]$

Our definition for Ongoing '*-tei-*' draws on this notion:

(19) '*-tei-*' $_{\textsc{ong}} \rightsquigarrow \lambda\rho_{\langle\epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge \tau^+(e)(j)] \wedge [i \neq s \rightarrow i \Subset j]]$

We now turn to the Anterior reading of '*-tei-*'. What would seem to be the most straightforward way to include this reading – by modifying (19) to allow for the case that $j < i$ – is not viable.

[16] Note that Igarashi and Gunji's implementation differs from ours: their constraints refert to the boundaries of the intervals in question, calling them the "start time" and "finish time" of the event (the latter also serving as the start time of the result state, where applicable), and the "reset time" marking the end of the result state. Aside from this difference, and modulo further fine distinctions that we cannot go into for lack of space, the intuitions are similar to our implementation, as far as we can see.

[17] This way of implementing the idea has certain consequences for the underlying notion of events. Ogihara (Ogihara, 1998, p. 96) points out that two different descriptions of the same state of affairs can have different aspectual properties. For instance, different sentences referring to the same opening of a door may or may not have Progressive readings depending on the grammatical form. This means that the value of $\tau^+(e)$ may differ depending on the sentence used. In order to avoid untoward consequences of this possibility (e.g., ensuring that τ^+ is a function), we have to assume that in such cases the model actually contains two distinct events representing the very same opening of the door which can serve as denotations of the different linguistic expressions.

This is because Anterior '*-tei-*' allows for the coexistence of past adverbs like '*kyonen*' 'last year' with Nonpast tense. In our framework, this would mean that the adverb places j within the year preceding that of the speech time, while the Nonpast tense rules out the possibility that j precedes i, leading to contradictory constraints in matrix contexts (where i ends up referring to the speech time). We avoid this unwelcome consequence by giving Anterior '*-tei-*' a denotation of an altogether different type and assuming that in the syntactic derivation it behaves in some respects more like a tense than an aspectual operator. Specifically, we assume that it co-occurs with, and outscopes, the covert aspectual operator $\emptyset$. Consequently, its complement denotes a relation between intervals, not a property of events, and this makes it possible for temporal adverbs to scope lower than '*-tei-*'. At the same time, as seen in the denotation in (20b), '*-tei-*' introduces an additional interval k at which the prejacent φ is evaluated and which can be constrained by temporal adverbs. The tense above '*-tei-*', meanwhile, constrains the relation between i and j. Thus past adverbs and present tense may co-occur without contradiction.[18]

(20) a. '*-tei-*' $_{\text{ONG}} \rightsquigarrow \lambda\rho_{\langle\epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge \tau^{+}(e)(j)] \wedge [i \neq s \rightarrow i \Subset j]]$

b. '*-tei-*' $_{\text{ant}} \rightsquigarrow \lambda\varphi_{\langle\langle i,t\rangle,\langle\langle i,t\rangle,t\rangle\rangle}\lambda i\lambda j[\exists k[\varphi(j)(k) \wedge k < j] \wedge [i \neq s \rightarrow i \Subset j]]$

We illustrate with a few examples. (21) is a matrix sentence with the temporal adverb '*kyonen*' 'last year'. (21a) shows the denotation (the conditions imposed by Present or Past tense are listed in the last conjunct) which is then evaluated at the speech time s (fixed by the model) and reference time r (contributed by context). In this case the two constraints contributed by LASTYEAR and tense are imposed on the same pair of intervals s, r. The ill-formedness of the Present-tense variant arises at this point due to the inconsistency of $\textsc{lastyear}(s)(r)$ and $s \leq r$.[19]

(21) Kyonen kimono-wo ki- { *ru / ta }
last year kimono-ACC wear NPST PST
[[kyonen [[kimono-wo ki] $\emptyset$]] { *ru / ta }]

a. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{KimonoKi}(e) \wedge j = \tau(e)] \wedge i \varnothing j \wedge \textsc{lastyear}(s)(j) \wedge \{i \leq j / j < i\}]$
(21a)$(s)(r) \Leftrightarrow \exists e[\textsc{KimonoKi}(e) \wedge r = \tau(e)] \wedge \textsc{lastyear}(s)(r) \wedge r < s$

We next turn to '*-tei-*'. For ease of exposition, we list examples of its Ongoing and Anterior use separately. The surface strings are indistinguishable, but we indicate the respective intended derivations in the bracketed representations. First consider Ongoing '*-tei-*', which due to its type must combine directly with the sentence radical and scope under the temporal adverb. Only the Past-tense variant of the sentence can have this reading; the Nonpast is ruled out in the same way as the Nonpast of (21) above. Which readings (Activity and/or Result State Perfect) (22) can have depends on which intervals are made available by the extended temporal trace $\tau^{+}(e)$. Which reading it has in any particular instance further depends on how $\tau^{+}(e)$ applies

[18] The reader may notice that according to (20b) the "high" '*-tei-*' has the same type as the tenses – both are modifiers of binary relations between structured intervals. This means that the denotations do not by themselves enforce the observed structural relationship, i.e., that tense invariably sits higher in the syntactic tree than '*-tei-*'. We assume that this relationship is enforced independently by syntactic factors.

[19] Note that it is not the past reference *per se* that is incompatible with Present tense. For instance, embedded under connectives like '*toki*' 'when' and '*mae*' 'before', Present tense is not interpreted as restricting s, r and can thus happily coexist with past intervals like '*kyonen*'.

to j (ultimately, r): it is a (non-initial and non-final) subinterval of either $\tau(e)$, giving rise to the Activity reading, or of *result*(e), corresponding to the Result State Perfect reading.

(22) Kyonen kimono-wo ki-tei$_{\text{ONG}}$- { *ru / ta }
last year kimono-ACC wear-TEI NPST PST
[[kyonen [[kimono-wo ki] tei]] ta] [PAST ACTIVITY/PAST RESULT]
a. $\rightsquigarrow \lambda i \lambda j [\exists e [\textsc{KimonoKi}(e) \wedge \tau^{+}(e)(j)] \wedge \textsc{lastyear}(s)(j) \wedge j < i]$
(22a)$(s)(r) \Leftrightarrow \exists e [\textsc{KimonoKi}(e) \wedge \tau^{+}(e)(r)] \wedge \textsc{lastyear}(s)(r) \wedge r < s$

For the Anterior reading of '*-tei-*', we do not predict that past adverbs with Nonpast tense result in inconsistency. This is shown in (23).

(23) Kyonen kimono-wo ki-tei$_{\text{ANT}}$-ru
last year kimono-ACC wear-TEI-NPST
[[[kyonen [[kimono-wo ki] $\emptyset$]] tei] ru] [PRES EXP]
a. $\rightsquigarrow \lambda i \lambda j \exists k [\exists e [\textsc{KimonoKi}(e) \wedge k = \tau(e)] \wedge k \varnothing j \wedge \textsc{lastyear}(s)(k) \wedge k < j \wedge i \leq j]$
(23a)$(s)(r) \Leftrightarrow \exists k [\exists e [\textsc{KimonoKi}(e) \wedge k = \tau(e)] \wedge \textsc{lastyear}(s)(k) \wedge k < r \wedge s \leq r]$

But we do not predict Anterior '*-tei-*' to be inconsistent with Past tense either. In fact, we derive two readings for (24), corresponding to two positions of the adverb relative to '*-tei-*'. On the reading in (24a/b), the adverb restricts k, the event of putting on the kimono; the reference time r, which must lie strictly between k and s, is thus a time at which the experiential state holds. On this interpretation the sentence means that at some point in the recent past (say, a week ago) it was true (or it turned out) that the subject had worn a kimono last year. On the reading in (24c/d) the adverb restricts the reference time r, while the time k of wearing the kimono must be found at an even earlier time. In other words, it turned out last year that (already then) the subject had the experience of having worn a kimono. We take it that both readings exist.

(24) Kyonen kimono-wo ki-tei$_{\text{ANT}}$-ta
last year kimono-ACC wear-TEI-PST
a. [[[kyonen [[kimono-wo ki] $\emptyset$]] tei] ta] [PAST EXP]
b. $\rightsquigarrow \lambda i \lambda j \exists k [\exists e [\textsc{KimonoKi}(e) \wedge k = \tau(e)] \wedge k \varnothing j \wedge \textsc{lastyear}(s)(k) \wedge k < j \wedge j < i]$
(24a)$(s)(r) \Leftrightarrow \exists k [\exists e [\textsc{KimonoKi}(e) \wedge k = \tau(e)] \wedge \textsc{lastyear}(s)(k) \wedge k < r \wedge r < s]$
c. [[kyonen [[[kimono-wo ki] $\emptyset$] tei]] ta] [PAST EXP]
d. $\rightsquigarrow \lambda i \lambda j \exists k [\exists e [\textsc{KimonoKi}(e) \wedge k = \tau(e)] \wedge k \varnothing j \wedge k < j \wedge \textsc{lastyear}(s)(j) \wedge j < i]$
(24c)$(s)(r) \Leftrightarrow \exists k [\exists e [\textsc{KimonoKi}(e) \wedge k = \tau(e)] \wedge k < r \wedge \textsc{lastyear}(s)(r) \wedge r < s]$

3.2. Event measurement

Tradionally, the temporal trace of an event has been taken to be an interval (assigned to the event by the function τ, Krifka (1989)), and we have followed this convention thus far. The left-hand side of Figure 1 is an illustration. We propose a straightforward modification of this simple picture: The temporal trace function $\tau_{\mathbf{S}}$ maps events to **structured intervals**, our term for sets

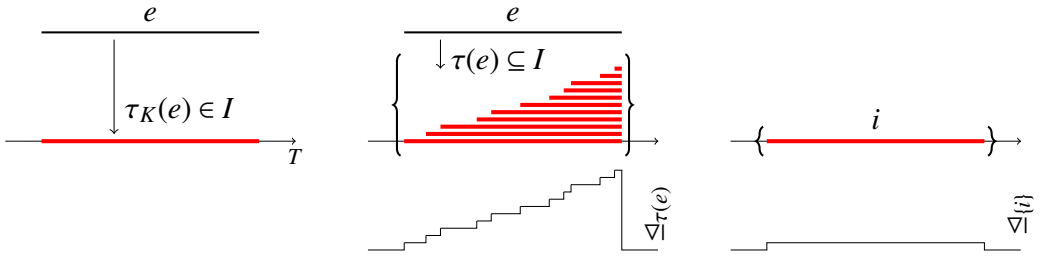

Figure 1: Left: Temporal trace τ mapping events to intervals. Middle: Temporal trace τ_S mapping events to structured intervals (top) and induced order $\trianglelefteq_{\tau(e)}$ on T (bottom). Right: Stative denotation i (top) and pre-order $\trianglelefteq_{\{i\}}$ on T (bottom).

of intervals which contain their own union.[20] In our type-theoretic compositional framework, structured intervals are represented by their characteristic functions, i.e., in $D_{\langle i,t\rangle}$, and we use variables **i**, **j**, etc. to range over them. For ease of exposition, we switch between talk of these characteristic functions and the sets of intervals they characterize, using variables like $\mathbf{A}, \mathbf{B}$, *etc.* for the latter. No confusion should result from this.

(25) A set **A** of intervals is a **structured interval** iff $\cup\mathbf{A}$ is an element of **A**.

The relations between intervals defined above can be extended to stuctured intervals straightforwardly as follows:

(26) $\mathbf{A} < \mathbf{B} := \cup\mathbf{A} < \cup\mathbf{B}$ $\quad \mathbf{A} \varnothing \mathbf{B} := \cup\mathbf{A} \varnothing \cup\mathbf{B}$ $\quad \mathbf{A} \Subset \mathbf{B} := \cup\mathbf{A} \Subset \cup\mathbf{B}$ $\quad \mathbf{A} \supset\subset \mathbf{B} := \cup\mathbf{A} \supset\subset \cup\mathbf{B}$

The shift from simple to structured temporal traces does not affect their durations, just their internal structure. Thus we assume that each $\tau_{\mathbf{S}}(e)$ contains $\tau(e)$ as its greatest element.

(27) A **structured temporal trace** is a function $\tau_{\mathbf{S}}$ mapping events to structured intervals, subject to the condition that for all events e, $\tau(e) = \cup\tau_{\mathbf{S}}(e)$.

Next, we use sets of intervals to derive a pre-order on the entire set T of times as in (28).[21] For our example in Figure 1, the relative ranking of the equivalence classes of the pre-order induced by $\tau(e)$ is shown in the lower middle graph.

(28) **Induced pre-order on *T***
Let A be a set of intervals. The pre-order $\trianglelefteq_A$ on T induced by A is defined as follows: $t \trianglelefteq_A t'$ iff all intervals in A which contain t also contain t'.

[20] In fact, the structured intervals we consider here are **nests** of **final** subintervals; but we refrain from imposing those stronger properties by definition since nothing in our proposal depends on them.

[21] This notion of an induced pre-order is inspired by Kratzer's treatment of modality (Kratzer, 1981, *i.a.*); but notice that here the order is reversed, in the sense that times that are contained in more intervals are ranked higher, rather than lower.

This latter change also affects the interpretation of statives. Recall from above that they were mapped to properties of intervals. This remains unchanged, but now what gets passed up in the compositional process is the singleton sets containing those intervals. Singleton sets of intervals induce single-step pre-orders as shown on the right-hand side in Figure 1. There, all points in i are ranked equally and strictly higher than any point outside of i. This is in line with the intuition that the denotations of statives do not involve any notion of change or development.

The switch to set-valued temporal traces requires minor adjustments to the overall system. Recall that our goal is to allow for expressions higher up in the syntactic tree, such '*tokoro*', which do not directly compose with event-denoting sentence radicals, to have access to the structure of the temporal traces despite the intervening tenses (and possibly other temporal/aspectual material). We achieve this by generalizing to the worst case, as it were, using structured intervals throughout the compositional process. For the most part, that change is insignificant. For instance, the denotation of the covert aspectual operator '∅', first given in (10a) above, changes to (29). The upper line, for stative complements, requires that there be an interval k of which φ is true and such that $\mathbf{j}$ is the singleton set containing k. The lower line, for non-statives, now implies that $\mathbf{j}$ encodes the structure of e. However, this information about the structure of e leaves no imprint on $\mathbf{i}$, since $\mathbf{i}$ and $\mathbf{j}$ are required to be disjoint.

(29) $\emptyset \quad \rightsquigarrow \lambda\varphi_{\langle i,t\rangle}\lambda\mathbf{i}\lambda\mathbf{j}\exists j[\varphi(j) \wedge \mathbf{j} = \lambda k[k = j]] \wedge [\mathbf{i} \neq \mathbf{s} \rightarrow \mathbf{i} \Subset \mathbf{j}]] \cup$
$\lambda\rho_{\langle \epsilon,t\rangle}\lambda\mathbf{i}\lambda\mathbf{j}[\exists e[\rho(e) \wedge \mathbf{j} = \tau_{\mathbf{S}}(e)] \wedge \mathbf{i} \varnothing \mathbf{j}]$

In fact, to keep things simple, it is a good idea to assume that the structured intervals used in the derivation are generally singleton **unless** they are non-trivially structured by the temporal trace of an event. Formally, this can be done by defining a predicate in the translation language that is true of structured intervals just in case they are singleton (e.g., $\textsc{sg}(\mathbf{i}) := \exists i[\mathbf{i} = \lambda j[j = i]]$) and assert this predicate of all the intervals that are not used to record event measurement (i.e., $\mathbf{i}$ in (29), $\mathbf{j}$ in (31a), and both $\mathbf{i}$,$\mathbf{j}$ in (31b)). We refrain from doing so in the interest of readability, but we do make the assumption that the structured intervals are singleton unless stated otherwise, and this assumption will in fact be significant below.

For the denotation of '*-tei-*', we redefine the notion of an extended temporal trace. Recall from (18) above that $\tau^+(e)$ is the property of being either the traditional temporal trace $\tau(e)$ or the result state $\mathit{result}(e)$. From τ^+ and the notion of a structured temporal trace $\tau_{\mathbf{S}}$ we now define a function mapping events to properties of structured events: $\mathbf{T}(e)$ is the property of being either the structured trace $\tau_{\mathbf{S}}(e)$ or the singleton set $\mathit{result}(e)$.

(30) Let τ^+ be an extended temporal trace function and $\tau_{\mathbf{S}}$ a structured temporal trace function defined on the same domain. The corresponding **extended structural temporal trace** function $\mathbf{T}$ maps events to properties of structured intervals as follows:
$\mathbf{T}(e) = \lambda\mathbf{i}[\mathbf{i} = \tau_{\mathbf{S}}(e) \vee \exists j[j = \mathit{result}(e) \wedge \mathbf{i} = \lambda k[k = j]]]$

With this notion in place, we adjust our definition of '*-tei-*' to structured intervals as in (31).

(31) a. '*-tei-*' $_{\textsc{ong}} \rightsquigarrow \lambda\rho_{\langle \epsilon,t\rangle}\lambda\mathbf{i}\lambda\mathbf{j}[\exists e[\varphi(e) \wedge \mathbf{T}(e)(\mathbf{j})] \wedge [\mathbf{i} \neq \mathbf{s} \rightarrow \mathbf{i} \Subset \mathbf{j}]]$
b. '*-tei*' $_{\textsc{ant}} \rightsquigarrow \lambda\varphi_{\langle\langle i,t\rangle,\langle\langle i,t\rangle,t\rangle\rangle}\lambda\mathbf{i}\lambda\mathbf{j}\exists\mathbf{k}[\varphi(\mathbf{j})(\mathbf{k}) \wedge \mathbf{k} < \mathbf{j} \wedge [\mathbf{i} \neq \mathbf{s} \rightarrow \mathbf{i} \Subset \mathbf{j}]$

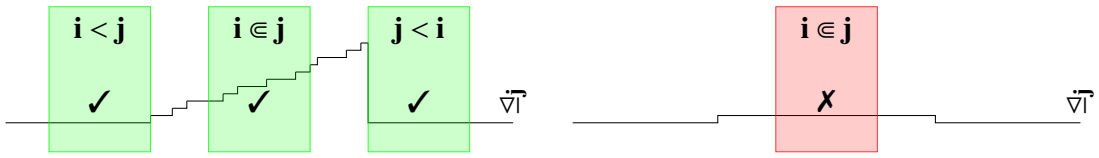

Figure 2: Permissible (left) and excluded (right) positions of **i** relative to the order induced by **j**.

3.3. '*Tokoro*': the uphill condition

'*Tokoro*' takes as its complement a tensed clause, which as we saw denotes a binary relation between structured intervals, constrained by the temporal semantics of the complement. '*Tokoro*' adds a single further condition on the pairs **i**,**j** in this relation: informally put, **i** must be adjacent to an interval with strictly higher "**j**-ness." Somewhat more formally: **i** must abut an interval which ranks strictly higher than **i** on the order induced by **j**. We introduce special terms and notation for this relationship in (32) and give the denotation of '*tokoro*' as in (33).

(32) **Uphill and downhill**
Let **i** and **j** be structured intervals. **i** is **downhill from j** (and **j** is uphill from **i**), written $\mathbf{i}\mathrel{-\!\!\!\nearrow^{\mathbf{j}}}$, iff there is an interval k such that $\cup\mathbf{i} \trianglelefteq_{\mathbf{j}} k$ and $\cup\mathbf{i} \rightthreetimes k$

(33) '*tokoro*' $\rightsquigarrow \lambda\varphi_{\langle\langle i,t\rangle,\langle\langle i,t\rangle,t\rangle\rangle}\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}[\varphi(\mathbf{i})(\mathbf{j}) \wedge \mathbf{i}\mathrel{-\!\!\!\nearrow^{\mathbf{j}}}]$

Figure 2 shows various possible locations of **i** relative to an order $\trianglelefteq_{\mathbf{j}}$, all of which may be delivered by the compositional semantics of the prejacent of '*tokoro*'. For instance, the pictures on the left are consistent with the denotations of a non-stative clause with simple Past, Progressive '*-tei-*' plus Present, and simple Present. These options are illustrated in (34) and (35).[22] In (34), where the precedence relation between **i** and **j** is fixed by the tense and aspect of the prejacent, '*tokoro*' strengthens this requirement to **immediate** precedence. In (35), the inclusion of **i** within **j** is ensured by '*-tei-*',[23] and '*tokoro*' imposes in the additional condition that **j** have internal structure, i.e., that it be the temporal trace of an activity (or of the activity phase of an accomplishment). This is the case for the Progressive reading of '*-tei-*'.

(34) Taro-ga { aruku // aruita } tokoro { da / datta }
Taro-NOM walk-NPST walk-PAST TOKORO COP-NPST COP-PAST
'Taro {{is/was} about to walk // {has/had} just walked'}
a. $\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{j} = \tau_{\mathbf{S}}(e)] \wedge \mathbf{i} \varnothing \mathbf{j} \wedge \{\mathbf{i} \leq \mathbf{j} // \mathbf{j} < \mathbf{i}\} \wedge \mathbf{i}\mathrel{-\!\!\!\nearrow^{\mathbf{j}}} \wedge \{\mathbf{h} \leq \mathbf{i} / \mathbf{i} < \mathbf{h}\}]$
(34a)(**s**)(**r**) $\Leftrightarrow$
$\exists\mathbf{j}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{j} = \tau_{\mathbf{S}}(e)] \wedge \{\mathbf{r} < \mathbf{j} // \mathbf{j} < \mathbf{r}\} \wedge \mathbf{r}\mathrel{-\!\!\!\nearrow^{\mathbf{j}}} \wedge \{\mathbf{s} \leq \mathbf{r} / \mathbf{r} < \mathbf{s}\}]$

[22] Notice that the matrix tense in these sentences is irrelevant for the present discussion, since it constrains the relation between **h** and **i**, which does not interact with '*tokoro*'.

[23] Here Past tense on the prejacent is ruled out because the position under '*tokoro*' is an embedding context.

(35) Taro-ga arui-tei- { ru // *ta } tokoro { da / datta }
Taro-NOM walk-TEI- NPST PAST TOKORO COP-NPST COP-PST
'Taro {is/was} walking.'
a. $\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{T}(e)(\mathbf{j})] \wedge \mathbf{i} \Subset \mathbf{j} \wedge \{\mathbf{i} \leq \mathbf{j} // \mathbf{j} < \mathbf{i}\} \wedge \mathbf{i}^{\curvearrowright \mathbf{j}} \wedge \{\mathbf{h} \leq \mathbf{i} / \mathbf{i} < \mathbf{h}\}]$
$(35a)(\mathbf{s})(\mathbf{r}) \Leftrightarrow \exists\mathbf{h}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{T}(e)(\mathbf{j})] \wedge \mathbf{r} \Subset \mathbf{j} \wedge \mathbf{r}^{\curvearrowright \mathbf{j}} \wedge \{\mathbf{s} \leq \mathbf{r} / \mathbf{r} < \mathbf{s}\}]$

Statives, on the other hand, do not have the right temporal denotations to serve as the prejacents of '*tokoro*'. This is shown for lexically statives in (36). Here **i** is placed within **j**, similarly to the Progressive reading available for (35) above; this time, however, the order induced by **j** is flat around **i**, thus the contour condition imposed by '*tokoro*' is not met, as on the right-hand side in Figure 2. The Perfect reading of (35) is ruled out in the same way.

(36) Zyon-ga Nihon-ni { iru // *ita } tokoro { da / datta }
Jon-NOM Japan-LOC be-NPST be-PAST TOKORO COP-NPST COP-PAST
a. $\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}[\exists j[\textsc{JonInJapan}(j) \wedge \mathbf{j} = \lambda k[k = j]] \wedge \mathbf{i} \Subset \mathbf{j} \wedge \mathbf{i}^{\curvearrowright \mathbf{j}} \wedge \{\mathbf{h} \leq \mathbf{i} / \mathbf{i} < \mathbf{h}\}]$
$(36a)(\mathbf{s})(\mathbf{r}) \Leftrightarrow \exists\mathbf{j}[\exists j[\textsc{JonInJapan}(j) \wedge \mathbf{j} = \lambda k[k = j]] \wedge \mathbf{r} \Subset \mathbf{j} \wedge \mathbf{r}^{\curvearrowright \mathbf{j}} \wedge \{\mathbf{s} \leq \mathbf{r} / \mathbf{r} < \mathbf{s}\}]$

Finally, the Anterior reading of '*-tei-*' is also incompatible with '*tokoro*'. The corresponding structure and interpretation for (35) is shown in (35').

(35') [[[[[[Taro-ga aruk] $\emptyset$] tei_{ANT}] {ru/*ta}] tokoro] {da/datta}]
'Taro {has/had} the experience of walking.'
a. $\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}\exists\mathbf{k}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{k} = \tau_S(e)] \wedge \mathbf{k} < \mathbf{j} \wedge \mathbf{i} \Subset \mathbf{j} \wedge \mathbf{i}^{\curvearrowright \mathbf{j}} \wedge \{\mathbf{h} \leq \mathbf{i} / \mathbf{i} < \mathbf{h}\}]$
$(36a)(\mathbf{s})(\mathbf{r}) \Leftrightarrow$
$\exists\mathbf{j}\exists\mathbf{k}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{k} = \tau_S(e)] \wedge \mathbf{k} < \mathbf{j} \wedge \mathbf{r} \Subset \mathbf{j} \wedge \mathbf{r}^{\curvearrowright \mathbf{j}} \wedge \{\mathbf{s} \leq \mathbf{r} / \mathbf{r} < \mathbf{s}\}]$

It is worth noting that the formula in (35'a) as it stands does not imply contradiction and ill-formedness, since it does not require **j** to be a singleton structured interval. This is not as it should be, since '*-tei-*' does not in fact have an experiential reading under '*tokoro*' (except for the counterfactual reading, which we do not deal with in this paper). It is here that our assumption that all structured intervals are singleton unless stated otherwise comes into play. We predict the unavailability of this reading if (and since) we assume that **j** in (36) is singleton, even though in the interest of readability we refrain from enforcing this in the formulas.

4. Conclusion

Rather than summarize what we have accomplished in this paper, we mention two things we left for future work. We already mentioned that we did not deal with counterfactual readings of lexical statives and non-Progressive '*-tei-*' under '*tokoro*'. We also did not touch on cases in which contextually given information can rescue a temporal reading. For instance, (37) can have a temporal interpretation even under a resultative reading of '*-tei-*', as indicated by the English gloss, if the state in question occurs as part of a set sequence of eventualities, as for instance in describing which outfit a model is wearing at this point as part of an ongoing fashion show.

(37) Tada ima kimono-wo ki-tei-ru tokoro da.
right now kimono-ACC wear-TEI-NPST TOKORO COP-NPST
'She's in the kimono right now.'

We leave a full analysis of these cases to a future occasion.

References

Allen, J. F. (1983). Maintaining knowledge about temporal intervals. *Communications of the ACM 26*, 832–843.

Bach, E. (1986). The algebra of events. *Linguistics and Philosophy 9*, 5–16.

Dowty, D. (1991). Thematic proto-roles and argument selection. *Language 67*, 547–619.

Fujii, T. (1976). "Dōshi + teiru" no imi. See Kindaichi (1976). [The semantics of *Verb + teiru*].

Gunji, T. (2004). Nihongo no asupekuto to hanzizitu kasô. *Theoretical and Applied Linguistics at Kobe Shoin 7*, 21–34. [=Japanese Aspects and Counterfactuals].

Hay, J., C. Kennedy, and B. Levin (1999). Scale structure underlies telicity in 'degree achievements'. In T. Matthews and D. Strolovitch (Eds.), *Proceedings of SALT 9*, Ithaca, NY, pp. 127–144. CLC Publications.

Igarashi, Y. and T. Gunji (1998). The temporal system in Japanese. In T. Gunji and K. Hasida (Eds.), *Topics in the Constraint-Based Grammar of Japanese*, pp. 81–97. Dordrecht: Kluwer.

Kaufmann, S. and M. Miyachi (2011). On the temporal interpretation of Japanese temporal connectives. *Journal of East Asian Linguistics 20*, 33–76.

Kennedy, C. and B. Levin (2008). Measure of change: The adjectival core of degree achievements. In L. McNally and C. Kennedy (Eds.), *Adjectives and Adverbs: Syntax, Semantics, and Discourse*, pp. 156–182. Oxford, UK: Oxford University Press.

Kindaichi, H. (1950). Kokugo dōshi no ichibunrui. *Gengo Kenkyū 15*. [A classification of Japanese verbs].

Kindaichi, H. (Ed.) (1976). *Nihongo Dōshi no Asupekuto*. Mugi Shobō. [Japanese verb aspect].

Kratzer, A. (1981). The notional category of modality. In H.-J. Eikmeyer and H. Riesner (Eds.), *Words, Worlds, and Contexts*, pp. 38–74. Walter de Gruyter.

Krifka, M. (1989). Nominal reference, temporal constitution and quantification in event semantics. In R. Bartsch, J. van Benthem, and E. Bos (Eds.), *Semantics and Contextual Expression*, pp. 75–115. Foris Publication.

Krifka, M. (1992). Thematic relations as links between nominal reference and temporal constitution. In I. Sag and A. Szabolcsi (Eds.), *Lexical Matters*, pp. 29–53. Stanford, CA: CSLI Publications.

Ogihara, T. (1998). The ambiguity of the *-te iru* form in Japanese. *Journal of East Asian Linguistics 7*, 87–120.

Smith, C. S. (1991). *The Parameter of Aspect*, Volume 43 of *Studies in Linguistics and Philosophy*. Kluwer.

Tenny, C. L. (1994). *Aspectual Roles and the Syntax-Semantics Interface*. Dordrecht: Kluwer.