

Tense, aktionsart and sequence of tense

in Corblin, F., Dobrovie-Sorin, C., and Mandarin, J. (eds.) *Empirical issues in Formal Syntax and Semantics 2*, Berne, France, Peter Lang.

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Traditionally, embedded past tense is considered to have two possible interpretations relative to the event time (ET) of the matrix verb: the backward shifted and the overlapping reading. Most sequence of tense theories propose that the embedded tense morphology is vacuous in the overlapping reading, i.e., its interpretation does not correspond with its specified lexical meaning as a precedence relation, and therefore this meaning is deleted or nullified via some syntactic mechanism. In this paper, I show that aktionsart properties have predictable effects on the temporal interpretation of embedded tenses. Overlapping readings between the ET of the embedded sentence and that of the main verb only arise with stative sentences (including progressive and generic ones). Stative aktionsart has this effect because states have a temporal implication based on entailments and causal relations that non-statives do not possess. The implication is that states are true at a superinterval that obtains before and after their ETs. Given this, the superinterval of an embedded complement can overlap with the main verb's ET. If the superinterval implication accounts for the problematic overlapping readings faced by sequence of tense theories, tenses can be assumed to have the same meaning in all independent and embedded contexts. To show this, I present a formal account of the embedded temporal readings, particularly of simple and progressive past, on the basis of an appropriate definition of their meanings and those of embedding verbs. The analysis shows that these tenses have the same meaning in all contexts and no special syntactic mechanism is needed to account for embedded readings.

1 Introduction

Sequence of tense (hereafter SOT) phenomena have been object of study since ancient times. The basic task of an SOT theory is to predict the temporal interpretations of tenses embedded under the scope of other tenses. The difficulty arises when one tries to determine the meaning of a given tense in a uniform manner for both independent (non-embedded) and embedded occurrences: embedded tenses do not seem to receive the same interpretation as their independent counterparts. Consider the following:

- (1) John thought that Mary was sick.

Supposing that the meaning of past tense denotes any interval prior to the speech time (ST), the second occurrence of the past in (1) should receive three possible interpretations: either the interval of being sick is prior to the

main verb's event time (ET), i.e., John's thinking interval (backward shifted reading), the interval of being sick is simultaneous with the thinking interval, or the embedded interval is later than John's thinking interval (forward shifted reading). However, the last is not a possible interpretation of (1). Therefore, if past tense is independently evaluated relative to the ST, incorrect predictions are made.

Suppose now that past tense does not always denote an interval prior to the ST, but rather, an interval prior to the local evaluation time (either the ST or, in SOTs, the main verb's ET). This approach predicts that the embedded tense in (1) would refer to an interval prior to the main verb's ET and thus fails to predict the overlapping reading.

Given this failure of a uniform treatment of tenses, the solution proposed by several studies is to claim that embedded tense morphology makes a semantic contribution to the temporal interpretation of the entire sentence different from that of their independent morphological counterparts (**non-uniform theories**). The surface past morphology is assumed to be vacuous in the case of the overlapping reading. The way in which the embedded tense morphology is semantically nullified varies from theory to theory. Ladusaw (1977), for example, proposes a transformation that erases a morphological embedded tense (e.g. present) and makes it equal to the matrix past verb, although the semantic interpretation of the original tense remains (e.g. overlap with the evaluation time). Abusch (1997) proposes a feature passing mechanism whereby the tense information of the matrix verb is transmitted to the embedded tense. The effect of such mechanism is that the semantic contribution of the embedded past tense is interpreted as equal to the evaluation time and so, an overlapping reading is predicted. Finally, Ogihara (1996) proposes a deletion rule applying at LF whereby a tense c-commanded by another morphologically identical tense can be erased.

As an example of this non-uniform solution, consider Ogihara's account in more detail. The SOT rule is an optional rule that applies at LF, deleting a tense locally commanded by another identical tense. This rule would turn (1), with a surface structure of (1a), into an LF representation such as (1b), which is suited for semantic interpretation:

- (1) John thought that Mary was sick.
 - a. John Past think that Mary Past be sick.
 - b. John Past think that Mary be sick.

The null tense resulting from the application of the rule is interpreted as equal to the evaluation time, generating the overlapping reading. Given the optionality of the rule, the two readings available in (1) are predicted. When the SOT rule does not apply, the embedded tense is interpreted relative to the matrix's ET and the backward shifted reading is obtained. Thus, for every case of past under past, two readings are predicted.

The problem with non-uniform theories is that they fail to predict all and only those readings that are possible in SOTs. Consider, for example, the following:

- (2) John said that
 - a. Mary arrived.
 - b. Mary worked hard.
 - c. Mary built the house.
 - d. Mary was arriving.
 - e. Mary built houses.
- (3) John decided that in ten days he would say to his mother that
 - a. Mary arrived in town.
 - b. he worked hard (on her account).
 - c. he built the house.
 - d. they were having their last meal together.

Both Abusch's and Ogihara's theories would predict two possible readings for these cases: the overlapping and backward shifted readings. But the former is not possible in (2a), (2c), (3a) and (3c). The difference between (1) and these examples is the aktionsart of the embedded sentence. (1) has a stative complement, while (2a), (2c), (3a) and (3c) have eventive ones. Note that (2b) and (3b) could in principle receive an overlapping reading, since activities are atelic predicates and no pragmatic information precludes such a reading. Mary could have been working hard at the time John said so in (2b). However, if (2b) and (3b) are interpreted as a single occurrence of the activity (sometimes called an episodic reading), the overlapping interpretation is not available. This temporal reading only arises if the embedded sentence in (2b) and (3b) is understood as generic or habitual¹ like (2e). Note also that (2d) and (3d) may receive an overlapping interpretation. Progressive aspect, which shares some properties with stative aktionsart (unlike activities *per se*), coerces any type of event into what

¹ Habitual sentences satisfy the tests of stative aktionsart. As far as aktionsart properties are concerned,

Moens & Steedman (1988) call progressive state. Thus, examples (2)-(3) suggest that aktionsart has predictable effects on temporal interpretation.

Another instance of the generalization that current theories fail to explain is the temporal interpretation of imperfect and perfect aspect in Romance Languages. While perfect aspect in embedded sentences correlates with sequential readings, imperfect aspect is usually correlated with overlapping readings. Imperfect in Romance, as progressive in English, shares entailments and semantic properties with statives (Cipria & Roberts 1996). Consider the following:

- (4) a. Juan pensó que María estaba enferma.
John think-past-perf that Mary be-past-imperf sick.
- b. Juan pensó que María estuvo enferma.
John think-past-perf. that Mary be-past-perf sick.

(4a) receives an overlapping reading, like (1) in English, although a backward shifted reading may be available with appropriate adverbial modifications or context. In contrast, (4b) only has the backward shifted reading. Thus, stative properties indicated by aspect determine the temporal readings available.

Further evidence that aktionsart properties affect the temporal readings also comes from independent sentences. Stative and progressive sentences in discourse usually yield overlapping readings relative to the reference time (RT), while event sentences generate sequential readings (Hinrichs 1986, Partee 1984, Kamp & Reyle 1993). Furthermore, tenses in independent sentences can receive an overlapping reading relative to the local evaluation time (the ST) in a way similar to embedded sentences. Compare, for example, *John will be at home now* with *John will leave now*. The overlapping reading only arises with the stative sentence, despite the adverbial modification *now*.

Given these facts, I pursue in this paper a uniform account of past tenses in embedded constructions under the hypothesis that an adequate treatment of tense meanings, including their interaction with aspect and aktionsart, as well as pragmatic implicatures, will predict the available readings. I argue that statives (including generic and progressive sentences) all share the property of implicating or entailing that they are true at a superinterval such that (a) it contains the sentence's ET, the time at which the sentence is true, and, (b) it is true at each of its component instants. It follows from this that the temporal interpretation of stative sentences may

overlap the sentence's local evaluation time (either ST or the main verb's ET). If overlapping readings are due to these semantic or pragmatic properties, rather than to the non-uniform tense meanings, one can maintain that tenses have the same meaning in all contexts but aspect and aktionsart lead to the overlapping readings. This would be, in principle, a simpler and more desirable theory, since (a) it would not claim vacuous temporal morphology, (b) it would not require any syntactic mechanism insensitive to aktionsart; and (c) it would explain tense meanings in a uniform way. For space reasons, however, this paper only deals with the problematic readings of simple and progressive past tense in English. For a discussion of embedded present and future as well as cross-linguistic data see Gennari (1998).

In what follows, I take for granted the following points: (a) the aktionsart class of a sentence is compositionally determined from the lexical class of its verb and the meaning of its arguments, as shown for example, in Verkuyl (1993); (b) grammatical elements such as progressive in English are treated as aspectual operators that apply to a proposition and return another one of different aktionsart (Dowty 1979, Moens & Steedman 1987, Kamp & Reyle 1993); and (c) conversational implicatures and common sense reasoning also intervene to determine the most likely temporal reading (Dowty 1986). In particular, the duration of an interval at which a sentence is true depends on world knowledge about the event or state in question. For example, the interval throughout which a state such as being sad holds is typically shorter than that of being German. Likewise for non-statives (writing a book vs. running a mile).

2 Theoretical framework

2.1 Aktionsart entailments and progressive aspect

In this paper, I adopt Taylor's (1977) and Dowty's (1979, 1986) defining criteria of aktionsart classes and truth conditions for progressive aspect. The criteria say what should follow from the truth of a sentence Q if Q is a sentence of a given class as determined by the internal semantic composition. The criteria and the definition of progressive are as follows (where $Q(i)$ refers to a sentence Q true at any interval i):

- (5) $Q(i)$ is stative iff it follows from its truth that Q is true at all instants within i .

- (6) $Q(i)$ is an accomplishment/achievement iff it follows from its truth that Q is false at all subintervals of i ².
- (7) $Q(i)$ is an activity iff it follows from its truth that Q is true at all subintervals of i down to a certain limit of size.
- (8) $PROG[Q(i)]$ is true at w iff $i' \supset i \supset i'$ & i is not a final or initial subinterval of i' & w' such that $w' \in \text{Inr}(\langle i, w \rangle)$, $[Q(i')]^{w'}$ is true³.

Entailment (7) is meant to capture the fact that activities do not hold at small subintervals of i (e.g. gardening). The relevant smallest size at which an activity can hold depends on the activity itself, i.e., on pragmatic considerations. Thus, activities differ from states in that they do not entail their truth at subinstants. Dowty (1979) suggests that this difference is due to what he calls the change-of-state entailment, which is the basic property that distinguishes states from non-statives. Activities are characterized by a change in physical or locative properties over time. The difference with accomplishments/achievements is that activities involve several (small) changes (hence the subinterval property) while accomplishments/achievements involve one definite change.

Definition (8) says that $PROG[Q]$ is true at an interval i at a world w iff there is an interval i' properly containing i and i is not the final or initial subinterval of i' and for all worlds w' in the inertia set of possible continuations of w at i , Q is true at i' in w' . Here I will not be concerned with the modal component. Note that (8) satisfies the defining criterion of stative aktionsart: If $PROG[Q]$ is true at i , for any subinstant t of i , there is a superinterval containing t (and i) where Q is true, therefore, $PROG[Q]$ is also true at every subinstant of i . This captures the fact that progressive sentences are statives; $PROG$ applies to any other aktionsart and returns a stative proposition.

2.2 The effect of aktionsart on temporal readings: introductory example

² Intuitively, i is the interval at which the change of state takes place. Q cannot be true at i until the instant immediately after the event was completed. If I painted my room exactly between 8 AM and 8 PM, *I painted my room* is false at all subintervals of this interval.

³ Dowty (1986) proposes that the possibility that i is the initial subinterval of i' should be excluded either by the addition of a requirement in the truth conditions or by pragmatic conversational implicatures. This is because progressive sentences do not receive inceptive interpretations and their ETs are clearly understood in the middle of the event denoted (e.g. *At 5, I was sleeping*). In the text, I

The fact that stative sentences lead to overlapping readings can be seen in the relation between the ET and its local evaluation time. Consider first the interpretation of independent accomplishment/achievement sentences:

- (9) John will leave (now).
FUT(John leave)'= $i [i > \text{st leave}(j)(i)]$

Under the standard analysis of future tense, (9) is true now iff there is an interval i after the ST such that John leaves at i . Note that (9) does not mean that John is leaving at the ST but that he is about to leave. To understand why an overlapping reading with the ST (the local evaluation time) is not possible, consider the aktionsart entailments. First, according to (6), an accomplishment/achievement sentence $Q(i)$ entails that Q is false at all subintervals of i . Second, this entailment in turn entails that if Q is true at an interval i , Q is false at all superintervals of i as well (Dowty 1986). For if Q were true at some superinterval i' of i and at i itself, it would be false at all subintervals of i' , including i , according to (6), contradicting the assumption. Thus, if *John leave* is true at some future interval i , the sentence entails that John's leaving does not hold at any subinterval within i , and therefore, it does not hold at any superinterval of i either. Given this and the standard meaning of future, it follows that *John will leave now* crucially cannot overlap with the ST, despite the adverbial modification⁴.

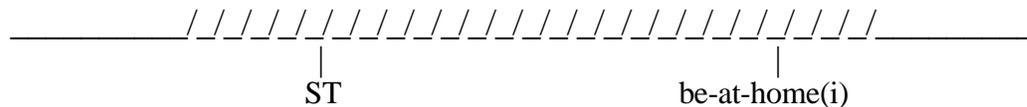
Consider now a stative sentence:

- (10) John will be at home (now).
FUT(be-at-home(j)(i)) = $i [i > \text{st} \ \& \ \text{be-at-home}(j)(i)]$

This is a use of simple future traditionally considered modal rather than temporal, since the sentence seems to refer to the ST instead of a future interval. However, the fact that the sentence is stative determines the overlapping reading with the ST. Recall that (10) entails its truth at all subinstants of i . In contrast to (9), this does not exclude the possibility that the sentence is actually true at a larger interval that properly includes its ET, the future interval provided by the future tense. In fact, when states are asserted the normal assumption (I call it the superinterval property) is that

⁴ What I have just said seems incompatible with the occurrence of *now* in (9). If the adverb modifies the ET of the sentence (the leaving time), this information contradicts the future tense. The solution to this puzzle is that *now* denotes an interval and not an instant. Such an interval could be extended

they are true at a larger indefinite interval surrounding their ETs. This is a pragmatic implication because it can be cancelled in certain contexts⁵ (Dowty 1986). Given this pragmatic assumption, *be-at-home(i)* in (10) may hold at an indefinite larger interval in which the future interval *i* provided by the tense operator and the ST are included. The slashes below represent this superinterval. Thus, the overlapping reading of the state in question with the ST is available.



Thus, the crucial factors in obtaining overlapping readings are the subinstant and the superinterval properties of states. The superinterval property is an implication that there is a larger interval (containing the state's ET) at which the state holds. This property and the subinstant property of (5) together entail that if the state is true at a superinterval, it is also true at all instants within this superinterval. Given this, the overlapping reading comes about because the superinterval is able to overlap with the evaluation time of the entire sentence.

2.3. The superinterval property

Since my analysis of the effect of aktionsart on temporal readings heavily relies on the superinterval implication of states, I now offer independent support for its existence based on pragmatic knowledge and discourse interpretation. First, note that states are facts, they characterize the static structure of the world describing locations and physical or psychological properties of entities. To start or stop being in a state depends on other events (e.g. being German), but the state's persistence does not. States remain true without the aid of an external force. These considerations are part of our pragmatic knowledge about this type of event in the world. In principle, if a state holds at time *t*, and no intervening event occurs between *t* and *t+I* that changes this state, then the state also holds at *t+I*. This is the intuition underlying the superinterval pragmatic implication of states. Dowty (1986) calls it the principle of inertia.

Second, the superinterval implication is clearly operative in discourse interpretation. As noted in discourse literature, a stative sentence in a

⁵ For example, when stative receive the so called inceptive reading: *Yesterday, John watched television*

narrative is most usually interpreted to obtain before and after the event denoted by the previous sentence as in (11). Crucially, the superinterval of the state can obtain even beyond the RT or the temporal location given in discourse (except for inceptive readings):

- (11) John went to see the president this morning. He was seriously sick.
(12) ?? The book was on the table at t_0Mary put the book on the table at t_n .

Also, Dowty observes that the conversational assumption that states persist in time makes (12) infelicitous, no matter how many events intervene between the sentences given, unless information is given otherwise. Thus, discourse interpretation, pragmatic knowledge and the lack of the ET-containment implication shown in (11) and below support the claim that states are pragmatically assumed to hold for periods larger than those specified by the tense and any adverbials (if any).

2.4 The superinterval property and activities

So far we have seen (a) that states receive overlapping readings because of the superinterval property, and (b) that accomplishments/achievements have aktionsart entailments logically incompatible with this property (sec. 2.2). Accordingly, accomplishments/achievements do not overlap their local evaluation times. However, the subinterval property of activities *is* in principle compatible with the superinterval implication. Thus, if this implication was available for activities, I would not have an explanation for why only statives generate overlapping readings with local evaluation times. I now suggest that the reasons why, states as opposed to activities, have the superinterval implication are to be found in the pragmatic implicatures, aktionsart entailments, and world knowledge that distinguish states from non-statives in general.

First, consider the contrast between the following sentences:

- (13) John ran. = $i [i < st \ \& \ run'(i)(j)]$
(14) John was running. = $i [i < st \ \& \ PROG'[run'(i)(j)]]$

(14) entails that there is superinterval containing i during which the process of running took place, by the definition of progressive in (8), while (13) simply says that the process took place at a past interval i . The choice between past progressive and simple past involves a quantity pattern of

implication. For if the speaker does not choose past progressive (the most informative form) but simple past, he/she implicates that the superinterval does not obtain. Thus, given the existence of an alternative and more informative form, episodic activities in simple past are not typically interpreted to hold at a superinterval, and therefore, they do not receive an overlapping interpretation relative to the evaluation time.

A consequence of this implicature (also due to world knowledge) is that episodic activities implicate that they take place within some arbitrary initial and end point of their interval of truth (Smith 1991), while stative sentences do not have such an implication (" " means *implicates*):

- (15) John ran this morning. He started and stopped running this morning.
- (16) John was sad this morning. * He started and stopped being sad this morning.
- (17) John was running this morning * John stopped running this morning.

States are not assumed to be contained in their ETs, while activities are, thus yielding sequential readings rather than overlapping ones relative to their evaluation times.

In addition to this pragmatic implicature, note that aktionsart entailments and world knowledge of non-statives in general do not support the pragmatic inference of a superinterval larger than the ET specified by temporal operators and adverbials. Recall that non-statives have the change-of-state entailment. This entailment in turn entails or implies other inferences that also affect temporal interpretations: the causal and contingent relations (in the sense of Moens & Steedman 1987) that non-stative events establish with other events. If non-statives involve changes from one state to another, a given non-stative event entails a cause and the temporal relation between causes and results is sequential. Likewise for contingent relations pragmatically implied. Thus, whenever interpreters infer a causal or contingent relation occurring (in-)between events X and Y, the temporal relation inferred is sequential. As noted in the literature, these inferences are operative in discourse interpretations⁶:

- (18) John went to see the president this morning. He asked him questions about the budget proposal.

⁶ When two events in discourse do not suggest clear dependencies (causal or contingent), they may

In (18), the event of asking questions is pragmatically contingent upon the events of entering the room, talking to the president etc., since one would not have occurred without the others. Thus, the change-of-state entailment and the sequentiality of pragmatic and causal dependencies support the fact shown in (15) that activities do not normally imply superintervals beyond their ETs.

To see this more clearly, recall that activities entail a sequence of small changes so that they are caused by some agentive force, which may be sustained for a while. Activities are events bringing about repeated changes. Given this, we do not assume that they hold at a superinterval because there is an intervening cause-event bringing about the changes, and this cause (whatever it may be) is in turn causally connected to other events. Intuitively, if an activity is true at t , it does not necessarily hold at a later time $t+1$ because the causal force applying at t may not apply at $t+1$. In contrast to states, the persistence of activities contingently depends on other events.

These observations suggest that the pragmatic knowledge and entailments associated with states and activities are fundamentally different. The change-of-state entailment, the ET-containment implication and the inferred temporal relations with other events suggest that activities (and non-statives in general) do not imply superintervals, but rather, they are interpreted to be maximally contained within a given spatio-temporal domain. In contrast, states do not entail changes and their persistence is independent of whatever caused them (hence, the implied superintervals).

3 Past tenses in complement sentences

3.1 The semantic analysis of cognitive verbs

Cognitive verbs such as *believe*, *think*, *know*, etc. are world-creating expressions, i.e., they denote a set of worlds which are determined by what the subject believes, thinks, knows, etc. Also, embedded sentences are evaluated with respect to the epistemic worlds introduced by the embedding verbs. To capture these facts, Hintikka (1969) defines the truth conditions of sentences such as (1) as follows: *John believed that Mary was sick* is true in a world w iff Mary is sick in every world w' that is compatible with the beliefs that John holds in w .

As for the temporal interpretation, most of the literature in SOT phenomena agrees that embedded tenses should be evaluated relative to the main verb's ET, at least for the case of backward shifted readings. To capture this in a straightforward compositional fashion, I let the cognitive verb take a temporal abstract (set of times) as an argument and apply it to its own temporal argument as follows:

- (19) $[[\text{believe}(Q_{\langle i,t \rangle}(i))(x)(i)]]^{w, st}$ is true iff for all w' compatible with x 's beliefs in w at i , $[[Q(i)]]^{w'}$ is true.

Believe is an expression of type $\langle \langle i,t \rangle \langle e, \langle i,t \rangle \rangle \rangle$. Note that it is crucial that the interval i appears twice in the definition: once as the interval with respect to which the embedded sentence Q is evaluated, once as the event interval of the matrix sentence, which will be bound by the outermost temporal operator when composing the meaning of the entire sentence. (19) captures that the embedded sentence is evaluated relative to the main verb's ET as part of the combinatorial contribution of this verb (see example below). Thus, the meaning of cognitive verbs specifies that the embedded sentence is evaluated relative to their ETs and worlds.

3.2 Simple past tense

Recall that past under past was problematic for a uniform theory of tenses because two readings were available and no postulated meaning of the tense could account for both of them appropriately. In my approach, past tense has a single meaning, equal to $Q_{\langle i,t \rangle} i_0 [i i < i_0 \ \& \ Q(i)]$, that requires the temporal property it modifies to be evaluated at an interval prior to the evaluation time. Past tense is treated as evaluation time sensitive rather than indexical. Thus, when past tense occurs in an independent sentence, its evaluation time is the ST, but when it occurs embedded under another tense, its evaluation time is given by the main verb's ET. This is clear in the case of past embedded under future tense:

- (20) Bill will tell you that Mary's exam went well.

The temporal interpretation of the embedded past is relative to the matrix future interval. The referred interval prior to the future interval can be located either after, before or overlapping the ST, since the meaning of past tense does not specify any relation to the ST.

Consider now how the problematic temporal readings of past under past come about. Here is the semantic composition:

- (1) John thought that Mary was sick.
 1. mary-be-sick' = i' [be-sick'(m)(i')]
 2. PAST' = $Q_{\langle i,t \rangle} i_0 i [i < i_0 \ \& \ Q(i)]$
 3. PAST'(mary be sick') = $Q_{\langle i,t \rangle} i_0 i [i < i_0 \ \& \ Q(i)](i' [be-sick'(m)(i')]) = i_0 i [i < i_0 \ \& \ i' [be-sick'(m)(i')](i)] = i_0 [i < i_0 \ \& \ be-sick'(m)(i)]$
 4. think'(PAST'(mary-be-sick')) = $Q_{\langle i,t \rangle} x i' [think'(Q(i'))(x)(i')](i_0 [i < i_0 \ \& \ be-sick'(m)(i)]) = x i' [think'(i_0 [i < i_0 \ \& \ be-sick'(m)(i)](i'))(x)(i')] = x i' [think'([i < i' \ \& \ be-sick'(m)(i)])(x)(i')]$
 5. john' = $P_{\langle e \langle i,t \rangle \rangle} i_1 [P(j)(i_1)]$
 6. john'(think'(PAST'(mary-be-sick')))) = $P i_1 [P(j)(i_1)](x i' [think'([i < i' \ \& \ be-sick'(m)(i)])(x)(i')]) = i_1 [x i' [think'([i < i' \ \& \ be-sick'(m)(i)])(x)(i')](j)(i_1)] = i_1 [think'([i < i_1 \ \& \ be-sick'(m)(i)])(j)(i_1)]$
 7. PAST'(John'(think'(PAST'(Mary-be-sick')))) = $Q i_0 [i' [i' < i_0 \ \& \ Q(i')]](i_1 [think'([i < i_1 \ \& \ be-sick'(m)(i)])(j)(i_1)]) = i_0 [i' [i' < i_0 \ \& \ i_1 [think'([i < i_1 \ \& \ be-sick'(m)(i)])(j)(i_1)](i')]] = i_0 [i' [i' < i_0 \ \& \ think'([i < i' \ \& \ be-sick'(m)(i)])(j)(i')]]^{st} i' [i' < st \ \& \ think'([i < i' \ \& \ be-sick'(m)(i)])(j)(i')]^7$

The truth conditions say that (1) is true iff there is a past interval i' before the ST at which John thinks that, at an interval earlier than the thinking interval, Mary is sick. Now, given the implication and the entailment associated with states, i.e., that (a) there is a superinterval i'' that contains i , the interval of *being sick*, and (b) for all instants within i'' , Mary is sick, it follows that both the interval of thinking and the interval of being sick can overlap. The slashes below represent the superinterval:



The superinterval of being sick can extend from an interval i earlier than the thinking interval until the thinking interval itself. This is indeed one possible

⁷ The last step of the derivation applies the lambda expression to the ST since all expressions are

reading and, in absence of adverbial modification or contextual information, the most likely one, given the superinterval implication⁸.

Note, however, that the superinterval of being sick does not have to overlap the thinking interval; this reading is not the only one available. The duration and past location assigned to the state interval will depend on context and general knowledge. More specific temporal and contextual information can generate a simple **backward shifted reading**. An obvious case of more specific temporal information is the occurrence of adverbs as in *Yesterday, John said that Mary was sick last year*. One case in which contextual information constrains the available readings of the complement is by means of the RT in discourse:

- (21) When John was a child, he went to a private school. He said the school was awful. He had to do everything he was told to do

Since the events narrated are located in John's childhood (the RT introduced by the *when*-clause), the state of the complement is accordingly located around this interval and not around John's saying interval. In this case, the complement clause behaves like an independent clause, i.e., it takes the RT from the previous sentence in discourse. In addition, the period of time assigned to the state in question depends on world knowledge assumptions about the school year. Thus, adverbials, contextual factors and world knowledge assumptions may constrain the interpretation of statives (their past location and duration).

Now consider a case in which an event complement is involved:

- (22) John believed that Mary went to the party.
 $i [i < st \ \& \ believe(\ i_2 [i_2 < i \ \& \ go\text{-to-the-party}(m)(i_2)])(j)(i)]$

Note that the *believe*-sentence is a state and so it implies a superinterval. It thus seems possible that the interval of going to the party could be included within this superinterval (overlap). However, this reading is not available because the entailment associated with states precludes it. A stative sentence such as *John believed that p* in (22) entails that for all instants *t* within the past *i* (the believing interval), it is true that John believes *p*. Since the complement is a past proposition that is believed at each instant *t* within the

⁸ There also is a conversational implicature that the RT or temporal location of the embedded sentence is not different from that of the matrix ET presupposed in the context, otherwise the speaker would indicate so. In *Yesterday, John thought that Mary was sick*, the embedded state is implied to obtain at

believing interval, the entailment amounts to the following: for each instant t within the believing state, there is a prior interval in which Mary went to the party. In other words, the belief is that there was a single event of going to the party and this belief is true at all instants within the believing interval. Thus, the believed event of going to the party precedes all these instants. It follows from this that the interval of going to the party cannot be included within the interval of believing. Otherwise, for some t within the believing interval, the entailment of statives would not be satisfied. Thus, the overlapping reading is precluded by virtue of the entailment of the sentence involved.

The same type of reasoning applies to other aktionsart combinations of main and complement sentences. As shown for (9), since accomplishments/achievements do not imply superintervals, an eventive main sentence such as $x \text{ say } p$ should be true within its interval of evaluation so that an event complement (what is said) will be true prior to it, given the sequence of past operators. No overlapping reading is possible. Activities will behave like accomplishments/achievements because they are true within their ETs and they do not have the superinterval implication. Their intervals could be more or less extensive, but they will be wholly located before the main verb's ET for similar reasons to those discussed in (22): For each instant within the believing state, it is entailed that there is some process that took place before it⁹. However, a stative complement under a non-stative sentence such as $x \text{ say } p$, or under a stative one, could generate an overlapping reading due to the superinterval property as in (1).

Thus, I have shown how the aktionsart properties of the sentences involved determine the available temporal readings. Embedded states yield overlapping readings if context allows them. In turn, embedded events yield sequential readings due to the involved entailments.

3.3. The past progressive

3.3.1 Tense and aspect composition

The definition of progressive aspect in (8) can be incorporated in a compositional treatment of tense and aspect. Aspectual operators are, as in Dowty (1979) of type $\langle\langle e, \langle i, t \rangle \rangle\rangle$, $\langle\langle e, i, t \rangle \rangle\rangle$, i.e., VP modifiers (they take and return a VP with an open argument position and a temporal

⁹ Note that this reasoning only applies to eventive complements in simple past. Progressive sentences

argument). After the VP combines with the subject position, the result is a temporal abstract of the right type to be an argument of a temporal operator. The result is that the tense operator provides the local evaluation time for the aspectual operator. In an expression such as PAST[PROG[Q]], the aspectual operator PROG is evaluated relative to the past interval of PAST. Consider the following (I omit the modal part of (8) and I abbreviate *i* is not final or initial in *i'* as $\neg \text{fin/in}(i)(i')$):

(23) John was saying the truth.

1. say-the-truth' = $x \ i_0 \ [\text{say}'(\text{the-truth}')(x)(i_0)]$
2. PROG' = $Q_{\langle e, \langle i, t \rangle \rangle} \ y \ i \ [i \ i' \ \& \ \neg \text{fin/in}(i)(i') \ \& \ Q(y)(i')]$.
3. PROG'(say-the-truth') =
 $Q_{\langle e, \langle i, t \rangle \rangle} \ y \ i \ [i \ i' \ \& \ \neg \text{fin/in}(i)(i') \ \& \ Q(y)(i')](\text{say-the-truth}') =$
 $y \ i \ [i \ i' \ \& \ \neg \text{fin/in}(i)(i') \ \& \ x \ i_0 \ [\text{say}'(\text{the-truth}')(x)(i_0)](y)(i')] =$
 $y \ i \ [i \ i' \ \& \ \neg \text{fin/in}(i)(i') \ \& \ \text{say}'(\text{the-truth}')(y)(i')]$
4. John' = $P_{\langle e, \langle i, t \rangle \rangle} \ i_0 \ [P(j)(i_0)]$
5. John'(PROG'(say-the-truth')) =
 $P_{\langle e, \langle i, t \rangle \rangle} \ i_0 [P(j)(i_0)](\text{PROG}(\text{say-the-truth}')) =$
 $i_0 \ [y \ i \ [i \ i' \ \& \ \neg \text{fin/in}(i)(i') \ \& \ \text{say}'(\text{the-truth}')(y)(i')]](j)(i_0) =$
 $i_0 \ [i \ i' \ [i_0 \ i' \ \& \ \neg \text{fin/in}(i_0)(i') \ \& \ \text{say}'(\text{the-truth}')(j)(i')]]$
6. PAST' = $Q_{\langle i, t \rangle} \ i_1 \ [i_2 \ [i_2 < i_1 \ \& \ Q(i_2)]]$
7. PAST'(John'(PROG'(say-the-truth'))) =
 $Q \ i_1 [i_2 \ [i_2 < i_1 \ \& \ Q(i_2)]](i_0 [i' [i_0 \ i' \ \& \ \neg \text{fin/in}(i_0)(i') \ \& \ \text{say}'(\text{the-truth}')(j)(i')]])$
 $= i_1 [i_2 \ [i_2 < i_1 \ \& \ i_0 [i' [i_0 \ i' \ \& \ \neg \text{fin/in}(i_0)(i') \ \& \ \text{say}'(\text{the-truth}')(j)(i')]](i_2)]]$
 $= i_1 [i_2 \ [i_2 < i_1 \ \& \ i' [i_2 \ i' \ \& \ \neg \text{fin/in}(i_2)(i') \ \& \ \text{say}'(\text{the-truth}')(j)(i')]]]^{st}$
 $= i_2 \ [i_2 < st \ \& \ i' [i_2 \ i' \ \& \ \neg \text{fin/in}(i_2)(i') \ \& \ \text{say}'(\text{the-truth}')(j)(i')]]$

The truth conditions say that (23) is true iff there is an interval i_2 before the ST and there is an interval i' containing this i_2 such that i_2 is not final or initial in i' and at i' , John is in the process of saying the truth. This composition shows how tense and aspect interact.

3.3.2. Past progressive in embedded constructions

Since progressive aspect entails the superinterval property, its effects on temporal interpretations are like those of states in simple past:

(24) John said that Mary was going to the party.

$$i \ [i < st \ \text{say}(i' [i' < i \ \& \ \text{PROG}(\text{go-to-the-party}(m)(i'))](i)(j))]$$

- (25) John said that he would say to his mother that they were having their last talk.
 $i[i < \text{st say}(i, j, i'[i] > i \text{ tell}(i', j, \text{mother}, i_1[i_1 < i' \text{ PROG}(\text{have}(i_1, \text{they}, \text{talk}))])]]]$

(24) means that John said at an interval prior to the ST that there was another interval prior to John's saying interval in which Mary was going to the party. The overlapping reading obtains as in the case of simple past under past, i.e., the superinterval introduced by PROG surrounding the going event at i' can overlap with the saying interval. Similarly for (25). The superinterval introduced around the past interval i_I before the telling interval may overlap the telling.

Also, the intervals introduced by PROG do not necessarily overlap with the interval that happens to be the local evaluation time:

- (26) (Today) John said that Mary was writing the paper yesterday.
(27) Today John said that he would tell his friend that we were having a good time yesterday.

Progressive also allows backward shifted readings and, as with simple past, the available reading (the assigned location and duration) depends on adverbial specifications or contextual information:

- (28) John was watching TV when Mary came in. But she said he was sleeping.

The interval of sleeping overlaps Mary's coming in, and not Mary's saying. This is because the *when*-clause provides the RT for the evaluation of following discourse. General principles of discourse interpretation determine the most likely reading for past progressive.

3.4 Independent past

Given that past statives (including progressives) in SOTs may overlap with the local evaluation time provided by the main verb's ET, it seems that an independent past stative sentence could overlap the ST, i.e., the local evaluation time. Although (29) below, for example, may still be true at the ST, it does not have the same obvious overlapping interpretation as past under past. This is because the overlapping reading is blocked by standard Gricean principles applied to grammatical elements as exemplified in (13) and (14). Consider the following:

(29) Karl was German.

Note that if the speaker wanted to convey that the state of being German obtains at the ST, he would have used present tense, since the superinterval of states would guarantee its application to present and at least some past times (it would be more informative). If the speaker does not use present, the implication is that he/she does not know whether this piece of information obtains. Thus, the hearer is less inclined to infer that the state obtains at the ST, although this may in fact be true.

Note that this implication is clearly operative in (29). In absence of a discourse RT, the implication is that Karl is dead or changed his citizenship, in which case the sentence is a habitual state totally located in the past. The state does not overlap the ST. This is because on the one hand, (29) involves a very stable and habitual property (individual level predicate) that could in principle hold at the ST. But on the other hand, the pragmatic implicature of the tense says that Karl's being German does not hold at the ST, hence the implications about Karl. This contrasts with *Karl was sad/was running* where the temporary state can simply be interpreted not to hold at the ST without further implications. Thus, independent past statives imply a superinterval in a way consistent with my proposal, but its duration may not overlap ST due to a Gricean quantity maxim, hence the contrast with embedded past.

4. Further Evidence: infinitival complements

There are different types of verbs that take infinitival complements and the particular temporal interpretation of which depends in part on the semantics of the main verb. Some verbs require either a future or past interpretation of the infinitive such as *promise*, *ask* or *remember* (Ogihara 1996). The future interpretation of infinitives is captured by Portner's (1992) proposal that infinitival phrases introduce a set of situations that lie in the future of the evaluation time. However, this does not agree with the intuitions of (30) below. Mary's being smart is not in the future of the believing time. Thus, there are verbs such as *believe* or *consider*, as Ogihara notes, that require the infinitival complement to be evaluated relative to the matrix ET. Assuming that infinitivals simply denote a set of times (situations) in this case, aktionsart considerations predict that overlapping readings are possible

only when the embedded infinitive and the embedding sentence are stative. Consider the following:

- (30) John believed Mary to be smart.
i [i < st & believe(be-smart(m)(i))(j)(i)]

Note that, in contrast to *that*-clauses, there is no temporal operator that provides the ET of the embedded clause so that the infinitival complement should hold at the main verb's ET, given the semantics of *belief* in (19). Note also that the entailment of *John believed p* is such that, for all instants *t* within the past *i*, it is true that John believes Mary to be smart. Since the complement is also a state, it could be true that Mary is smart in each instant within *i*. In contrast, event infinitives cannot occur as complements of verbs such as *believe*, given that no temporal operator intervenes:

- (31) *John believed Mary to build the house/ to come/ to run.
i [i < st & believe(build(the house)(m)(i))(j)(i)]

The belief-sentence and the complement event have incompatible aktionsart entailments. *believe(p)(i)* entails that for all instants *t* within the believing interval, it is true that Mary builds the house at *t*, which is incompatible with the fact that non-statives in general cannot be true at instants. Note that the addition of *have* makes the complements in (31) possible. This is because such complements would denote the resulting state of the event in question, rather than the event itself. These facts indicate that only stative aktionsart can appear as infinitival complements of verbs such as *believe*. With non-statives, the entailments involved are incompatible. This supports the basic idea of my account that aktionsart considerations play an important role in determining temporal interpretations¹⁰.

5 Conclusions

¹⁰ It should be noted that our conclusions about this infinitival construction with *believe* are supported only by some native speakers. Other speakers think that *I believe him to know the truth* is not fine and the construction is only acceptable with the verb *to be*. Yet for other speakers, the construction is not grammatical in any case. However, all speakers recognize the degree of acceptability of state vs. event infinitives. This variability may be due to the fact that this is an archaic use of the verb *believe* so that the construction may have fallen out of use or be part of the passive competence. Much more

I have shown in this paper that overlapping readings in SOT constructions depend on stative aktionsart properties. I have argued that the reason why overlapping readings are available only with statives is because this aktionsart class typically implicates or entails the truth of the sentence at a superinterval. Given the superinterval property and standard pragmatic principles, I have proposed an account of the temporal readings available in SOT past constructions based on an adequate definition of the meaning of simple and progressive past tenses. By my account, no special mechanism is needed to delete or nullify the tense meanings, and a uniform theory of tense meanings can be assumed.

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