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TENSE, ASPECT, AND THE INTERPRETATION OF TENSELESS ELEMENTS IN ENGLISH

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1 Abstract

An analysis of English tense and aspect is presented that specifies temporal precedence relations within a sentence.¹ The relevant reference points for interpretation are taken to be the initial and terminal points of events in the world, as well as two “hypothetical” times: the *perfect* time (when a sentence contains perfect aspect) and the *progressive* or *during* time. We also describe a method for providing temporal interpretation for nontensed elements such as nouns and adjectives, whose interpretation may be temporally dependent.

2 Introduction

The analysis of tense and aspect requires specifying what relations can or cannot hold among times and events in the world. For example, a specification of the meaning of the past-tense sentence “John ate a cake” involves the fact that the time of the main event—in this case, the cake-eating event—precedes the time of utterance of the sentence. Various proposals have also been made regarding the analysis of aspect which involve auxiliary times or events, whereby the proper relationship of these auxiliary times or events to “real” main events is specified.

We provide an analysis of English tense and aspect that involves specifying relations among times rather than events. We also offer a means of interpreting tenseless elements like nouns and adjectives whose interpretation may be temporally dependent. For example, the noun phrase “the warm cakes” picks out different sets of cakes, depending on the time relative to which it receives an interpretation.

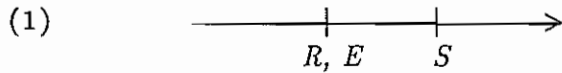
The analysis presented here has been implemented with the Prolog data base query system CHAT (Pereira 1983), and the representations are based on those used in that system. We shall show that an analysis of tense and aspect involving specification of relations among times rather than among events results in a clean analysis of various types of sentences.

3 Reichenbach

One of the earliest analyses of English tense and aspect was given by Reichenbach (1947). He introduced the notion of *point of reference* as distinct from *point of the event* and *point of speech*. According to his analysis, the semantic representations of all tensed sentences contain all three of these event points.

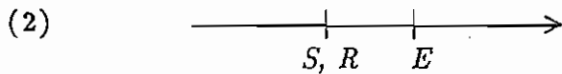
The following is Reichenbach’s representation of the simple past:

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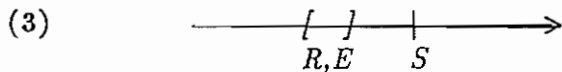
R denotes the reference point, E the point characterized by the main verb, and S the speech time. The arrow indicates progression through time. Even for a simple tense, all three points are involved in the representation. Here the reference point R and the main event time E are identified.

The following is a representation of a sentence in the simple future:



Here it is the speech point S and the reference point R that are identified, with the main event time E situated at a future time.

Reichenbach's analysis involves the claim that these "points" are not exactly like one-dimensional points on a time continuum, since they can have duration if progressive aspect is involved. If there is progressive aspect, the points are considered to be extended. Reichenbach analyzes past progressives in the following way:



The reference event R and the main event E are identified with a reference point of non-zero duration. This point precedes the speech time S.

Analyses similar to this one, in which three time points are posited for each tensed clause and their position is fixed on a time line, have been proposed by Hornstein (1977) and Yip (1985), among others. We shall now discuss some deficiencies of analyses such as these.

4 Harper and Charniak

Harper and Charniak (1986) present an interesting and revealing analysis of tense and aspect for English which involves relations between events. There are several kinds of events: the *utterance* event, which is associated with the time of the utterance; the *main* event, or the event being described by the main verb of the sentence; the *perfect* event; and the *progressive* event. The representation of every sentence involves the utterance event and the main event; sentences with progressive or perfect aspect also involve progressive or perfect events.

Note that Harper and Charniak's "utterance event" and "main event" are exactly parallel to the "speech point" and "main point" proposed by Reichenbach; the difference in Harper and Charniak's analysis is that their representations do not include a reference point, but may include a perfect event or a progressive event. This is an important advantage of their proposal: they do not assume that the interpretation of every sentence involves exactly three events.

In addition to the main event and the speech event, sentences in progressive aspect embody a progressive event, and sentences in perfect aspect embody a perfect event. A perfect progressive sentence embodies a speech event, a main event, a progressive event, and a perfect event. In this way, Harper and Charniak furnish a uniform analysis of perfects and progressives without the need to introduce extraneous events or reference times into simple tense sentences.

In the case of perfect sentences like *I will have arrived*, the perfect event is a hypothetical event that occurs after the arriving event. It is this event that is adverbially modified in a sentence like *I will have arrived by 3:00*; the perfect event is constrained to occur at 3:00, and the arriving event occurs prior to it. As for the progressive event, it takes place during the main event. In the case of simple progressive sentences, it is a hypothetical event that occurs during the main event. It is the event modified in utterances such as *He was swimming at 3:00*; the progressive event takes place at 3:00, during the swimming event. In the case of perfect progressives, the progressive event occurs during the main event, while the perfect event follows the progressive event.

This treatment is quite different from Reichenbach's conception of "reference time", which is assumed to be relevant for all sentences. To translate between the two systems, the reference time may be thought of as being represented by the perfect event in perfect sentences and by the progressive event in progressive sentences. In the case of perfect progressives, one might consider that there are two reference events, while in simple tenses there is no reference event at all. Alternatively, in a system like Webber (1987) in which reference points for each sentence are used to construct an event structure, the tensed event (what H&C call the "anchor event") is the relevant one: the perfect event for sentences with perfect aspect; for sentences with progressive but no perfect aspect, the progressive event; or the main event for simple tense sentences.²

Another attractive feature of Harper and Charniak's analysis is that they do not impose an absolute order on all the events in the representation of the sentence. That is, they do not represent the relations among these events on a Reichenbach-style time line. Rather, they impose constraints on relations among the events that need not fully determine all interevent precedence relations. For example, a simplified representation for a sentence like *He will have arrived* is the following:

- (4) $(\leq (\text{end arriving-event}) (\text{begin perfect-event}))$
 $(< (\text{end utterance-event}) (\text{begin perfect-event}))$

²Although instants rather than events are used in the representation described here, a similar strategy would be employable in building up a Webber-style event structure.

The main event (an arriving event) must conclude at or prior to the beginning of the perfect event. The perfect event must begin after the utterance event ends: that is, it must lie in the future.

Note that, in this case, no specification is made as to the relation of the main event (the arriving event) to the utterance time. In Reichenbach's treatment, and in more recent treatments (Hornstein 1977; Yip 1985), the main event is constrained to be in the future when the sentence is future perfect. This comes about because the representation of each sentence is constructed with reference to a time line, and it is not possible to assign a "vague" placement to an event on a time line. Its relation to all the other reference points must be completely specified. For Harper and Charniak's analysis, but not for the others, a sentence like

(5) *He will surely have arrived by tomorrow, and he may already have arrived.*

is not a contradiction. That is, even when the main event has occurred in the past, a future perfect sentence referring to that event may be true. By underspecifying relations among events, Harper and Charniak provide better coverage of the facts.

One important aspect of Harper and Charniak's analysis is their treatment of sequencing constraints among the events they posit. The order in which constraints are applied is main-progressive-perfect-tense, in a manner reminiscent of that described in Mathiessen (1984):

- First the main event times are provided; at the outset, the main event is the one to be predicated about.
- If the sentence contains progressive aspect, a progressive event is introduced and its relation to the main event made explicit. Progressive events are taken to be events that occur during the main event: they begin after the main event has started and end before its termination. The progressive event then becomes the event to be predicated about next.
- If the sentence contains perfect aspect, a perfect event is introduced. It is constrained to follow the event being predicated about (the progressive event, if there is one; otherwise the main event). The perfect event then becomes the one to be predicated about next.
- Finally, tense specifications are applied to whatever event is being predicated about (the perfect event, if there is one; otherwise the progressive event, if there is one; otherwise the main event). For example, if the sentence has future tense, the event is constrained to be in the future.

Harper and Charniak also pick out what they call the "anchor" event in the tensed clause. This is the event that is marked by tense: it is the first verb in the verb phrase except in the special case of the auxiliary verb *will*, which is treated as a tense marker. In the case of future tense, the event represented by the second verb is the anchor event.

Harper and Charniak use the “anchor event” in their analysis of adverbial subordinate clauses. They provide a very detailed analysis of several subordinate clause types; for the correct interpretation to be made, it is sometimes necessary in their analysis to determine whether the main clause or the subordinate clause contains progressive or perfect events. The information that must be present for adverbial subordinate clause interpretation is, therefore, the following:

1. aspect of the subordinate clause and main clause;
2. main and anchor events of the subordinate and main clause;
3. lexical form of the temporal connective.

The operation performed depends on the temporal connective.

Harper and Charniak take the position that every event can be modified. For example, a present perfect progressive sentence containing an adverb is triply ambiguous, depending on which of its three events is regarded as being modified by the adverb. This claim seems to be too strong. Consider a sentence with perfect and progressive aspect:

(6) *John will have been swimming.*

This sentence contains a perfect, a progressive, and a main event. Harper and Charniak place the following constraints on their sequencing: the perfect event is in the future, the progressive event precedes the perfect event, and the progressive event occurs during the main event.

We may add the adverbial modifier *for three hours* to produce

(7) *John will have been swimming for three hours.*

It does not seem reasonable to maintain that this sentence can be true when John has swum for only twenty minutes if one requires the perfect event to have a duration of three hours. It does not even seem to make sense to speak of the duration of the perfect event in this case, nor of the progressive event. A phrase like *for three hours* can be sensibly taken to modify only the main event. We shall return below to a discussion of problems such as this.

5 Time Points

In accordance with Harper and Charniak, we propose perfect reference points for sentences with perfect aspect and progressive reference points for sentences with progressive aspect. Thus, the interpretation of each sentence involves a number of relevant times: the beginning and end of the event described by the main verb for all sentences, the *perfect* time if it has perfect aspect, and the *progressive* time if it has progressive aspect. Our analysis differs

from that of Harper and Charniak, however, in the contention that what is relevant for the interpretation of sentences is not a set of events but a set of times or instants. Instants, unlike events, have no beginning or end: they are one-dimensional points. In our analysis, then, temporal relations will be specified between instants of time (such as the beginning and ending points of an event) rather than between events. There are several reasons for making this choice.

First, if the reference points for perfect and progressive sentences are events rather than instants, it ought to be possible to predicate duration of them. However, this is not a possible option for perfect and progressive sentences: durational adjuncts are only interpreted relative to the main event. The sentence *John has swum for three hours* is only true when the duration of the main event (the swimming event) is three hours.

Second, relations among events in Harper and Charniak's system reduce anyway to relations between the starting and ending points of events. That is, the primitives of systems like Harper and Charniak's are relations among times. There seems to be little to be gained from constructing hypothetical events based on these relations when a simpler and cleaner analysis can be constructed on the basis of these primitive notions alone.

There might seem to be the following objection to adopting times as relevant for the interpretation of sentences: given a sentence like 'John was frosting a cake from 3:00 to 4:00 yesterday', we know about the progressive reference point only that it lies between 3:00 and 4:00; there are infinitely many instants satisfying that condition. It would be impossible to iterate over all of these times to determine the truth of any utterance.

In fact, though, to determine whether a sentence containing perfect or progressive aspect is true, it is unnecessary to do this type of iteration. That is, there is no need to instantiate the perfect or progressive time to a specific value; it suffices to show that an interval exists within which such a point can be found. In this manner, perfect or progressive times may give the appearance of being similar to events with a starting and an ending point, because they are constrained only to exist within some nonnull interval. Checking whether or not the sentence is true involves determining whether the interval exists.

First, let us examine the form of representation for simple sentences and for sentences containing perfect and progressive aspect. (We shall see later that the representation of simple sentences must be enriched somewhat; here we present only a first approximation.) Next we will examine the way truth values of the formulas in these representations are determined.

The following is the representation for the simple past sentence *John frosted a cake*, with words in upper case representing variables and words in lower case representing predicate names or constants:

- (8) *exists C Start End*
 holds(frost(john, C), Start, End)
 & *cake(C)*
 & *precede(End, now)*

The predicate *holds* in the first clause of the representation takes three arguments:

1. the predicate *frost* with its two arguments;
2. the beginning time of the cake-frosting event;
3. the ending time of the cake-frosting event.

The predicate *cake(C)* specifies that the thing John frosted was a cake. We do not represent this with a *holds* predicate because we assume here that the property of being a cake is a static property, not one that changes over time.³

The predicate *precede(End, now)* specifies that the ending time *End* of the cake-frosting event must precede *now*, the current time. In the course of validating this logical form, the variable *End* will be instantiated to a numerical value, and the atom *now* will be replaced by the value of the current time. The predicate *precede* represents the less-than-or-equal-to relation, while the predicate *strictly_precede* represents the less-than relation. Thus, the cake-frosting event must occur in the past. This sentence will be true if there is an event involving John's frosting *C*, where *C* is a cake and the end of this cake-frosting event lies in the past.

Let us next consider the semantic representation of a sentence with perfect aspect, *John will have frosted a cake*:

- (9) *exists C Start End Perfect*
holds(frost(john, C), Start, End)
∃ cake(C)
∃ precede(End, Perfect)
∃ strictly_precede(now, Perfect)

The interpretation of perfect sentences involves a perfect time: the variable *Perfect* in the example above. This time is constrained to follow the main event; this is enforced by the clause *precede(End, Perfect)*. Since this is a future perfect sentence, the perfect time *Perfect* is constrained to be in the future. The future tense is represented by the predicate *strictly_precede*; the perfect time must follow *now* (not coincide with it).

Note, therefore, that in the case of future perfect sentences the main event is required only to end before a time in the future, and that (as with Harper and Charniak's analysis) the following sentence is not a contradiction:

- (10) *John will have arrived by 3:00, and he may already have arrived.*

³This is not a necessary part of the analysis; this decision has been made partly to simplify the representations presented here. It would be equally satisfactory to represent the predicate *cake(C)* inside a *holds* predicate, with the beginning and ending times corresponding to the times the cake began and ceased to exist.

Unlike analyses like Reichenbach's, in which relations among all reference points are fully specified, this analysis allows the main event to be in the past even though the sentence itself is in future perfect aspect.

We shall now turn to the representation of sentences in the progressive. The following is a representation of the past progressive *John was frosting a cake*:

- (11) *exists C Start End Progressive*
holds(frost(john, C), Start, End)
ℰ cake(C)
ℰ precede(Start, Progressive)
ℰ precede(Progressive, End)
ℰ precede(Progressive, now)

Here the progressive time is represented by the variable *Progressive*. *Progressive* must occur during the cake-frosting event; that is, it must occur after the start of the main event *Start*, and before the end of the main event *End*. Since the sentence is a past progressive, there is a final requirement on the progressive time *Progressive*: it must precede *now*.

Notice that past progressives differ from simple past sentences in that it is the progressive time and not the ending time of the main event that is required to be in the past. Consequently, as in Harper and Charniak's analysis, the interpretation of a past progressive like *John was frosting a cake* does not require that the main event lie entirely in the past, but only that some part of it be in the past. The following sentence is not a contradiction:

- (12) *John was frosting a cake at 3:00, and he is still frosting it.*

The present analysis allows for the possibility that sentences analogous to this can be true.

We shall see in the next section that what was referred to as the *progressive time* in the foregoing example actually appears in the representation not only of progressives, but of every sentence, as what we shall call the *during time*. The *during time* will be used in the temporal interpretation of nontensed elements in the sentence. For this reason, the above representations of the simple past and future perfect sentences above were only a first approximation.

Finally, the representation of a sentence with both progressive and perfect aspect, like *John will have been frosting a cake*, is the following:

- (13) *exists C Start End Perfect Progressive*
holds(frost(john, C), Start, End)
ℰ cake(C)
ℰ precede(Start, Progressive)
ℰ precede(Progressive, End)
ℰ precede(Progressive, Perfect)
ℰ strictly_precede(now, Perfect)