Tense and Aspect in English

Hans Kamp
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DYANA Administrator
Centre for Cognitive Science
University of Edinburgh
2, Buccleuch Place
Edinburgh EH8 9LW, UK

The Semantics of the Progressive and the Perfect in English

Toshiyuki Ogihara
University of Stuttgart

1 Introduction

The purpose of this paper is to investigate the progressive and the perfect in English, and to provide a framework which accounts for the semantics of these two constructions. In order to reach this goal, we should isolate each aspectual form and consider its semantic contribution. However, it is also important to realize that the progressive and the perfect can cooccur in a single clause. Thus, one of the desiderata for a semantic analysis of these two constructions is that it correctly predicts the interaction of the two constructions. We consider the progressive first, and the perfect later.

2 The Progressive

As far as I can see, there are two major ways of dealing with the semantics of the progressive. One approach is to try to obtain the times at which a progressive sentence is true from the times at which its non-progressive counterpart is true (henceforth, the traditional approach). The other is to say that the extension of a progressive sentence is related to that of its non-progressive counterpart in some other way (henceforth, the non-traditional approach).

2.1 The Traditional Approach

I will not go into a detailed review of how the English progressive has been analyzed in formal semantics, but it should be noted that all the analyses of the progressive in the formal semantics literature up to and including Dowty (1977, 1979) pursue the idea that the times at which a progressive sentence is true are derived systematically from the times at which its non-progressive counterpart is true. More specifically, a progressive sentence is said to be true at a time t iff there is an interval t' such that t' includes t and the non-progressive counterpart of φ is true at t'. These analyses include Scott (1970), Bennett and Partee (1972). It is well-known that these analyses face the problems associated with the imperfective paradox. For details, the reader is referred to Dowty (1979). Dowty (1977, 1979) introduces modal concepts, thereby trying to remove the problems associated with the earlier proposals. According to Dowty's proposal, the truth conditions of the progressive are described in the following manner:

(1) [Prog φ] is true at $\langle$I,w$\rangle$ iff for some interval I$'$ such that I $\subset$ I$'$ and I is not a final subinterval of I$'$, and for all w$'$ such that w$'$ $\in$ Inr ($\langle$I,w$\rangle$), φ is true at $\langle$I$'$,w$'\rangle$.

[N.B. Inr is a primitive function which picks out a set of worlds which are exactly like the real world up to the time in question and in which the future course of events after this time develops in ways most compatible with the past course of events.]

It is important to note that Dowty's proposal inherits from the earlier analyses the idea that the time(s) at which φ is true "surround(s)" the times at which Prog φ is true.

However, as other linguists such as Vlach (1981) and Abusch (1985) demonstrate, it is quite difficult to determine the set of inertia worlds. For example, Vlach states that when Max is crossing a street and a bus traveling at 30 miles per hour is an inch away from hitting him, the most natural course of event would be that Max is hit by the bus, and he will never cross the street. Yet, (2) is perceived to be a true statement describing the situation:

(2) John was crossing the street when the bus hit him.

Although this is not a conclusive argument against Dowty's analysis, it shows the difficulty involved in selecting the desired set of inertia worlds for a given progressive sentence. Abusch (1985: 177–8) finds another problem with Dowty's analysis. She shows that it is not sufficient to have a single inertia function. For example, suppose that John was hit by a car at 12 o'clock. Then, the following sentences are both true at 11:59:

(3) a. John was crossing the street.
b. John was walking to his death.

This is impossible if we have a single inertia function. In all inertia worlds in which John dies, he does not cross the street, whereas in all inertia worlds in which John crosses the street, he does not die. Thus, it seems that these two sentences must be evaluated by different inertia functions. In other words, the function must be a variable whose value is fixed in a given context. However, even this modification is not sufficient. Consider the following example (Abusch 1985: 179):

(4) The wheel was rolling across the road when it was knocked over by the falling rock.

Since the rolling of the wheel and the falling of the rock are both governed by the laws of motion, we cannot pick a notion of inertia that contains one but not the other. Thus,

we cannot pick a set of inertia worlds which makes the entire sentence true. This also shows how problematic is the idea that we can (and should) derive the extensions of progressives from the times at which their non-progressive counterparts are true.

There is another line of attack on Dowty's analysis of the English progressive suggested by Vlach (1979). It involves achievement sentences, but it is independent of the imperfective paradox:

(5) a. John was dying at t & John died $\not\longrightarrow$ John died at some t$'$ such that t $\subseteq$ t$'$
b. John was leaving at home at t & John left $\not\longrightarrow$ John left home at some t$'$ such that t $\subseteq$ t$'$

Suppose that John was dying at t. Our intuition about death (or any other achievements) is that it takes place instantaneously or almost instantaneously. For instance, if John's life comes to an end at some time t because of the illness with which he was afflicted at some time before t, John dies at t, not at an extended interval including an earlier interval during which he was dying.[1] If so, the time at which John was dying cannot be (at least need not be) included in the interval at which *John die* is true, and we cannot derive the times at which *John be dying* is true from the times at which *John die* is true.

Dowty's proposal has another problem which, to the best of my knowledge, has not been noted in the literature. If we blindly apply Dowty's semantics, examples such as (6b) and (6d), which are dubious, are predicted to be true at some time t if there is an interval t$'$ which properly includes t and at which their non-progressive counterparts are true:

(6) a. John was drinking a glass of wine at 10.
b. ?John was drinking three glasses of wine and a cup of tea at 10.
c. John was reading a book at 10 p.m. on May 5th.
d. ?John was reading 500 books at 10 p.m. on May 5th.

Suppose that John drank a cup of tea and three glasses of wine yesterday and that he was in the process of drinking a glass of wine at 10 yesterday. Then, Dowty's theory predicts that (6b) is as good as (6a). The same is true of the pair (6c) and (6d). Suppose that John is an avid reader, and he actually read five hundred books last year. Suppose further that he was reading a book at 10 p.m. on May 5th last year. Then, (6c) is predicted to be just as good as (6d). Contrary to what Dowty's theory predicts, however, (6b) and (6d) sound very strange given the circumstances described. We might say that the reason has to do with the fact that these drinking or reading events cannot be regarded as constituting one coherent event. This is partly because

[1]Sometimes it is argued that dying takes time. However, even if it is true, it need not be the case that the time at which *John be dying* is true is included in the interval at which *John die* is true.

John does not consider the four drinking events or the five hundred reading events to form one unit. The following example due to Hans Kamp (p.c.) shows that there are some criteria (probably influenced by our world-knowledge) which determine whether an amalgamation of some atomic events counts as a collective event. Suppose Jones has a course with 50 students, and he gave an exam today. He has to return the exams to the students tomorrow, so he is now working on them. A student stops by and asks his secretary if he is available. (7) is the answer uttered by the secretary:

(7) I am sorry, Professor Jones is busy right now. He is grading 50 exams.

In the context under consideration, it is natural to consider the fifty grading events to form one unit. This seems to contribute to the fact that (7) is more acceptable than (6b) or (6d).

2.2 The Non-traditional Approach – The Progressive and Stativity

Having found problems with the traditional approach in which the set of times at which a progressive sentence is true is determined on the basis of the set of times at which its non-progressive counterpart is true, I now turn to the non-traditional approach. As mentioned earlier, the general idea behind the non-traditional approach is that the truth conditions of a progressive sentence do not make reference to the times at which its non-progressive counterpart is true. In principle, this leaves us with a lot of possible ways of making a connection between the extension of a non-progressive sentence and that of its progressive counterpart. However, to the best of my knowledge, only one concrete proposal has been presented in the literature. It is a proposal advocated by Vlach (1981) and Moens (1987), and it claims that the progressive form is a "stativizer".

The linguistics literature which concerns the progressive and stativity is rather confusing. One source of the claim that progressives are stative is Vlach (1981). He contends that the traditional approach, in which one tries to derive the times at which a progressive sentence is true from the times at which its non-progressive counterpart is true, is fundamentally misguided. Vlach argues for a proposal in which the notion of "process" plays an important role. For him, the progressive marker in English (i.e. be V-ing) is a stativizer. That is, it combines with a process and produces a stative sentence as a result. The leading idea in his account of the semantics of the progressive is that the progressive operator always combines with a process sentence. When a non-process sentence combines with the progressive operator, the sentence is turned into a process in advance. If the progressive marker always combines with a process, it is clear that the problems associated with the imperfective paradox (Dowty 1977, 1979) never arise there.

Let us see how Vlach's argument proceeds. Consider first the following pair of sentences.

(8) a. John ran.

b. John was in the room.

What is the difference between (8a) and (8b)? The difference between them is brought out clearly when they occur with *when*-adverbials:

(9) a. John ran when I arrived.
b. John was in the room when I arrived.

It is clear that (9a) is true in cases where the time at which *John run* is true follows the time at which *I arrive* is true. On the other hand, (9b) is true iff the time at which *John be in the room* is true continues at least until the time at which *I arrive* is true. Vlach assumes that point adverbials like *when*-clauses and *at*-adverbials serve as the means by which to distinguish between stative and non-stative sentences. Vlach adopts the following truth conditions for stative sentences:

(10) A sentence φ is stative if and only if the truth of *(Past φ) when I arrived* requires that φ was true for some period leading up to the time of my arrival.

Let us now consider progressive sentences such as (11)?

(11) John was running when I arrived.

Examples like (11) lead Vlach to conclude that progressives are stative because the truth of the sentence entails that the process of John's running must continue at least until the time of my arrival. Note that when the main clause is not progressivized as in (9a), the time of John's running is understood as following the time of my arrival. The above truth conditions also apply to progressive sentences involving the imperfective paradox:

(12) John was building a house when he was struck by the lightning and died.

(12) requires that *John be building a house* be true at an interval extending up to the time of his death. (The possibility that John's building a house surrounds the time of his death is excluded due to pragmatic reasons.)

In order to do justice to these intuitive judgments, Vlach sets up his system in the following way: The progressive is a stativizer. What does a stativizer do? It simply changes the way in which a sentence interacts with point adverbials. The progressive operator combines only with a process sentence, and the resulting sentence has exactly the same truth conditions as the process sentence with which the progressive operator combines. For example, *John run* and *John be running* have exactly the same truth

conditions in Vlach's system. The difference between them manifests itself only when they cooccur with point adverbials. A question naturally arises as to how to deal with progressivized telic sentences. Consider the following examples:

(13) a. John was building a house.
b. John was running.
c. John was dying.

a′. PST PROG PROC [John build a house]
b′. PST PROG [John run]
c′. PST PROG PROC [John die]

As mentioned above, the progressive operator always combines with a process sentence. In order to cope with progressivized telic sentences, Vlach posits the operator PROC, which serves to turn a telic sentence into a process sentence. Note that for someone subscribing to the traditional approach, the imperfective paradox is construed as the problem of deriving from the times at which a telic sentence φ is true the times at which PROG φ is true. As the progressive operator never combines directly with a telic sentence in Vlach's system, the imperfective paradox in its original form never arises. This does not mean, however, that we have found a true solution to the problem. What Vlach has done is to shift the problem associated with the imperfective paradox elsewhere. It is now trivial to account for the meaning of the progressive operator because it always combines with a process sentence and simply changes the sentence with which it combines into a stative sentence. But the imperfective paradox re-emerges as the problem of deriving from the extension of a telic sentence φ the extension of PROC φ. Vlach argues against the view that the times at which a progressive sentence is true should be predictable from the times at which its non-progressive counterpart is true. Moreover, the truth conditions for PROG PROC φ and PROC φ (where φ is a telic sentence) are exactly the same for Vlach. It follows, therefore, that he is required to derive the extension of PROC φ from the extension of φ without making reference to the times at which φ is true. As far as I can see, Vlach does not offer a proposal which is truly distinct from Dowty's account of the imperfective paradox. Vlach characterizes the process associated with an accomplishment in the following way (Vlach 1979: 288):

(14) If φ is an accomplishment sentence, then Proc [φ] is that process P that leads to the truth of φ, and such that if φ is to become true at I, then P starts at the beginning of I and ends at the end of I.

Here the definition includes the phrase "the process P that leads to the truth of φ". This phrase is subject to several possible interpretations. One is that it is the process that *typically* leads to the truth of φ. Another interpretation is that it is the process that *actually* leads to the truth of φ if the process continues without being blocked or interrupted. In what follows, I will show that (i) the first interpretation does not work, and that (ii) if we take the latter interpretation, it is not very different from Dowty's proposal.

One way of making Vlach's analysis truly distinct from Dowty's analysis is to pursue the following line of reasoning. In order to derive the extension of a progressive sentence from the "meaning" of its non-progressive counterpart, we assume that the process (or the set of processes) associated with an accomplishment is conventionalized, and it is known to the native speaker in advance. It seems prima facie reasonable to assume that there is a series of processes which jointly make up an accomplishment event. For example, an event of John's building a house can be assumed to consist of the following set of activities: {John hammers in nails, John puts up posts, etc.}. Then the truth condition of the progressivized sentence can be described in the following way:

(15) *John is building a house* is true if and only if one (or more) of the processes obtains at the speech time.

Unfortunately, this truth condition is wrong on two counts. First, this is not a sufficient condition. Suppose that John was hammering in nails, and someone utters the following sentence:

(16) John is building a house.

But it is possible that John was in fact building a kennel for his dog. (Of course, a question arises as to how we can verify this. For our purposes, it is sufficient to assume that John had the intention of building a kennel and he in fact finished building one later.) If so, John can legitimately complain that (16) does not accurately describe what he was doing at the time. This shows that engaging in one of the activities described above does not constitute a sufficient condition for the truth of (16). Secondly, it is not a necessary condition, either. Due to technological advances, modern house-building does not have to involve all of the sub-events associated with conventional house-building. Suppose John is welding pre-fabricated parts together. This is not part of a conventional house-building event. However, once we understand this act as something which leads to the completion of a house, it becomes possible to use (16) in order to make reference to this process. That is, knowing the meaning of the lexical items constituting the sentence (16) is not sufficient to predict what counts as a "process of building a house". The occurrence of any concrete process can qualify as a "process of building a house" if it can be understood in a particular situation as a process "leading to" the completion of a house. Hinrichs (1983) makes the same point by giving the following example:

(17) John was making Bill a millionaire.

There are many ways in which John can make Bill a millionaire. John may have been dying, leaving a fortune to be inherited by Bill. John may have helped Bill invest his money in a clever way. It is obvious that there is no predetermined set of specific processes that jointly make up an event of "John's making Bill a millionaire", nor is there

a set of alternative processes. The above discussion shows that the first interpretation of Vlach's approach fails.

Another way of interpreting Vlach's condition is to say that the process associated with φ is the process that *actually* "leads to" the truth of φ. This interpretation works as long as we restrict ourselves to examples which do not involve the imperfective paradox. However, once we turn to examples involving the imperfective paradox, it is hard to avoid the conclusion that the progressive operator involves modal concepts just as Dowty's proposal does. That is, if the process is in fact blocked or interrupted in the real world, how could we check whether a certain process would lead to the truth of φ? The only possibility is to consider if the process would lead to the truth of φ if it had not been blocked. This clearly involves modal concepts. Presumably, Vlach's proposal still differs from Dowty's in that it does not make reference to the times at which non-process sentences are true. However, this makes only a very small difference between Dowty's approach and Vlach's approach. With some achievement verbs such as *die*, Vlach's approach may have some advantages over Dowty's. Vlach can say that any achievement event is necessarily preceded and abutted by a process which leads to the event. For example, suppose that John is in the extension of the predicate *die* at an interval I. Then, there is another interval I$'$ which precedes and abuts I and throughout which the process which leads to the truth of *John die* obtains. This predicts that the times at which *John die* is true do not surround the times at which *John be dying* is true. Thus, Vlach is able to avoid the problem pointed out above in connection with (5a) and (5b). However, with accomplishment sentences, I do not see any substantial difference between Dowty's approach and Vlach's approach. According to (14), the process associated with an accomplishment sentence is that process P that leads to the truth of φ, and such that if φ is to become true at I, then P starts at the beginning of I and ends at the end of I. Note that if we confine ourselves to cases in which φ is true in the actual world at some interval, say I, it follows from Vlach's semantics that the times at which Proc [φ] obtains are restricted to the subintervals of I. This is completely equivalent to Dowty's semantics for progressives. In other words, Vlach makes reference to times at which φ is true in order to define the interval at which Proc [φ] obtains. This is precisely what Vlach argues against. If we turn to accomplishment sentences which trigger the imperfective paradox, we arrive at the same conclusion: Vlach's proposal is essentially equivalent to Dowty's proposal. We must conclude that Vlach's contribution lies in pointing out problems with the existing systems, not in offering something that substantially improves on them.

Moens (1987) also claims that the progressive aspect marker in English only combines with process sentences and the resulting sentence is stative. If I understand him correctly, his leading idea is essentially the same as that made by Vlach (1979), and the comments directed at Vlach also apply to Moens's analysis of the progressive. He describes the transition from culminated processes to processes as something that "strips off" the culmination:

(18) A culminated process (like write a novel) can only combine with a progressive if a route is found from culminated process to process first. The most obvious one is labelled "–culmination", involving the "stripping off" of the culmination

> point from the referent of the expression. What we are left with is a process (that of writing), with its associated culmination point, but without indication as to whether this culmination point was actually reached. (Moens 1987: 58)

It is not clear how one can strip off the culmination point, while maintaining that the process has the associated culmination point.

As the above discussion shows, the Vlach-Moens approach is not problem-free. Despite the problems pointed out above, we adopt the idea that the progressive is a stativizer. There are several motivations for pursuing this strategy. First, the type of distinction between stative sentences and non-stative sentences that Vlach attempts to draw is similar to the one that Kamp & Rohrer (1983, ms.) try to draw. For K & R, the difference between events and states resides in the difference in the ability to move narrative time forward: events generally move narrative time forward, whereas states do not. Although Vlach's proposal is not designed for discourses, his criterion for distinguishing between statives and non-statives is similar to the criterion employed by K & R to distinguish between the two classes of sentences. A *when*-clause can be thought of as a means of giving a "reference time", and the way in which Vlach defines stative and non-stative sentences can be interpreted as a means of distinguishing between sentences which move narrative time forward and those that do not. At this point we turn to K & R.

K & R distinguish between events and states by making reference to the ability (or inability) of a certain sentence to move narrative time forward. For example, consider the following examples:[2]

(19) a. John opened his eyes. Mary was smiling at him.
b. John opened his eyes. Mary smiled at him.
c. Mary was smiling at him when John opened his eyes.
d. Mary smiled at him when John opened his eyes.

Since events and states are primitive entities in K & R's system and they are distinguished in terms of their capacity to move narrative time forward, and this is closely related to their interaction with *when*-clauses, we should conclude that K & R's theory closely resembles Vlach's theory so far as the way is concerned in which statives and non-statives are distinguished. Although Vlach's criterion fairly accurately distinguishes between what we normally take to be stative expressions and non-stative expressions, it is not always the case that lexical statives and accomplishment sentences are classified as statives and non-statives, respectively. In what follows, I will present and discuss some examples which show some discrepancy between the distinction between statives

[2]Kamp & Rohrer (1983: 253) give French examples, but the main point remains the same:

(a) Quand Pierre entra, Marie téléphona.
(b) Quand Pierre entra, Marie téléphonait.
(c) Pierre entra. Marie téléphona.
(d) Pierre entra. Marie téléphonait.

and non-statives informed by our pre-empirical intuitions *and* the classification that Vlach's proposal predicts.

First, some telic sentences do not qualify as non-statives according to the Vlach-KR criterion. Ed Keenan, when commenting on a paper by Livia Polanyi at WCCFL VI (1987), gave an interesting example which runs something like the following:

(20) [Suppose that John knows that Mary hates cigaret smoke.]
John smoked a cigaret in front of Mary. He offended her intentionally.

Keenan says that the second sentence, which is clearly an event sentence, does not have to be construed as the description of an event which occurs after John's smoking. Rather, this can be taken to be an explanation or restatement of what John did. Namely, John irritated Mary by smoking a cigaret in front of her. If this interpretation is adopted, the second sentence does not seem to move narrative time forward. The usage of statives we considered above is quite similar to this usage of event sentences. Note that we can construct a parallel example with a *when*-clause:

(21) When John smoked a cigaret in front of Mary, he irritated her intentionally.

Moens (1987: 26) also offers examples involving *when*-clauses which show that events described in main clauses do not necessarily follow the event described in the *when*-clause.

(22) When the terrorists blew up the bank
a. they phoned a warning.
b. they destroyed the whole building.
c. they escaped in a van.
d. they were caught by the police.

The problematic examples are (22a) and (22b). It is clear in (22a) that their phoning precedes their blowing up the bank. (22b) is similar to Keenan's example in that the event described in the main clause is a comment on the event described in the *when*-clause. They do not conform to Vlach's generalization that whatever is described by an event sentence occurring as a main clause is understood to obtain slightly after the event described in the *when*-clause. Stump (1985: 155) gives an example similar to (22a):

(23) When Lindbergh crossed the Atlantic, he chose Long Island as his starting point.

In view of these examples, it seems hard to describe the temporal relationship between non-stative sentences and *when*-clauses in a succinct manner. If we apply Vlach's definition of non-stative sentences strictly, we are led to conclude that sentences like (22a) and (22b) are not event sentences. However, this is counterintuitive. We slightly liberalize the definition of non-stative sentences in the following way: We simply keep Vlach's definition of stative sentences, and say that everything that fails to conform to this definition is a non-stative sentence. This will do at least for our purposes because none of the above "problematic" event sentences satisfies the condition for state sentences. For example, although in (22a) their phoning a warning temporally precedes their blowing up the bank, it is not the case that phoning extends up to the time of their blowing up the bank. The fact that the event described in a main clause and the event described in a *when*-clause can stand in various temporal relationships is not particularly problematic.

Second, it is also possible, in fact easy, to find examples in which lexical statives do move narrative time forward. Smith (1983: 485) presents the following examples:

(24) a. I owned the yacht when Great-Uncle Herbert died.
b. Macbeth believed in ghosts when he saw Banquo.

(24a) allows the interpretation in which the speaker's owning the yacht started when Herbert died. The same point can be made with (24b). These examples show that some occurrences of lexical statives (i.e. sentences which are classified as statives by our intuitions and all other often employed criteria) are not classified as statives according to the criterion established by Vlach. Discourse examples which serve to make the same point have been discussed by Dowty (1986: 50):[3]

(25) John went over the day's perplexing events once more in his mind. Suddenly, he was fast asleep.

(25) is an acceptable discourse, and with the help of the adverbial *suddenly*, the second sentence, which is a lexical stative sentence, serves to move narrative time forward. Both Smith and Dowty note that this is not possible with progressives. For example, Smith (1983: 487) gives the following example:

(26) Mary was laughing when she saw John.

The only interpretation of (26) is that at the time indicated by the *when*-clause, Mary was already laughing. The inchoative reading of a progressive sentence cannot be forced by pragmatics:

[3]See also Hinrichs (1986: 68).

(27) Mary was crying when John hit her.

The possibility that Mary started crying after John hit her is excluded despite the fact that this is the most pragmatically plausible interpretation. Dowty (1986: 56) provides a discourse example:

(28) ? John dropped the letter from the bridge and watched it hit the swiftly flowing water. (Suddenly/the next thing he knew), the water was carrying the letter downstream and out of sight.

Dowty observes that even with adverbials like *suddenly* or *the next thing he knew*, the second sentence with the progressive sounds strange. Note that this is in contrast with lexical statives as we saw above.

It does not seem to me to be necessary to modify the definition of statives. One way of analyzing the above facts is the following: lexical stative sentences can function either as statives or as events depending upon circumstances. By contrast, progressive sentences always come out as statives even if we set up the context in such a way that an event interpretation is plausible. This points to a possible difference between progressives and lexical statives.

One confusing point in the discussion of stativity in the existing literature is the following: Vlach seems to assume that the idea that progressives are statives was non-standard in the traditional analyses of the progressive,[4] which include Dowty's (1977, 1979). However, Dowty's proposal is not necessarily against the view that progressive sentences are statives. Dowty (1986) shows that under the proposal presented in Dowty (1979) progressives are predicted to be statives. Dowty (1986:42) defines a stative sentence φ in terms of the subinterval property:

(29) A sentence φ is stative iff it follows from the truth of φ at an interval I that φ is true at all subintervals of I.

He defines truth conditions for PROG φ in the following way (ignoring the "imperfective paradox"):

(30) [PROG φ] (i.e. the progressive form of φ) is true at I iff there is an interval I$'$ properly containing I such that φ is true at I$'$.

Dowty (1986: 44) says that the problems associated with the imperfective paradox are irrelevant to the purpose of his paper. Dowty shows from the above two definitions that

[4]Vlach (1981: 274) says "it seems that my claim that progressives are statives is a radical one, but I have seen no evidence against it," and he goes on to provide some evidence for his position.

PROG φ is stative: Suppose that PROG φ is true at I. Then it follows from the truth conditions of PROG φ that there is an interval I′ properly containing I such that φ is true at I′. It follows from (30) that for any subinterval of I, PROG φ is true because any arbitrary subinterval of I is by definition a subinterval of I′. This means that PROG φ has the subinterval property and is a stative sentence. As mentioned above, Vlach's theory *defines* events and states in terms of the ability (or inability) to move narrative time forward. By contrast, Dowty claims that his definition of stativity accounts for the fact that event sentences generally move narrative time forward whereas stative sentences generally do not. Dowty proposes what he calls the "Temporal Discourse Interpretation Principle (TDIP)":

(31) Given a sequence of sentences S_1, S_2, ..., S_n to be interpreted as a narrative discourse, the reference time of each sentence S_i (for i such that $1 < i \leq n$) is interpreted to be: (a) a time consistent with the definite time adverbials in S_i, if there are any; (b) otherwise, a time which immediately follows the reference time of the previous sentence S_{i-1}.

According to Dowty, this simple principle is all we need to interpret the temporal relations holding between sentences in a discourse; the difference between events and states in narratives *follows* from the definition of events and states which is independently motivated. He gives a pragmatic account of the difference between events and states in discourse contexts: As the TDIP says, any sentence is asserted to be true at a time immediately following the time at which the previous sentence is asserted to be true. However, there are pragmatic differences between events and states. According to Dowty, achievements and accomplishments (here identified with events) are defined in the following way:

(32) A sentence φ is an accomplishment/achievement iff it follows from the truth of φ at an interval I that φ is false at all subintervals of I.[5]

Suppose that an accomplishment sentence is asserted to be true at t. (32) disallows the possibility that φ is also true at some superinterval of t. On the other hand, if we adopt Dowty's definition of a stative sentence, given that a stative sentence φ is true at t, φ is allowed to be true at a superinterval of t. What we perceive, as a result, is the *impression* that states do not move narrative time forward.

However, when we consider cases involving the imperfective paradox, it becomes unclear whether all progressive sentences are stative.

(33) [PROG φ] is true at $\langle$I,w$\rangle$ iff for some interval I′ such that I $\subset$ I′ and I is not a final subinterval for I′, and for all w′ such that w′ $\in$ Inr ($\langle$I,w$\rangle$), φ is true at $\langle$I′,w′$\rangle$.

[5]Here, "subinterval" must be taken as meaning "proper-subinterval".

Suppose that PROG φ is true at $\langle$I, w$\rangle$. Then it follows that for some interval I$'$ such that I$'$ properly contains I and I is not a final subinterval for I$'$ and for all w$'$ such that w$'$ $\in$ Inr ($\langle$I,w$\rangle$), φ is true at $\langle$I$'$, w$'\rangle$. Now, take an arbitrary subinterval of I, call it I$''$, and consider if PROG φ is true at $\langle$I$''$, w$\rangle$. PROG φ is true at $\langle$I$''$,w$\rangle$ iff for some interval I$'''$ such that I$''$ $\subset$ I$'''$ and I$''$ is not a final sub-interval for I$'''$, and for all w$''$ such that w$''$ $\in$ Inr ($\langle$I$''$,w$\rangle$), φ is true at $\langle$I$'''$,w$''\rangle$. We know that in any world belonging to the set Inr ($\langle$I, w$\rangle$), φ is true at I$'$. We also know that I$''$ is a (proper-)subinterval of I$'$. Thus, if we can show that Inr ($\langle$I$''$,w$\rangle$) is a subset of Inr ($\langle$I,w$\rangle$), we can prove that PROG φ is true at $\langle$I$''$,w$\rangle$, thereby predicting that progressive sentences have the subinterval property. It depends on the nature of the inertia function whether we can show this. Given the way in which Inr is defined, it seems likely that Inr ($\langle$I$''$,w$\rangle$) is not a subset of Inr ($\langle$I,w$\rangle$). In fact, we have reason to believe that Inr ($\langle$I,w$\rangle$) is a subset of Inr ($\langle$I$''$,w$\rangle$). Inr picks out the worlds "which are exactly like the given world up to the time in question and in which the future course of events after this time develops in ways most compatible with the past course of events" (Dowty 1979: 148). Since I$''$ is a subinterval of I, the set of inertia worlds for $\langle$I$''$,w$\rangle$ properly contains the set of inertia worlds for $\langle$I,w$\rangle$. If this is the right way of understanding the inertia function, the truth of PROG φ at I does not guarantee the truth of PROG φ at all subintervals of I when the imperfective paradox is involved.[6] This, in turn, means that progressive sentences are not always stative sentences. The following example illustrates the problem. Assume the set of real numbers (considered to be temporal points) and a dense simple ordering $\leq$ on this set. Suppose that John starts drawing something at t_1 without deciding in advance whether to draw a circle or an arc. At t_2, he decides to draw a circle, and he completes it at t_3. Now, suppose that *John was drawing a circle* is true at the interval [$t_{1.5}$, $t_{2.9}$]. Does this entail that the same sentence is also true at any sub-interval of [$t_{1.5}$, $t_{2.9}$]? Dowty's theory, it seems to me, leaves open the possibility that the sentence is false at least at some subintervals of [$t_{1.5}$, $t_{2.9}$], namely the subintervals of [$t_{1.5}$, t_2]. The best that we can say is that a progressive sentence is a stative if we restrict our attention to cases not involving the imperfective paradox.

It turns out that what Dowty tries to show in his paper (Dowty 1986) does not crucially depend upon his claim that progressives are stative. I believe that he tries to prove something stronger than what he actually needs to make his point. Let us go back to his argumentation. His point is that a sentence φ is asserted to be true at t and φ has the subinterval property, it leaves open the possibility that φ is true at a superinterval of t. However, note that we only need something weaker than the subinterval property to make the same point; we only need to say that if φ is true at t, φ is not required to be false at all proper-subintervals of t. It is obvious that this weaker condition is satisfied by all progressives, including those that involve the imperfective paradox. I do not know if this is what Dowty intended, but he does seem to show that the difference between lexical statives and progressives on the one hand and accomplishments and achievements on the other in narrative discourses can be made to follow from their definitions.[7]

[6] I do not intend to make an empirical claim about the semantics of the imperfective progressive. I merely wish to suggest that Dowty's intertia function must be constrained in some way in order to make it follow that all progressive sentences, including imperfective ones, have the subinterval property.

[7] Vlach (1981: 280) notes that progressives have the subinterval property according to Dowty's analysis (which I deny here) and says that this is empirically undesirable.

Dowty's definition of statives and progressives has another interesting consequence. It predicts that there is a difference between progressives and lexical statives. Note that according to Dowty's definition of statives, the truth of a stative sentence φ at t does not entail that there is an interval $t' \supset t$ such that φ is true at t'. On the other hand, the truth of a progressive sentence φ at t entails that there is an interval $t' \supset t$ such that φ is true at t'. To see this, let us assume that PROG φ is true in w at some interval I. Then, it follows from the above truth definition of PROG φ that for some interval $I' \supset I$ and for every world w' belonging to the set Inr ($\langle I,w\rangle$), φ is true at $\langle I', w'\rangle$. Given the assumption that time is dense, there must be an interval I'' such that $I \supset I'' \supset I'$. Now the question is whether PROG φ is true at I''. The answer is yes if we can prove that Inr ($\langle I'',w\rangle$) is a subset of ($\langle I,w\rangle$). Following the argumentation given above, this seems in fact the case because I is a subinterval of I''. Thus, if PROG φ is true at t, then there is a more inclusive interval t' at which PROG φ is true. By contrast, a lexical stative sentence φ allows the possibility that the interval at which it is asserted to be true is the maximal interval at which it is true. This establishes a difference between lexical statives and progressives. Although Dowty himself does not note this difference between progressives and lexical statives in his paper, the discourse examples that he presents (see above) seem to support this distinction. We can say that a lexical stative sometimes appears to move narrative time forward because it allows the possibility that when it is asserted to be true at a certain interval I, it is the maximal interval at which it is true.

The possible difference between lexical statives and progressives is not only important for the observed difference between them in narrative discourse but also for the interaction of the perfect and these two constructions. If progressives and lexical statives have genuine semantic differences, we predict that they interact with the perfect in different ways. In other words, the perfect serves as a test for checking the hypothesis that progressive and lexical statives have different properties.

3 The Perfect

In what follows, I will pursue the result state analysis of the perfect presented in Moens (1987). He claims that the English perfect has a result state interpretation. This view can be thought of as a formalization of what McCoard (1978) terms as the "current relevance theory." As is summarized by McCoard (1978), the meaning of the perfect has been analyzed in several major ways, and the current relevance theory is one of them. The basic idea behind this theory is that (at least part of) the meaning of the perfect is to assert that some "aftereffect" of the past event (or perhaps of the past state) described in the sentence obtains at the speech time. This idea has been unpopular in the formal semantics literature partly because "current relevance" is a highly abstract entity and it is not easy to substantiate it empirically. However, this does not necessarily mean that the analysis of the perfect in terms of "current relevance" is fundamentally misguided. For example, Dowty (1979: 340) argues against McCoard (1978), who claims that the current relevance theory is not defensible:

(34) What McCoard has not ruled out, it seems to me, is the possibility that the perfect has as part of its meaning (or to be more exact, as part of its conventional implicature) a very, very general notion of "current relevance," more general than any of the particular theories he examines would allow (say roughly, "the event described has some relevance or other to the present context, the nature of which is to be inferred entirely from contextual factors"). If so, this "current relevance" implicature, however it is to be stated, could no doubt be added to the perfect rule given below, but I will not have anything to add here about this aspect of the perfect's meaning.

In the framework that I will defend in this paper, the "current relevance" is replaced by "result state", which at least gives us the hope that the concept of "current relevance" can be made more amenable to formal treatments. I think that the claim that the perfect (at least many occurrences of the perfect) serves to assert that a/the result state of the event (or the state) described by the sentence is defensible. In what follows, I will try to motivate the result state analysis of the perfect.

Let us start with an event sentence:

(35) John has lost his book.

The observation is that under the salient reading of (35), it is required that the state of John's not having his book continue until the speech time. Thus, if John has found the book by the time (35) is uttered, it is infelicitous. The truth conditions are informally described in the following way:

(36) PERF φ is true at t iff there is a time $t' < t$ such that φ is true at t' and there is a time t'' which abuts t' and includes t and a result state of φ obtains at t''.[8]

If this is all there is to the semantics of the perfect, then we can say that the perfect is used to make two assertions: (i) the event denoted by the sentence obtains in the past of the speech time; (ii) a result state associated with the event obtains at an interval abutting the time of the event and encompassing the speech time. However, even if we assume that the result state analysis of the perfect is right, the above truth condition does not cover all the cases. Consider the following examples, which involve lexical statives and progressives:

(37) a. John has lived in Stuttgart for three years.
b. John has been living in Stuttgart for three years.

[8]I argued elsewhere (Ogihara 1989) that the English perfect is ambiguous between a tense interpretation and an aspect interpretation. However, if my analysis is correct, the tense interpretation is excluded in main clauses (among others). Therefore, as long as we restrict our attention to main clauses as we do in this paper, we are assured that the perfect always receives an aspect interpretation. The interested reader is referred to Ogihara (1989).

I assume the following compositional structures for (37a) and (37b), respectively:

(37) a′. PRES [HAVE [John live in Stuttgart for three years.]]
b′. PRES [HAVE [PROG [John live in Stuttgart for three years]]]

(37a) receives two interpretations: (i) the period of John's living in Stuttgart continues up to the speech time; (ii) the period of John's living in Stuttgart is wholly located in the past of the speech time. By contrast, (37b) only receives a reading where John's living in Stuttgart continues up to the speech time.

We must consider several issues here. First, let us discuss Moens's argument (Moens 1987: 70) that the perfect always involves an assertion about a result state of something. I will show that the perfect is not always used to assert that a result state of something (usually an event) obtains at an "extended now" interval. (An extended now interval is an interval which starts at some point in the past and continues up to the speech time.) As mentioned right above, (37a) can receive an interpretation in which John's living in Stuttgart is wholly located in the past. In this case, we might argue that the truth condition (36) is also valid. The prediction is that (37a) can mean that the result state of John's living in Stuttgart (e.g. he knows a lot about the city) obtains at the speech time. However, a perfect occurring with either a progressive sentence or a lexical stative sentence (e.g. (37a) and (37b)) can receive an interpretation in which the state[9] described by the sentence that combines with the perfect obtains at an extended now interval (henceforth a "continuous state interpretation"). In fact, this interpretation is obligatory with (37b) in which a *for*-adverbial occurs. Note that a continuous state interpretation does not fit the above characterization of the perfect in that it does not seem to say anything about result states. Moens (p.c.) claims that even when a perfect sentence is used for a continuous state interpretation, it does assert that the result state of the continuous state obtains at the speech time. However, I do not see how one can substantiate this claim. In many languages (e.g. French, German, Japanese, etc.) a continuous state interpretation is conveyed by a sentence in the simple present tense accompanied by an adverbial denoting an extended now. This leads us to believe that this interpretation is substantially different from result state interpretations associated with perfect sentences with event verbs. Thus, it seems that it is hard to give a unified characterization of the function of the perfect. The best that we can do would be the following:

(38) PERF φ is true at t iff one of the following conditions is satisfied: (i) there is an interval $t' < t$ such that φ is true at t' and there is an interval t'' such that t' abuts t'', t'' includes t, and a result state of φ obtains at t''; (ii) there is an extended now interval (with respect to t) at which φ is true (where φ is stative in the sense of Vlach-Kamp-Rohrer).

The only generalization that we can obtain from the above truth condition is that a perfect sentence of the form PERF φ involves an assertion about a certain state: φ

[9]We assume here that a progressive sentence describes a state.

(when φ itself is stative) or a result state of the event or state denoted by φ. Thus, I do not see any way of providing the perfect with a purely homogeneous semantic characterization, contra Moens.

Another question is whether there is an important difference between a progressive sentence and a sentence with a lexical stative verb. As the above examples show, these two classes of sentences interact with *for*-adverbials in different ways. Combined with the fact that lexical statives can behave more like event sentences in other environments as well, this fact seems to strengthen the argument that lexical stative sentences and progressive sentences should be treated in different ways. We might hope to be able to show that a progressive sentence is inherently incapable of producing a result state due to its semantic property. Unfortunately, the facts are more chaotic than we hope them to be. When accompanied by no adverbial, a perfect sentence in the progressive form can receive an "event-like" interpretation:

(39) I have been writing a difficult letter; thank goodness it's finished.
(Hatcher (1951) cited by Mittwoch (1988))

It is obvious in this example that the writing of the letter is completed before the speech time. Thus, we are obliged to conclude that a perfect sentence is not forced to receive a continuous state interpretation. Although it is not intuitively appealing, we must say that (39) conveys something about a "result state" of the progressive state. Thus, what we can say about stative sentences (including progressives) is quite limited after all. We must retain the above truth conditions for the perfect. Any present perfect sentence can receive a "result state" interpretation.

At this point, we will discuss Dowty's analysis of the perfect (Dowty 1979, chapter 7), which falls within what McCoard calls the "extended now theory" of the perfect. The extended now theory claims that the perfect serves to locate an event or state denoted by the sentence within an interval which starts in the past and extends up to now. In the formal semantics literature, this has been the most favored theory for the perfect (e.g. Bennett and Partee (1972), Saurer (1984)). I will concentrate upon two issues and examine if Dowty's proposal offers something better than our theory. A first point concerns the possible difference between progressives and lexical statives. Dowty notes that (40a) is ambiguous, whereas (40b) is not:

(40) a. John has lived in Boston for two years.
b. For two years, John has lived in Boston.

(40b) only allows a continuous state interpretation. Dowty's proposal is to assume that *for*-adverbials come in two different types: temporal adverbials, which operate on sentences, and IV/IV's, which are VP modifiers. Dowty then stipulates that temporal adverbials, but not IV/IV's, can occur sentence-initially. According to Dowty's rules, the reading in which John's living in Boston wholly took place in the past can be

obtained by assuming that *for two years* is a VP modifier. The final translation is the following:

(41) $\exists t_1$[XN (t_1) & $\exists t_2$[$t_2 \subseteq t_1$ & two-year′ (t_2) & $\forall t$ [$t \subseteq t_2$ $\rightarrow$ AT (t, live-in-Boston′ (j))]]]
(N.B. [XN (t_1)]^{M,w,t,g} = 1 iff t is a final subinterval for t_1.)

Notice that the two-year period in question is not required to extend up to the speech time here; it can be located wholly in the past. By contrast, the preposed *for*-adverbial as in (40b) measures an extended now period. The final translation is the following:

(42) $\exists t_1$[XN (t_1) & two-year′ (t_1) & $\forall t_2$[[$t_2 \subseteq t_1$ & XN (t_2)] $\rightarrow$ AT (t_2, live-in-Boston′ (j))]]

This translation requires that the two-year period be an extended now interval. By positing the constraint that the temporal adverbial *for two years*, but not its VP modifier counterpart, can occur in the sentence-initial position, Dowty's proposal accounts for the observed difference between preposed and non-preposed *for*-adverbials.

However, Dowty's proposal does not account for the fact that when a perfect progressive sentence is accompanied by a *for*-adverbial, it only allows a "continuous state" interpretation regardless of the position of the adverbial. If we follow Dowty's rules faithfully, we should be able to have a progressive sentence with a *for*-adverbial acting as a VP modifier. The prediction is, then, that (43a) has the interpretation given in (43b):

(43) a. John has been living in Boston for two years.
b. $\exists t_1$[XN (t_1) & $\exists t_2$ [$t_2 \subseteq t_1$ & PROG [two-year′ (t_2) & $\forall t$ [$t \subseteq t_2$ $\rightarrow$ AT (t, live-in-Boston′ (j))]]]]

This formula does not predict that the two-year period must be an extended now period. It can be a period wholly located in the past of the speech time. This prediction is incorrect. Thus, under Dowty's account the difference between progressives and lexical statives in relation to *for*-adverbials remains a mystery. This fact, however, does not count against Dowty's theory because this is a problem for any other analyses of the perfect including the one that I defend in this paper.

A second point concerns the interaction of the perfect and temporal adverbials. Dowty proposes two semantic rules for the perfect: one for sentences without adverbials and the other for those with adverbials. The decision was motivated by the desire to account for the fact that *for*-adverbials and *since*-adverbials refer to extended now intervals. If I understand Dowty's rules correctly, the rule for perfects with adverbials is used also for adverbials like *today* or *this morning*, which refer to intervals that include the speech time. Consider (44), for example:

(44) John has walked a mile today.

Following Dowty's rules, we arrive at the following translation of (45):

(45) $\exists t\ [t \subseteq \text{today}' \ \&\ \text{XN}\ (t)\ \&\ \text{AT}\ (t,\ \text{walk-a-mile}'\ (j))]$

This translation requires that John's walking a mile must have taken place at an extended now. However, this is in fact not required at all. John's walking a mile can be wholly located in the past as long as it falls within today.[10]

Needless to say, we could fix Dowty's system in such a way that the event of John's walking a mile falls within today. However, this means that we lose the explanation that a preposed *for*-adverbial occurring with a present perfect sentence only allows an interpretation in which the state denoted by the sentence continues up to the speech time. In addition, the conceptual problem remains: the perfect only allows adverbials which include within their denotation the speech time, but the perfect serves to locate states or events *within* these intervals, not necessarily *at* these intervals. If the perfect is not required to make any assertion about the speech time, it is not clear why adverbials are *required* to denoted extended nows, which necessarily include the speech time. Moreover, the only truthconditional difference between (46a) and its past tense counterpart (46b) would be that the first moment at which (46a) is true is slightly earlier than that for (46b):[11]

(46) a. I have seen him.
b. I saw him.

However, it is counterintuitive to say that this is the crucial difference between the perfect and the past tense. The same is true of the following minimal pair containing the same adverbial *today*:

(47) a. I lost my wallet today.
b. I have lost my wallet today.

According to Dowty's theory, the only difference between (47a) and (47b) is that (47b) allows the possibility that the time of my losing my wallet is simultaneous with the

[10] In fact, there is one other derivation for the sentence in question in which *today* is treated as a "main tense adverbial" (Dowty 1979: 327–328). However, this derivation allows the time of John's walking a mile to be located before today. This interpretation is in fact unavailable.

(a) $\exists t_1[t_1 \subseteq \text{today}' \ \&\ \text{PRES}\ (t_1)\ \&\ \text{AT}\ (t_1,\ \exists t\ [\text{XN}\ (t)\ \&\ \exists t_2\ [t_2 \subseteq t\ \&\ \text{AT}\ (t_2,\ \text{walk-a-mile}'\ (j))]])]$

[11] Dowty (1979: 373, note 14) also considers this possibility, but he is not sure if this is supported by empirical evidence.

speech time whereas (47a) locates the event time wholly in the past. However, this is counterintuitive. Intuitively, the time of the event is located in the past in both examples, and yet (47a) and (47b) are not in free variation. Thus, the extended now analysis does not provide us with a means of capturing the difference between them. By contrast, the result state analysis gives us an account of why the perfect requires that a co-occurring adverbial denote an extended now interval. An adverbial occurring in a present perfect sentence measures an interval within which both the event described by the sentence and its result state obtain.[12]

Lastly, I will discuss briefly the question of whether the extension of a perfect sentence can be derived from the extension of its non-perfect counterpart. The answer seems to be negative given the vague meaning of the perfect. Let us consider a concrete example: if we know the extension of the sentence *John build a house*, do we know the extension of its perfect counterpart *John have built a house*? According to our proposal, one of the two functions of the perfect is to assert that a result state of the event or state denoted by the sentence obtains at an extended now interval. What is a result state of an event? A result state of an event can be defined as a state which comes into existence right after the completion of the event. It is clear, then, that there are many states that qualify as result states of a certain event. For example, we can think of many states that come into existence immediately after the interval at which *John build a house* is true: there being a house that he has built, John's having the experience of having built a house, etc. Since the selection of what is taken to be a result state of John's building a house is context-dependent, the best that we can do is to say that at least one of the states that qualify as a result state of John's building a house obtains at the speech time. This is obviously unsatisfactory because it makes a very weak empirical claim: it is not clear when a perfect sentence is true. However, I do not believe that the weak predictive ability of the present theory reveals its fundamental problem. I believe that it is possible to develop a system which incorporates result states and which is empirically more satisfactory, but such an approach is far beyond the scope of the present paper and will not be considered here.[13]

4 Concluding Remarks

I claimed that the Vlach-Kamp-Rohrer proposal, which attempts to distinguish between statives and non-statives in terms of their ability to move narrative time forward, should be adopted in spite of its problems. According to this proposal, progressives are statives. The progressive marker itself does not trigger the imperfective paradox. The problem is now relegated to the mechanism of deriving a process from an accomplishment or achievement, and it remains a problem. As for the perfect, I adopt a result state analysis following Moens. The perfect is claimed to have either of the following two

[12] With a continuous state interpretation, the adverbial measures an interval within which the state denoted by the sentence obtains.

[13] Japanese has a construction, the *te iru* form, which has an interpretation similar to that conveyed by the perfect in English (Kindaichi 1950). What is interesting about the construction is that it has two types of result state interpretations, and their availability is influenced by unaccusativity in an interesting way.

interpretations: i) the event denoted by the sentence took place in the past and its result state obtains at an extended-now interval; ii) the state denoted by the sentence obtains at an extended now. There are some indications that lexical statives and progressives differ in their behavior. However, they are not conclusive. I conclude that both lexical statives and progressives can produce result states.

Appendix: A DRT Fragment

Remarks:

The main purpose of this paper is to propose a framework for aspectual morphemes in English. In order to discuss the behavior of aspectual morphemes, however, we should motivate the tense system within which my proposal for the English aspectual morphemes is embedded. The tense system adopted in this paper is the one originally proposed and defended in Ogihara (1989). In what follows, I outline my argument for this proposal. Henceforth, I refer to the past tense morpheme '-ed' as "the tense morpheme", and all the morphemes having to do with temporal reference (i.e. the past tense morpheme '-ed', the future auxiliary *will*, and the perfect *have* '+en') "the temporal morphemes". One important characteristic of my proposal is that it adopts the standard analysis of the English Auxiliary system originally proposed by Chomsky (1957). It allows us to account for the temporal semantics of English straightforwardly. When I say "the standard analysis of the English Auxiliary system," I refer to any system in which the tense morpheme and the future auxiliary *will*[14] have independent syntactic slots. This entails that the tense morpheme and the future auxiliary can occur in the same clause. This indeed seems to be the right analysis because it allows us to claim that *would* is the past tense form of the future auxiliary. If I understand the history of the syntactic analyses of the English Auxiliary system correctly, most of the syntactic theories developed after Chomsky (1957) preserve the idea that the tense morpheme and the modal auxiliary occupy independent syntactic slots. Although these theories are different in detail (whether these morphemes are hierarchically or flatly organized, etc.), they preserve the basic insight of Chomsky's analysis. By contrast, the formal semantic analyses of English that have been proposed so far deviate from the above empirical observation. First, let us consider PTQ. In PTQ, the syntax of English syncategorematically introduces a tense morpheme when a term phrase combines with an IV (intransitive verb) phrase to produce a tensed sentence. The tense forms that can be introduced are: the future tense, the present tense, and the present perfect. Two remarks are in order with respect to this proposal. The system is organized in such a way that one and only one of the three tense forms (i.e. the past, the present, and the future) can occur in a clause. In phrase-structure-grammar terms, this means that these morphemes are treated as if they occur in the same syntactic slot. This does not conform to the syntactician's view I mentioned above. Another point is that the present perfect, and not the past tense morpheme, is treated as something that represents existential quantification over past intervals. It is not clear why Montague opted for this choice, and this position is different from the position defended in this paper.[15] The system cannot produce various combinations of tense morphemes that

[14]Put more accurately, the future auxiliary morpheme (call it *woll*) which underlies both *will* and *would*.

[15]One possibility is suggested by Bennett and Partee (1972) when they say "the central difference

English grammar is capable of producing: the past tense form, the past perfect, the future perfect, etc. Dowty's proposal (Dowty 1979, chapter 7) removes some of the inadequacies of Montague's proposal. Dowty's system treats both the past tense form and the present perfect form, but assigns them independent syntactic slots. For Dowty, the perfect is an IV (i.e. VP) operator, whereas the future tense and the past tense are sentence operators. Thus, Dowty's system can produce some of the tense forms that PTQ fails to produce: the past perfect, the past tense and the future perfect. However, Dowty's system does not quite do justice to the syntactic generalization that we would like to capture. In the standard syntactic analysis of the English temporal morphemes, the tense morpheme and the future auxiliary have independent syntactic slots. However, Dowty's system assigns the same syntactic slot to the tense morpheme and the future auxiliary. The standard syntactic analysis predicts the possibility that the past tense and the future auxiliary occur in the same clause, thereby producing *would*. By contrast, Dowty's analysis does not produce the form *would*. I demonstrated in my thesis that the problem cannot be solved by adding another unanalyzable tense form *would* which occupies the same syntactic slot as the other three tense morphemes. The reason is that there is no way of proposing a compositional semantic system under this syntactic system. Other analyses of the English tense system such as Bennett and Partee (1972), Saurer (1984) and Stump (1985) fall into the same category as Dowty (1979): they do not treat tense forms which involve *would*. To the best of my knowledge, the only semantic analyses of the English tense system which adopt the distribution of morphemes proposed by Chomsky are Ladusaw (1977) and Abusch (1988).[16] Part of the reason that the first group of authors do not adopt the standard syntactic analysis is that they are not concerned with the sequence-of-tense phenomenon. When we do not deal with the ST phenomenon, it seems plausible to adopt the traditional semantic system because the tense form *would* is almost exclusively found in ST contexts. It is not an accident, therefore, that the second group of authors are concerned with the ST phenomenon. When we consider data involving the ST phenomenon, it becomes clear that the standard syntactic analysis of the tense morphemes combined with the ST rule is an optimal system for describing the semantics of the English tense morphemes. In Ogihara (1989), I discussed in more detail why the standard syntactic analysis of the auxiliary goes well with the semantic system adopted here. The interested reader is referred there.

My claim is that if we assume the standard syntactic analysis of the auxiliary, we can say that each morpheme makes an independent semantic contribution in determining the temporal interpretation of the entire sentence. The idea that each tense morpheme makes an independent semantic contribution can be spelled out in various ways in various frameworks. In DRT, because of the way in which the construction algorithm works, the temporal information which is assumed to reside in the Aux node must be available at the sentence level. This necessitates the feature convention assumed here.

between the simple past tense and the present perfect tense is that the former involves a specified time whereas the latter involves only an unspecified time, or indefinite time, supplied by the existential quantifier". That is, Montague might have thought that the existential quantifier character of his operator H can be better captured by the present perfect form. This view is referred to as the "indefinite past theory" by McCoard (1978).

[16]Enc (1987) presupposes a syntax in which the future auxiliary is a modal verb and patterns with *must, may*, etc. However, she does not deal with the semantics of modal verbs.

The relative "scope" relationships among the tense and aspect features are specified by the algorithm, as the rules in [1] (see p. **??**) show. I also claimed in my dissertation that whenever a tense morpheme is used, a new "reference time" is introduced. The idea that the interpretation of tense morphemes is sensitive to intervals salient in the given context originates in Reichenbach (1947) and is incorporated in the work by Kamp and Rohrer (1983, ms., etc.), among others. However, the use of "reference times" in the present framework and that in the framework of Kamp and Rohrer differ in the following respects: (i) Kamp and Rohrer's framework (K & R, ms.) for French introduces the "temporal perspective point" in addition to the reference point. But in K & R's framework, the use of temporal points is determined partially by the use of adverbials, not purely by tense forms. On the other hand, the current fragment produces three "reference points" (sometimes identical to each other) the relative order of which is strictly determined by tense forms; (ii) One of the basic assumptions that K & R make is that an event can move narrative time forward, whereas a state does not. This stems from the following (controversial) observations: when a series of events occur one after another in a text, their order corresponds to the actual order in which these events took place; when an event sentence is followed by a state sentence, the state is understood as overlapping the event. K & R represent these observations by saying that an event sentence serves to move narrative time (i.e. reference time) forward. In the current framework, reference times are assumed to play different roles. Reference times are intervals which are salient at a certain point in a discourse and within which events are located as in K & R's framework, but the reference time itself is not necessarily moved when a new event sentence is introduced. In other words, we simply require that the event denoted by an event sentence fall within the contextually salient interval. I assume that this aspect of temporal interpretation is determined by semantics in the strict sense of the term. When a series of event sentences occurs in a discourse and the reference time is not moved, this proposal predicts that these events are not strictly ordered with respect to each other. The fact that the order of the events represented by a series of sentences is (generally) isomorphic to the order in which these sentences appear in the text is relegated to pragmatic principles. Although this treatment of event sentences is not problem-free, it is at least as good as any other approach with which I am acquainted.

I explain in more detail the function of the temporal morphemes here. The rules 1.1.1. through 1.3.4. (see p. **??**–**??**) cover them. The tense morpheme (+ indicates the past tense, whereas – indicates the present tense) indicates the location of Rpt_1 (which can be thought of as the primary reference point); the modal auxiliary indicates the location of Rpt_2; and the perfect indicates the location of Rpt_3. Rpt_2 and Rpt_3 can be thought of as secondary reference times in that they do not carry the main story line. In some cases, some or all of these points are simultaneous. The point here is that these reference points are determined strictly in a "compositional" manner: the tense morpheme determines the relative order of the speech time and Rpt_1, the future auxiliary the relative order of Rpt_1 and Rpt_2, and the perfect the relative order of Rpt_3 and Rpt_2. Finally, the event or state described by the sentence in question is located in relation to Rpt_3. That is, each morpheme has a well-defined semantic role to play. Some complications must be noted here. Progressives and lexical statives are grouped together here as states. I assume that the perfect in English is ambiguous between a tense interpretation and

an aspectual interpretation. There are many reasons to assume this. Here, I adopt the argument given by Stump (1985): temporal adverbials which clearly denote past intervals generally cannot occur in the present perfect used in main clauses, whereas they can occur freely in other constructions of the perfect. For convenience, I call the interpretation that is assigned obligatorily to the present perfect in a main clause the "aspectual interpretation" of the perfect. I refer to the other reading the "tense interpretation" of the perfect. I would like to note in passing that the current fragment overgenerate interpretations for the perfect. For example, it allows a main clause in the perfect to receive a tense interpretation, but this is empirically wrong. As far as I can see, the fact that main clauses in the perfect cannot receive a tense interpretation must be stipulated. The tense interpretation of the perfect is straightforward: locating an event or state described by the sentence in relation to Rpt_3. On the other hand, it is controversial how the aspectual interpretation of the perfect should be captured in a formal way. As mentioned earlier, I assume that it has two sub-cases: (i) a result state of the event or state described by the sentence obtains at an extended now; (ii) the state described by the sentence obtains at an extended now. For the purpose of this paper, I assume that both progressives and lexical statives have exactly the same properties. For example, both lexical states and progressives can produce result states. The above mentioned assumptions lead us to posit the sub-cases given in the fragment. The predicate RS is employed to show the relationship between an event (or state) and its result state: RS (s, s′) should be read as s is a result state of s′.

Temporal adverbials are not included in the fragment. This decision was motivated by the desire to keep the fragment maximally simple. Another reason is that I do not see any immediate solution to the empirical problems associated with such adverbials as *for*-adverbials and *since*-adverbials discussed in the paper. However, this brings some problems with it. Mittwoch (1982:117) shows that process sentences cannot occur in the perfect without a cooccurring adverbial. Moens (p.c.) pointed out to me that a stative sentence in the perfect has only one interpretation. Consider the following examples:

(48) a. ?John has worked in the garden.
b. ?John has played the piano.
c. ?John has held his breath.
d. John has lived in Austin.

(48a), (48b) and (48c) are infelicitous and (48d) only allows an interpretation in which John's living in Austin is wholly located in the past of the speech time. When appropriate adverbials are supplied (e.g. *for*-adverbials) as in the following, missing readings surface.

(49) a. John has worked in the garden for several hours.
b. Harry has played the piano for a while.
c. Mary has held her breath for 2 minutes.
d. John has lived in Austin for three years.

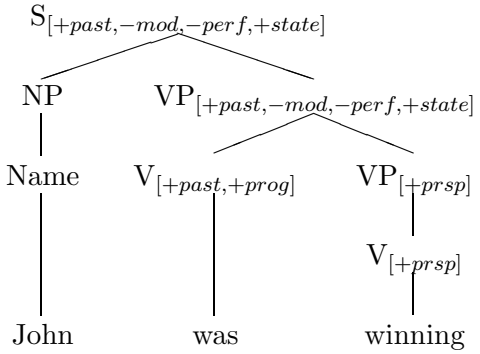
I let the fragment overgenerate interpretations so that they also include those interpretations that become available when appropriate adverbials are supplied. As I plan to incorporate a full set of adverbials in future versions of the fragment, this choice was partly motivated by practical considerations.

Lastly, I point out some difficulties that the fragment faces in dealing with the imperfective paradox. Consider the verb *win* as an example:

(50) John was winning.

This sentence has the following structure:

(51)



now, t, x

$t < now$, $Rpt_1 := t$, $Rpt_2 := Rpt_1$, $Rpt_3 := Rpt_2$, $t \subseteq s$
John (x)
s: [x be winning]

Now, the question is how this is going to be verified by the model. We might assume that the model contains the following three predicates: *win, winning*, and *be-winning*. *Win* is an event predicate, *winning* is a process predicate, and *be-winning* is a state predicate. It is easy to do the semantics in a compositional manner, and to assign a fixed interpretation to the progressive operator. Since the predicate *winning* is a process predicate, the extensions of the process predicate *winning* and the progressive predicate *be-winning* are exactly the same. It looks as if the imperfective paradox has been solved because it is now easy to derive the extension of *be-winning* from that of *winning*. However, note that *winning* is not a simplex predicate and is derived from *win*. Now the imperfective paradox surfaces again as the problem of deriving the extension of *winning* from the extension of *win*.

Syntax

[**1**] $\text{S}\begin{bmatrix} \alpha\ past \\ \beta\ mod \\ \gamma\ perf \\ \delta\ state \end{bmatrix} \rightarrow \text{NP} \quad \text{VP}\begin{bmatrix} \alpha\ past \\ \beta\ mod \\ \gamma\ perf \\ \delta\ state \end{bmatrix}$

[**2**] NP → Name

[**3**] $\text{VP}\begin{bmatrix} \alpha\ past \\ +\ mod \\ \gamma\ perf \\ \delta\ state \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} \alpha\ past \\ +\ mod \end{bmatrix} \quad \text{VP}\begin{bmatrix} \gamma\ perf \\ \delta\ state \\ +\ inf \end{bmatrix}$

[**4**] $\text{VP}\begin{bmatrix} \alpha\ past \\ -\ mod \\ +\ perf \\ \delta\ state \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} \alpha\ past \\ +\ perf \end{bmatrix} \quad \text{VP}\begin{bmatrix} \delta\ state \\ +\ \ pstp \end{bmatrix}$

[**5**] $\text{VP}\begin{bmatrix} \alpha\ past \\ -\ mod \\ -\ perf \\ \delta\ state \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} \alpha\ past \\ \delta\ state \end{bmatrix} \quad (\text{NP})$

[**6**] $\text{VP}\begin{bmatrix} \alpha\ past \\ -\ mod \\ -\ perf \\ +\ state \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} \alpha\ past \\ +\ prog \end{bmatrix} \quad \text{VP}\begin{bmatrix} +\ prsp \end{bmatrix}$

[**7**] $\text{VP}\begin{bmatrix} +\ perf \\ \delta\ state \\ +\ inf \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} +\ perf \\ +\ inf \end{bmatrix} \quad \text{VP}\begin{bmatrix} \delta\ state \\ +\ pstp \end{bmatrix}$

[**8**] $\text{VP}\begin{bmatrix} -\ perf \\ +\ state \\ +\ inf \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} +\ prog \end{bmatrix} \quad \text{VP}\begin{bmatrix} +\ prsp \\ +\ inf \end{bmatrix}$

[**9**] $\text{VP}\begin{bmatrix} \delta\ state \\ +\ inf \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} \delta\ state \\ +\ inf \end{bmatrix} \quad (\text{NP})$

[**10**] $\text{VP}\begin{bmatrix} \delta\ state \\ +\ pstp \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} \delta\ state \\ +\ pstp \end{bmatrix} \quad (\text{NP})$

[**11**] $\text{VP}\begin{bmatrix} +\ state \\ +\ pstp \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} +\ prog \\ +\ pstp \end{bmatrix} \quad \text{VP}\begin{bmatrix} +\ prsp \end{bmatrix}$

[**12**] $\text{VP}\begin{bmatrix} +\ prsp \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} +\ prsp \end{bmatrix} \quad (\text{NP})$

[**13**] $\text{VP}\begin{bmatrix} +\ pstp \end{bmatrix} \rightarrow \text{V}\begin{bmatrix} +\ pstp \end{bmatrix} \quad (\text{NP})$

Lexical Insertion Rules:

[**1**] $\mathrm{V}\begin{bmatrix} +\,past \\ +\,mod \end{bmatrix}$ → would

[**2**] $\mathrm{V}\begin{bmatrix} -\,past \\ +\,mod \end{bmatrix}$ → will

[**3**] $\mathrm{V}\begin{bmatrix} +\,past \\ +\,perf \end{bmatrix}$ → had

[**4**] $\mathrm{V}\begin{bmatrix} -\,past \\ +\,perf \end{bmatrix}$ → has, have

[**5**] $\mathrm{V}\begin{bmatrix} +\,perf \\ +\,inf \end{bmatrix}$ → have

[**6**] $\mathrm{V}\begin{bmatrix} +\,past \\ +\,prog \end{bmatrix}$ → was, were

[**7**] $\mathrm{V}\begin{bmatrix} -\,past \\ +\,prog \end{bmatrix}$ → am, are, is

[**8**] $\mathrm{V}\begin{bmatrix} +\,prog \\ +\,inf \end{bmatrix}$ → be

[**9**] $\mathrm{V}\begin{bmatrix} +\,prog \\ +\,pstp \end{bmatrix}$ → been

[**10**] $\mathrm{V}\begin{bmatrix} +\,prsp \end{bmatrix}$ → building, running, eating

[**11**] $\mathrm{V}\begin{bmatrix} +\,pstp \end{bmatrix}$ → built, run, eaten

[**12**] $\mathrm{V}\begin{bmatrix} +\,past \\ +\,state \end{bmatrix}$ → lived-in, loved

[**13**] $\mathrm{V}\begin{bmatrix} +\,past \\ -\,state \end{bmatrix}$ → kicked, built, loved

[**14**] $\mathrm{V}\begin{bmatrix} -\,past \\ +\,state \end{bmatrix}$ → lives-in, loves

[**15**] $\mathrm{V}\begin{bmatrix} -\,past \\ -\,state \end{bmatrix}$ → kicks, builds

[**16**] $\mathrm{V}\begin{bmatrix} +\,state \\ +\,inf \end{bmatrix}$ → live-in, love

[**17**] Name → John, Mary

The DRS Construction Algorithm

[1] Rules for syntactic structures of the form [$_S$ NP Aux VP] where S has features.

[**1.1.1.**] If S has the feature [+past], add a new time t (or choose a time t which is already in the DRS) and the following conditions, and delete the feature:
$\langle t < now \rangle$, $\langle Rpt_1 := t \rangle$

[**1.1.2.**] If S has the feature [–past], add a new time t (or choose a time t which is already in the DRS) and the following conditions, and delete the feature:
$\langle t = now \rangle$, $\langle Rpt_1 := t \rangle$

[**1.2.1.**] If S has the feature [+mod], add a new time t' (or choose a time t' which is already in the DRS) and the following conditions, and delete the feature:
$\langle t' > Rpt_1 \rangle$, $\langle Rpt_2 := t' \rangle$

[**1.2.2.**] If S has the feature [–mod], add the following condition, and delete the feature:
$\langle Rpt_2 := Rpt_1 \rangle$

[**1.3.1.**] If S has the feature [+perf] and the feature [+state], we have three options:

[**Option 1**] Introduce a new time t'' (or choose a time t'' which is already in the DRS) and a new state s, and add the following conditions (for the tense interpretation):
$\langle t'' < Rpt_2 \rangle$, $\langle Rpt_3 := t'' \rangle$, $\langle t'' \subseteq s \rangle$
s: $\boxed{\overset{S}{\Delta}}$
where '$\overset{S}{\Delta}$' is the tree obtained from the input syntactic tree by removing all the remaining features on the S node.

[**Option 2**] Introduce a new time t''(or choose a time t'' which is already in the DRS) , new states s and s', and add the following conditions (for the result state interpretation):
$\langle t'' < Rpt_2 \rangle$, $\langle Rpt_3 := t'' \rangle$, $\langle t'' \subseteq s \rangle$, $\langle s \text{ A } s' \rangle$, $\langle Rpt_2 \subseteq s' \rangle$ (A stands for abuts)
s: $\boxed{\overset{S}{\Delta}}$
RS (s', s)
where '$\overset{S}{\Delta}$' is the tree obtained from the input syntactic tree by removing all the remaining features on the S node.

[**Option 3**] Introduce a new time t'' (or choose a time t'' which is already in the DRS) and a new state s, and add the following conditions (for the continuous state interpretation):
$\langle t'' < Rpt_2 \rangle$, $\langle Rpt_3 := t'' \rangle$, $\langle t'' \subseteq s \rangle$, $\langle Rpt_2 \subseteq s \rangle$
s: $\boxed{\overset{S}{\Delta}}$
where '$\overset{S}{\Delta}$' is the tree obtained from the input syntactic tree by removing all the remaining features on the S node.

[**1.3.2.**] If S has the features [+perf] and [–state], we have two options:

[**Option 1**] Introduce a new time t″ (or choose a time t″ which is already in the DRS) and a new event e, and introduce the following conditions (for the tense interpretation):
⟨t″< Rpt_2⟩, ⟨Rpt_3 :=t″⟩, ⟨e ⊆ t″⟩

e: $\boxed{\overset{\text{S}}{\Delta}}$

where '$\overset{\text{S}}{\Delta}$' is the tree obtained from the input syntactic tree by removing all the remaining features on the S node.

[**Option 2**] Introduce a new time t″ (or choose a time t″ which is already in the DRS), a new event e, and a new state s′, and add the following conditions (for the result state interpretation):
⟨t″<Rpt_2⟩, ⟨Rpt_3 := t″⟩, ⟨e ⊆ t″⟩, ⟨e A s′⟩, ⟨Rpt_2⊆ s′⟩

e: $\boxed{\overset{\text{S}}{\Delta}}$
RS (s′, e)

where '$\overset{\text{S}}{\Delta}$' is the tree obtained from the input syntactic tree by removing all the remaining features on the S node.

[**1.3.3.**] If S has the feature [–perf] and the feature [+state], introduce a new state s, and add the following conditions:
⟨Rpt_3 := Rpt_2⟩, ⟨ Rpt_3⊆ s⟩

s: $\boxed{\overset{\text{S}}{\Delta}}$

where '$\overset{\text{S}}{\Delta}$' is the tree obtained from the input syntactic tree by removing all the remaining features on the S node.

[**1.3.4.**] If S has the feature [–perf], the feature [–prog], and the feature [–state], introduce a new event e, and add the following conditions:
⟨Rpt_3 := Rpt_2⟩, ⟨ e ⊆ Rpt_3⟩

e: $\boxed{\overset{\text{S}}{\Delta}}$

where '$\overset{\text{S}}{\Delta}$' is the tree obtained from the input syntactic tree by removing all the remaining features on the S node.

[2] Rule for syntactic structures of the form [$_{\text{S}}$ NP VP] where S has no features.

[**2.1.**] NP directly dominates Name:
Introduce a new reference marker x and add the condition ⟨α (x)⟩ for the name α, and replace the NP in the tree with x. Delete all the features on the Aux node with the exception of prog features.

[**2.2.**] VP is of the form [$_{VP}$ V X], where V has either [+mod] or [+ perf]
Rewrite the VP as X

[**2.3.**] If V has [+prog]
Rewrite the V as [$_{V}$ be]

[**2.4.**] If V has [+past] or [+pres]
Change the verb into its infinitival form

Model Theory

Let the model be a tuple $\langle \mathcal{E}, \mathcal{T}, S, U, Dur, RS, Name, Pred \rangle$ where:

(i) $\mathcal{E}$ is a triple $\langle E, O, o\!< \rangle$ where E is a set (the set of events), O and $o\!<$ are binary relations on E (overlap and complete precedence, respectively) satisfying the following postulates:

1. $X\ o\!< Y \rightarrow -\ Y\ o\!< X$
2. $X\ o\!< Y\ \&\ Y\ o\!< Z \rightarrow X\ o\!< Z$
3. $X\ O\ X$
4. $X\ O\ Y \rightarrow Y\ O\ X$
5. $X\ O\ Y \rightarrow -\ X\ o\!< Y$
6. $X\ o\!< Y\ \&\ Y\ O\ Z\ \&\ Z\ o\!< U \rightarrow X\ o\!< U$
7. $X\ o\!< Y\ \ X\ O\ Y\ \ Y\ o\!< X$

(ii) $\mathcal{T}$ is a linear ordering $\langle T, < \rangle$ where T is the set of instants, where T is induced by $\mathcal{E}$ (See Kamp 1979, 1981).

(iii) S is the set of states.

(iv) U is the set of individuals.

(v) Dur is a function which maps an event, state, or an interval onto an interval. Intuitively, this interval is occupied by the event or state to which Dur is applied. Dur is an identity function when applied to an interval.

(vi) RS is a two-place relation holding between an event or state and its result state. For example, RS (s,e) where $s \in S$ and $e \in E$ reads s is a result state of e.

(vii) Name is a function which assigns to each proper name a member of U

(viii) Pred is a function whose domain consists of the set of basic intransitive verbs and transitive verbs and which maps each common noun into a set of pairs consisting of an interval and a member of U, each intransitive verb into a set of pairs consisting of an element of $S \cup E$ and an element of U, and each transitive verb into a set of 3-tuples consisting of a member of $S \cup E$, an element of U, and another element of U.

(ix) If α is an event predicate, β is a stative predicate, β is the progressive form of α, and β is satisfied by a tuple $\langle e, u_1, ..., u_n \rangle$ where $e \in E$ and $u_1, ..., u_n \in U$, then there exists an $s \in S$ such that a tuple $\langle s, u_1, ..., u_n \rangle$ satisfies β and Dur (s) $\subseteq$ Dur (e)

1. Let f be a function from the set of discourse referents into $T \cup E \cup S \cup U$ such that

   f(t) $\in$ T, for a temporal discourse referent t
   f(e) $\in$ E, for an event discourse referent e
   f(s) $\in$ S, for a state discourse referent s
   f(u) $\in$ U, for an individual discourse referent u

2. f verifies a condition γ at t if

   (a) if γ has the form s: x α, then $\langle f(s), f(x) \rangle \in$ Pred (α)
   (b) if γ has the form s: x α y, then $\langle f(s), f(x), f(y) \rangle \in$ Pred (α)
   (c) if γ has the form e: x α, then $\langle f(e), f(x) \rangle \in$ Pred (α)
   (d) if γ has the form e: x α y, then $\langle f(e), f(x), f(y) \rangle \in$ Pred (α)
   (e) if γ is of the form $\alpha(x)$ where α is a proper name, then f(x) = Name (α)
   (f) if γ is of the form $\alpha(x)$ where α is a common noun, then $\langle t, f(x) \rangle \in$ Pred (α)
   (g) if γ is of the form $\tau \alpha \tau'$ where $\alpha \in <, \subseteq, :=$, A and $\tau, \tau' \in E \cup S \cup T$, then Dur (f($\tau$)) α_M Dur (f(τ'))
   (N.B. The condition is clear with $<$, $\subseteq$, and $:=$. As for A, the condition is defined in the following way: Dur (τ) A_M Dur (τ') iff Dur (τ) o$\prec_M$ Dur (τ') and there is no interval i such that Dur (τ) o$\prec_M$ i o$\prec_M$ Dur (τ').)
   (h) if γ is of the form RS (s,e), then RS (f(s), f(e))
   (i) if γ is of the form RS (s,s'), then RS (f(s), f(s'))

3. Truth definition: A discourse D is true in a model M at a time i relative to a DRS K for D iff there is a proper embedding K into M with respect to i.

Examples

1. John has lived in Austin. [ambiguous]

   (i)

   now, t, t″, s, s′, x

   t = now, Rpt_1 := t, Rpt_2 := Rpt_1, t″ < Rpt_2,
   Rpt_3 := t″, t″ $\subseteq$ s, s A s′, t $\subseteq$ s′
   John (x)
   s: [x live in Austin]
   RS (s′, s)

(ii)

now, t, t'', s, x

t = now, Rpt_1 := t, Rpt_2 := Rpt_1, t''<Rpt_2,
Rpt_3 := t'', $t''\subseteq$ s, $Rpt_2\subseteq$ s
John (x)
s: [x live in Austin]

2. John has been swimming.

(i)

now, t, t'', s, s', x

t = now, Rpt_1 := t, Rpt_2 := Rpt_1, $t'' < Rpt_2$,
Rpt_3 := t'', $t'' \subseteq$ s, s A s', t $\subseteq$ s'
John (x)
s: [x be swimming]
RS (s', s)

(ii)

now, t, t'', s, x

t = now, Rpt_1 := t, Rpt_2 := Rpt_1, $t'' < Rpt_2$,
Rpt_3 := t'', $t'' \subseteq$ s, t $\subseteq$ s
John (x)
s: [x be swimming]

3. John is swimming.

now, t, s, x

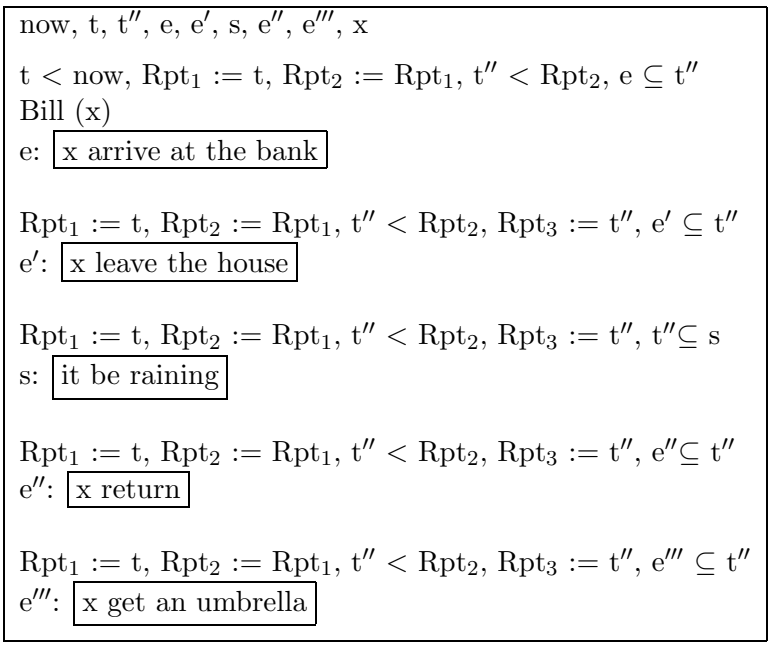
t = now, Rpt_1 := t, Rpt_2 := Rpt_1, Rpt_3 := Rpt_2, t $\subseteq$ s
John (x)
s: [x be swimming]

4. John has lost his book.

now, t, t'', e, s, x

t = now, Rpt_1 := t, Rpt_2 := Rpt_1, $t'' < Rpt$,
Rpt_3 := t'', e $\subseteq$ t'', e A s, t $\subseteq$ s
John (x)
e: [x lose his book]
RS (s, e)

5. Bill arrived at the bank at 10:45. He had left the house at ten. It had been raining. He had returned and got an umbrella.



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