

TEMPORAL ADVERBIALS, TENSES AND THE PERFECT*

1. INTRODUCTION

Most of the important new work on the temporal structure of discourse (e.g. [28, 68]) makes use of the framework for sentential temporal semantics proposed in 1947 by Reichenbach [56]. As Webber [67] puts it this model is “imprecise in some cases, incomplete in some, and only seductively suggestive in others”. Presumably it is still used because it includes concepts that can be made relevant to the temporal structure of discourse, something which is by no means true of all accounts of temporal semantics. The Reichenbach model was productive for a time, because it brought into temporal semantics the idea that multiple times might be involved in the interpretation process; but now it can be seen that the model is confused, and new insights gained into the temporal structure of discourse can be formulated with more clarity and accuracy if the Reichenbach model is abandoned.

No existing framework for temporal semantics provides a general treatment of durative (e.g. *for two weeks*) and frequency (e.g. *regularly*) adverbials. To my knowledge no existing account claims to be able to deal with such a straightforward sentence as

- (1) Allen worked out regularly for two weeks last month.

This leaves a substantial gap in our ability to describe the temporal structure of English sentences.

Closely related to both of these issues are the questions of the widely-noted parallels between nominal and temporal anaphora, and of the role of tense and aspect within the system of temporal reference.

In this paper I present a framework for the temporal semantics of English that deals with these two central issues (the Reichenbach framework and its replacement, and the treatment of durative and frequency

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adverbials) and with a number of other important but less central difficulties. I make essential use of the representation of sentential content in terms of explicit quantification over states, events, and processes, and in terms of the roles (or *cases*) of entities with respect to these events [1, 9, 13, 21, 47, 48, 53, 65].¹ I also rely heavily on the idea that the interpretation of discourse is a “dynamic process mapping partial models plus contexts onto new partial models plus contexts” [53], developed, discussed, and argued for in e.g. [3, 23, 24, 31, 53, 68]. The treatment of durative and frequency adverbials depends on the close analogies between the domain of things and substances on the one hand and the domain of events, processes, and states on the other [5, 45, 63, 64]. A number of writers [2, 52, 53] have demonstrated extensive parallels between nominal and temporal anaphora; these analogies have influenced some treatments of temporal semantics, but in my opinion not nearly enough; I suggest that the treatments of nominal and temporal anaphora are formally and computationally the same. This does not mean that the two are analogous in every respect.

In Section 2 I very briefly describe the event representations (ER’s) to be used later and their role in the interpretation process. Section 3 concerns the ontology of eventualities. (I follow Bach [5] in referring to events, processes, and states together as *eventualities*.) I discuss some important categories of sentence whose aspectual classification is controversial or not widely recognized, I argue that the different aspectual categories of sentences relate to temporal intervals in radically different ways. Section 4 describes tenses in terms of the conventions for their use and their role in interpretation; if this description is correct then there is no compositional semantics of tense and temporal semantics is the semantics of temporal adverbials (TA’s). Section 5 contains a discussion of temporal adverbials, especially the semantics of durative and frequency adverbials. In Section 6 I discuss the perfect, concentrating on the difference between the past and the present perfect, and argue that the present perfect is on a par with the past tense with respect to temporal anaphora. Finally in Section 7 I discuss the role of sentence-level temporal semantics in discourse, and argue that the idea of temporal indices or points of reference should be replaced by the idea of TA anaphora, which works just like, and in close conjunction with, NP anaphora.

¹ Davidson [13] and Fillmore [21] are crucial early contributions to the development of this sort of representation. The history since then is complex, with contributions from linguists (computational and otherwise), philosophers, and logicians. See [9] for a short history of this idea within the natural language processing community, which extends back at least to the early 70’s.

2. EVENT REPRESENTATIONS

The event representations to be used in this paper are traditional with regard to their structure and intended purpose. Only a brief introduction will be provided here. More detailed exposition may be found in Parsons [47, 48] and, from a somewhat complementary point of view, Allen [1].² I use ER's because it is much easier to discuss the matters of this paper using such representations. Arguments for ER's may be found in the previous citations; I hope that the remainder of this paper will also help to make the point.

The ER of a sentence like

- (2) Allen has talked to Betsy since Thursday

is something like

- (3) Type(E , Talk-event)
 & Agent(E , Allen)
 & To-Location(E , Betsy)
 & At(Consq(E), t_s)
 & In(E , Interval(th , t_s))
 & Day(th , Thursday).

In (3), occurring as one of a sequence of ER's that represent an extended discourse, E is a new *identifier* that designates the event reported by (2). The identifier t_s designates the speech time, which is really some representation of the context of utterance of the sentence, whether written or spoken. The identifier th designates the interval of the mentioned Thursday. The 'Type' predicate identifies the type of the event, the 'Agent' and 'To-location' predicates identify the roles played by Allen and Betsy [1, 21], the 'Consq' operator produces the consequent state of E (Section 6), which is asserted to hold 'At' the speech time. The 'Interval' operator produces the interval between th and the speech time, and finally the 'Day' predicate is used to include the information that th is a Thursday.

All context-related elements (e.g the perfect, the present tense, and personal pronouns, had there been any) have disappeared from (3) because the contextual information has already been used in order to replace

² See also [53] for a discussion of representations that are not different from our ER's in any fundamental way. All semantic solutions proposed by Partee as extensions of the work of Kamp [31] may readily be incorporated into the present framework. (Since this paper was written, I have seen Parsons [51], which is now the best introduction to ER's. With respect to the present paper, I don't believe that Parsons' new book raises fundamental issues that are not also to be found in his earlier work cited here.)

these elements by non-context-dependent representations of what they designate. In particular there is nothing in (3) that corresponds directly to the past tense of (2). This is in accord with what will be said about the past tense in Section 4. The ER's therefore do not represent any aspect of meaning that has to do with how the interpretation of expressions depends on context. A full description of the meaning of the sentence would have to contain everything about context dependence. I will not discuss in this paper the question of whether it is useful, or possible, also to make use of some other formal representation that specifies all aspects of sentence meaning.

The *identifiers* (e.g. *E*, *th*, *t_s*) contained in ER's are taken to designate 'discourse entities' approximately as they are understood in [23, 31, 68]. They do not necessarily correspond to entities in the real world. Throughout this paper I will use the term 'discourse entity' loosely, but in this general way: A discourse entity, relative to a given point in the discourse, is an entity that has been introduced in the previous discourse, probably by an identifier in some previous ER. I will ignore the problem raised by the fact that it is probably not feasible for the process of discourse interpretation to produce an identifier for every entity that is capable of being referred to in later discourse [44, 53]. A *specifiable* entity is to be one that can be specified at a given point in the discourse, either because it is a discourse entity, or it is related in some salient way to a discourse entity, or its existence is common knowledge (or belief) among participants in the discourse. I will use these terms in connection with TA's as well as NP's. An important concept will be *understood* TA's. An understood TA is just one that takes part in the interpretation of a sentence but has no surface representation; obviously the designation of such a TA must be specifiable at the given point in the discourse. Discourse states, discourse processes, discourse intervals, etc., are just discourse entities of the given type, and the same for specifiable states, etc.

I will not have much to say in this paper about the process of producing ER's from sentences in discourse, which I will call *discourse interpretation*, or just *interpretation*. I leave open the possibility, for example, that there is an intermediate level of representation that leaves various features (perhaps quantifier scope) to be resolved later by context (cf. [3, 24]).

I will also not have much to say about the process of sentence production. I assume that sentences are built up by applying operations to their parts. This process is assumed to be mediated by a *structural description* (SD) of the sentence, which is some formal representation of syntactic structure. I assume also that SD's take part in interpretation, in that one or more such structural descriptions, probably along with tentative parts of

other SD's, is constructed (perhaps implicitly) as part of the interpretation process. Speaking informally, I will say that e.g. *Max has been walking* is the present tense (i.e. the result of applying the syntactic present tense operation) of *Max have been walking* (tenseless, because the tense operation has not applied to it), which is in turn the perfect of *Max be walking*, which is the progressive of *Max walk*, which is formed from the noun phrase *Max* and the verb phrase *walk*. Formally this would have to be spelled out in terms of the correspondence of sequences of words to parts of SD's. This raises hard questions, because sentence production has to take account of discourse context in the same way as interpretation. These questions will not be answered in this paper.³

The concepts of *intension* and *extension* apply only at the level of event representation [47, 48]. It is possible in our framework for there to be features of a sentence that take part in the interpretation process but correspond directly to no part of an ER; in fact it will be argued that tenses are just such features.

The point has been recognized that what is required for language understanding or processing in context (where the processor must interact with its external environment on the basis of the representations it builds) is a way for the processor to associate discourse entities with actual objects in its environment; the picture here is that identifiers might be associated with the processor's means of identifying entities in its own environment, and not necessarily with any neutral way of identifying these entities (cf. [58]).

3. ASPECTUAL CLASSES OF SENTENCES

Sentences may be classified as *statives*; *activities*, or *processes*; *achievements*, or momentary event sentences; and *accomplishments*, or nonmomentary (extended) event sentences. This is fairly standard terminology, and I refer the reader elsewhere ([5, 45, 62] and especially [17, Section 2.2]) for more detailed discussion. The classification is primarily semantic rather than syntactic, and the four categories of sentence at least typically report entities in the world called states, processes, momentary events (or achievements), and extended events (or accomplishments). Following [5], I refer to all of these together as *eventualities*. I will make use of the type-token distinction for all classes of eventualities.

Few of the concerns of this paper can be addressed without first becom-

³ For an outline of how this general sort of thing would work, ignoring the problem of discourse context, see [47].

ing clear about the aspectual classification of sentences. In particular, the distinction about to be made between mass and count eventualities, and the corresponding distinction between holding *at* and *for* an interval, are crucial to the understanding of durative and frequency adverbials and therefore to the semantics of all process and stative sentences. My account of durative and frequency adverbials depends on these distinctions.

It has long been recognized [5, 45, 63] that the aspectual category of a sentence may depend on various features of the sentence and not only its verb. In *Max has been walking* the constituents *Max have been walking* and *Max be walking* are statives (i.e., in the process of interpretation the parts of the ER that correspond to these parts of the sentence will designate discourse states), but *Max walk* is an activity. *Max eat* is a process but *Max eat a sandwich* is an accomplishment. *Max build a house* is an accomplishment, but *Max build houses* is an activity, and *Max be building a house* and *Max have built a house* are statives. There are semantic reasons for all of this of which some of the basic principles are obvious: for instance, the fact that eating is a process is related to the fact that (sufficiently large) parts or combinations of chunks of eating are typically also chunks of eating, whereas parts or combinations of eatings of a sandwich are not eatings of a sandwich. (I will use the word *chunk* for spatiotemporal portions of a state or process.)

The preceding observations describe distinctions that are analogous to the criteria that distinguish among mass nouns, count nouns, and bare plurals. It is for instance fairly obvious why eating oatmeal (mass) and eating peanuts (plural) are processes while eating a sandwich (count) is an accomplishment.⁴ These analogies are so central to the understanding of eventualities that I find it convenient to use the terms *mass sentence* and *count sentence* in the corresponding way. I will also refer to what mass sentences report, namely processes and states, as *mass eventualities*. Count eventualities are the same as events (momentary and nonmomentary).

Going to church every Sunday is a process with fairly coarse *granularity*: one has to look at a period of some weeks to “see” the pattern of the process. Other processes have much finer granularity (*run, laugh*), or even zero granularity (*grow*). All states have zero granularity. Processes with nonzero granularity will be referred to as *coarse* processes, and states or processes with zero granularity will be called *smooth*.

⁴ Actually *eating a sandwich* is ambiguous: there is the action (event) of eating a sandwich and the process of eating a sandwich, which goes on during the action; but there is no such thing as the event of eating sandwiches.

3.1. *Mass Sentences*

Mass entities are divisible in the sense that a part of a chunk of running or a mass of water is, up to some limit of granularity, still a chunk of running or a mass of water. Bare plurals (e.g. *dogs* with no article) designate entities that are divisible up to a point and are therefore analogous to coarse processes. One test for distinguishing mass sentences from count sentences is that most mass sentences readily take *for*-adverbials but count sentences tend to reject them strongly. There is an analogy between a process going on *for* an interval and a space being *full of* some sort of stuff: working regularly *for* a week is an accomplishment that takes place when there is a week full of regular working,⁵ just as a cubic yard of concrete is a thing that is found where there is a cubic yard of space full of concrete.

3.1.1. *Process Sentences*

Examples of process sentences are basic sentences involving such verbs as *vibrate*, *rain*, *cry*, *push*, and *look for*. Many transitive verbs produce process sentences with mass or plural objects: *build houses*, *eat soup*. Process sentences may be described as nonstative mass sentences. Like most statives they occur happily with durative adverbials (*Max walked for two hours*, *Max walked every day for a year*). They occur naturally as the complement of *stop* and *keep*, but not so happily with *finish*: (*Max stopped walking*, *Max stopped walking every day* (ambiguous), ?*Max finished walking*). For a process sentence, unlike an accomplishment, *A stopped V-ing* entails *A V-ed*: e.g. if Max stopped walking then Max walked, but if Max stopped drawing a circle then he didn't draw the circle.⁶

In Section 5.2.1 we will discuss process sentences that are constructed by applying a frequency adverbial to a sentence. The notion of frequency or pattern is in the nature of processes; they consist of some pattern of distribution of one or more eventuality types over an interval. The granularity of any process is the same as the coarseness of its pattern of distribution. Sometimes the pattern is determined by the main verb and sometimes it is determined by a frequency adverbial, mass or plural noun phrase, or other modifier. Lexical or *basic* processes are those reported by basic sentences containing process verbs, like *walk*: *Max walk* in *Max walked*

⁵ I owe this idea to Emmon Bach. Such analogies are discussed in [5, 6, 45].

⁶ See [17] for more discussion.

for two hours is a basic process sentence. (But *Max walk for two hours* in *Max walked for two hours* is a nonbasic event sentence.)

Every process verb specifies its own pattern of eventualities and therefore its own granularity. *Laugh* means approximately *go 'ha' regularly*, *walk* includes something about moving the legs alternately (*alternately* in this usage is a two-place frequency adverbial), and so on. Of course some basic processes, like *grow*, are smooth.

Process sentences derived by means of frequency adverbials or some other combination of expressions will be referred to as *nonbasic* process sentences. In the sentence

- (4) Allen saw Betsy occasionally in 1989,

Allen see Betsy occasionally is a nonbasic process sentence, because it is formed from the event sentence *Allen see Betsy* and the frequency adverb *occasionally*. Aside from frequency adverbials, nonbasic process sentences may be due to plural or mass NP's, as in *Allen repaired transmissions yesterday*, or to other constructions. Of course there are basic and nonbasic sentences of other categories, as already noted.

3.1.2. *Statives*

The stative/nonstative distinction is central to the interpretation of discourse because as everyone knows stative sentences tend to play a sort of background role with respect to the other categories. In this section I formulate fairly extensive criteria for stativity in order to classify some important sentence categories.

Examples of stative sentences are: most sentences whose main verb is *have*, including perfects; many sentences whose main verb is *be*, including progressives, but excluding passives and sentences with nonstative adjectives, such as *Max is being careful*;⁷ habituals, as in *Max works for IBM*; modal sentences, like *Max can speak Portuguese*; and many sentences involving a wide class of stative verbs including e.g. *exist*, *love*, *resemble*, and *know*. There have been quite a few criteria proposed for stativity. I propose the following as a set that is relatively clear and for which there is relatively good agreement among the members. The first four of these are traditional [17, 34] and the last was proposed in [64].⁸

⁷ Or maybe these sentences contain an active verb *be*. I have nothing to say about this question.

⁸ The last was noticed by Jespersen [30] as a feature of progressives, but is in fact typical of statives in general.

1. Statives do not take the progressive: **Max is being in the kitchen*, **Max is having a car*.
2. Statives do not take manner adverbials: **Max is carefully under the table*.
3. Statives do not appear in pseudo-cleft constructions: **What Betsy did was owe Max dinner*. (This criterion requires that *do* is not itself habitual; in e.g. *what Max did was work for Texas Instruments*, *work for Texas Instruments* is stative (habitual), but so is *did*.)
4. Statives occur in the present without a habitual interpretation: compare *Max is here* (stative) with *Max drives a Ford* (habitual of process).
5. Statives behave uniquely when modified by *when*-adverbials. Statives and only statives (actually pasts of statives and only pasts of statives) may (but do not always) occur in the ϕ position of (ϕ when ψ), where ψ is an achievement, with the interpretation where ϕ and ψ are claimed to be true simultaneously. This test requires that the *when*-clause applies to the whole of ϕ and not just a part.
 - (5) Max was here when Mary arrived.
 - (6) Max left when Mary arrived.
 - (7) Max was angry when Mary arrived.

Sentence (5), where *Max was here* is stative, contrasts with (6), with nonstative *Max left*. For (5) to be true it is necessary that Max be here at the time of Mary's arrival. Sentence (6) is true when Max's leaving immediately follows Mary's arrival. I am not sure whether (6) is true when Max's leaving and Mary's arrival are precisely simultaneous, but it doesn't matter; it is nonstative because it has no interpretation where Max's leaving must be simultaneous with Mary's arrival, as Max's being here must be in (5).

As Jespersen describes it the stative provides a "time-frame" for the event of the *when*-clause, i.e., it must be true for a period extending both before and after that event; but Dowty's sentence [16] *John was watching television when he fell asleep* shows that the period need not extend after the event. The sentence *it was 3:00 when Mary arrived* shows that the period need not extend before the event either. I doubt that any example will be found to show that the period can extend after the event but not before.

Sentence (7) is ambiguous between interpretations analogous to those of (5) and (6); but since (7) has the interpretation analogous to (5), this criterion classifies *Max be angry* as a stative.

Some older discussions seemed to categorize verbs rather than sentences

with respect to stativity. This has long been recognized as incorrect, and there are several sorts of sentence, such as modals, progressives, perfects, and habituais, whose stativity does not depend on the main verb nor on other constituents such as object NP's. In fact all of those just mentioned are extremely strong satisfiers of criteria 1–5, and therefore they are statives. I will discuss habituais and progressives here and perfects in Section 6.

Habituais. It is generally recognized (cf. [46]) that nonstative sentences in the present tense have a so-called 'habitual' sense different from their sense in most contexts. (More carefully, sentences whose nonpresent versions would typically be nonstative are stative in the present tense *because* the habitual is the only possible interpretation. Here and elsewhere in this paper I exclude reportive, futurate, and other special uses of the present [36, pp. 6–12, 64–67], unless specifically indicated. I also usually ignore the less obvious readings of example sentences.)

- (8) Max is in the kitchen.
- (9) Max was in the kitchen at 3:00.
- (10) Max puts sugar in his tea.
- (11) Max put sugar in his tea at 3:00.

Sentence (8) says the same thing about the present moment that (9) says about 3:00. *Max be in the kitchen* has the same meaning in both sentences. Sentence (10) does not say the same thing about the present moment that (11) says about 3:00.

The tenseless *Max put sugar in his tea* has its primary nonhabitual interpretation in (11), but in (10) has a habitual interpretation, meaning something about Max's habitually putting sugar in his tea. (The name *habitual* is often inappropriate, since many habituais such as *the sun rises in the east* report regularities that are not habits.)

Sentences (12)–(14) illustrate three levels of increasing 'habituality' for the same nonbasic process. Habituais often include frequency adverbials, as in *Max runs every day*, but it is important and often overlooked that frequency adverbials, as is obvious from (12), very often occur in nonhabitual sentences.⁹

- (12) Max sold at least two cars every day for a week.
- (13) Max is selling at least two cars every day.

⁹ This misunderstanding is explicit for example in [46, pp. 62–63], resulting in the misclassification of e.g. *he has come to see me every day*, or some part thereof, as a habitual.

(14) Max sells at least two cars every day.

Sentence (12) could be true now even if (14) was never true, and perhaps even if (13) was never true. A wholly random fluctuation in sales volume could be responsible for the truth of (12), but (14) requires that a state holds now which is, or typically would be, responsible for the going on of the process of Max's selling at least two cars every day for some prolonged interval including the present moment, and moreover which is of a certain sort – the general idea is that it is a “permanent” state: Max is a particularly good salesman, or his dealership has a particularly apt location, or he sells a steadily popular sort of car. If he is selling two cars a day because of a sale, or because of a sudden temporary economic change, or because there is a convention in town, or because it is the season when lots of people buy cars, then (14) is less appropriate than – and probably even less true than – (13) [36, p. 20]. Possibly some of the weaker conditions are not even enough for (13). Since the habitual interpretation of a sentence is a function of the ordinary interpretation, we introduce the operator ‘Hab’, that takes an eventuality type into the corresponding habitual state type. Thus the ER of (14) is

(15) $At(\text{Hab}(P), t_s)$,

where P is the process of Max's selling two cars every day, whose representation will be discussed in Section 5.2.1, and t_s is the speech time. The adverbial in (15) is an ordinary punctual adverbial; it is essential to (or at least typical of) a habitual state that it lasts a long time, but what (14) says of the habitual state is that it holds now.

I repeat here the observation that habituais are stative, as may be seen by testing them against the criteria of Section 3.1.2.

The progressive. The progressive is represented in the ER framework using another operator ‘Prog’, which takes a nonstative eventuality type and returns the corresponding progressive state type [63]. Progressives are always stative and always report that some process is in progress. For convenience we will speak of the process of ϕ -ing, for a process sentence ϕ .

We have already said that processes go on *for* intervals. Whenever a process is going on, there is a corresponding state that holds, namely the state of the process being in progress. When someone builds a house, *being in the process of building a house* denotes the state, and *building a house* denotes the process (it may also denote the accomplishment itself), associated with the event of building the house. We assume that the state

holds at any moment within any interval for which the process goes on, just because this seems to work in terms of producing the right truth conditions for sentences. Thus also the state corresponding to Max's working regularly holds at any time within an interval for which Max works regularly, including the times when he is not working as well as the times when he is. The result of this is that *Max is working regularly right now* is true, but *Max is working right now* is false, at a moment which is inside an interval for which Max works regularly, but at which he is not working.

For an accomplishment sentence such as *Max build a house*, what has just been said is that the state corresponding to the process of building a house holds throughout any interval for which the process goes on; but the event of building a house contains times when the process is going on and times when it is not. The progressive state of the house-building process holds at all moments within intervals for which the process goes on, but probably not at all times within the building of the house.

Progressives of statives do not exist because there is no such thing as the process of e.g. Max's being tall. Progressives of process sentences are simple: a process sentence ϕ itself reports the process of ϕ -ing, and so for any process P , $\text{Prog}(P)$ is the state that holds at any moment within an interval for which P is true. In other words, $\text{Prog}(P)$ is the state of P 's being in progress.

Progressives of achievements and accomplishments are more difficult. *Max is arriving* (achievement) reports that the process of Max's arriving is in progress, and *Max is building a house* (accomplishment) reports that the process of Max's building a house is in progress, but it is hard to say in these cases how the process relates to the event. It is clear that the process of Max's arriving is a process that leads to the truth of *Max arrive*, if continued, and that stops at the time of Max's arrival; it is also clear that the process of Max's building a house is a process that leads to the truth of *Max build a house*, if continued, and that begins at the beginning and stops at the end (but does not necessarily go on at all subintervals) of the interval at which Max builds a house. The corresponding facts probably hold for all achievements and accomplishments, with possibly a few qualifications, but it is not obvious how near this comes to a specification of these processes (for instance, what has been said so far does not capture the fact that *Max is arriving* indicates that Max's arrival is very near at hand [36, p. 23]), nor how to provide a more complete specification. In any case, though, to specify these processes would be to specify the interpretation of progressives of achievements and accomplishments [49, 63].

The sentence *Max was working out every day last month* has (on the more natural reading, where *every day* is inside Prog) the ER:

(16) For(Prog(*P*),last month),

where *P* denotes the process of Max's working out every day. It is true if the process of Max's working out every day went on for the interval of last month, because it is only in this case that Prog(*P*) will be true at every time last month. The process of Max's working out every day is in progress even between the intervals at which *Max work out* is true. Thus progressives of processes, like all other statives, can occur with punctual adverbials as in *Max was working out every day when he met Joan*.

It has already been observed that progressives are stative, because they are champion satisfiers of the criteria of Section 3.1.2.¹⁰

3.2. Count Sentences

As mentioned earlier, one criterion for distinguishing count sentences is that they don't take *for*-adverbials. It has also been noted (e.g. [17, p. 60]) that count sentences but not mass sentences are typically good with take [*length of time*] to: *it took an hour to read the paper, ??It took an hour to be reading the paper*.

The difference between achievements and accomplishments is simply that achievements are momentary but accomplishments span extended intervals. Standard tests [17, p. 60] depend on this in obvious ways; for instance accomplishments but not achievements can (in a noniterative usage) be complements of *stop* and *finish*.

3.3. Eventualities Occurring at and for an interval

It is not sufficient to define a single relation between eventualities and intervals. Count eventualities (events) may be located *at* an interval, as a thing may be located at a place. A spatiotemporal area may be filled by a mass eventuality, just as such an area might be filled by some sort of

¹⁰ In fact, there is overwhelming evidence [4, 8] that progressives belong to the more exclusive category of *locative* statives, which would include for example *Allen is under the table* but not *Betsy is angry*. One illustrative fact is that *Betsy was angry when Allen sold the car* lends itself to an interpretation where Betsy's anger was caused by the sale, but a parallel reading is extremely difficult for locative *Betsy was at work when Allen sold the car*, and also for progressive *Betsy was working when Allen sold the car*.

stuff, like water. When an interval I is filled by a mass eventuality E , we say the process E goes on, or the state E holds, *for* I .

This analogy is intuitively satisfying, but the main point is that it makes possible the semantics given for durative and frequency adverbials in Section 5.2.

We say that an event (count eventuality) E occurs *at* an interval I if and only if E temporally coincides with I . Thus *John run a mile* reports a one-mile run that occurs at the interval that extends from the beginning to the end of the run. (*John run a mile* reports an event that consists of a quantity of running (process), just as *a beer* designates a thing that consists of a quantity of beer (stuff).) A count eventuality E may also occur *in* an interval I , which means simply that E occurs at a subinterval of I . For count sentences the preposition *in* usually corresponds with occurring in an interval as just defined; this is not the case for mass sentences, as we will see in Section 5.3.

We will also say that a smooth mass sentence may occur at a moment; the sentence *Max was in the kitchen at noon* is true if and only if the state of Max's being in the kitchen occurred at the moment *noon*. I will argue soon that a mass sentence cannot occur at (but only for) an extended interval.

I have just been using *occur* in an extended sense to express the relation that obtains between an eventuality and an interval where it is temporally located. When the aspectual class of the eventuality is known, the more natural verbs are *happen* for an event (an event happens at an interval), *go on* or *be in progress* for processes (a process goes on for an interval), and *hold* for states (a state holds for an interval).

The relation between mass eventualities and intervals is more complex than between events and intervals. There is no event corresponding directly, for example, to the process sentence *Max go to church every Sunday*, which reports the process of Max's going to church every Sunday, and thus there is no question of occurring at an interval. Nevertheless the process may extend over an interval I , which is to say in this case that an event type *Max go to church* happens throughout I with a certain frequency, namely at least once in every Sunday. We will say in this situation that the process of Max's going to church every Sunday goes on *for* I . We use the preposition *for* because it is the one most typically used to express this relation in English, as in *Max went to church every Sunday for a year*. Max's going to church every Sunday for a year is a determinate chunk of going to church every Sunday, and is the event corresponding to the count sentence *Max go to church every Sunday for a year*. In terms of the event-

thing analogy, a chunk of going to church every Sunday is an event, just as a chunk of concrete is a thing.

Aside from the fact that it is necessary for the semantics of durative and frequency adverbials, a separate notion of occurrence for an interval increases the modularity of the semantic framework. In order to define the interpretation of any preposition *P* that makes durative TA's, as for example *for*, *since*, *until*, *from-to*, *during*, it is necessary only to say that *P* makes durative adverbials and how *P* specifies an interval. The rest follows from the fact that all durative adverbials express occurrence *for* an interval.

The *for* relation is commonly expressed in English using the preposition *for*: If Max's walking goes on for an hour, then we can say *Max walked for an hour*. We cannot use *for* to express the *at* relation: If Max's baking a cake happens at an hour-long interval we can't say *Max baked a cake for an hour*. In the present framework this is simply because the prepositions *for* and *at* stand for different relations. The fact that the *at* and *for* relations as described here are not similarly expressed in English is in itself a reason to consider them different. (As is often noted, we use *at* in English to indicate the time of an achievement, or the beginning of the time of an accomplishment. *Max drove to the store at 3:00* means that his drive started at 3:00. Extended events are also often located using *in* and other inclusive prepositions. There seems to be no brief way in English to locate both the beginning and the end of the time at which an accomplishment takes place.)

Sometimes it is convenient to generalize over the *at* and *for* relations; in this case I will speak of an eventuality's occurring *with respect to* an interval *I*, which means occurring *at I* for count sentences and occurring *for I* for mass sentences. It might be terminologically possible to do away with the notions of occurring *at* and *for* an interval by using the same word for both but defining it separately for count and mass eventualities and in general separating the count and mass cases. This would not be a simplification overall, and anyway occurring *at* and *for* an interval are different conceptually and with respect to their entailments, so it is more straightforward to give them distinct names.¹¹

¹¹ I assume in this paper that eventualities occur with respect to continuous intervals of time. Phrases like (*) *in my spare time* [61] may require a generalization to sets of intervals, but I hope this can be avoided. The adverbial (*) functions as a frequency adverbial in *I worked on the house in my spare time for a year* (it occupies the standard frequency adverbial position), but in (**) *I built the house in my spare time*, (*) has another use, which apparently does not fit any of the categories discussed in this paper. Adverbial (*) is obviously not the top-level inclusive adverbial of (**), because it places no lower or upper bound on the time

3.3.1. *Aspectual Classes and the Lexicon*

It is assumed that the lexicon specifies for any verb *V* the eventualities reported by basic sentences involving *V*. Though the aspectual categories are fundamentally categories of sentences, we can often classify a verb *V* according to the aspectual class of simple sentences containing *V*; for instance, *walk* is classified as a process verb because basic sentences with *walk* are process sentences. Therefore what the lexicon specifies for *walk* is the set of intervals *for* which the process of *A*'s walking goes on, for any individual *A*; these are intervals throughout which *A* walks without interruption. For other verbs (stative, achievement, or accomplishment) it is sufficient for the lexicon to specify the set of intervals *at* which the corresponding eventualities occur. These minimal intervals will be moments for states and achievements, but extended intervals for accomplishments.

For transitive verbs like *drink*, the lexicon specifies the events of *x* drinking *y*, where *y* is a thing (count). The interpretation of sentences like *Max drank water* will be defined in terms of the accomplishment of drinking a quantity of water (a thing); this is required by the framework of Section 5.2.

4. THE NONSEMANTICS OF TENSE

A simple book about English for nonnative speakers might tell students to use the past tense (in ordinary top-level sentences) when speaking about the past and the present tense when speaking about the present. This needs to be elaborated and qualified, but I argue that such a convention is in fact the basis for usage of the past and present tense, and moreover that it is all one needs to know in order to understand how tense takes its part in the interpretation of discourse.¹² (Though I argue that tense is a sort of agreement phenomenon, perhaps I should stress at the outset that whether the (possibly understood) top-level adverbial is past or pre-

of the event, and because we can have *I built the house in my spare time last year*, where *last year* and not (*) is the top-level TA. Possibly *on Thursdays* and *at night* belong in the same category as (*). I am inclined to believe that this is an independent category which requires its own particular semantic treatment.

¹² Ideas similar to this have been put forward before. See for instance Anderson [4, pp. 41–42], who says “‘Tense’ has an adverbial source . . . [It depends on] accompanying (though possibly deleted) adverbials, so the marking of tense by the verb is a concord feature (and thus in this respect like verbal person and number in English)”. Cresswell [12, p. 196n] says “It may be that surface tenses have no semantic effect except to indicate the presence in deep structure of a temporal operator which does not reach the surface”.

sent depends on an indefinite number of pragmatic factors, and so the idea that this agreement could be described in terms of the lexicon, semantic features, and the like is totally out of the question.)

One of the frequently noted complications about tensed sentences is that sometimes there is an explicit temporal adverbial and sometimes there isn't.

- (17)a. Allen had a party last night.
 b. Betsy had a good time at the party.
- (18)a. Allen had a party last night.
 b. Betsy had a good time.

These two-sentence discourses are difficult because for (17b) one is tempted to say that the tense contributes nothing to the meaning, whereas for (18b) one is tempted to say that the tense serves an anaphoric function, contributing the information that the temporal and spatial location of Betsy's good time was the party [52]. (As is frequently the case, in these sentences there is no purely temporal adverbial, but instead an adverbial that fixes time as the time of some discourse eventuality.) Since there is little or no difference between (17b) and (18b) except that the TA that is explicit in (17b) is understood in (18b), both sentences must have the same ER, which specifies the party as the occasion of Betsy's good time. The tense contributes nothing to the event representation, except that it helps to determine which adverbial is to be understood – if (18b) were in the present tense, it would not be clear what was intended.

According to this (17b) and (18b) both have the following ER.

- (19) Type(E , Have-a-good-time-event)
 & Experiencer(E , Betsy)
 & Location(E , p_1).

(I make no attempt at the internal structure of *have a good time*. The term p_1 is an identifier referring back to *the party* of the previous sentence.)

Things will work as just described if we assume that English has the following convention:

- (20) In a sentence about the present (the top level TA is present), use the present tense, and in a sentence about the past (the top level TA is past), use the past tense.

(I take the fairly standard position [46, pp. 33, 36–38] that English has only two tenses, past and present, so that sentences in the present perfect are in the present tense and there is no such thing as the present perfect

tense.) Rule (20) ignores at least various futurate usages (*when I leave*) and a number of clearly special uses of tense, such as the historical present and the use of the past tense in counterfactual conditionals. (Also, “the temporal adverbial” is the top level temporal adverbial, which is a present adverbial in a present perfect sentence (cf. Section 6).) Rule (20) is probably fairly correct for what might be described as ordinary top level clauses, and maybe even for what is called *sequence of tenses* or *indirect speech*. It is also the basic principle for understanding the semantic role of tense within this domain. English has a convention about when to use which tense, and whatever is done with tense in the process of interpretation is done as a pragmatic inference on the assumption that the speaker is following the convention.

There is nothing to be said about (17b) and rule (20) except that the sentence is in accord with the rule. About (18b), there is slightly more to be said: it is also in accord with the rule, but in this case the rule helps to determine the understood adverbial. *At the party* is something like the most salient adverbial around, and it is a past adverbial, and the past tense requires a past adverbial. A roughly parallel case is the *he/she* rule, which says you’re supposed to use *he (she)*, when you’re talking about a male (female) person. The *he/she* rule tells us who is being referred to in the second clause of *Allen kissed Betsy and he liked it*, just as Rule (20) tells us about the adverbial of (18b).

Once the temporal modifier is determined, tense plays no further part in the process of interpretation. The way in which tense helps to determine the temporal modifier is obvious in broad outline: Part of the process of interpretation is the determination of the temporal adverbial. Tense facilitates this process by constraining it, so that the adverbial has to be a past adverbial if the tense is past, and a present adverbial if the tense is present. The constraint is pragmatic and relies on the assumption that the speaker is following rule (20). This account of tense is in accord with the current model of semantic interpretation as “a dynamic process mapping partial models plus contexts onto new partial models plus contexts” [53, p. 244]. Tense is a linguistic feature whose function is defined totally in terms of the way it affects the dynamic process. When the process is complete, tense is gone: tense has no representation at the ER level.

The idea of accounting for tense in terms of conventions for when to use which tense, rather than in terms of meanings of the tenses, also works better for other uses of the tenses. Consider the use of the past tense in counterfactual conditionals, e.g. *I would be a lot more comfortable if Max sat down*. Nobody would try to account for the meaning of the

past tense itself in such contexts. Instead the goal would be to account for the meaning of the counterfactual conditional, and all that is needed with respect to the past tense in such contexts is a specification of its syntactic usage.

Another advantage of this way of dealing with the tenses is that it provides an intuitive account of what is wrong with past tense sentences that contain present adverbials, or where no past adverbial can be understood. Such sentences are neither true nor false because the concept of truth applies directly only to ER's and there is no ER because the interpretation process cannot be carried out. The process cannot be carried out because the past tense is in effect an instruction to find a past adverbial, and this instruction cannot be obeyed. (A number of writers (e.g. Vlach [64]) have made the past tense *assert* that the reported eventuality is in the past. This is an error parallel to making *he left* assert that the subject is male.)

In the present framework the past tense has no compositional meaning and is not strictly speaking anaphoric, though it takes part in the determination of anaphoric reference. Its role in the dynamic process of interpretation is straightforward and psychologically plausible, and so is its role in the similarly dynamic process of discourse production. Since tenses are not operators they do not participate in scope relationships, though of course the TA's that the tenses help to determine do participate in such relationships.

It is clear that tense is not in general the bearer of temporal anaphora on the simple grounds that temporal anaphora exists where there is no tense. Consider

- (21) We can't get very far today. In fact, I don't expect to get past Texarkana.

To get past Texarkana has an understood inclusive adverbial *today*. The process of determining this adverbial is no different here than it is for a tensed sentence, except that tense limits the range of allowable adverbials.

4.1. *Tenses and Temporal Adverbials*

For sentences in the past tense, the question of which temporal adverbials are allowable will be discussed at some length in Section 6.2.

The present tense selects for a present adverbial, which must be either a punctual adverbial meaning *at the present moment* (usually understood) or a durative adverbial whose time includes the present moment.

- (22) Max is here at this moment.
 (23) Max is here today.

Ignoring the futurate sense of (23), the adverb *today* must be given a durative interpretation, meaning *for the present day*, not an inclusive interpretation, meaning *at some time in the present day*. Presumably this is because the inclusive interpretation would allow the possibility that the event time does not include the present moment.

5. OUTLINE OF TEMPORAL ADVERBIALS

Temporal adverbials, or at least most of them, may be divided into four classes: punctual, inclusive, durative, and frequency. Many such adverbials are prepositional phrases, and the class of such a phrase is often (but also often not) indicated primarily by the preposition. An analysis of temporal prepositions is the natural beginning for the investigation of temporal semantics.

5.1. Temporal Prepositional Phrases

Many TA's of the first three categories (punctual, inclusive, durative) are prepositional phrases. Possibly the most typical preposition for each of these three categories is *at*, *in*, and *for*, for punctual, inclusive, and durative, respectively.

Punctual PP's perhaps usually consist of *at* plus a NP denoting a moment. Nonmomentary events happen at extended intervals but there are no simple PP's that identify the extended intervals at which they happen. To do this one has to say something like *I ran a mile starting at 3:15:20 and ending at 3:19:37*, or maybe *I ran a mile from 3:15:20 to 3:19:37*.

The inclusive preposition is in the simplest case either *in* or *on*, or is absent (I say *nil*), depending on the type of its object: *on Thursday*, *Thursday*, *in June*, *in 1987*, *yesterday*, *last week*, *in the last hour*, *the day before*. Without trying to formulate a rule, there are some obvious generalizations: *on* or *nil* is used before the name of a day of the week, *in* before the name of a month or year, *nil* before *last* or *next*. For definite descriptions the principle of choice is less obvious, but also sometimes has to do with the type (day, week, etc.) of the interval: *in the last three days*, *on the day when Betsy arrived*, *on that day*, *in the month when Betsy arrived* (cf. [55, pp. 317–320]).

One might expect *for* to be the standard durative adverbial, but in fact durative *for* is most usually used with temporal measure phrases like *for*

an hour and a half, and is not usually good with most ordinary temporal NP's, as in *?for yesterday, ?for June, ?for 1989*, etc.¹³ This raises the question of how one says in a natural way that some process went on for the year 1989, for instance. There will be more about this later, but the general answer is that the inclusive prepositions can also be used with durative force, so that (4) probably means that the process of Allen seeing Betsy occasionally went on *for* 1989. Thus the correspondence between preposition and class of adverbial is more complex than might at first be imagined, and in some cases the choice of preposition depends more on the object of the preposition than on whether the meaning is inclusive or durative.

5.2. Frequency (Pattern) Adverbials

Some frequency adverbials are *often, seldom, rarely, frequently, usually, regularly, always, never, irregularly, sporadically, occasionally, continually, every week, every other week, three times a week, at least once a week, whenever Larry sneezed, without interruption, except when it rains*. "Frequency" is the standard name for these adverbials and will be used here, but "pattern" would be a better name, because some of these adverbials, such as *regularly*, say something about pattern but nothing about how much of the given eventuality occurs per unit time. These adverbials typically can occur in the *freq* position in ϕ *freq* *for* *I*, as in (4). Semantically they say something about the pattern of occurrence of some eventuality over some period of time.

As has been noted, frequency adverbials create process sentences, as can be seen by applying the criteria of Section 3.1.1.

It is important that phrases like *three times* are straightforward quantifiers over events, not frequency adverbials.¹⁴ They do not go in the syntactic position of frequency adverbials (**Allen went to Nome three times for a year*), which is to say they don't create process sentences. One semantic difference is as follows: Frequency adverbs, or at least the ones that say something about actual frequency as opposed to only pattern, express the analogue of density, not of mass. In order to conclude anything about how many times something happened one must be given the length of time as well as the frequency: e.g., if something happened every week for

¹³ I exclude the special meanings in sentences like *Betsy rented a room for Thursday*, where the PP does not apply to the event reported by the sentence, but instead specifies the period for which the room is to be occupied.

¹⁴ *Pace* Tichy [61, pp. 277–278] and many others.

a year then it happened 52 times. Frequency adverbials at most say something about how much per unit of time, not about how much in absolute terms.

Like other temporal adverbials, frequency adverbials are very often understood. An example is the following pair of sentences.

- (24) Mary slept for a week.
 (25) Mary slept in the attic for a week.

These sentences¹⁵ are understood in context as if they contain very different frequency adverbials. In (25) the understood adverbial would be something like *whenever she slept*, or possibly *for a typical sleeping distribution*. In (24), for obvious pragmatic reasons (be informative), the implied frequency adverbial must be much stronger than the one in (25), and is presumably equivalent in context to something like *almost continuously*.

Event representations include what is provided by context and therefore must contain this different frequency information. To say there is an understood frequency adverbial is just to say that the sentence requires frequency information, and that this information is in fact available despite the absence of an explicit frequency adverbial.

5.2.1. *Nonbasic Processes*

In thinking about processes I rely fundamentally on the analogy between processes and mass nouns.¹⁶ The only way I know of¹⁷ to define *concrete* is something like the following: concrete is that stuff such that a space *s* is full of concrete if and only if *s* contains sand, cement, and aggregate in a certain proportion, distributed in a pattern that satisfies a certain property *P*; in such a case, there is a chunk of concrete which consists of the concrete within space *s*. Similarly, *walking regularly* is that process type such that it goes on for an interval *I* if and only if walking is distributed in a regular pattern over *I*. In this case, there is an event *walking regularly for I* which is the same as (or at least consists of) the chunk of walking regularly that takes place over *I*.

In general, given an eventuality type *E* and a frequency adverb *F*, the corresponding process type is that process type *P* such that for any interval *I*, *P* goes on for *I* if and only if the amount and pattern of *E* within *I* is

¹⁵ Sentences (24) and (25) were suggested by Barbara Partee.

¹⁶ See [6] and [45, pp. 202–210]. Mourelatos cites a number of previous discussions in [45].

¹⁷ I have not yet found anything in the literature on mass terms that addresses the logical question of defining compound substances. It seems to me to be the same as the present question of defining nonbasic processes.

as determined by F .¹⁸ This type will be denoted by ‘Pattern-process(E, F)’. The frequency adverb F is essentially a function that takes each interval I to a set of sets of subintervals of I : to each interval I , F assigns the set J of sets of subintervals of I such that a set K of subintervals of I belongs to J if and only if the members of K have the appropriate size, number, and distribution over I . For instance, the frequency adverb designated by *regularly* assigns to each interval I the set of sets K of subintervals of I such that the members of K are distributed regularly over I . So the process of John’s working regularly is Pattern-process(W, R), where W is the process of John’s working and R is the interpretation of *regularly*. It is always the case that

- (26) Pattern-process(E, F) goes on for interval I if and only if the distribution of E over I is a member of $F(I)$. (Where by “the distribution of E over I ” I mean the set of subsets of I with respect to which E holds.)

A smooth eventuality will hold for an extended interval I if and only if it holds at each moment within I . The notion of holding for an interval is therefore dispensable for such eventualities, because it can be reduced to holding at a moment. For coarse processes this is not the case – they irreducibly hold for extended intervals.

Consequently only durative adverbials may modify coarse process sentences. The most natural interpretation of

- (27) Max worked regularly last year

is the one where the regularity extends over the whole year, so that (27) may be paraphrased as *Max worked regularly for the interval of last year*. Possibly (27) can also be interpreted in context as something like *Max worked regularly for a while last year*; in this case the frequency adverbial is immediately within the scope of the understood durative adverbial *for a while* and *last year* is truly inclusive.

There is a competing theory of durative adverbials [17, 26, 42, 57] which says that

- (28) ϕ for I is true if and only if ϕ is true at every subinterval of I ,

so that

- (29) John slept in his office frequently for six weeks

is true if and only if

¹⁸ It is easy to generalize this to multi-place frequency adverbials, like *alternately*.

(30) John sleep(s) in his office frequently

is true at every subinterval of some past six-week period (including every moment within that period).¹⁹

Suppose that this theory is correct. Sentence (29) has (30) and *for six weeks* as constituents, and (30) is now held to be true at moments and only derivatively at longer intervals, so that the theory still has to tell us how to decide whether (30) is true at a moment *I*, in terms of the intensions of the constituents of (30), namely *John sleep in his office* and *frequently* – somewhere there has to be a semantic rule that combines *frequently* with the sentence it applies to. Obviously we cannot relate *frequently* directly to a moment *i*, because *i* has only one subinterval. The alternative theory is silent as to how this is supposed to work.

But no matter how this is resolved, the alternative theory fails to provide the right truth values. On the alternative theory, *for* has the subinterval property, in the sense that if ϕ *for* *I* is true, then ϕ *for* *I'* must also be true for any subinterval *I'* of *I*. It also has a corresponding superinterval property: if ϕ is true for each member of a set of *I* of intervals, and the union *J* of the members of *I* is also an interval, then ϕ must also be true for *J*.

Many coarse process sentences, e.g. any nonbasic process whose frequency adverb is *regularly*, don't have these properties. Suppose we consider the 24 one-hour intervals that make up a day. Something that happens regularly for the day (once each 70 minutes, say) doesn't necessarily happen regularly for each of the hours. Conversely, something that happens regularly throughout each hour (but perhaps with a different pattern for each hour) doesn't necessarily happen regularly for the day. These facts are obvious; the alternative theory results from failure to consider a range of nonbasic processes, which has led to the error of building typical understood frequency adverbials into the interpretation of durative adverbials.²⁰

I suspect that the appeal of the alternative theory is partly due to this observation: the sentence *Max worked out every day in 1987* is true if and only if *Max works out every day* would have been true if uttered at any time in 1987. This is true, or very nearly so, because *Max works out every*

¹⁹ A slightly better version, to be found in [63] and elsewhere, says something like “enough (relevant) subintervals”, instead of “every subinterval”. Similar arguments apply. Sentence (29) is due to Dowty [17, p. 332], who intends the alternative theory to apply to it, though he does not show how this would work.

²⁰ These remarks are adapted from [64] and also owe something to Tichy [61].

day is a habitual, and it is very hard to imagine that Max worked out every day in 1987 without it being a habit.

But this does not support the alternative theory. For one thing, the frequency adverbial inside the habitual still has to be accounted for, which leads back to the first of the two objections just stated. Also, sentences about coarse processes (or any processes) are only sometimes habituals, as was noted in Section 3.1.2.

5.2.2. *Chunk Accomplishments*

Sentences like *Max worked regularly for three months last year* require a mechanism for constructing events that consist of an interval full of some process or state. If P is a process or state type, I is an interval, and P goes on for I , then there is an event (an accomplishment) token that consists of P 's going on or holding for I . Working regularly for three months, for example, is an accomplishment, as may be checked by applying the standard criteria. We say ' $\text{Chunk}(E, P, I)$ ' to mean that E is an event token of P 's going on or holding for I , where P is a mass eventuality type. Such an E will exist only when P does go on for I . This definition is indispensable for the semantics of all sentences that locate a chunk of a mass eventuality within an interval, which is not a rare type of sentence. To my knowledge no previous framework for temporal semantics claims to account for such sentences in general.²¹

Given these definitions, we can introduce E as an identifier for *Max work regularly for an hour* this way:

$$(31) \quad \text{Chunk}(E, \text{Pattern-process}(W, R), T) \ \& \ \text{Length}(T) = \text{one hour}$$

where W and R are the obvious process and frequency adverbial.²²

The ER that says that E is an event of living in Boston for three months is

²¹ But Bach [6] discusses this basic idea of chunk events, under the concept of "packaging".

²² I have not seen it recognized that durative adverbials cannot be treated independently of frequency adverbials except (independently) in [40, p. 85], [60], and [64]. Tichy sees what the problem is and how to solve it, except that his solution lacks the generality of the 'chunk events' of this section. For him the frequency adverbial and the durative adverbial must be combined by a third operator, which is either the past or the perfect operator. This solution would have to be extended by complicating the semantics of every operator that can apply directly to an accomplishment sentence. Even a sentence like *Max has lived in Boston for a year since 1985* cannot be handled without extending the formalism, because the highest temporal adverbial is the inclusive *since 1985*, not the durative *for a year*. The same would hold for *I expect Max to study for three hours tonight*, etc.

A non-ER version of the present treatment of duratives was given in [64].

- (32) $\exists T \exists S (\text{Length}(T) = \text{three months}$
 $\& \text{Chunk}(E, S, T)$
 $\& S = \text{State-type}(S': \text{Type}(S', \text{Living})$
 $\& \text{Location}(S', \text{Boston}))$).

Sentences like (32) are about events consisting of a chunk of some type of state. The ER language thus needs a variable-binding operator ‘State-type’ that specifies a state type S in terms of some complex predicate that defines tokens of S .

5.3. *Inclusive/Durative Ambiguity*

The preposition and conjunction *since*, which usually forms perfect adverbials (i.e., top-level adverbials of sentences in the perfect), is ambiguous with respect to inclusive or durative interpretation.

- (33) I’ve known Max since 1960.
 (34) I’ve visited Paris since 1960.
 (35) I’ve been ill since September.

In (33), *since 1960* is a durative adverbial; (33) means that I have known Max for the interval 1960-present (an inclusive interpretation is possible, meaning I’ve known Max at some time in the interval 1960-present). In (34), *since 1960* is an inclusive adverbial; (34) means that I’ve visited Paris at some time in the interval 1960-present (a durative interpretation is possible, meaning that I’ve visited Paris repeatedly throughout the interval 1960-present). In (35) both readings are plausible.

The temporal preposition *in* has the same ambiguity, though it is not so immediately apparent.²³ Consider first that the preposition *for* occurs typically before quantifier phrases, as in *Max lived in Sydney for a year*, and does not occur before unquantified noun phrases with its durative interpretation – *I was here for January* means approximately that I was scheduled to be here for the month of January. This raises the question of how one says that Max lived in Sydney for some particular year. The proposed answer is that *in* may have a durative interpretation, so that *Max lived in Sydney in 1987* may mean that he lived in Sydney for the year 1987. This is strongly supported by the acceptability of such sentences as *Max lived in Sydney in 1987 and Joan lived there for a year too*. This is another of the cases where the choice of preposition depends on its

²³ So do its variant realizations *on* and *nil*. This point was made in [64]. Related observations are made in [61].

object, rather than on whether the prepositional phrase is to be interpreted as durative or inclusive (cf. Section 5.1).

McCawley [39] and many others have seen the perfect aspect itself as ambiguous between a “universal” (or “continuous”) and an “existential” (or “experiential”) interpretation corresponding to what I consider a durative and inclusive interpretation, respectively, of the perfect adverbial. It is simpler to account for the facts in this way: The perfect can in general combine with either inclusive (corresponding to McCawley’s “existential”) or durative (“universal”) adverbials, which are frequently understood; there is always either an understood adverbial or an explicit one. Since the adverbials themselves are sufficient to account for the inclusive/durative difference (Section 6), it is superfluous to consider the perfect itself ambiguous.²⁴

5.4. A Note on When

Temporal subordinating conjunctions like *when*, *while*, *since*, *after*, *before*, and *until*, present no particular difficulties within the present framework.²⁵ But for some of them there are difficulties of interpretation that are independent of framework. As a relatively straightforward case, a sentence like

(36) Allen called Betsy after she arrived

has an ER such as

(37) Type(*E*, Call-event)
 & Agent(*E*, Allen)
 & Theme(*E*, Betsy)
 & After(*E*, *E_a*).

Here I have assumed what is probably the typical context, where Betsy’s arrival is a preexisting discourse event, identified as *E_a*. (If (36) introduces the event of Betsy’s arrival into the discourse, then obviously the ER must contain a description of *E_a*.) The ‘After’ conjunct of course states the temporal relationship between the two events.

When ϕ and ψ are both event sentences,

²⁴ Those who have claimed that the perfect itself is ambiguous [39, 42] have never given any account at all of how the two purported meanings combine with durative and inclusive TA’s. A little reflection on this point raises daunting questions; for instance: Why and how are both types of perfect able, or not able, to combine with both types of adverbials?

²⁵ See [47, 48] for some of the technical details.

(38) ψ when ϕ

very often locates ψ within the *sequel* of ϕ . By the sequel of an event E I mean the situation that begins immediately after E . This is obviously an extremely vague notion, but it is what is required for the analysis of sentences like *I'll call you when I reach Chicago*.²⁶ The real intuitive idea behind this may be revealed by considering *then*. Consider

(39) I'll reach Chicago. Then I'll call you.

The second sentence could approximately be paraphrased as *in that situation I'll call you*; i.e., *that situation* would be understood as the situation that obtains just after I reach Chicago. This is the *sequel*. The time when I'll call is within that situation, and the vagueness is due to the fact that there is no clear time when things have changed enough so that the current situation is no longer *that* one. Lycan [38] has produced a theory of conditionals that includes among other key points the view that the *then* of *if . . . then* means something like *in that situation*. He enumerates an impressive number of advantages of such a theory, but one that he does not mention is that it helps to show why "temporal" *then* and the *then* of *if . . . then* don't just happen to be spelled the same way. The content of *when* is due to the same intuition, and so is what happens (sometimes) when two past tense sentences occur in sequence.

This view makes *when*-adverbials not purely temporal, as also argued by Moens and Steedman [43], and seems to be in accord with the examples they give.²⁷

5.5. *Quantifiers, Scope, and Temporal Adverbials*

There is a complication²⁸ about sentences like

(40) Every fugitive is now in jail

The issue with (40) for example is that the time of the state being reported

²⁶ This is at least similar to the notion of *consequent phase* in Moens and Steedman [43], though they don't say much about when the consequent phase is supposed to end. I don't like the word "phase" for this notion because it suggests that the state is part of the event rather than something that follows it.

²⁷ See also the discussion of subordinate conjunctions in [53], particularly the comments on "just after".

²⁸ My [64] may have been the first paper to recognize this problem. I now consider the solution offered there a little bit goofy, though it may really be what one is driven to if one absolutely insists on trying to account for these cases in terms of scope. The point that the interpretation of common nouns in context is a complex and partly anaphoric process not to be accounted for in terms of scope was forcefully made by Enç [20].

is now, but the people who are in jail obviously are not fugitives now, as would be predicted by scope relationships, but are probably people who were fugitives at some past time, not necessarily the same for all. This other time would have to be supplied by context.²⁹ We have to build this into our ER's somehow.³⁰ Thus we might have something like

$$(41) \quad \forall x(Q(x) \rightarrow \\ \exists S(\text{Theme}(S, x) \\ \& \text{At-location}(S, j_1) \\ \& \text{Type}(S, \text{In}) \\ \& \text{At}(S, t_s))),$$

where $Q(x)$ states some property of x , probably having something to do with x being a fugitive at a time or in a situation which might vary for different x . Using ER's, sentence (40) does not raise even an apparent problem, because the question of scope has disappeared. Instead of an operator that applies to the whole sentence, there is simply an assertion that the state described by the whole sentence holds at a certain time. The statements as to the type and theme of the state are timeless. Whatever time relationships are internal to $Q(x)$ are independent of the time of being in jail.

This flexibility could be taken further – maybe the Agent and Theme relations should not be timeless. In [65] it is argued that the location of Oswald's shooting Kennedy is different from the location of Kennedy's being shot by Oswald. In [61, pp. 273–274] similar arguments are given for temporal location: If John pleases Henrietta by writing her a letter, the time when he is pleasing her and the time when she is being pleased are probably not the same. If one accepts these arguments, it is easy to structure the event representations accordingly: it is necessary only to reconstrue the 'Agent' and Theme' relations as time (and place) dependent, so the time when John writes the letter is thought of as the time when he is the agent of the action, i.e. the time when he does what he does; and the time when Henrietta reads the letter and is pleased is

²⁹ Sentence (40) is from [28]. Actually (40) would often refer to some previously mentioned group of fugitives, in which case what is anaphorically determined is not the time but the group itself.

³⁰ To be thoroughgoing we would have to refer to the state of being a fugitive. It may be neither feasible nor useful to make explicit *every* eventuality involved in a discourse [44, 53].

Also, our representation stipulates one state per fugitive, but maybe it is better to have one state of all the fugitives being in jail.

thought of as the time when she is the theme of the action (of pleasing her), i.e. the time when what happens to her happens to her.³¹

In sum, though sentences like (40) require multiple time intervals in the ER as in any other representation, the absence of worries about scope means that there is no particular problem involved. Moreover, the flexibility that facilitates the representation of sentences like (40) has other advantages.

6. THE PERFECT

Given the ER framework and the stativity of the perfect, the perfect is to be represented in terms of a certain sort of state. E.g.

(42) Max has left

reports that a certain state token currently holds, namely the state of Max's having left. This state token is consequent on the event of Max's leaving. In general we will denote the consequent state of an event E by $\text{Consq}(E)$.³² The consequent state of an eventuality E is the state of E 's occurring with respect to some past time, and so it begins to hold immediately after E occurs and continues to hold forever. It does not relate to physical consequences of E . (The consequent state of an event E in this sense is a much more abstract sort of state than the *sequel* state of Section 5.4, and even more so with respect to the 'continuing effects' of Section 6.2.4.) Thus the ER for (42) is

(43) $\text{Type}(E, \text{Leave-event})$
 & $\text{Agent}(E, \text{Max})$
 & $\text{In}(E, t_r)$
 & $\text{At}(\text{Consq}(E), t_s)$,

where t_r is the time of the perfect adverbial specified by context. (And so t_r must extend up to t_s . From this point forward, I will use the term *top adverbial* to refer to the TA that locates the top level eventuality of a sentence (the consequent state for a perfect sentence), and *perfect adverbial* to refer to the TA in a perfect sentence ϕ that locates the eventuality of which ϕ reports the consequent state. In (43) the top level eventuality is $\text{Consq}(E)$, so the top adverbial is ' $\text{At}(\text{Consq}(E), t_s)$ '. The sentence

³¹ See also Davidson [14]. Since Henrietta is the theme of the pleasing event and not the theme (but the goal) of the writing event, on this view these are two distinct events.

³² Parsons [49] is possibly the first to analyze the perfect in terms of explicit quantification over states. I have followed Parsons in this, but otherwise the view of the perfect stated here is the same as in [64].

of the *for*-adverbial and the perfect.³³ It has been recognized that such sentences are ambiguous between a reading according to which Betsy's three-month stay took place at some unspecified time in the past, and a reading according to which it lasts up until the present time. This ambiguity is straightforwardly accounted for in the present treatment, where the up-to-now reading of (48) is just the instance of (47) where $Q(P)$ says that P is the state of living in Boston, and where the length is three months. The fact that the interval of top-level *for* must extend up to now is due to the 'extended now' requirement of the present perfect (Section 6.2). The other reading is just the instance of (45) where $P(E)$ says that E is an event of living in Boston for three months (to be specified as in Section 5.2.2), T' is the speech time, and T is whatever interval is specified by the understood inclusive adverbial, which might or might not be Betsy's lifetime up to T' .

There are no problems about this analysis that I know of. For example, one of the standard observations about these sentences is that only the up-to-now reading is possible when the adverb is preposed, as in

(49) For three months, Betsy has been in Boston.

This cannot be explained by supposing that the adverbial has scope over the perfect, because it is easy to see that *for*-adverbials cannot have scope outside of the perfect: If they could, then (48) would have a reading where it means that the state of Betsy's having been in Boston holds for a three-month period. But that state would hold forever on the basis of *any* stay by Betsy in Boston, so that (48) would become true three months after such a stay. Hence a reading of (48) where *for three months* has the widest scope would be true even in a situation where the total time that Betsy spends in Boston is one week, which is wrong as a matter of actual usage.

Of course on the present analysis the meaning of (49) is the same as the up-to-now reading of (48). The forbidden reading of (49), where the stay does not necessarily continue to the present, is of the form of (45), where the durative adverbial is inside the scope of an inclusive adverbial, and therefore does not have widest scope. In other words, Betsy's being in Boston for three months is a chunk event whose role is exactly the same as her building a house in *Mary has built a house*. The forbidden reading is excluded by the general principle that an adverbial cannot be preposed over another adverbial of wider scope. (The careful reader will

³³ Mittwoch [42, pp. 217–219] is unable to give a compositional analysis of (48), and instead gives a "syncategorematic" interpretation for the combination of perfect and durative adverbial.

note that the ER contains no such scope relationship, if 'scope' is interpreted in the ordinary way. We are here referring to what would be indicated by a scope relationship in a non-ER representation, and is indicated in the ER framework by definitional relationships. If event E is defined in terms of event E' , e.g. E is $\text{Consq}(E')$, then it is 'higher' than E' .)

6.1. *Negation and For*

An interesting example discussed by Mittwoch [42] is

- (50) This is the $\left. \begin{array}{l} \text{first} \\ \text{only} \end{array} \right\}$ proper meal I have had for a week.

An attempt to read this sentence with the ordinary durative interpretation of *for* runs into obvious problems. This leads Mittwoch to postulate a complex analysis in which *for* does not apply to anything that looks like a part of (50), and in which no interpretation of *first* or *only* participates. A much more natural analysis is made possible by recognizing existential *for* as a negative polarity item whose force in a negative context is inclusive, analogous to existential *any*. (Other durative prepositions, such as *during* and *until*, behave similarly.) I note the following points in support of this:

Little if any change in the meaning of (50) results from the substitution of *in* for *for*. This is parallel to substituting *some* for *any* in a sentence like *this is the first time I've had any problems*.

First and *only* do produce negative contexts, where negative polarity items occur.

It used to be claimed [29, 54] that *any* in a negative context is a universal quantifier with wide scope, but this is definitely wrong, as is shown by sentences like *few students did any homework* (cf. [37]). The force of negative *any* has to be existential, whether or not it is precisely equivalent to *some* (cf. [35]). Thus there is a known case where what has universal force in a positive context has existential force in a negative context. It is argued in Section 5.2.1 that duratives are not really universal (though inclusives are really existential), but this mistaken classification is based on genuine analogies, so that one could believe that whatever led English to treat *any* as it does might have done the same for *for*.

This analysis allows a straightforward treatment of (50), where *first* means first, and (50) simply says that the present meal is the $\left. \begin{array}{l} \text{first} \\ \text{only} \end{array} \right\}$ meal

m such that m is eaten by the speaker within the immediately preceding one-week interval ending at speech time.

A more satisfying analysis can now also be given for simple sentences like

- (51) I haven't eaten for two hours.

The analysis of this sentence where *for* has wider scope than *not* has the disadvantage that it requires that *not* be given a special interpretation as a frequency adverbial. The present analysis gives (51) the structure more obviously assigned to *I haven't eaten in two hours*, or more explicitly *it is not the case that I have eaten in the preceding two-hour interval*.

6.2. Temporal Adverbials and the Present Perfect

Most of the points in this section have been made before, though some are often overlooked. What is new, so far as I know, is an attempt to unify most or all of these points within a single compact characterization of the conditions for the choice between past and present perfect.

There is a difference between the past tense and the present perfect, exemplified by the following sentences.

- (52) I saw John { Thursday.
*since Thursday. }

- (53) I have seen John { *Thursday.
since Thursday. }

- (54) Mary has seen Bill, but she didn't talk to him.

The adverbial *since Thursday* is an *extended now*, or *XN* adverbial, because it specifies a time that extends up to (but does not necessarily include) the speech situation. *Thursday* in (52) on the other hand is a non-*XN* adverbial, because it is an adverbial whose time is past and which does not extend up to the speech situation, in the sense that there is a past time, in this case midnight of Thursday, which comes after the time of *Thursday* and is separated from the present situation by some nonmomentary interval. Of course almost every interval that precedes the present situation is separated from it by some nonmomentary interval; a non-*XN* interval I must therefore be defined as an interval such that there is a *discourse* interval or eventuality E such that I precedes E and the beginning of E precedes the present by some nonzero amount. This makes the

notion of an XN interval a discourse-dependent notion which cannot be defined in purely topological terms.

The generalization exemplified by (52)–(54) is that the present perfect is used when the adverbial is an XN adverbial, and the past when the adverbial is non-XN.³⁴ Sentence (54) exemplifies the point about discourse moments; in (54) obviously nothing more is known about the time of the second clause than about the time of seeing Bill. Nevertheless the adverbial of the second clause is non-XN because it refers back to the time of the just-introduced seeing of Bill by Mary. Thus the second clause is in the past tense but the first clause is in the present perfect.

I use the notion *speech situation* rather than *moment of speech* because the relevant notion of the present is not to be specified in absolute temporal terms. If Allen meets Betsy on the corner then Betsy may appropriately say *I've been waiting for an hour* at a time later than the moment of Allen's arrival. The idea is that the time she waited reaches up to the present situation, namely the one where she and Allen are having the discussion that began with his arrival. (This is the *sequel* of Allen's arrival.) It is probably not until after that discussion that *I waited for an hour* becomes clearly more appropriate.

I will argue in this section that the XN thesis, with suitable modification, is correct. I stress that the XN thesis belongs to pragmatics; it has to do only with what adverbials, explicit or understood, may conventionally be combined with the present perfect. The XN thesis in no way needs to be taken into account when describing the meaning of the perfect, as is strongly suggested by the fact that it has no application to nonfinite or past tense perfects. Finding the correct XN thesis is hard, but describing the meaning of the perfect is relatively easy. I begin with a statement of criteria for application of the XN distinction, particularly for understood adverbials, and continue by showing how these criteria apply to various usages of the present perfect and the past tense. The final part of this section argues that past clauses and perfect clauses are at least approximately equal in their need for an understood temporal adverbial where no explicit TA is present.

³⁴ This thesis is extensively argued for by McCoard [41], who also points out that it and several competing theories of the present perfect are at least two hundred years old; McCoard recognizes Bryan [11] as a classical statement of the XN position, with brilliantly clear and concise statements of many of the main arguments.

6.2.1. *How to Choose between Present Perfect and Past*

The following is an attempt to specify which adverbials, especially understood adverbials, take the past and which take the present perfect. To my knowledge no one has given such a criterion for understood adverbials. The individual criteria are in order of decreasing strength; where two criteria conflict, the earlier one is to count.

Rules for choosing between past and present perfect:

1. Where there is an explicit temporal adverbial, then
 - (a) If the adverbial is an adverbial of recency, the choice depends on the particular adverbial. Most allow either past or present perfect.
 - (b) Otherwise, a non-XN adverbial requires the past tense and an XN adverbial requires the present perfect.
2. Where there is some clear contextual emphasis on an XN interval, the present perfect is used. (But the past tense is also possible if the condition of Rule 3 is met.)
3. Where the reported eventuality is located as a matter of common knowledge within some non-XN interval the past tense is required.
4. Where the reported eventuality is recent (is “news”), either the past tense or the present perfect is acceptable. (In colloquial American usage the past tense is far more common.)
5. Otherwise the perfect is used.

Rules 2 and 3 don’t amount to much more than the observation that a clear contextual understanding overrides mere common knowledge, but that nevertheless common knowledge counts if it is all there is.

Recency is a special case. As is widely recognized, it is an area where usage is uncertain, is changing, and varies from speaker to speaker, particularly between British and American speakers.

6.2.2. *Explicit Adverbials*

Where the adverbial is explicit, as in (52) and (53), most cases are obviously in accord with the XN thesis. In this connection Leech [36] gives a number of examples under the headings of “state-up-to-the-present” and “habit-in-a-period-leading-up-to-the-present”.

Adverbials like *today* and *this morning* require comment. *This morning* is typically an XN adverbial in the morning and always a non-XN adverbial after noon. It is sometimes claimed [36, p. 46] that there is little difference between the past and the present perfect with *today*, but I disagree: if

Allen and Betsy are colleagues who work together until five o'clock but don't see each other in the evenings, then a question like *Did you speak to Betsy today?* might be asked of Allen by his wife at dinner, but not by his supervisor at work (unless his supervisor is referring to a meeting earlier in the day, or the like). Adverbs like *today* are often partially understood; *today* places upper and lower bounds on the interval, but very often context specifies a particular subinterval. In fact *today* is very often used to refer to the period of 'the day's activities', when one goes out into the world to do whatever it is one does. Thus *today* can be a present, past, or future adverbial, depending on context;³⁵ this is also possible with adverbs like *this morning* or *this month*, when used during the period to which they ostensibly refer, but is less likely because these periods are typically not similarly divided into salient subintervals.

6.2.3. Understood Adverbials

Where there is no explicit adverbial it is harder to decide whether the adverbial is XN because it is harder to decide which adverbial is to be understood. We list here some of the types of example that have been discussed in the literature.

The notorious Einstein/Princeton example [39, 46] falls under Rules 2 and 3: *Princeton has been visited by Einstein* is imagined to occur within something like a history of Princeton, and so falls under Rule 2. *Einstein has visited Princeton* is wrong because Rule 3 applies, and because Rule 2 typically would not apply. We would not expect Rule 2 to apply because the sentence would ordinarily occur as part of some sort of discourse about Einstein where the temporal emphasis is probably on some part of the life of Einstein.

A somewhat harder case is *Columbus has discovered America, so you don't have to*, which falls under Rule 2. We would expect *Columbus discovered America* on the basis of common knowledge, but explicit or implied connection with the present seems sufficient to allow the present perfect (the past would also be acceptable here). Possibly occurrence as part of a discourse in the present tense always supplies enough of an XN

³⁵ This point was seen clearly by Bryan [11, p. 380], but is still very often missed. Numerous writers (cf. [61, p. 278], [28, p. 7]), have thought that the past tense restricts an adverbial whose time *t* extends into the future to the nonfuture part of *t*; this is in order to deal with a sentence like *Max left today*. But this claim is wrong just on the grounds that the nonfuture part of *t* is an XN interval and would demand the present perfect; *Max left today* is acceptable only in a context where *today* is a non-XN adverbial to begin with.

emphasis to allow the perfect where there is no explicit past adverbial.³⁶ This may especially be the case when the focus of discussion is truly the present, as opposed to a historical period leading up to the present.

Sentences like *I didn't turn off the stove* and *I went to UCLA* also fall under Rule 3.

An interesting example of the application of Rule 3 is the fact³⁷ that “We do not use the present perfect to explain the origin or cause of something that people already know about” [59]. This is true because such a cause is located within the past with respect to a discourse eventuality, namely the one that people already know about.

(55) Some fool's let the cat in.

(56) Who let the cat in.

The past tense is appropriate in (56) because the letting in of the cat is situated before a previous discourse state, namely the state of the cat being in the house. Sentence (55) introduces the state into the discourse, so that the perfect is appropriate. Other sentences are *who gave you that tie?* (cf. *?who has given you that tie*), *I. M. Pei designed that building*. There is also *what have you done this time?* vs. *?what have you done that time?*

Very many perfects fall under Rule 5. Consider ordinary utterances of *have you been to America?*, *he has experienced suffering*, *all my kids have had measles*.

6.2.4. Present Relevance and Continuing Effect

One traditional theory (again more than two hundred years old [41]) about the use of the past and the present perfect is that the latter is apropos when the past eventuality has some form of present relevance. McCoard [41] and Kilby [32] have argued convincingly that the requirement of present relevance for the present perfect is predictable on Gricean principles, and does not belong to any account of the meaning of the perfect.

It is a basic discourse principle that one's contribution should be relevant [22]. Sentences with perfect aspect, like other sentences, appear in the present tense when the temporal focus is present. In other words they occur when what is being talked about is present rather than past. The

³⁶ This seems wrong. What is crucial about this *Columbus* example may be that the context explicitly makes reference to the alternative possible case where the key event takes place now rather than long ago, and thus the times in question span an XN interval. Perhaps this can be regarded as contextual emphasis on an XN interval.

³⁷ Noticed by Swan [59, p. 494] and others.

principle that one should be relevant means that one should be relevant to what one is talking about and not something else. Thus on general principles of cooperative discourse sentences in the present, including perfects, are supposed to have present relevance. For this reason the observation that the present perfect requires present relevance is true but of little or no distinguishing value – all sentences in the present tense have to have present relevance for the same reason, and sentences in the past tense also have to have present relevance when they occur in a discourse whose focus is present, as in

(57) Take a nap, Allen. You didn't sleep much last night.

The continuing effect theory. Probably the most typical way for a sentence that reports a past eventuality to be relevant to the present is for the consequences of the past eventuality still to hold at the present time. Thus one form of the present relevance theory is the *continuing effect theory*, or what Leech [36] calls “resultative past”. Leech gives examples like

(58) The taxi has arrived

(59) She has been given a camera

(60) I've taken a bath.

McCoard argues convincingly [41, pp. 41–44] that the tendency of such sentences to suggest that their consequences remain in effect is due to the same pragmatic factors just discussed here, and moreover shows that this tendency does not hold where the usual pragmatic factors do not apply.³⁸ Having consequences still in effect is a stronger criterion than present relevance, but in very many cases it is by having present consequences that a statement would have present relevance. This is by no means always the case, however: We might say *Max has written a word processor in C*, not because we want the program, but because we are interested in Max's qualifications for a programming job. In fact we might cite as an exception to the continuing effect theory any discourse where past events are reported as evidence for some conclusion about the character, capabilities, or other dispositional characteristics of some person or thing, rather than because of an interest in the present consequences. What is relevant is not the action's present effects, but the fact that it was performed and is

³⁸ I was initially tempted by the following argument: Sentences in the present perfect imply that there are continuing effects, because if the effects did not continue, then the the past eventuality would be limited to the time before the effects ceased, which would be a non-XN interval, and therefore the past tense would be required. This runs afoul of the fact that continuing effects are by no means always implied; when they are implied it is for independent Gricean reasons, namely that the relevance of the sentence requires them.

of a certain type. The label “experiential perfect” is traditionally applied to some similar class of uses of the perfect.

It has often not been recognized that none of this has anything to do with the meaning of the present perfect, but relates only to when it is used. A perfectly coherent ER similar to (43) could be assigned to a sentence like *Max has been here yesterday* – it is only that the sentence violates the convention that certain adverbials are used with the present perfect and others are used with the past (though there is considerable uncertainty and overlap, at least when the adverbials are understood). This restriction on adverbials relates to the present perfect only (better: relates to the perfect only when it is in the present tense), and this is obviously historically related to the fact that it is only in this case that the simple past tense would be an alternative. There is no similar restriction on adverbials for perfects in the past tense or in nonfinite forms.

6.2.5. *The Past and the Perfect are Equally Anaphoric*

It has frequently been observed that clauses in the past tense are anaphoric in some sense, but the parallel claim for the perfect is less widely accepted.³⁹ In fact the two forms are very similar in this respect. Both require an adverbial to locate the time of the reported eventuality, and in both cases this time is often not explicitly stated and must be supplied anaphorically. Past clauses and perfect clauses differ not in their ability to contain understood TA's, but only with respect to the type (XN or non-XN) of possible adverbials.

Various writers⁴⁰ have noticed that a past tense clause can pick up its temporal adverb from a present perfect antecedent. The supposed asymmetry between past and present perfect depends partly on this observation, but consideration of the following sentences strongly suggests that there is no difference other than the XN distinction. In each case the first clause introduces a TA and an event *E*. From *E* it is natural to infer an XN adverbial *since E* or a non-XN adverbial *when E*. The only difference to be found between past tense and present perfect second clauses is that the past clauses can pick up the non-XN adverbials and the perfect clauses can pick up the XN ones. (The adverbials in the past tense sentences

³⁹ But see [7, p. 9].

⁴⁰ R. L. Allen [2, pp. 155–157] is so far as I know the first to catalogue the similarities between NP anaphora and temporal anaphora. He draws his analogies between temporal anaphora and definite NP's, rather than pronouns. See also [27, 36, 52, 53].

are top level, but in the present perfect sentences they are the perfect adverbials.)

- (61) Bill has arrived, but Mary didn't talk to him.
- (62) Bill has arrived, but Mary hasn't talked to him.
- (63) Bill arrived last night, but Mary hasn't talked to him.
- (64) Bill arrived last night, but Mary didn't talk to him.

Supposing for (61) that the antecedent for the understood adverbial of the second clause comes from the first clause, and not from some previous discourse, the adverbial for the second clause of (61) must as a matter of usage be *when Bill arrived*. In (62) the adverbial of the second clause is either *since Bill arrived* or something inferred from the previous discourse. In (63) the adverbial of the second clause is *since Bill arrived*. The adverbial of the second clause of (64) must be *last night* or *when Bill arrived*. In all these cases the possibilities are consistent with the idea that the available adverbials for the second clause are those that can straightforwardly be inferred from the events and adverbials of the first clause, given the XN/non-XN restrictions for the present perfect and past.⁴¹

⁴¹ Sentence (61) is a little odd, though everyone understands it as suggested in the text. Almost everyone is happy with the rest of these sentences. It is of course not (61) but mainly (62) and (63) that are needed for the argument of this Section. Similar sentences where the second clause does not contain any negative constructions tend not to sound as good, for reasons that are not clear to me. On the other hand, all of these anaphoric combinations (perfect-past, perfect-perfect, etc.) occur in ordinary discourse, where the clause is usually more widely separated from the antecedent of its understood adverbial.

An anonymous reviewer suggested the possibility that past temporal anaphora is different from perfect temporal anaphora, because the past tense is in some way analogous to a definite NP and the perfect correspondingly analogous to an indefinite NP. There is some initial appeal to this view – one has the feeling that in using the past tense one typically has some definite context in mind, but in using the perfect one does not. (Actually this only holds, to the extent that it holds at all, when the clause is in the present tense.) Sentences (63) and (64) are perhaps a case in point: in the second clause of (64), we might say, one refers to the specific occasion of Bill's arrival, but in (63) only to some time in the interval between that occasion and now. Though I guess this is a correct way of describing a difference between (63) and (64), I don't think there is really any analogy to the definite/indefinite distinction for NP's. Suppose we express the approximate content of the understood TA's of (63) and (64) using a temporal preposition together with an NP denoting the specified interval. For (64) we could say *in the sequel of Bill's arrival*, and for (63) we could say *in the interval between Bill's arrival and now*. Both of these explicit TA's are expressed using definite NP's, and if it makes sense at all to talk about the definiteness of the two intervals, then neither is more definite, though one is bigger. Even if one of the TA's were vague as to what interval it denoted, this would have nothing to do with definiteness in the sense of "definite NP" – a definite NP can be as vague as one wants it to be.

We might say that (64) is more definite than (63) as to the time of the event of Mary's talking to Bill, but even if the sense of "definite" here is the relevant one, it is irrelevant to

7. DISCOURSE AND THE INADEQUACY OF REICHENBACH'S THEORY

Most of the important recent work on the temporal processing of discourse (e.g. [28, 68]) assumes some version of the Reichenbach model of the semantics of tense and aspect, which I will not repeat here. I have already argued in Section 4 that temporal anaphora is TA anaphora and not tense anaphora. What I want to say now is that TA anaphora is to be described very much in the same manner as NP anaphora. Two of the main analogies are

There should be a notion of temporal focus (with associated lists of potential foci, etc.) that relates to TA anaphora as discourse focus relates to NP anaphora; this has been set out by Webber [68]. The main difference between temporal focus and temporal point of reference is that temporal focus helps to resolve anaphora, whereas a temporal point of reference is claimed to be a parameter that takes part in sentence-level semantics.

There should be no temporal indices or points of reference, just as there are no nominal indices or points of reference.

The following are points in favor of these claims.

7.1. Complexity of TA Anaphora

One sentence may contain a number of NP's, whose reference may depend on all sorts of features of context and previous discourse. Exactly the same is true for TA's. (The TA's, unlike the NP's (typically pronouns), often have no syntactic realization, but this difference is a mere accident from the semantic point of view.) Consider the following sentences.

- (65) She had better tell him about the book.
 (66) Max had expected Leslie to leave.

Sentence (65) has three NP's to be resolved and (66) has three TA's. (Namely the top TA, the perfect TA (specifying the time of the expectation), and the TA for *to leave*.) Probably the reference of *she* or one of

the present claim, which, crucially, has to do with the time of the TA, *not* with event time. We could use an indefinite NP to specify the *event* time of (63) ("a time between Bill's arrival and now") but again, event time is not what we're talking about. All inclusive TA's (whether in association with the past tense, the perfect, or neither) are indefinite as to the exact time of the event they locate; but they are not indefinite as to how they themselves are determined, which is what matters for the present discussion.

the other NP's depends on the discourse focus, and probably the reference of the top TA or one of the other TA's depends on the temporal focus. Why would we expect the means of resolution to be in principle different?

7.2. *Are Adverbials Anaphoric?*

Some accounts in terms of indices or points of reference have tended to view (top level?) temporal TA's as providing an antecedent for the tense anaphor, so that *when he finished his chores* in (67) is the antecedent of some anaphor that occurs in *John went to bed*.

Consider the following sentences (adopted from [68]).

- (67) When he finished his chores, John went to bed.
- (68) John finished his chores and went to bed.
- (69) John went to bed when he finished his chores.

Discussion of sentences like these in the literature [27, 53, 68] begins with the anaphoric relationship in (68), which links the second clause with the event of John finishing his chores. Sentence (67) is then seen as exhibiting the same anaphoric relationship. The adverb can "serve as an antecedent for . . . a tense morpheme" [27, p. 79] or "provid[e] an antecedent for the past tense of the main clause" [53, p. 245]. Webber [68, p. 64] also views eventualities "described in the previous discourse" and "[described] by a temporal adverbial in the current sentence" as equally "established by the context" and anaphoric.

According to the present framework, based on understood TA's, no temporal anaphor occurs in the main clause of (67); *when he finished his chores* is simply an adverbial, not different in any deep way from a locative adverbial or a reason adverbial. The idea of the present approach is to assimilate (68) to (67), not vice versa, so that what the first clause of (68) contributes to the second clause is an understood TA which is approximately the same as the explicit TA of (67).

On the present view, there is no disanalogy between (67) and (69). Both of them simply contain the TA *when he finished his chores*, and the only difference is the obvious one, namely that in (67) we determine the TA before the rest of the sentence, and in (69) vice versa. The tense in *John went to bed* in (69) does not carry temporal information (see next paragraph), so why should we complicate things by saying that it does so in (67)?

The tense in *John went to bed* in (69) does not carry the temporal information, because the only way it could come to carry such information would be through a backwards anaphoric relationship with the TA *when*

he finished his chores, but then we have backwards anaphora with the antecedent in the subordinate clause, and things don't ordinarily work that way: in *he went to bed when John finished his chores*, the pronoun *he* cannot refer to John.

Finally, we don't want to say that *all* adverbs (or even all preposed adverbs) are interpreted in terms of anaphora (do we?), so what exactly is so special about temporal adverbs?

7.3. *Intervals and Events Don't Have Enough Content*

There must be understood TA's, on any account, and TA's have more content than can be supplied by intervals or events, in two ways:

7.3.1. *TA's Specify a Temporal Relation*

TA's specify not only a location, but a relation (*at*, *in*, or *for*, at least), between an eventuality and a location. The notions of reference time or temporal focus are inadequate for temporal semantics because context must provide not only a time (or event) as the location of a newly introduced eventuality *E*, but must also specify the relation between *E* and the time. Consider for example

(70) He mowed the lawn.

Sentence (70) can serve as an answer to the question *what did Max do in the yard this morning?* or to the question *what did Max do regularly during the summer?* (Less trivial ways can be found for the discourse to specify similar understood adverbials.) In the first case the understood adverbial is inclusive and its time is *this morning*. In the second case the understood top adverbial is durative and its time is the summer; there is (and must be, since a durative adverbial is present and *he mow the lawn* is an accomplishment) also an understood frequency adverbial, which is *regularly*. Context supplies the difference in interpretation between these two possible occurrences of (70), which would plainly be impossible if context could provide only a temporal location, whether it was a time or an event.

7.3.2. *TA's Specify Different Times for Different Events*

TA's may specify functional relationships (i.e., different times for different events); intervals and events, or even sets of them, can't do that. Hinrichs [28] considers the sentence

(71) Every admiral graduated from Annapolis

under the assumption that it is to be interpreted in context as meaning that

(72) All present or past admirals graduated from the Naval Academy in Annapolis prior to their being admirals.

If this assumption is correct (admittedly debatable) then the adverbial “prior to their being admirals” is an understood adverbial of (71). What it conveys is that for each admiral x within the given period, the time of x 's graduation precedes the time of x 's being an admiral. This is a functional relationship which plainly cannot be captured by means of any reference point or set of reference points, whatever the reference points may be; an adequate representation has to include the dependency of graduation times on the admirals and the times of their being admirals. There is really a different ‘reference interval’ for each admiral.

Hinrichs symbolizes (71) as

(73) $\forall x[\exists t[\text{admiral}'(x)(t) \ \& \ R(x)(t)] \rightarrow \exists t'[t' < ts \ \& \ t' \subseteq tr \ \& \ \text{graduate-from}'(\text{Annapolis}')(x)(t')]]$.

(The relation $R(x)(t)$ is used to make it possible for (71) to be about everyone who is an admiral at a time which may be different for each admiral. There is nothing exactly wrong with this, but there is also nothing special about *time* in this context. In the general case a universal sentence about admirals may involve restriction not only with respect to time, but might refer to a particular place, membership in some particular group, and so on.)

Representation (73) fails to say what Hinrichs wants it to, namely that x graduated from Annapolis *before* x was an admiral. The time of graduation given by (73) is characterized for any x in the same way as for any other, namely as an arbitrary time within the constant interval tr , which is the ‘reference interval’. If we are to accept what Hinrichs says about the interpretation in context of (71), then it should have exactly the same ER as (72). Sentence (71) is an example of the need to recognize that it is not times but adverbials which may be understood. Its representation requires that each admiral be understood as graduating from Annapolis before *he* becomes an admiral. An obvious way to meet this requirement is by means of a TA meaning *before x becomes an admiral*; in this way the indefinite number of times can be specified as a function of the admirals. No single reference time is sufficient, nor can the correct set of times be stipulated except by relating them to the later time of becoming an

admiral. As a matter of pure logic, adverbials do but sets of intervals don't have the power to represent the required relation.

7.4. Reichenbach's Framework is Confused

In this section I will consider the Reichenbach framework as it used in Webber [68], which is chosen because it seems to me to be one of the best papers on the temporal interpretation of discourse. My point will be that what Webber says can be said better independently of the Reichenbach framework, simply in terms of the concept of understood TA's.

Sentences in the perfect will be prominent in this section. As already noted, every perfect sentence contains a top level TA (call it *TAV*), which locates the consequent state *CS* of some past eventuality *PE*, and a perfect TA (*PAV*), which locates *PE*. I will use the abbreviations *TAV*, etc., throughout this section.

For a perfect sentence (past perfect or present perfect), Reichenbach makes a distinction between *reference time*, or *point of reference*, and *event time*, or *point of the event*. We are never really told what reference time *is*, but it is clear from Reichenbach's examples that it has something to do with *TAV* and *CS*; for a perfect sentence it may be identified with *TAV*. (Perfect sentences are simple in this respect because their *TAV* is always punctual.)

Event time, for a present perfect or past perfect sentence, is clearly considered by Reichenbach to be the time of *PE*. For Reichenbach reference time and event time are two temporal parameters involved in the interpretation of every sentence. For a past or a present sentence reference time and event time are said to coincide, but for present perfect or a past perfect sentence event time is said to precede reference time. It thus follows from Reichenbach's theory that past perfect sentences are not past and present perfect sentences are not present; that is, the sentences he classifies as past (present) perfect are disjoint from the sentences he classifies as past (present). Whatever follows from the pastness (presentness) of past (present) perfect sentences does not, in Reichenbach's scheme follow from the fact that they are past (present), but must be stated separately.

To see why this is wrong, consider the sentences:

(74) John had a Volvo.

(75) John had left.

Both sentences are stative, so both of them report states. Sentence (74) reports the state of John's having a Volvo, and says that it holds at the

time specified by the understood top adverbial, which can be identified with Reichenbach's reference time. Sentence (75) is the same, except that the state (*CS*) is the state of John's having left, i.e., the consequent state of the event *PE* of John's leaving. For sentence (74) we can only interpret Reichenbach's statement that event time and reference time are the same as a statement that the time of the adverbial is a time when the state holds. (Reichenbach uses *event* to include states.) Given this interpretation what Reichenbach says is true. All of this is exactly the same for (75); for it to be true the state *CS* has to hold at the time of the top level TA. If we consider (75) to be a past tense sentence (as it is not, in Reichenbach's scheme), then we can interpret what Reichenbach says in a way that makes sense, and that works just the same for both (74) and (75). The states reported by the two sentences are treated similarly; the state reported by (75) has something to do with an event of John's leaving, but this is not a complication with respect to the treatment of the past tense.

The only interpretation that can be given to Reichenbach's statement that the event time of a past perfect sentence precedes the reference time is that the time of *PE* precedes the time of *TAV*. This is true, but it identifies the perfect event (rather than the top eventuality, namely *CS*) of a past perfect sentence (e.g. (75)) with the top eventuality of a past sentence (e.g. (74)), which is just wrong, because it obscures the fact that past perfect sentences behave just like other past tense sentences with respect to the eventualities they report, namely the top level eventualities. If there is to be a thing called event time, uniformity demands that it always be the time of the top level eventuality, even when, as in a perfect sentence, more than one eventuality is semantically involved.

It is this misanalogy that makes it necessary in Reichenbach's system to have separate accounts of the past perfect and the present perfect (and what about nonfinite perfects?) in addition to an account of the past and the present. The past perfect is so often cited in explanations of Reichenbach's theory that it seems that many advocates of the theory consider the past perfect one of its major successes. In fact it is a failure of the theory that the past perfect is treated as a separate entity, and not simply as a perfect which is in the past tense.⁴²

A careful reading of Webber [68] shows that the notion of reference time only comes into play for perfect sentences (we are never told what reference time *is*), and is only required in order to provide a special treatment for the case when event time precedes reference time. If the Reichenbach framework is dropped and the perfect is treated as in Section

⁴² For other bad things about Reichenbach's theory, see [60, pp. 366–367].

6, then the same results can be produced by treating past perfects the same as all other stative past sentences. The fact that E comes before $\text{Consq}(E)$ belongs to the logic of ‘Consq’, and is the same for all perfects, tensed or otherwise.

7.5. Temporal Focus and the Perfect

Both *TAV* and *PAV* may be determined anaphorically and both behave anaphorically in much the same way, depending on whether *CS* or *PE* is the focus of the discourse. Consider the following discourses adapted from [68] (approximately Webber’s (19) and (20)):

- (76)a. I was talking with Mary yesterday.
 b. She told me about her trip to Alaska.
 c. She $\left\{ \begin{array}{l} \text{(i) spent} \\ \text{(ii) had spent} \end{array} \right\}$ five weeks above the Arctic Circle with two friends.
 d. The three of them $\left\{ \begin{array}{l} \text{(i) climbed} \\ \text{(ii) had climbed} \end{array} \right\}$ Mt. McKinley.
 e. She said that next year they would go for Aconcagua.

Webber claims that temporal focus moves in (c)–(d) of (76i) but not in (c)–(d) of (76ii). This is presumably because she identifies temporal focus with reference time (= the time of the top adverbial), which indeed does not change in (c)–(d) of (76ii). But given the definition of temporal focus as what “is most attended to”, the focus in (c) and (d) of (76ii) is the time of the perfect adverbial (something like *during her trip to Alaska*) – which is the same as the time of the top adverbial in (c) and (d) of (76i) – and not the time of the top adverbial. In both cases the movement from (c) to (d) appears to instantiate one of Webber’s standard types of shift of focus, namely the one (her function β_{prep}) that typically moves the focus from an eventuality to some part of it. In the Reichenbach model what goes on in (76i) is of a radically different kind from what goes on in (76ii), because (76i) shifts reference time and (76ii) shifts event time. But in reality the temporal focus is just the TA that locates the event that is the actual focus of the discourse and could be either *TAV* or *PAV*– there is no particular reason to believe that the perfect adverbial can’t move by the same mechanisms as the top adverbial, and there is nothing to stop us from capturing the intuitive similarity between (76i) and (76ii) by regarding them both as instances of the standard means of shifting temporal focus.

The idea that the temporal focus of a past perfect can be either *TAV* or *PAV* gives some content (not otherwise easy to find) to the traditional idea that a past perfect can be either the past of a past or the past of a perfect. The top adverbial is the focus when the consequent state is being emphasized, in which case the past perfect is a shifted-back present perfect in terms of focus. Similarly, when the perfect adverbial is the focus then the past perfect is analogous to a shifted-back past tense sentence.

7.6. *What are Reference Times?*

It was argued in Section 7.4 that Reichenbach's notion of reference time as contrasted with event time is confused. What about some other notion of reference time that doesn't make the same mistake? I don't think we have much idea of what reference time would be aside from Reichenbach's model.

Consider for example the notion of reference interval (RI) used by Hinrichs [27].⁴³ Hinrichs sets out a model for the interpretation of past tense narrative discourse, which includes rules for determining the current RI and for using it in the interpretation of a sentence. For a past tense event sentence, the reported event *E* is interpreted as occurring within the current RI, and the sentence determines a new RI, which is an interval that immediately follows *E*. For a past tense mass sentence, the reported mass eventuality *S* is interpreted as going on or holding at (I would say *for*) the current RI, and the current RI is not changed. In this model, the RI is an entity which both is determined by previous discourse and has a known role in the interpretation of the next sentence. The conceptual problem is that in the general case there is nothing that meets both of these conditions. (To take a simple case, consider (66); a time determined by the preceding sentence might determine any of the three TA's.) So what is the RI in the general case? We might say that it is an interval determined by the preceding sentence; in this case the generalized notion of RI might be identified with Webber's 'temporal focus', so that RI helps to resolve TA anaphora and is not a parameter of sentence interpretation. The other possibility is to define RI in terms of its role in sentence interpretation; the most obvious idea would be to make RI the time of the top level TA. In this case it is hard to see the utility of such a notion,

⁴³ This is discussed in [53] and criticized in [68].

because the RI is never known before the sentence is processed.⁴⁴ We could say that the RI is determined as the sentence is being processed, but in that case what is it for? 'Reference interval' then becomes merely a name that is given to the time of a TA while the TA is being determined. It seems likely to me that the idea of 'reference interval' gets its plausibility by supposed analogy with the way indices are used in some systems of temporal and modal logic; but there is really no analogy, because such indices play a determinate role in the evaluation of expressions of the formal system. In temporal sentence processing, there is no interval that works like that.

8. CONCLUSION

This paper has presented the following.

A relatively extensive model of the compositional semantics of temporal adverbials, especially durative and frequency adverbials.

A straightforward story about how tenses work, stated in terms of the conventional uses of the past and present tenses. I have argued that such an account is to be preferred over any theory of tenses as operators, and provides a satisfying explanation of the anaphoricity of the past tense.

An analysis of the interaction of tense, the perfect, and temporal adverbials that overcomes certain long-standing difficulties.

A relatively specific statement of the difference between sentences in the past tense and the present perfect.

The following points have been argued for.

There is no such thing as the semantics of tense. Tense has no compositional meaning. Temporal semantics is the semantics of temporal adverbials.

The unitary idea of truth, or occurrence, at an interval is inadequate. We need to distinguish between mass and count eventualities, which relate to intervals in two fundamentally distinct ways.

The central concept of temporal semantics at a discourse level is *under-*

⁴⁴ It isn't known even in past tense narrative discourse. Real discourse may contain fairly long stretches of past tense narrative, but it is unlikely that a whole discourse will fit this pattern, and even more unlikely that this would be known in advance.

stood temporal adverbial; such a model provides a better foundation for discourse interpretation than anything based on Reichenbach's analysis of tense.

REFERENCES

- [1] Allen, James: 1987, *Natural Language Understanding*, Benjamin/Cummings, Menlo Park.
- [2] Allen, Robert L.: 1966, *The Verb System of Present-Day American English*, Mouton, The Hague.
- [3] Alshawi, Hiyun: 1990, 'Resolving Quasi Logical Forms', *Computational Linguistics* **16**, 133–144.
- [4] Anderson, John: 1973, *An Essay Concerning Aspect*, Mouton, The Hague.
- [5] Bach, Emmon: 1981, 'On Time, Tense, and Aspect: An Essay in English Metaphysics', in P. Cole (ed.), *Radical Pragmatics*, Academic Press, New York, pp. 63–81.
- [6] Bach, Emmon: 1986, 'The Algebra of Events', *Linguistics and Philosophy* **9**, 5–16.
- [7] Bennett, Michael and Barbara Partee: 1972, 'Toward the Logic of Tense and Aspect in English', distributed 1978 by the Indiana University Linguistics Club, Bloomington.
- [8] Bolinger, Dwight: 1971, 'The Nominal in the Progressive', *Linguistic Inquiry* **2**, 246–250.
- [9] Brachman, Ronald J.: 1979, 'On the Epistemological Status of Semantic Networks', in N. V. Findler (ed.), *Associative Networks: Representation and Use of Knowledge by Computers*, Academic Press, New York. Reprinted in [10].
- [10] Brachman, Ronald J. and Hector J. Levesque (eds): 1985, *Readings in Knowledge Representation*, Morgan Kaufman, Los Altos, California.
- [11] Bryan, W. F.: 1936, 'The Preterite and the Perfect Tense in Present-Day English', *Journal of English and Germanic Philology* **35**, 363–382.
- [12] Cresswell, Max J.: 1973, *Logics and Languages*, Methuen, London.
- [13] Davidson, Donald: 1967, 'The Logical Form of Action Sentences', in Nicholas Rescher (ed.), *The Logic of Decision and Action*, University of Pittsburgh Press, Pittsburgh. Reprinted in [15].
- [14] Davidson, Donald: 1969, 'The Individuation of Events', in Nicholas Rescher (ed.), *Essays in Honor of Carl G. Hempel*, Reidel, Dordrecht, pp. 216–234. Reprinted in [15].
- [15] Davidson, Donald: 1980, *Essays on Actions and Events*, Oxford University Press, Oxford.
- [16] Dowty, David R.: 1977, 'Toward a Semantic Analysis of Verb Aspect and the English "Imperfective" Progressive', *Linguistics and Philosophy* **1**, 45–78.
- [17] Dowty, David R.: 1979, *Word Meaning and Montague Grammar*, Reidel, Dordrecht.
- [18] Dowty, David R.: 1982, 'Tenses, Time Adverbials and Compositional Semantic Theory', *Linguistics and Philosophy* **5**, 23–33.
- [19] Dowty, David R.: 1986, 'The Effects of Aspectual Class on the Temporal Structure of Discourse: Semantics or Pragmatics?', *Linguistics and Philosophy* **9**, 37–62.
- [20] Eneç, Mürvet: 1981, *Tense without Scope: An Analysis of Nouns as Indexicals*, Ph.D. dissertation, University of Wisconsin, Madison.
- [21] Fillmore, Charles: 1968, 'The Case for Case', in Emmon Bach and R. T. Harms (eds.), *Universals in Linguistic Theory*, Holt, Rinehart & Winston, New York.
- [22] Grice, H. P.: 1975, 'Logic and Conversation', in P. Cole and J. Morgan (eds.), *Syntax and Semantics 3: Speech Acts*. Academic Press, New York, pp. 41–58.
- [23] Grosz, Barbara: 1977, 'The Representation and Use of Focus in a System for Under-

- standing Dialogs', *Proceedings of the Fifth International Joint Conference on Artificial Intelligence*, Cambridge, Massachusetts, pp. 67–76.
- [24] Grosz, Barbara, et. al.: 1987, 'TEAM: an Experiment in the Design of Transportable Natural-Language Interfaces', *Artificial Intelligence* 2, 173–244.
- [25] Grosz, Barbara and Candice Sidner: 1986, 'Attention, Intention, and the Structure of Discourse', *Computational Linguistics* 12, 175–204.
- [26] Heny, Frank: 1982, 'Tense, Aspect, and Time Adverbials, Part II', *Linguistics and Philosophy* 5, 109–154.
- [27] Hinrichs, Erhard W.: 1986, 'Temporal Anaphora in Discourses of English', *Linguistics and Philosophy* 9, 63–82.
- [28] Hinrichs, Erhard W.: 1988, 'Tense, Quantifiers, and Contexts', *Computational Linguistics* 14, 3–14.
- [29] Hintikka, Jaakko: 1980, 'On the Any-Thesis and the Methodology of Linguistics', *Linguistics and Philosophy* 4, 101–122.
- [30] Jespersen, Otto: 1931, *A Modern English Grammar on Historical Principles*, Part IV, Allen and Unwin, London.
- [31] Kamp, Hans: 1981, 'A Theory of Truth and Semantic Representation', in J. Groenendijk, Th. Janssen, and M. Stokhof (eds.), *Formal Methods in the Study of Language, Part I*, Mathematisch Centrum, Amsterdam, pp. 277–322.
- [32] Kilby, David: 1984, *Descriptive Syntax and the English Verb*, Croon Helm, London.
- [33] Kuhn, Steven: 1979, 'The Pragmatics of Tense', *Synthese* 40, 231–263.
- [34] Lakoff, George: 1966, 'Stative Adjectives and Verbs in English', in *Harvard Computation Laboratory Report NSF-17*.
- [35] Lakoff, Robin: 1969, 'Some Reasons Why There Can't Be Any Some-Any Rule', *Language* 45, 608–615.
- [36] Leech, Geoffrey N.: 1987, *Meaning and the English Verb*, 2nd Edition, Longman, London.
- [37] Lineberger, Marcia C.: 1980, 'Polarity Any as an Existential Quantifier', in Jody Kreiman and Almerindo Ojeda (eds.), *Papers from the Sixteenth Regional Meeting of the Chicago Linguistic Society*, Chicago Linguistic Society, Chicago, pp. 211–219.
- [38] Lycan, W.: 1984, 'A Syntactically Motivated Theory of Conditionals', in P. French, T. E. Uehling, and H. K. Wettstein (eds.), *Midwest Studies in Philosophy*, Vol. IX, University of Minnesota Press, Minneapolis, pp. 437–456.
- [39] McCawley, James D.: 1971, 'Tense and Time Reference in English', in C. J. Fillmore and D. T. Langendoen (eds.), *Studies in Linguistic Semantics*, Holt, Rinehart and Winston, New York.
- [40] McCawley, James D.: 1981, 'Notes on the English Present Perfect', *Australian Journal of Linguistics* 1, 81–90.
- [41] McCoard, Robert W.: 1987, *The English Perfect: Tense-Choice and Pragmatic Inferences*, North-Holland, Amsterdam.
- [42] Mittwoch, Anita: 1988, 'Aspects of English Aspect: On the Interaction of Perfect, Progressive and Durational Phrases', *Linguistics and Philosophy* 11, 203–254.
- [43] Moens, Mark and Mark Steedman: 1988, 'Temporal Ontology and Temporal Reference', *Computational Linguistics* 14, 15–28.
- [44] Moore, Robert: 1981, 'Problems in Logical Form', in *Proceedings of the 19th Annual Meeting of the Association for Computational Linguistics*, Association for Computational Linguistics, Urbana-Champaign, pp. 117–124. Reprinted in [10].
- [45] Mourelatos, Alexander P. D.: 1978, 'Events, Processes, and States', *Linguistics and Philosophy* 2, 415–434. Reprinted in Philip Tedeschi and Annie Zaenen (eds.), *Syntax and Semantics 14: Tense and Aspect*. Academic Press, New York, pp. 191–212.
- [46] Palmer, F. R.: 1974, *The English Verb*. Longman, London.
- [47] Parsons, Terry: 1980, 'Modifiers and Quantifiers in Natural Language', *Canadian Journal of Philosophy*, Supplementary Vol. 6, 29–60.

- [48] Parsons, Terry: 1985, 'Underlying events in the Logical Analysis of English', in Ernest LePore and Brian P. McLaughlin (eds.), *Actions and Events: Perspectives on the Philosophy of Donald Davidson*, Blackwell, Oxford, pp. 235–267.
- [49] Parsons, Terry: 1988, 'The Semantics of the Perfect (and the Progressive) in Modern English, and its Evolution from Old English, developed within a Framework of underlying Events and States', ms.
- [50] Parsons, Terry: 1989, 'The Progressive in English: Events, States, and Processes', *Linguistics and Philosophy* 12, 213–242.
- [51] Parsons, Terry: 1990, *Events in the Semantics of English: A Study in Subatomic Semantics*, MIT Press, Cambridge.
- [52] Partee, Barbara H.: 1973, 'Some Structural Analogies Between Tense and Pronouns in English', *The Journal of Philosophy* 70.
- [53] Partee, Barbara: 1984, 'Nominal and Temporal Anaphora', *Linguistics and Philosophy* 3, 243–286.
- [54] Quine, Willard V. O.: 1960, *Word and Object*, MIT Press, Cambridge, Mass.
- [55] Quirk, Randolph, Sidney Greenbaum, Geoffrey Leech, and Jan Svartvik: 1972, *A Grammar of Contemporary English* (ninth impression), Longman, London.
- [56] Reichenbach, Hans: 1966, *The Elements of Symbolic Logic*, The Free Press, New York.
- [57] Richards, Barry: 1982, 'Tense, Aspect, and Time Adverbials, Part I', *Linguistics and Philosophy* 5, 59–107.
- [58] Stucky, Susan U.: 1989, 'The Situated Processing of Situated Language', *Linguistics and Philosophy* 12, 347–358.
- [59] Swan, Michael: 1980, *Practical English Usage*, Oxford University Press, Oxford.
- [60] Tichy, Pavel: 1980, 'The Logic of Temporal Discourse', *Linguistics and Philosophy* 3, 343–370.
- [61] Tichy, Pavel: 1985, 'Do We Need Interval Semantics?', *Linguistics and Philosophy* 8, 263–282.
- [62] Vendler, Zeno: 1976, 'Verbs and Times', in *Linguistics in Philosophy*, Cornell University Press, Ithaca.
- [63] Vlach, Frank: 1981, 'The Semantics of the Progressive', in Philip Tedeschi and Annie Zaenen (eds.), *Syntax and Semantics 14: Tense and Aspect*, Academic Press, New York, pp. 271–292.
- [64] Vlach, Frank: 1981, 'La sémantique du temps et de l'aspect en anglais' (translated by F. Nef), *Langage* 64, 65–79.
- [65] Vlach, Frank: 1983, 'On Situation Semantics for Perception', *Synthese* 54, 129–152.
- [66] Webber, Bonnie Lynn: 1983, 'So What can we Talk about Now?', in M. Brady and R. Berwick (eds.), *Computational Models of Discourse*, MIT Press, Cambridge, Mass.
- [67] Webber, Bonnie Lynn: 1988, 'Foreword', *Computational Linguistics* 14, 1–2.
- [68] Webber, Bonnie Lynn: 1988, 'Tense as Discourse Anaphor', *Computational Linguistics* 14, 61–73.

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