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THE SYNTAX AND INTERPRETATION OF TEMPORAL EXPRESSIONS IN ENGLISH

ABSTRACT The only obligatory temporal expression in English is tense, yet Hans Reichenbach (1947) has argued convincingly that the simplest sentence is understood in terms of three temporal notions. Additional possibilities for a simple sentence are limited: English sentences have one time adverbial each. It is not immediately clear how to resolve these matters, that is, how (if at all) Reichenbach's account can be reconciled with the facts of English. This paper attempts to show that they can be reconciled, and presents an analysis of temporal specification that is based directly on Reichenbach's account.

Part I is devoted to a study of the way the three times – speech time, reference time, event time – are realized and interpreted. The relevant syntactic structures and their interaction and interpretation are examined in detail. Part II discusses how a grammar should deal with time specification, and proposes a set of interpretive rules. The study offers an analysis of simple sentences, sentences with complements, and habitual sentences. It is shown that tense and adverbials function differently, depending on the structure in which they appear. The temporal system is relational: the orientation and values of temporal expressions are not fixed, but their relational values are consistent. This consistency allows the statement of principles of interpretation.

An interesting result of the study is that the domain of temporal specification is shown to be larger than a sentence. Sentences that are independent syntactically may be dependent on other sentences for a complete temporal interpretation; complements may be dependent on sentences other than their matrix sentences. Time adverbials and tense may be shared, in the sense that a temporal expression in one sentence may contribute to the interpretation of another sentence. These facts have important consequences: only a grammar with surface structure interpretation rules can account for temporal specification in a unified manner, because more than one sentence may be involved. Context is thus shown to be crucial for the temporal interpretation of sentences.

Part I – The Temporal System of English

1. In this section I discuss how the notions essential to temporal interpretation are conveyed in simple sentences. In particular, I ask what elements of sentences correspond to speech time, reference time, and event time. The answer to this question shows that there is no contradiction between the traditional view that sentences have one time adverbial, and the scheme for temporal specification in which three separate times are distinguished. Both are correct, as I hope to demonstrate. The demonstration will bring out the fact that time specification is an area in which semantic and syntactic structures are quite different. In a sense, what follows constitutes an argument for a grammar with an autonomous syntax, although I will not be directly concerned with how a grammar can best deal with this material until the second part of the paper.[1]

According to Reichenbach,[2] temporal specification involves three notions of time: Speech Time, Reference Time, and Event Time. Speech Time (ST) is the time at which a given sentence is uttered, that is, the moment of utterance. Reference Time (RT) is the time indicated by a sentence, which need not be the same as ST. Event Time (ET) refers to the moment at which the relevant event or state occurs, which need not be the same as RT. For instance, in (1) ET and RT are the same, and are prior to ST:

(1)   Marilyn won the prize last week.

In (2) all three times are different:

(2)   Marilyn had already won the prize last week.

For the second example ST is the moment of utterance, RT is last week, and ET is an unspecified time prior to last week.

To understand the temporal specification of a sentence, one must know the values of the three times, and their relations to each other. The relations of sequence and simultaneity are basic to the system. Two times may be simultaneous, or one may precede the other: RT may but need not be simultaneous with ST, and ET may but need not be simultaneous with RT.

Speech Time is the keystone of the system, in that Reference Time is oriented to it. When RT is simultaneous with ST, RT indicates Present time; when RT precedes ST, it indicates Past time; when RT follows ST, it indicates Future time.

Only Reference Time is actually specified in independent sentences. Event Time is not specified if it differs from Reference Time, but the relation between the two is given. Since RT is oriented to ST, it need not be specified. In support of these statements, consider how the following English sentences are interpreted temporally:

(3)   Allan swam at midnight
(4)   Tim mowed the lawn yesterday
(5)   Joe wrecked the car before evening
(6)   We fixed the hammock before Todd left
(7)   The boys had already eaten dinner
(8)   Mary left the party before the guest of honor arrived after she had spilled coffee on her dress.

All of these sentences are interpreted as referring to the Past; the way the three reference periods are established will be discussed below.

Close consideration of the examples shows that they specify RT, and the relation between ET and RT, but they do not specify an ET that differs from RT. To see this, consider the information one may draw from these sentences. In (5), for instance, one does not know when Joe actually wrecked the car: only that he did so before a specified time, evening (RT). In (8), although the time adverbial is complex, it indicates only one time as RT. Complex adverbials do not specify both ET and RT, but rather give a detailed specification of RT.

These sentences are typical of non-habituals in English. Although only RT is specified, they are not felt to be incomplete. It is sufficient for interpretation to know RT and the relation between ET and RT; the relation between ST and RT is evident if one knows RT.

1.1. *Relational Values of Temporal Expressions*

The absolute values of temporal expressions change, and their functions differ, according to the syntactic configuration in which they occur. However, the relational values of the temporal expressions are consistent. This consistency is an essential part of the temporal system of English, it will be shown, and underlies the analysis presented here.

The relational values of temporal expressions mirror the three relations possible among times, simultaneity and sequence. Temporal expressions fall into three classes according to whether they indicate simultaneity, anteriority, or posteriority. Consider first the relational values of adverbials. Certain adverbials have explicit relations with the moment of speech: thus *right now* is simultaneous with ST, *yesterday* precedes ST, *tomorrow* follows ST. These will be referred to as explicitly Past, Present or Future, following current usage. Other adverbials are not anchored to a particular point and will be referred to as Unanchored: for instance, *on Tuesday* or *in March* may indicate a time that precedes or follows ST. These are the classes of temporal adverbials (frequency adverbs are not relevant to this classification; they are taken up in Section 3 below).

Classification of Adverbials

ANTERIOR ($\leftarrow$)
    yesterday;—*ago*; *last*—   Explicitly Past
    on Tuesday; *in April*; etc.   Unanchored
SIMULTANEOUS ($=$)
    now; *right now*; *at this moment*; $\emptyset$ Explicitly Present

POSTERIOR($\rightarrow$)

    tomorrow; *next*—; *in*—   Explicitly Future
    on Tuesday; *in April*; etc.   Unanchored

Explicitly anchored adverbials are oriented to the present moment. For instance, the times of (9)–(11) are computed in relation to ST, although all indicate a Past RT.

    (9)   Arthur borrowed the canoe yesterday
    (10)   They sold the house 3 weeks ago
    (11)   Gwen passed the examination last month.

For some speakers, anchored adverbials are always oriented to ST; for others, they can also occur in dependent sentences with a different orientation. See Section 2 for further discussion of anchored adverbials.

The other temporal expressions of English are prepositions, tenses, and auxiliary *have*. The traditional meaning for auxiliary *have* is anteriority; I have argued elsewhere (Smith, 1976b) that this is its relational value in English, and that it indicates that ET is anterior to RT. Prepositions have the relational values that correspond to their lexical meanings: e.g. *before* indicates anteriority, *at* indicates simultaneity, *after* indicates posteriority. The relational values of temporal expressions in English are given below.

ANTERIORITY ($\leftarrow$)	SIMULTANEITY ($=$)	POSTERIORITY ($\rightarrow$)
past tense	present tense	
Past adverbial	Present adverbial	Future adverbial
Unanchored adverbial	zero ($\varnothing$) adverbial	Unanchored adverbial
before, etc.	*at, on, $\varnothing$*, etc.	*after*, etc.
auxiliary *have*		
Past RT	Present RT	Future RT

In the analysis to be developed below, the relational meanings of temporal expressions are referred to frequently.

1.2. *Past, Present, Future Reference Time*

The question of how RT is established can now be taken up. I will show that it is the COMBINATION of tense and adverbial that establishes RT. Some combinations establish RT and others do not; however, all combinations occur somewhere in English. Sentences that do not have RT cannot be fully interpreted without additional information.

The possible combinations of tense and adverbial are these:

tense	adverbial	tense	adverbial
present	Present	past	Present
present	Past	past	Past
present	Future	past	Future
present	Unanchored	past	Unanchored

The combinations of tense and adverbial that establish RT have compatible relational values, whereas non-RT combinations have contradictory relational values. For instance, past tense and Future adverbials have the values ← and → and do not establish RT in combination with each other.

I now give the RT combinations, with examples:

tense	adverb	RT	
present	Present	Present	(12) I am playing now[3]
present	Future	Future	(13) Chris is working tomorrow
present	Unanchored	Future	(14) Emily leaves on Thursday
past	Past	Past	(15) Scott won the race a week ago
past	Unanchored	Past	(16) I won the race on Tuesday

The following combinations do not establish RT:

past	Future	(17)	Ross was leaving in 3 days
past	Present	(18)	Emily was annoyed now
past have	Unanchored	(19)	Ross had left on Tuesday[4]
present	Past	(20)	Last week, Todd accidentally stumbles on a snail

Sentences (17)–(19) cannot be interpreted without additional information, which shows that they do not establish RT. (17) tells us that Ross was going to leave 3 days from some time, but no more; (19) gives no anchor for the Tuesday on which Ross left; (18) tells us that Emily was annoyed at some time, but not more. What is needed in each case is a point of reference: that is, an RT. In the following section I will show that sentences like (17)–(19) occur as complements dependent on sentences other than the matrix, and as independent sentences that depend semantically on other sentences.

The Historical Present is exemplified by (20). Although the Historical Present is not semantically dependent on other sentences as are (17)–(19),

it appears to be dependent on context in ways not yet understood. I will not deal with the Historical Present in this paper.

Sentences with tense alone are incomplete semantically. The reference period is not unambiguous, and the relation between ET and RT is not specified. Since they specify so little, sentences with tense alone may be interpreted in more than one way, depending on the context in which they occur. For instance, consider the interpretation of (21):

> (21)   Albert is playing tennis
>   a   Something unusual is scheduled for tomorrow: Albert is playing tennis
>   b   We can't discuss the problem now: Albert is playing tennis.

Depending on the context, (21) is taken as having either Present or Future RT. The same kind of vagueness and flexibility can be seen with (22):

> (22)   Albert was playing tennis
>   a   I saw him yesterday afternoon: Albert was playing tennis
>   b   The plans for the following day were made: Albert was playing tennis.

In (22a), (22) establishes a Past RT, whereas in (22b) the same sentence does not establish RT and represents what has been called a future-in-past. Detailed interpretations of sentences of this type will be given in Section 2; what I wish to establish here is that sentences with tense alone are incomplete semantically in that they do not establish RT.

Time adverbials may be simple or complex. Complex time adverbials may have prepositional phrases, embedded sentences, or both; in principle, they may have infinitely many of each. [For discussion of adverbials, see Crystal (1966) or Leech (1969).] Complex time adverbials are single units in temporal interpretation, even though they need not occur as a unit in surface structure. Compare, for instance, the interpretation of (23)–(25):

> (23)   Bill arrived at 10 o'clock
> (24)   Bill arrived at 10 o'clock in the morning last Wednesday
> (25)   Last Wednesday, Bill arrived at 10 o'clock in the morning.

There is only one RT for all of these sentences, that specified by the adverbial in combination with past tense. The complex adverbial of (25) specifies RT more precisely than does that of (24) or (23), but only RT.

Adverbials have a double function in the sentences discussed above. The adverb contributes to the specification of RT, as indicated; the introductory preposition also plays an important role. The preposition gives the

relation between ET and RT, according to its relational value. If the relational value of a preposition is ←, for instance, an adverbial introduced by that preposition indicates that ET precedes RT as well as contributing to the specification of RT. For instance:

(26)   Phyllis decorated the cake before midday.

In this sentence, RT is Past, midday; ET precedes RT as indicated by *before*.

Note that although an adverb and its introductory preposition form a constituent syntactically, they have different functions semantically. The adverb establishes RT in conjunction with tense, the preposition gives the relation between ET and RT. If an adverb lacks an introductory preposition, the relation between ET and RT is taken to be simultaneous.

The reader has probably noticed that *will* is not treated as a tense in this analysis. There are several strong arguments against such a treatment. First, note that *will* can occur with Present and Past, as well as Future, sentences:

(27)   The store will have your book by now
(28)   The documents will have arrived last week.

If *will* were to be treated as a future, it would be necessary to set up at least one other *will* to account for sentences such as (27) and (28); but this would be undesirable, since all have the same predictive meaning. Moreover, *will* is not the only predictive form that appears in Future and other RTs; there is no reason to give it a status different from *may*, for instance. The syntactic complexities of *will*-deletion, a transformational rule which would be required if *will* were a future tense, also make the analysis of *will* as tense dubious. (For discussion of this question, see Braroe (1974), Jenkins (1972), Lakoff (1969), Smith (1975a, 1976b).)

Will and other modals occur with present and past tense. With present tense, modals have Future or Present RT, depending on the adverb with which they occur. They are in this respect like other verbs:

(29)   Allan will be in Colorado now
(30)   Mary will be in the Valley tomorrow.

However, the distribution of modals with past tense is more complicated: modals do not appear with past tense in independent sentences. (31), for instance, is grammatical only if taken as semantically incomplete and dependent on another sentence.

(31)   John would work tomorrow.

(I ignore here the contrary-to-fact uses of these forms.) The fact that (31) is incomplete semantically is predicted by the analysis here: according to the analysis, the combination of tense and adverbial of a sentence establish RT, and combinations that do not establish it are incomplete. In (31) the adverbial cannot specify RT; the sentence can be interpreted only if RT is established in another sentence. In other words, the sentence is incomplete not because of the modal but because of the combination of tense and adverbial.

So far, I have established that reference times are indicated by combinations of tense and adverbial. In such combinations, the adverbial contributes to the specification of RT and gives the relation between ET and RT.

1.3. *Event Time*

I turn now to the specification of Event Time. So far, no examples have specified ET unless it is simultaneous with RT.

If sentences with one time adverbial specify RT, sentences with two adverbials might be expected to specify both RT and ET. Consider some examples; the adverbials are given in two positions to facilitate the interpretation.

(32)   Bill wrecked the car last night 3 weeks ago
(33)   3 weeks ago, Bill wrecked the car last night
(34)   Tom broke his leg on Wednesday as soon as he was released from the hospital
(35)   On Wednesday, Bill broke his leg as soon as he was released from the hospital
(36)   John arrived yesterday on Monday
(37)   On Monday, John arrived yesterday
(38)   Mary takes the train in a month tomorrow
(39)   Tomorrow, Mary takes the train in a month.

Most native speakers that I have consulted find these sentences ungrammatical and almost unintelligible;[5] asterisks are omitted so as not to prejudice the reader. The examples in which one adverb is fronted are somewhat easier to interpret than the others; the fronted adverb is taken to specify RT, so that a sentence like (39) for instance may be interpreted, roughly, to mean "It will be the case tomorrow that Mary takes the train in a month." (Sentences like (33) and (39) must be distinguished from sentences in which part of a time adverbial is fronted, as in (40):

(40)   On Tuesday Bill played squash at 2 pm.

Complex adverbials of this type constitute one adverbial in the present analysis.) The ungrammaticality of the examples above shows that ET cannot be specified by simple adjunction of a time adverbial to a sentence specifying RT. The examples also show that English sentences can have only one time adverbial.

A more fruitful approach will be to look for sentences that indicate an ET different from RT. There are such sentences. For instance:

(41)   They told me yesterday that the play had closed 3 weeks ago
(42)   I heard last night that the show was opening in a few days.

The complement sentences of both these examples indicate an ET different from RT. Note that the adverbials in the complements specify ET, and the relation between ET and RT is given by the relational value of the adverbial.

The interesting point about these examples is that RT for the complements is partly established in the matrix sentence. The complements have as RT a time of the matrix, and can be said to SHARE that time. I have shown above that adverbials contribute to the specification of RT; in these sentences RT has been specified so that the complement adverbial is free, as it were, to specify ET. In other words, ET can be specified only if – for a given sentence – RT is also specified.

There are syntactically independent sentences that correspond in their temporal interpretation to the complements of (41) and (42). For instance:

(43)   John had read the article three weeks ago[6]
(44)   Harry was arriving tomorrow.

Both of these sentences are somewhat odd in isolation: they are felt to be incomplete in some way. Within Reichenbach's scheme for temporal specification, it is clear what is odd about these sentences; they lack a reference time. The examples do not have combinations of tense and adverbial that establish RT. A nearby sentence can give an RT for sentences like this, and in fact such sentences cannot be fully interpreted except in a domain larger than a sentence. The semantic dependence of sentences like this have far-reaching implications for the question of how a grammar can best account for time specification. It can be shown that the information completing these incomplete sentences is just that which can appear in matrix sentences for the corresponding complements. Therefore the same principles are involved in relating syntactically and semantically dependent sentences to other sentences that establish RT.

There are some sentences with two time adverbials that seem to be counter-examples to the analysis developed here. These sentences are not

grammatical for all speakers; they are a subset of the type of sentence exemplified in (32)–(39).

(45)   Last night, Mary had disappeared 3 months ago
(46)   Next June, Todd will be graduating in a month.

The interpretation of these examples is that the first adverbial establishes RT and the second gives ET. The first adverbial is interpreted with the tense, and the second separately, on the pattern of complements with shared RT discussed above. That (45) and (46) follow the pattern of shared RT sentences suggests that they are in fact reductions of sentences that share RT. This is the analysis that will be suggested here. I suggest that sentences like (45) and (46) have a 2-sentence source, the first containing the matrix RT and a proform for the second sentence. For instance, a plausible source for (45) would be something like (47) or (48):

(47)   Bill told me last night: Mary had disappeared 3 months ago
(48)   It was the case last night: Mary had disappeared 3 months ago.

(48) is preferable to (47) as a source since it does not involve irrecoverable deletion. A sequence such as (48) is artificial in isolation, but can be imagined as part of a discourse. A more natural sequence is (49):

(49)   Bill finally told me the terrible thing that has been bothering
        him. Last night, Mary had disappeared 3 weeks ago.

A detailed account of such sequences must be undertaken before a precise source for sentences that are reductions of 2 sentences can be suggested. However, I would like now to give some arguments in favor of the general approach.

The first adverbial in sentences like (45) is rigid in position, unlike normal time adverbials. It can occur only to the left of the sentence, preceding and set off by comma intonation.

A precedent for analysing (45) as a reduction of two sentences may be found in Emonds' analysis of parentheticals, discussed in Emonds (1974). Emonds suggests that sequences like (50) underlie sentences with parentheticals such as (51):

(50)   Mary is a secret agent; you know it
(51)   Mary, you know, is a secret agent.

A transformation inserts the non-anaphoric material of the second sentence into the first. The source suggested here for sentences with two time adverbials is similar to the sequence in (51): there is one full sentence, and one sentence consisting of a predicate of existence, a pro-form, and

some new material. The transformation that reduces the two sentences to one inserts the new material of one sentence into the other and sets it off with comma intonation. Sentences with two time adverbials differ, of course, from the parentheticals that concern Emonds. In Emonds' examples the inserted material is subject and verb (*you know*), whereas subject and verb introduce the new material in the sentences discussed here. The fact that such different types of material may be inserted into other sentences is suggestive: perhaps reduction of two sentences to one is a more general process in English than has been heretofore appreciated.

A final piece of evidence for the 2-sentence analysis comes from examination of contexts in which sentences like (45) and (46) occur. Whenever I have found such sentences in actual discourse, or tried to construct a plausible context for them, there have been other sentences in the neighborhood that shared the RT and had a verb of saying or a related verb. Such sentences are like those of the suggested source sequence.

To summarize, sentences that specify ET are not independent sentences. They are dependent semantically on another sentence for the specification of RT, and are similar in this respect to complement sentences. Further discussion appears in Section 2, which is devoted to the analysis of complement sentences.

1.4. *Event Time and Auxiliary* have

There is one independent structure that I know of in which ET can be specified, or at least indicated: Present sentences with *have*.[7] *Have* is a relational element semantically, indicating that ET precedes RT. Its semantic function is similar to that of relational adverbials, but it differs syntactically. Consider, for instance, the interpretation of (52):

(52)   They have eaten all the fudge while you were out.

This sentence seems to be a counter-example to the claim that ET can be specified only when RT is specified: its interpretation is that the adverbial indicates ET, yet there is no specification of RT. However RT is, in effect, specified in (52). Consider the role of *have* in the sentence: *have* indicates anteriority of ET from RT, and therefore implies a specific RT. Since the sentence has Present RT, a specific RT is available, namely ST. In other words, the appearance of *have* in a Present sentence directly implies that the RT of the sentence is ST. Therefore (52) is not a counter-example to the claim that RT must be specified if ET is specified.

Present sentences with a modal and *have* also have an implied RT of ST. For instance:

(53)   They will have planted all the roses while you were away
(54)   They will have arrived last week
(55)   Bill may have won the race on Tuesday[8]

(53)–(55) all make predictions about the Past, but from a Present RT. As in (52), the adverbials are past and indicate an ET that precedes ST.

Sentences similar to these but with Past or Future RT cannot be constructed. The combinations of tense and adverb are ungrammatical, or are interpretable only as specifications of RT. Sentences with Past RT that correspond to (53)–(55) would have past tense, *have*, and a Past or Unanchored adverbial. For instance:

(56)   They had eaten all the cookies while we were away
(57)   Bill had already arrived last week
(58)   They would have left on Tuesday.

In (56) and (57) the combination of tense and adverbial is interpreted as indicating Past RT. This interpretation occurs because Past sentences have no specific orientation point, as Present sentences have ST in the Present. Therefore the adverbials are taken to contribute to RT. Sentences like (58) have already been discussed; dependent on other sentences, they do not specify RT.

An attempt to construct Future sentences corresponding to (52) runs into difficulty. What makes (52) unusual is that it specifies ET and makes the specification of RT unnecessary. Recall that Future RT is indicated by present tense and Future or Unanchored adverbial. Sentences may have only one time adverbial, and Future sentences have no specific orientation in the Future as Present sentences have ST in the Present. This means that there is no way to specify a separate ET. In fact the combination of present tense, *have* and Future or Unanchored adverbials is ungrammatical and must be blocked, as the following sentences show.

(59)   *They have eaten all the cookies tomorrow
(60)   *They have arrived on Tuesday.

The reason for the ungrammaticality of these sentences is that *have* and the adverbials are not compatible elements. Both indicate relations between times: *have* indicates anteriority, while Future adverbials indicate posteriority (to ST). The forms are mutually exclusive and cannot occur together.

The possibility that remains is a Future sentence with a modal, *have*, and an adverbial, for instance:

(61)   They will have eaten all the cookies tomorrow

(62)   They will have eaten all the cookies on Tuesday.

In this case the sentences are grammatical but they specify RT rather than ET. These are the only adverbs that could occur in such sentences: with Past or Present adverbials the sentences would not have Future RT. As in the Past sentences, there is no possibility of interpreting the adverbial as ET.

That the Present examples are interpreted as specifying ET is due partly to the fact that the combination of present tense and past adverbial does not function to specify RT in independent sentences. Just as important, however, is the interpretation that RT = ST for Present sentences with *have*. This interpretation, or implication, frees the adverbial to specify ET. The implication is possible because ST has a central position in the system of time specification, and need not be given explicitly.

I have shown that sentences specify ET only when RT is already specified, and that this situation occurs only under particular circumstances. The reason for this is syntactic: English sentences are limited to containing one time adverbial, although the adverbial may be complex and distributed in surface structure. Therefore RT can be specified when a sentence shares RT with another sentence, or when RT is implied in Present sentences with auxiliary *have*. That sentences with one time adverbial are interpreted as specifying RT shows that RT is essential for interpretation.

2. THE TEMPORAL INTERPRETATION OF COMPLEMENT SENTENCES

This section deals with the vexed question of how complements in English sentences are interpreted temporally. I present an analysis that explains the interpretation of well-known cases, and of others not usually mentioned in the literature. The interpretation of complements is somewhat problematic.[9] One fact that makes analysis difficult is that temporal expressions may have different values in complements than they do in independent sentences. Further, the distribution of temporal expressions is apparently different for complements and independent sentences. Presumably for these and other reasons, a unified account of complements has so far not been given.

I suggest that complements have resisted satisfactory analysis because they have not been approached as part of the temporal system of English. It is necessary to consider the entire system in order to deal with part of it.

The account of the temporal system developed above provides a basis from which complements can be analyzed without difficulty.

I give first a general account of the detailed analysis to follow. Before embarking on the discussion, I present a set of examples that indicates the various types of complements to be provided for.

a. (63)   The boy said that he was eager to enter the debate
   (64)   Stuart will announce tomorrow that he will enter the debate in a week
   (65)   The spokesman assured us a week ago that the candidate was leaving 3 days earlier
   (66)   I remembered in the morning that Ed had left the party before midnight

b. (67)   The leaders claim that the tribes were betrayed
   (68)   The President will say next month that Congress resisted him weeks earlier

c. (69)   The narrator says that the heroine was worried now
   (70)   Mrs. Dalloway will murmur that the party had been a success
   (71)   The Egyptians realized that the world is round.

In group *a*, matrix and complement have the same tense, exhibiting what is traditionally known as Sequence of Tense.[10] However, the sentences in this group are not all interpreted in the same way. In (63) for instance the matrix and complement are taken to be simultaneous, but in (64) the complement is not taken to be simultaneous with the matrix. Sequence of Tense is not a strong enough notion to account for this difference.

In group *b*, matrix and complement do not have the same tense. The complement of (67) has the normal temporal interpretation, in which past tense is anterior to ST; but that of (68) has an interpretation in which the past tense is not anterior to ST. The complements of both groups are dependent syntactically and semantically on their matrix sentences.

The sentences of *c*, however, are different: the complements cannot be interpreted temporally without more information. They depend syntactically on their matrix sentences, but semantically they are dependent on other sentences.

A fairly satisfactory account of these examples – which exhaust the possible types of matrix and complement – can be given by extending the account of temporal specification to include relations between sentences. What is needed is an understanding of how sentences may be temporally related to each other, and principles stating how the relationships are realized.

I will argue that complements of English are dependent on other sentences in two different ways. First, a complement may have as a point of reference – that is, RT – a time established in the matrix or another sentence. In this case the sentences will be said to SHARE the time established in the matrix, since it holds for both. The principle of interpretation for such sentences will be called the Sharing Principle.

A complement may also be anchored, or ORIENTED, to a time in the matrix rather than to ST. Recall that RT in independent sentences is oriented to ST: in other words, ST provides the point of orientation to which a reference time is simultaneous or sequential. In a dependent sentence RT has its usual relational value, but is related to a time established in the matrix rather than to ST. The principle of interpretation for such sentences will be called the Orientation Principle.

The principles of Sharing and Orientation account for the interpretation of the various examples above. In the sentences of a, matrix and complement have the same tense and are explained by the Sharing Principle: a time established in S_1 acts as RT for S_2. In the sentences of b, the Orientation Principle applies: the RT of S_2 is oriented to a time established in S_1. The sentences of c are interpreted as sharing a time with a sentence other than the matrix; the other sentence establishes RT for the complement. For these sentences, the Sharing Principle must have a domain larger than a sentence.

2.1.   I now discuss sentences in which matrix and complement have the same tense; such sentences are interpreted by the Sharing Principle, and are exemplified in a of Section 2.

Consider the interpretation of sentence (72):

(72)   They told us yesterday that Tom had arrived 3 days earlier.

The matrix sentence establishes an RT in the Past, namely *yesterday*; the complement is dependent on the matrix, in a way to be precisely determined. The complement has a combination of tense and adverbial that does not establish RT, according to the principles of Section 1. Yet (72) is fully interpretable: informally, we can say that S_2 indicates an arrival 3 days anterior to yesterday. Therefore, S_1 establishes RT for S_2. The relationship between the two sentences is particularly evident in this case, because S_2 lacks RT. Since S_2 is interpretable it must be getting RT from some temporal expression outside S_2, and S_1 is the only possibility.

There are three important points to notice here. First, a time established in S_1 is essential to the interpretation of both sentences. (In (72) only one time is established in S_1, because ET = RT; see 3.2 for a discussion of what

time in S_1 acts as RT for S_2.) S_1 and S_2 can be said to share the time in question, in that it holds formally and semantically for both: the sentences have the same tense, and the adverbial of S_1 has both sentences in its domain. Recall that RT is established by the combination of tense and adverbial.

Second, the complement specifies a time other than RT – namely, ET. The interpretation of S_2 involves two specified times, RT and ET. To see this, consider the roles of the adverbials in matrix and complement: the adverbial of S_1 contributes to RT, whereas the adverbial of S_2 specifies ET. A rough schematic interpretation of (72) brings out the difference:

(73) S_1: RT: Past, yesterday   ET = RT
          S_2: RT = RT_1ET ← RT   ET: 3 days earlier.

The arrow in the interpretation above indicates anteriority; similarly, → will be used in such interpretations to indicate posteriority, and = to indicate simultaneity. The interpretation shows that complements such as that of (72) differ from independent sentences in specifying ET. Independent sentences can indicate ET but not specify it, if ET differs from RT. For instance, take the interpretation of (74):

(74)   Harry ate before noon.

The time specified by this sentence is noon in the Past, which serves as RT; we know that ET precedes RT because of the introductory preposition *before*, but we do not know the actual time of ET.

A sentence must establish RT, and English allows only one time adverbial per sentence, as noted in Section 1. Since an adverbial is necessary to establish RT, it follows that a single independent sentence cannot specify ET. However, a complement differs from an independent sentence in having, as it were, two adverbials, because the matrix adverbial is available to the complement. Since the matrix adverbial contributes to the specification of RT for the complement, the complement adverbial is free to specify ET.

The third point of interest, in the interpretation of (72), is how the adverbial in S_2 indicates the relation between ET and RT. In the complement of (72) ET is taken as anterior to RT. Recall that the adverbial of the complement is explicitly Past, and that its relational value is anteriority. It is the relational value of the adverbial in S_2 that gives the relation between ET and RT; the adverbial itself specifies ET. For instance, in the examples below the relational values of the adverbials in S_2 differ, and the relations between ET and RT of S_2 differ accordingly:

(75)   I realized at midnight that Sam had left the party earlier

$$ET \leftarrow RT$$

(76)   The nurse explained that the doctor was busy now $ET = RT$

(77)   The office announced last week that the chairman
         was resigning in two days. $ET \rightarrow RT$

Unanchored adverbials have the values of both anteriority and posteriority: they are ambiguous, out of context, between the values of $\leftarrow$ and $\rightarrow$. Therefore (78) has two readings, as the disambiguating contexts show.

(78)   The nurse explained that the doctor was working on Tuesday
    a   ... so he couldn't have committed the crime $ET \leftarrow RT$
    b   ... so he couldn't come to the charity bazaar. $ET \rightarrow RT$

If a sentence has in the complement auxiliary *have* and an Unanchored adverbial, it specifies unambiguously that ET is anterior to RT, since *have* indicates anteriority:

(79)   The nurse explained that the doctor had been working on
         Tuesday.

2.2.1.   I turn now to two essential details of the interpretation. I first look more closely at the time in S_1 which S_2 shares, and then consider the interpretation of embedded anchored adverbials.

The Sharing Principle says that a time established in S_1 acts as RT for S_2. In the relevant examples above, it is RT of the matrix that acts as RT for the complement: both sentences have the same RT. But in those examples, ET is simultaneous to RT, so that only one time is indicated in the matrix. Sentences in which the matrix ET is not simultaneous to RT exhibit a rather different dependence, for instance:

(80)   They announced before noon that the fugitive had been caught
         3 hours earlier

(81)   I told the hotel clerk several hours after midnight that I was
         leaving in 2 hours.

In these examples, the complement depends on ET of the matrix rather than RT. To see this, consider how to compute the time specified as ET by the complement. In (80), when was the fugutive caught? If $RT_2 = RT_1$, the fugitive was caught 3 hours before noon; but if $RT_2 = ET_1$, he was caught 3 hours before a time before noon. The latter corresponds unambiguously to the interpretation of (80). Again, in (81), if $RT_1 = RT_2$ then I planned to

leave two hours after midnight; but the sentence can only mean that I was to leave 2 hours later than some time several hours after midnight.

All of the examples can be accounted for with the generalization that ET_1 acts as reference time for S_2; included of course are sentences where $ET = RT$ in S_1. This same dependency occurs in more complicated embeddings. Generally, then, if an embedded sentence has the same tense as the sentence above it, ET of the higher sentence acts as RT for the lower. This relation holds even if the higher sentence does not have a combination of tense and adverbial that independently establishes RT:

> (82)   Sam announced that Bill had told him 3 days earlier that Charlie was arriving in a week
>
> (83)   Mary says now that Sue will announce next week that Amy is threatening to disclose in 5 days that Janes leaves in March.

2.2.2.   There is a complicating factor in the interpretation of many sentences that share a time between matrix and complement. The adverbial of S_2 specifies ET_2, and the relational value of the adverbial gives the relation between ET and RT. Complications arise if the adverbial in S_2 is explicitly Past or explicitly Future, because these adverbials are usually oriented to ST. If they appear in a complement that has an RT different from ST, they may be interpreted with respect to ST or to RT of the complement. This means that sentences with embedded ST-anchored adverbials are ambiguous as to the value of ET_2. For instance:

> (84)   Sally told me on Tuesday that Bill had arrived 3 weeks ago
>
> (85)   I explained on Tuesday that Bill had left last week
>
> (86)   The radio reported on Tuesday that Bill had disappeared last week.

In (84), Bill may have arrived 3 weeks before ST, or 3 weeks before Tuesday; in (85), he left either a week before ST or a week before Tuesday; and so on. The same ambiguities hold for sentences with Future RT and explicitly Future adverbials:

> (87)   Bill will announce on Tuesday that he is leaving next week.

There appears to be some difference among anchored adverbials, and among speakers, as to whether the adverbials are flexible in orientation.[11] For some speakers these adverbials are inflexible, and can be anchored only to ST; for them, (84)–(87) are not ambiguous. A number of people find that some adverbials are more tightly anchored than others: *yesterday*, for instance, is for many less flexible than *a week ago*; *tomorrow* is less flexible than *in a week*.

When embedded adverbials such as these are taken as anchored to ST, their interpretation is rather complicated. The adverbial has two functions, one with respect to RT_2 and the other to ST. For instance, consider the interpretation of (87). The adverbial of S_2 has the relational value of posteriority, and gives the information that ET_2 follows RT_2. The adverbial also specifies ET_2, and this specification is calculated from ST. Such a calculation involves a coding by the speaker of the time referred to in the complement. This is why the ST-anchored interpretation is particularly plausible for sentences in which S_1 and S_2 have the same subject, and rather implausible where the embedded sentence is not easily available to the speaker. Compare, for instance:

(88)   I admitted yesterday that I found the letter a week ago
(89)   Fred knew on Tuesday that the gang had stolen the jewels last week.

Adverbials that are oriented to ST can occur in deeply embedded sentences, producing multiple ambiguities, for instance:

(90)   The reporters found out on Tuesday that the investigators had been told 3 days earlier that the count had left last week.

In summary, the Sharing Principle works in the following way. It applies to syntactically dependent sentences that have the same tense, and interprets ET_1 as RT_2. If S_2 has no adverbial, the sentences are taken as simultaneous; if S_2 has an adverbial, it specifies ET_2 which is not simultaneous with RT_2.[12] The relational value of the adverbial gives the relation between ET and RT, and the adverbial specifies ET. Adverbials in S_2 that are usually anchored to ST may be taken as oriented either to ST or to RT_2.

2.3.   I turn now to sentences in which matrix and complement do not have the same tense. There are two possibilities: either S_1 has past tense and S_2 present tense, or S_1 has present tense and S_2 past. The different cases will be handled by the Orientation Principle and by an extended version of the Sharing Principle.

Consider first sentences such as (91) and (92). In both, S_1 has present tense and S_2 past tense, and S_2 has a combination of tense and adverbial that establishes RT.

(91)   The report states that the spy was denounced last month
(92)   The investigator will insist next month that he talked to the suspects 3 weeks earlier.

In (91) the complement has the same temporal interpretation as it would in an independent sentence: RT is anterior to ST. But in (92) the complement does not receive its 'normal' interpretation. The time referred to is prior to S_1 but not necessarily prior to ST, whereas normally Past RT is anterior to ST.

These interpretations are predicted by the Orientation Principle, which says that the RT of the complement is oriented to a time established in S_1 rather than to ST. The relational value of RT to its point of orientation is unchanged; what is different is that the point of orientation is not necessarily ST. For instance, in (91) S_1 has a Present RT and RT = ST; the complement is oriented to Present RT and automatically receives its normal interpretation. In (92) the matrix has a Future RT and RT = ET; the complement has Past RT, and is taken as preceding RT_1. But RT_1 is posterior to ST, so that RT_2 need not be anterior to ST.

In contrast to the Sharing Principle, the Orientation Principle says that S_2 establishes its own RT. One might object that sentences such as those just considered do not differ in general interpretation from the examples of the preceding section – that is, that the complements share a time with the matrix in all cases. The objection can be tested by asking whether, in sentences where S_1 and S_2 have different tenses, S_1 establishes RT for S_2. This is the essential point of the Sharing analysis. Crucial examples will have complements that do not establish RT, and that have a different tense from the matrix. For instance:

(93)   William will insist next week that Mary was returning to London in three days

(94)   Bill will say next week that Mary had left 3 days ago

(95)   Bill says that Mary was leaving in 3 days.

If some form of the Sharing Principle is applicable to these sentences, they should be fully interpretable temporally: S_1 should provide RT for S_2.

But none of the examples can be fully interpreted: more information is needed. In (95) for instance, one knows that Mary was leaving 3 days after some point, but not what point. These examples show conclusively that S_1 does not establish RT for S_2 in the sentences under consideration. No form of the Sharing Principle could account for them, therefore, and the Orientation Principle is shown to be necessary.

The matrix time to which complements such as (92) are oriented is ET. To see this, consider the interpretation of (96), where ET_1 is not simultaneous with RT_1.

(96)   Sam will announce before midnight that Sue left 3 hours earlier.

The complement RT is anterior to its orientation point, so one can ask whether Sam will announce that Sue left at 9 (3 hours earlier than midnight), or that she left earlier than this. The sentence can only be interpreted to mean that the point of reference for *3 hours earlier* is *before midnight*, not *midnight*.

For both the Sharing Principle and the Orientation Principle, then, ET_1 is the time in S_1 that is crucial for the interpretation of S_2. According to the Sharing Principle, ET_1 is RT_2; according to the Orientation Principle, ET_1 is the point of orientation for RT_2.

2.3.1.   There are a number of sentences to which both the Sharing Principle and the Orientation Principle might apply, according to the preceding discussion. These are sentences in which matrix and complement have the same tense, and in which the complement has an RT combination of tense and adverbial. In the examples that supported the Sharing Principle, the complements do not have RT combinations; in the examples supporting the Orientation Principle, the complements establish an independent RT.

I now ask whether the two principles give different interpretations for sentences to which both apply; and if so, which one is correct. Consider, for instance:

(97)   Bill will say tomorrow that the committee rules on the problem in three days

(98)   Sam believes that he is justified now

(99)   Sharon admitted that she had already arrived on Tuesday.

The Sharing Principle can apply to these examples, because S_1 and S_2 have the same tense; the Orientation Principle can apply, because S_2 establishes RT.

In many cases a sentence receives the same interpretation from both principles; this is true of (97)–(99). For instance, both interpretations of (97) are given in (100)

(100)   Interpretations of (97)
         Sharing
         S_1: Future RT, tomorrow   ET = RT
                                       S_2: RT = ET_1 ET → RT
                                       ET: in 3 days (from tmw)
         Orientation
         S_1: Future RT, tomorrow   ET = RT
                                       S_2: RT → ET_1
                                       RT: in 3 days (from tmw)
                                                          ET = RT

According to the Sharing interpretation, matrix and complement have the same RT because $ET = RT$ in S_1; the Future adverbial in S_2 indicates that ET_2 is posterior to RT, and it specifies ET_2. According to the Orientation interpretation, S_2 establishes its own RT, in which ET and RT are simultaneous; RT_2 is posterior to RT_1 because of the relational meaning of Future RT.

However, there are sentences for which the principles give different interpretations. Consider, for instance, (101) and its interpretations (102).

(101)   Bill said yesterday that Tom was sick

(102)   Sharing
       S_1: Past RT, yesterday $ET = RT$ S_2: $RT = ET_1$ $ET = RT$
       Orientation
       S_1: Past RT, yesterday $ET = RT$ S_2: $RT \leftarrow ET_1$ $ET = RT$

(101) can mean only that matrix and complement are simultaneous. The Sharing Principle correctly makes this interpretation, but the Orientation Principle predicts that S_2 be anterior to S_1. Therefore, only the Sharing Principle must be allowed to apply to sentences like (101).

There are two ways to accomplish this. The rules of interpretation might be ordered, with the Sharing Principle applying first. This would ensure that the Orientation Principle would never apply to sentences to which the Sharing Principle was applicable. Another possibility would be to state the Orientation Principle so that it applied only to sentences in which the complement did not establish RT. The complement of (101) has only tense and therefore does not establish RT. The first of these alternatives is preferable because there is another case (see below) which requires that the Sharing Principle precede the Orientation Principle.

2.3.2.   I now turn to sentences such as (103) and (104), in which S_1 has present tense and S_2 past tense, and S_2 does not establish RT. According to the analysis developed above, neither principle of interpretation applies to them.

(103)   The prosecuting attorney claims that the nurse was tired now

(104)   The public will learn next week that Smith had already withdrawn his offer of open negotiations.

Note, however, that neither of these sentences can be fully interpreted. A point of reference is needed for *now* in (103) and for *have* in (104). In the terms of this analysis, both complements require an RT.

What is needed to interpret these examples are other sentences that supply RT for the complements. In fact, sequences of the type required

occur fairly frequently, especially perhaps in rather formal discourse of the narrative type. The following sequences allow an interpretation of (103) and (104):

(105) It was 3 o'clock in the morning when the old lady rang for the nurse on duty. The prosecuting attorney claims that the nurse was tired now, and didn't pay much attention to the old lady.

(106) The conference took place before March, ostensibly to arrive at a peaceful solution. But the public will learn next week that Smith had already withdrawn his offer of open negotiations.

In these sequences the sentences preceding (103) and (104) establish reference times for the complements of the sentences. Thus, *3 o'clock in the morning* is the point of reference for *now* in (105); *before March* is the point of reference for *had already* in (106). These reference points are related to the complements of the following sentences just as the time established in a matrix sentence relates to a complement that has the same tense. The sentences involved have the same tense, and ET of the preceding sentence acts as RT of the complement. In terms of the previous discussion, the complement sentences share a time established in a preceding sentence. Indeed, except for the fact that S_1 and S_2 are not syntactically dependent on each other, the situation is the same as in the case of sentences to which the Sharing Principle applies.

An extension of the Sharing Principle can account for the interpretation of (103) and (104), in contexts that allow for such an interpretation. In the examples discussed in Section 3, syntactically dependent sentences share a time; in the examples discussed here, syntactically independent sentences share a time. If the Sharing Principle were extended so that its domain were larger than a sentence, the different cases could be accounted for in the same way. The extended Sharing Principle would work roughly as follows: from the complement of a sentence, it would look for a sentence with the same tense.

If the matrix has a different tense, another sentence would be sought that had the same tense, and could provide RT. The exact conditions under which a sentence may provide RT for a neighboring sentence is an interesting and important topic that requires investigation in its own right.

It is interesting to note that an extended Sharing Principle is needed elsewhere in the grammar of English. The relevant sentences are syntactically independent, unlike the complements just examined, but semantically dependent in exactly the same way on other sentences. Such sentences have tense + adverb combinations that do not establish RT, as mentioned briefly in Section 1. For instance:

(107)   Ross was leaving in 3 days
(108)   Ross had left on Tuesday
(109)   Ross was annoyed now.

Exactly the same principles that apply to complements without RT predict the interpretation of (107)–(109). In isolation they cannot be fully interpreted; in the neighborhood of a sentence that has the same tense and that establishes RT, they can be interpreted according to the Sharing Principle. I have discussed sentences like this at some length elsewhere. Although they seem odd in isolation, they are natural and far from infrequent in fictional and non-fictional narratives; see the examples in Smith (1976b).

All the cases in which S_1 has present tense and S_2 past tense have now been discussed. If S_2 establishes RT, the complements are accounted for by the Orientation Principle. If S_2 does not establish RT, the extended Sharing Principle applies. It was shown that the extended Sharing Principle is needed independently to account for sentences that are semantically incomplete but syntactically complete.

2.4.   One type of sentence has yet to be considered: that in which the matrix has past tense and the complement has present tense. The following sentences illustrate:

(110)   The Egyptians knew that the earth is round
(111)   Sam told me that Mary is leaving next week
(112)   I heard last night that Whitney is sick.

I will argue that an interpretation of these sentences can be made by using the extended Sharing Principle, and by postulating an abstract performative sentence in which RT = ST. First, however, consider how the Orientation Principle might apply to them (since the matrix and complement have different tenses, the Sharing Principle is not applicable).

According to the Orientation Principle, the relational value of the complement RT gives the relation between RT_1 and RT_2. In these examples S_1 has Past RT and S_2 has Present RT. Since the relational value of Present RT is simultaneity, the Orientation Principle predicts that the complements of (110)–(112) are simultaneous with the matrix sentences. But this is incorrect: the complements of all three examples refer unambiguously to ST and not to the matrix.

The correct interpretation of such sentences is that the speaker is responsible, as it were, for the complement's being true or relevant at ST. More precisely, they indicate that the same event or state referred to holds at the time referred to in the matrix and at ST. For instance, (112) means that Whitney was sick last night, and that he is sick at ST with the same illness. It cannot mean that he is sick again.

Not all matrix verbs allow speaker-oriented complements. It appears to be a valid generalization that factive verbs and verbs of saying do allow them.[13] The following sentences, which do not contain such verbs, are distinctly odd:

(113)   Mary feared that Bill is sick
(114)   The family thought that the money is safe.

Since the Orientation Principle does not make correct predictions for sentences like these, one might seek to revise the relational system to allow for such predictions. The system might be revised so that Present RT would have a value other than that of simultaneity: rather, Present RT might be given the value of a time between Past and Future, anterior to Future RT and posterior to Past RT. If Present RT were given such a value, (110)–(112) would be correctly interpreted by the Orientation Principle. The complements of the sentences, oriented to the matrix RT, would indicate a time posterior to the Past, namely the Present.

But this revision will not work for the full range of relevant cases. It fails for sentences like (115), in which both S_1 and S_2 have present tense:

(115)   Gwendolyn will say tomorrow that the Abbess of Crewes is dangerous.

Sentences like (115) have only the interpretation that matrix and complement are simultaneous. But if the Orientation Principle were revised so that Present RT did not indicate simultaneity, the wrong prediction would be made for (115).

In fact, no one principle can explain all the relevant sentences. In some cases complements with present tense are taken as simultaneous with the matrix, and in other cases such complements are taken as simultaneous with a sentence other than the matrix. What is needed is a way to allow the two different principles of interpretation to apply. If the Sharing Principle were applicable to some of the cases, and ordered before the Orientation Principle, it would be possible to provide for the interpretation of sentences like (112) and (115).

Speaker-oriented complements pose a problem for analysis because there is no sentence to which the complement appears to be related. This problem can be solved by positing an abstract performative sentence, associated with the main sentence, in which $RT = ST$.[14] Such a sentence would be available to the extended Sharing Principle. The Sharing Principle relates sentences with the same tense; in its extended form it relates a complement to a sentence other than the matrix. For sentences with speaker-oriented complements, the performative sentence and the complement – both of which have Present RT and ST – would be related by

the extended Sharing Principle. The extended form of the principle was introduced in the preceding section to account for certain complements, and for independent sentences that are semantically related to other sentences. In the cases discussed here, a complement is dependent on its associated performative (S_0) rather than on the sentence that directly dominates it (S_1).

The interpretation of adverbials in speaker-oriented complements is straightforward, according to the principles developed above. The relational value of the adverbial gives the relation between ET and RT, and the adverbial specifies ET; if there is no adverbial, ET is simultaneous with RT. In (111) for instance the complement adverbial is explicitly Future. This means that ET_2 follows RT_0, or ST, and is future with respect to ST; the complement has just this interpretation.

By positing an abstract performative sentence one can also account for the interpretation of embedded speaker-oriented adverbials such as *yesterday*. In the discussion of such adverbials, it was noted that they may be taken as oriented to ST rather than to RT of the sentence in which they occur. For instance, (116) has such an interpretation for many speakers.

(116)   The butler reported yesterday that the count had vanished a week ago.

If the adverbial is oriented to ST, then ET_2 is a week prior to ST rather than to *yesterday*, which is RT_1. If a performative with RT = ST is associated with each sentence, the speaker-oriented interpretation of (116) can be accounted for in a natural manner.

One more adjustment must be made to account for the interpretation of speaker oriented complements. The principles of interpretation must be ordered so that Sharing precedes Orientation, and applies obligatorily if application is possible. This ordering will prevent the Orientation Principle from applying to such sentences, and yet allow it to apply in other cases. For instance, consider (117) and (118).

(117)   Myrna reported that the bomb will go off next week
(118)   The papers will report next week that the bomb went off on Tuesday.

The extended Sharing Principle will apply to (117), relating the complement to S_0, the performative associated with the sentence. Since (117) is interpreted, the Orientation Principle will not apply to it. (118) does not meet the conditions for the Sharing Principle, since the complement has Past RT and neither S_0 nor S_1 have past tense. Therefore the Orientation

Principle applies, relating RT of the complement to RT_1 rather than to ST.

This ordering of the principles of interpretation is necessary because of an asymmetry in the way complements are interpreted. Present is always related to a sentence with present or Future RT: a complement with present shares RT with a sentence other than the matrix, if the matrix is Past. Past, however, need not be related to a Past RT. It is because of the flexibility of the Past that the Orientation Principle is needed, and because of the formal similarity of the crucial cases that an ordering of the principles is needed.

Summary. I have developed in this section an account of the temporal interpretation of complement sentences in English. Relating, by principles of interpretation, matrix sentences and their complements, and complements to sentences other than the matrix, all the possibilities are provided for. The extended Sharing Principle applies to most of the cases; but the Orientation Principle is necessary for an important small group.

The next step in this research will be to investigate the circumstances, syntactic and perhaps semantic, in which a sentence may contribute to the interpretation of a neighboring sentence. This step is necessary for the formulation in precise terms of the principles presented here.

3. HABITUAL SENTENCES

This section characterizes habitual sentences, and shows how they fit into Reichenbach's scheme for temporal specification.[15] No special extension of the system is needed to account for habituals, although Reichenbach did not discuss them particularly. Habitual sentences are particularly interesting for the study of syntax and semantics, because adverbial forms may function quite differently in habitual and non-habitual sentences.

Habitual sentences indicate that an event or state recurs, with a given frequency, during a given interval. Consider some typical habitual sentences:

(119)   Lee was often in love last summer
(120)   Bill swam 3 times a week in March
(121)   Scott got up early every morning that year.

None of these sentences refers to a particular event or state: rather, they indicate the recurrence of an event or state. Since habituals do not refer to particulars, they do not specify a particular moment or interval. This is the crucial fact about habituals from the point of view of time specification.

Habituals are thus fundamentally different from non-habituals, which pick out a particular moment or interval for ET even though it may be specified only relationally.

An adverbial of frequency signals the habitual sentence. As the examples show, the adverbial may be general or quite specific. Frequency adverbials may indicate the number of times per unit that an event or state recurs; they may also indicate the typical time of recurrence. The unit (day, week, etc.) must have an indefinite determiner. If the determiner is definite the result is ungrammatical as (123) below; if the determiner is deictic the result is grammatical but not habitual. (124), for instance, gives number of repetitions rather than rate of recurrence and does not contain a frequency adverbial.

(122)   They went to the movies 3 times a week
(123)   *They went to the movies 3 times the week
(124)   They went to the movies 3 times that week.

(125) has a complex frequency adverbial which indicates the time of recurrence as well as its rate:

(125)   They went to the movies every afternoon at 3 o'clock last year.

Completely specified habitual sentences indicate the interval during which the recurrence takes places as well as its frequency. However, habitual sentences often have less than complete temporal specification. The interval may be unspecified, as in (126); the frequency may be omitted, as in (127):

(126)   They went to the movies 3 times
(127)   Fido chased cats.[16]

Another possibility is that a sentence that does not have an habitual reading in isolation, receives one in the context of a frequency adverbial. For instance:

(128)   Mary ate an apple
(129)   At lunchtime every day, the same thing happened: Mary ate an apple.

Many sentences can take on an habitual reading in the appropriate context; sentences that specify a number of repetitions, with a deictic (as in (124)) cannot be interpreted as habitual.[17]

Temporal expressions play different roles in habitual and non-habitual sentences. Consider, for instance, the interpretation of the following examples:

(130)   John got up at noon
(131)   Joh got up at noon every day last summer.

In (130), a non-habitual, the adverbial specifies RT, which is simultaneous with ET. However, in the habitual (131) the same adverbial (*at noon*) is part of the frequency adverbial and does not specify RT. Since non-habitual sentences pick out a particular moment or interval, it will be convenient to refer to them as 'specifying'.

Habituals can now be fitted into the scheme for temporal specification that underlies the analysis of this paper. Habituals specify RT, the interval during which the recurring event or state appears. Habituals do not have a particular ET: rather than specifying one or several events, they indicate recurrence. A natural analysis, then, will interpret the frequency adverbial that is characteristic of habituals as ET. It is the indication of recurrence for ET that precludes a specific interpretation, so that this account gives exactly the correct results. The analysis of (131) for instance, would be something like (132):

(132) $_s$[RT: past, last summer   ET = RT   ET: every day at noon].

While specifying sentences specify ET under certain circumstances only, it is normal for habituals to specify ET; as pointed out at the beginning of this section, a frequency adverbial signals that a sentence is habitual.

Since specifying sentences have the same adverbial forms with different functions, one would expect to find structurally ambiguous sentences in which a time adverbial might be part of ET or part of RT. The possibility is even greater since sentences may not be fully specified temporally. Structurally ambiguous sentences can be constructed with adverbials that refer to intervals:

(133)   Janet swam in the mountain lake from June to September.

This sentence might be taken as specifying the interval during which the separate events of swimming recurred, the frequency and time of recurrence being unspecified; on this interpretation the time adverbial specifies RT. It might also be taken as specifying the time (though vaguely), but neither the interval nor the frequency during which the swimming took place. A fuller version of this second interpretation might be (134):

(134)   Janet swam in the mountain lake from June to September every
         year during her childhood.

If a sentence has two time adverbials and a frequency specification and one adverbial has been moved e.g. to the front, the sentence is structurally

ambiguous. The displaced adverbial might be part of the frequency specification, or it might indicate RT. Actually such sentences are rarely ambiguous when the details of the adverbials are considered: adverbials associated with frequency specifications tend not to specify intervals, and only such adverbials can lead to structural ambiguity of this particular type.

The analysis of habitual sentences shows that time adverbials may function as part of the frequency specification, as well as to specify RT or a particular ET. Semantically, the relevant characteristic of habituals is that they do not indicate a particular moment or interval; syntactically, habituals characteristically contain a frequency adverbial. The crucial fact about the interpretation of habituals is that the frequency specification functions as ET.

4. The analysis developed above is based on consistent relational values for the temporal expressions of English. I have emphasized the interaction of adverbials and other elements in temporal specification. It is the combination of adverbial and tense that establishes RT; adverbials specify ET, when syntactic conditions allow; adverbs may contribute to the specification of an habitual. In order to interpret an adverbial, then, the syntactic configuration in which it occurs, and the relational values of the relevant expressions, must be considered together.

An important result of this study is that sentences that are dependent on others for semantic interpretation need not be syntactically dependent. The same rules of interpretation apply, moreover, regardless of syntactic dependency, to all temporal expressions. When semantically dependent sentences are considered as well as complements and independent sentences, it is evident that all combinations of temporal expressions occur in English, so that there is no need for selectional restrictions such as those sketched in e.g. *Aspects*.

Literary forms do not need special treatment in this analysis, it should be noted. There are no rules for shifting into e.g. the style indirecte libre, or the more widely-used reportive style. Rather, these forms are generated as combinations of temporal expressions like any others, and are interpreted by the basic principles set up for the sentences of the language. It has been suggested that some languages have special syntactic forms for literary discourse; Benveniste (1966) has made this suggestion for French, and Hamburger (1968) has developed a similar approach for German. For English, as the discussion above makes clear, no such special approach is needed. One can say that the forms taken as literary tend to be those in which syntactically independent sentences are dependent on other sentences for full semantic interpretation.

Part II – The Treatment of Temporal Expressions in Generative Grammar

Temporal expressions and their interpretations have been discussed in Part I of this paper. Part II is concerned with the question of how temporal specification should be handled in a generative grammar.

There are three possible approaches, I believe, to this issue. Generative rules might be constructed that would relate semantic representations to surface structures, following the general outline suggested by McCawley and others as 'generative semantics.' Alternatively, syntax might be autonomous in a grammar, with semantic rules relating underlying structures to semantic representations. This is the approach of the 'standard theory', of course. A third possibility is that syntax be autonomous, and rules of interpretation relate surface structures to semantic representations. I will consider all three approaches, and will argue that only the third can deal adequately with temporal specification. In Section 3 below I discuss rules of interpretation, and present a set of rules for time specification.

1. UNIFIED GENERATIVE RULES: SEMANTAX

I begin with a brief discussion of a proposal that tense and adverb be treated as a single category in underlying structure. Kiparsky (1968), McCawley (1971), and Gallagher (1970) have all supported this proposal, although without much detail.[18] The proposal hardly represents a full-fledged account of time specification, but it seems worth considering since it is one of the few explicit proposals that have actually been made in this area.

It seems reasonable to interpret the proposal as referring to the reference time of a sentence. An underlying adverbial indicating Past, Present, or Future RT would be the source for a copy that would have the form of surface tense. This would account for the fact that tense does not given enough information to establish RT.

For sentences with Present RT, then, an underlying Present adverbial would be the source for present tense. This might work for Present sentences, but it is unable to account for sentences with either Future or Past RT.

Consider, for instance, sentences with Past RT. The adverbials that occur to establish Past RT are either explicitly Past, or Unanchored:

(1)   They hired Carol last week
(2)   They hired Carol on Tuesday.

There is nothing intrinsically Past about adverbials that are Unanchored – how then could they be sources for past tense? The same difficulty arises for Future sentences, which have either Future or Unanchored adverbials and present tense: there is no way that an Unanchored adverbial could function as the source for present tense in Future RT sentences.

The analysis of tense as a copy of an underlying adverbial is dependent, perhaps, on the analysis of *will* as a Future tense. If English has a Future tense, then the problem noted above does not arise for sentences with Future RT (although it remains for sentences with Past RT). However, there are good arguments against the analysis of *will* as a future tense; see Section 1 of Part I, and the references mentioned there. Since the proposal that tense and adverbial are a single category in underlying structure is feasible for only one RT of English, it must be rejected.

A more abstract semantic representation would be needed for a grammar that related semantics directly to surface structures. One possibility would be an abstract temporal constituent, which would generate the temporal elements in direct relation to their semantic function; a transformational rule could distribute the temporal elements into sentences before the application of cyclic syntactic rules. Such a possibility was suggested in Smith (1975b).

I outline how such a constituent might be organized. The temporal constituent, if keyed to a Reichenbach analysis of time specification, might have two parts, termed Reference and Relation. The Reference constituent would specify RT and its relation to ST. The Relation constituent would specify the relation between ET and RT, and ET where appropriate.

The following generative and transformational rules account roughly for temporal specification in independent sentences (adverb movement is not included). Selectional details are omitted except for the essential adverbial selection. Generative rules:

Temporal constituent $\rightarrow$ Reference + Relation

Reference $\rightarrow \left\{ \begin{array}{l} \text{Precedes ST (Past)} \\ \text{Simultaneous with ST (Present)} \\ \text{Follows ST (Future)} \end{array} \right\}$

Past $\rightarrow$ past tense $\left\{ \begin{array}{l} \text{Past} \\ \text{Unanchored} \end{array} \right.$ adverb $\left. \right\}$

Present $\rightarrow$ present tense + Present adverb

Future $\rightarrow$ present tense + $\left\{ \begin{array}{l} \text{Future} \\ \text{Unanchored} \end{array} \right.$ adverb$\left. \right\}$

Relation $\rightarrow$ Rel + (ET)

Rel → $\begin{cases} \text{Precedes ET } (\leftarrow) \\ \text{Simultaneous with ET}(=) \\ \text{Follows ET } (\rightarrow) \end{cases}$

ET → Habitual

Habitual → Frequency adv + (Rel + Unanchored adv)

Past adv → *last—, —ago*; etc.

Present adv → *this—; now*; etc.

Future adv → *next—; in—*; etc.

Unanchored adv → $\begin{cases} \text{NP} \\ \text{S} \end{cases}$ + (PP)

Precedes ET → *before*, (aux) *have*, etc.

Simultaneous with ET → *at, on, while*, $\varnothing$, etc.

Follows ET → *after, as soon as*, etc.

Frequency → Number + Unit

Transformational rules for distributing temporal elements (pre-cyclic):

$$_\text{s}[\ldots {}_\text{Aux}[x] \ldots]_\text{VP} \ldots] \, _\text{Temp}[\text{tense} + \text{Adverb} + \text{Rel} + (\text{Habitual})]$$
$$\quad 1 \quad 2 \; 3 \; 4 \quad 5 \qquad 6 \qquad 7 \qquad 8 \qquad\quad 9$$

Structural Change: 1 6 + 2 3 4 + 8 ⧣ 7 + 9 5
Condition: 8 is not aux *have*
$$_\text{s}[\ldots {}_\text{Aux}[\text{tense (modal)} \times]y] \, _\text{Temp}[\text{have}]$$
$$\quad 1 \qquad 2 \qquad 3 \qquad 4 \qquad 5$$

Structural Change: 1 2 3 + 5 4

The first, portmanteau, transformation moves temporal elements from the abstract temporal constituent into the sentence. Tense becomes the first member of Aux; the relational element and Adverb are adjoined by Chomsky adjunction to the VP, creating a time adverbial; the habitual is sister-adjoined to the VP. The second transformation places *have* appropriately within Aux.

The rules given above would have to be extended if they were to include dependent sentences. There are three extensions that would be necessary: first, two combinations of tense and adverb occur only in dependent sentences, and are not provided for in the rules above. The additional combinations are the non-RT pairs, past tense and future adverb, and past tense and present adverb.[19] They are exemplified in 3 and 4:

(3)   Kelly left tomorrow
(4)   Kelly was satisfied now.

A second extension would be required by the fact that ET may be specified in dependent sentences if different from RT; no provision for a non-habitual ET is made in the rules above, since it is not specified in in-dependent sentences. Although the same temporal elements indicate ET and RT, the rules would have to be changed for ET to account for the difference in semantic interpretation. The third change involves the inter-pretation of tense in dependent sentences, which differs significantly from the interpretation of tense in independent sentences.

All three extensions of the rules would require conditions that are incompatible with generative rules of this type. It would be necessary to look ahead to a higher sentence in generating the temporal forms of the complement. This might be possible for the tenses of complement sentences with shared RT if, looking ahead to see that a sentence was a complement, a temporal constituent could be generated with an empty RT. A transformational rule could then copy the tense of the higher sentence into the complement RT. This would produce the correct combinations of tense and adverbials for shared RT complements. It would not, however, work for other complements, or provide for the generation of a separate ET.

These problems might be dealt with if drastic formal changes were made in the way semantic representations were generated. (Actually no one has given any careful account of how underlying structures are to be generated in this framework.) Structures involving more than one underlying sentence might begin with the generation of the highest rather than the most deeply embedded sentence (one has no clear idea of what constitutes a sentence here). If such a way of generating could be specified, provisions for temporal elements in dependent complements could be made. Context-sensitive rules might be keyed to the RT of a matrix sentence, for instance, to allow for the interaction between matrix and complement. Even such drastic changes – if they could be worked out – would not save the approach of semantax, however.

There are difficulties of a totally different kind that arise when the full range of sentences with temporal elements is considered. These difficulties could not be handled by allowing embedded sentences access to in-formation in higher sentences, or by any other revision of the rules under discussion. Semantic representations give all the information needed to complete a given sentence, and the rules proposed above generate struc-tures that are complete semantically and syntactically. However, some sentences are not complete semantically, as shown at length in Part I of this paper. They present an insuperable problem for rules that interpret under-lying structures.

If sentences with incomplete time specifications were somehow generated from underlying semantic representations, other rules would be needed in the grammar to account for their interpretation. Such sentences may be semantically completed with material from other sentences; but rules of interpretation with a domain larger than a sentence would have to apply to surface structures. The conclusion seems unavoidable that this approach to time specification cannot be successful.

2. Autonomous syntax and underlying structure interpretation

I turn next to a treatment in which semantics and syntax are separate: rules of semantic interpretation would apply to the underlying structures generated by syntactic phrase structure rules. This approach is preferable to the one explored above.

The semantic interpretation rules would have access to full structures, so that no difficulties arise in accounting for the relationships between matrix and complement sentences. The fact that temporal elements have different functions and values in different configurations would not be problematic, because the full configurations would be available to the rules. Another point in favor of this approach is that the phrase structure rules of an autonomous syntax are simpler than generative rules that relate semantic and surface structures to each other. Compare, for instance, the relevant rules of *Aspects* or a standard text to the generative rules of the preceding section. The generative rules are cumbersome because they relate elements that function differently from a syntactic point of view than from the semantic point of view. For instance: the prepositions that introduce time adverbs are syntactically a unit with the adverb; but semantically they indicate the relation of ET and RT, while the adverb contributes to RT. Auxiliary *have* is a verbal auxiliary in terms of syntax, but semantically it is a relational element.

Autonomous phrase structure syntactic rules would generate sentences with tense, *have*, and a time adverbial. The latter two are optional, of course. Two transformations would be needed to account for surface structure variation: a rule or rules of Adverb Movement, and a Reduction transformation that inserts the time adverbial of one sentence to the left of another.[20]

The question arises as to whether any restrictions should be imposed on the combinations of temporal expressions generated by the grammar. I have pointed out that all combinations of tense and adverbial occur in English. Certain combinations, however, are not independent. The

traditional way to deal with the facts is to take as basic the independent combinations, and produce the dependent forms with additional opera-tions (in generative grammar, with transformations such as Sequence of Tense). Another approach is to generate all the combinations with a basically unrestricted set of phrase structure rules. Certain combinations, of course, must be interpreted as dependent and/or semantically in-complete. This approach is both simpler and more satisfactory than the other: no transformations are needed to produce the so-called shifted forms, and restrictions need not be imposed on the generative rules. I have argued in favor of doing away with Sequence of Tense rules in Smith (1976b); see also Riddle (1976). (A crippling argument against Sequence of Tense rules is that they change meaning, since the dependency of a complement is indicated by tense.)

Certain restrictions on phrase structure rules are required, however, to block combinations of elements that are ungrammatical rather than dependent. Certain combinations with *have* are ungrammatical, for in-stance:

(5)   *Mary has left at noon
(6)   *Jane has arrived tomorrow.

Sentences like (5) are discussed by Hofmann and McCawley, and in Smith (1976b); (5) is intelligible although clearly ungrammatical. (6), on the other hand, is almost impossible to interpret. I will discuss the two cases separately.

There are perfectly good English sentences that have the same temporal elements as (5):

(7)   Mary has often left at noon
(8)   Mary's having left at noon didn't surprise me
(9)   Mary may have left at noon.

In (7), a frequency adverbial makes the sentence habitual; in (8) and (9), the temporal expression of which *have* is a part does not dominate the entire sentence. What must blocked is just the configuration exemplified in (5), in an independent Specifying Present sentence.

The combination of relational elements in sentence (6) – *have* and a Future adverb – must be blocked throughout the grammar. The expres-sions are contradictory semantically, but since they play different syntactic roles a special syntactic restriction is needed to block their simultaneous occurrence. Note that both restrictions involve auxiliary *have*, a form with several idiosyncratic properties.

Difficulties arise for this approach, as for the preceding, with the interpretation of sentences that are semantically incomplete. Such sentences will be generated by the syntax, which allows tense as the only temporal element and all combinations of tense and adverbial. Since the interpretive rules operate on underlying structures, they would not be able to do anything with incomplete sentences except to recognize their incompleteness. Dependent sentences would have to be handled differently, with semantic rules that interpreted sequences of sentences and that applied to surface structures. These rules would duplicate in many ways the rules dealing with underlying structures: dependent sentences relate to other sentences just as complements relate to matrix sentences.

Since rules relating to underlying structures cannot deal with sequences of sentences, they are not adequate to account for temporal specification. It is preferable to adopt the third alternative suggested at the beginning of this discussion: a grammar with an autonomous syntax and semantic interpretation rules that apply to surface structure. One should perhaps not be very surprised that a surface structure approach is called for in this domain. Surface structure considerations have already proved to be important for other aspects of sentences that involve deixis.

3. AUTONOMOUS SYNTAX AND SURFACE INTERPRETATION

This approach has the advantages of autonomous syntax, without the disadvantages of underlying structure semantic rules. I will propose a set of semantic interpretation rules that apply to the surface structure of sentences and of domains larger than a sentence. These rules, and the relevant syntactic rules, are stated in 3.2 below. In 3.1 I give a general account of how the rules are constructed.

The semantic interpretation rules relate surface structures to semantic representations. Surface structures are interpreted via model configurations that represent temporal elements as they occur in sentences. Associated with each configuration is a semantic representation that constitutes its interpretation. To interpret a particular sentence, one matches its surface configuration with the appropriate model, and then consults the associated semantic representation.

The semantic representations are organized according to Reichenbach's scheme: for each sentence, RT and its relation to ST, the relation of ET to RT, and ET (where appropriate), will be given. The actual values of these notions will be given rather crudely, in terms of the adverbials and other forms that occur in sentences; a more sophisticated treatment will no doubt be desirable at a later stage.

3.1. *Principles of Interpretation*

Surface structure configurations will be interpreted according to the principles developed in the first part of this paper. The principles are simple, and can be applied by referring to the information given in surface structure.

Recall what information is necessary for the interpretation of a sentence. One must know the relational values of the tense and adverbial(s); whether the sentence has a frequency adverbial; whether the sentence is syntactically independent or not. With this information, a sentence can be interpreted. I will show, in discussions of the main types of configurations that appear, just how the principles of interpretation are applied.

Independent sentences have tense and a time adverbial.[21] A decision must be made as to whether these constitute an RT combination: if they do, tense and adverbial have the same relational value, or the relational value of tense is simultaneous. The combinations of tense and adverbial are repeated here for convenience:

RT	*Tense*	*Adverbial*
Present	present	Present
Past	past	Past
Past	past	Unanchored
Future	present	Future
Future	present	Unanchored
—	present	Past[22]
—	past	Present
—	past	Future

The principles of interpretation compute the value of RT, and the relation between ET and RT, by considering the relational values of the time expressions in each configuration.

As an example, consider sentence (10) below. The surface (temporal) configuration of (10) is (11). The configuration includes only temporal elements, and indicates their relational value; this information is crucial, as shown above, for interpretation. The configurations also indicate syntactic embedding where relevant.

(10)   Sue boarded the ferry before noon

(11) $_S$[past $_{Temp}$[P Unanch]   ].

(11) is to be read as follows: tense is represented as 'present' or 'past'; temporal adverbials are labelled 'Temp', to distinguish them from

frequency adverbials, labelled 'Freq'. 'p' indicates the preposition that introduces the adverbial; 'Unanch', 'Past', 'Present', and 'Future', indicate the four types of adverbials. The configuration (11) is matched with its associated semantic representation, (12).

(12) $_s$[RT ← ST: Unanch   ET ← RT].

(12) indicates the relational value of RT, and the relation between ET and RT.[23] The actual semantic representation for (10), in which the particular material of the sentence occurs rather than the general symbols ← and Unanch, is (13).

(13) $_s$[RT: Past, noon   ET before RT].

The interpretation of other sentences with RT combinations of tense and adverbial is determined in the same manner. Adverbials specify RT no matter how complex they are, so that the internal structure of adverbials need not be included in the model configurations. The actual position of the adverbial in surface structure is irrelevant for this interpretation (although it may well be important for determining other properties such as those associated with emphasis and presupposition).

Habituals, that is, sentences with frequency adverbials, are interpreted in the same manner also, except that the frequency value functions as ET:

(14)   Steve will play tennis every day next summer
(15) $_s$[present [Freq] $_{Temp}$[Future]]
(16) $_s$[RT → ST: Future   ET = RT   ET: Freq].

If no introductory preposition appears in a temporal adverbial, ET = RT. Habitual sentences such as (17), that lack specification of RT, will not be included in the rules given here.

(17)   Steve played tennis every day.

For the interpretation of sentences with complements, it is essential to determine how the complement is related to the matrix. If the complement shares a time with the matrix RT, its RT is ET_1 and its adverbial specifies ET and the relation between ET and RT; if the complement does not share the matrix RT, it establishes RT as usual but is oriented to another sentence. Complements that share a time with the matrix have the same tense as the matrix sentence.[24] An example of such a sentence is (18); its temporal configuration and associated semantic representation are (19) and (20), respectively.

(18) ˙ They told Rachel last week that Pete left Texas in 3 days

(19) $_s$[past $_{Temp}$[Past] $_s$[past $_{Temp}$[Future]]]^{25}
(20) $_s$[RT ← ST: Past ET
                    = RT $_s$[RT = ET$_1$ ET → RT ET: Future]].

Complements that do not share the RT of the matrix are oriented to the matrix RT rather than to ST: The complement is interpreted as simultaneous or sequential to the matrix RT. This difference in orientation is indicated in the semantic representation of such complements. For example:

(21)   Reuben will announce next week that he conferred with Jack on Tuesday
(22) $_s$[present $_{Temp}$[Future] $_s$[past $_{Temp}$[P Unanch]]]
(23) $_s$[RT → ST: Future ET
                    = RT $_s$[RT ← RT$_1$: Unanch ET = RT]].

Sentences that have two adverbials as those above (resulting from the Reduction transformation) are analyzed in the same manner as those above, except that RT is established with the leftmost adverbial and tense. For example:

(24)   Last week, Bill had won the race 3 days ago
(25) $_s$[$_{Temp}$[Past$_1$]   past have $_{Temp_2}$[Past$_2$]]
(26) $_s$[RT ← ST: Past$_1$ ET ← RT ET: Past$_2$].

Just as the rules assign a relational interpretation to adverbials, auxiliary *have* is assigned the interpretation of anteriority.

Sentences with nonRT combinations of tense and adverbial do not have a complete semantic representation. The model configurations that correspond to such sentences will be associated with semantic representations marked accordingly:

(27)   Mary was amused now
(28) $_s$[past $_{Temp}$[Present]]
(29) $_s$[INCOMPLETE   ].

To interpret a sentence like (27) one looks for an appropriate larger configuration. What is needed is a sentence that establishes RT, and that has the same tense as. The two sentences can be analyzed as sharing RT, and the adverbial of the incomplete, or dependent sentence specifies ET. A configuration that would provide an interpretation for (27), for instance, is (30):

(30)   [$_s$[past $_{Temp}$[Unanch]] $_s$[past $_{Temp}$[Present]]]

and the semantic representation associated with this configuration is (31):

(31) $[_s[RT \leftarrow ST: \text{Unanch } ET = RT]$ $_s[RT = RT_1 \text{ } ET = RT]]$.

Since I have been concerned in this paper only with establishing single complete semantic interpretations, no configuration will be associated with a semantic representation in which more than one RT occurs in an independent sentence.

A set of model configurations, their associated semantic representations, and examples of each is presented in the following section. They correspond to the types of sentences discussed here: sentences with tense and adverbial that establish RT, habitual sentences, complement sentences, sentences with tense and adverbial that do not establish RT.

These rules are far from complete: a number of problems remain to be solved or investigated before a less tentative set of rules can be offered. However, the rules that are given indicate clearly that this approach is both desirable and feasible. I mention briefly some of the problems, ignored in the rules, that would have to be handled in a complete set of interpretive rules.

The semantic representations interpret sentences as complete whenever possible. This means that they do not deal with potential ambiguity. Sentences are potentially ambiguous when they have an interpretation in isolation, but may receive (a) different interpretation(s) in different context(s). (32), for instance, is potentially ambiguous:

(32)   Jonathan played croquet on Tuesday.

On one reading it is complete, indicating a Past RT and ET simultaneous with RT. There are two incomplete readings, dependent on context: in the neighborhood of a frequency adverbial (32) may be taken as habitual; in the neighborhood of a sentence with which it might share RT, it might be taken as a dependent sentence that specified ET (this would involve the → interpretation of the Unanchored adverbial). Only the first of these readings will be accounted for in the rules that follow, although a full set of interpretive rules should deal with potential ambiguity in some way. I plan further research on this topic, which includes not only potentially ambiguous sentences but also the conditions that force one or another reading of such sentences.

The configurations for interpreting incomplete sentences are little more than schematic: they indicate adjacent sentences with the appropriate temporal elements. At this point it is not possible to give a fuller account; what is needed is, again study of the conditions for semantic dependency between sentences. The rules are stated only for single embeddings; however, multiple embeddings are interpreted by the same principles, so

that new situations would not arise if the rules were to be extended to cover sentences in which more than one sentence were embedded.

Several difficulties arise in connection with the recognition of adverbials in surface structure. Since the Adverb Movement transformation may break up complex adverbials, it is necessary to amalgamate them into one unit for interpretation. No mechanism has been provided for doing this. It is also necessary to distinguish between distributed adverbials (the result of Adverb Movement) and sentences with two adverbials; both have similar surface structures. Compare, for instance, (33) and (34):

(33)   On Tuesday, Tom had arrived at noon
(34)   Last week, Tom had arrived 3 days ago.

Both sentences have two temporal prepositional phrases, one initial and one final. Yet their interpretations are entirely different: (33) contains one complex adverbial that contributes to the specification of a Past RT; (34) contains two adverbials, one specifying RT and the other ET. (34) results from the reduction of two sentences, and its adverbials cannot be amalgamated into one. Thus it contrasts with (33), whose adverbials can be amalgamated. Compare for instance:

(35)   Tom had arrived at noon on Tuesday
(36)   *Tom had arrived 3 days ago last week.

Another difficulty involves the interpretation of habitual sentences. Frequency adverbials may contain temporal adverbials (e.g. *every day at noon*). In habitual sentences, then, a temporal adverbial may be part of the frequency adverbial or part of the specification of RT. If an habitual sentence has two temporal adverbials, it may not be clear which one is associated with the frequency adverbial. Actually, the difficulty only arises with temporal adverbials that indicate an interval, as in the examples below:

(37)   Jeff rode the rollercoaster from morning till night from June till August
(38)   From June till August, Jeff rode the rollercoaster from morning till night
(39)   From morning till night, Jeff rode the rollercoaster from June till August.

Such sentences may have to be regarded as structurally ambiguous. They are rarely ambiguous, however, when the individual lexical items are considered. Such considerations may have to be provided for in complete rules for sentences of this type.

Another omission that I wish to mention is the serious consideration of incomplete sentences. Although I have attempted to account for their interpretation above, informally, I am not yet certain of the principles involved. Incomplete habituals are not treated at all, nor are sentences with complements in which the matrix sentence does not establish RT.

To complete this list (although not, I am sure, the list of omissions in the rules), the absence of complex adverbials that have embedded sentences, such as (40), should be noted;

(40)   Mrs Bogen left before Mrs Mackay had arrived.

Interpretation of these will be integrated into the rules at a later stage; their syntactic analysis is given in Smith, 1975a.

3.2. *Interpretive Rules*

In this section I present a list of interpretive rules. Each rule has the form of a pair, the pair consisting of a model surface structure configuration and a semantic interpretation. The pairs are numbered; following the rules is a list of example sentences, numbered to correspond with the rules. The reader will thus be able to find an example for every rule given.

The first group of rules, list A, accounts for simple sentences with tense and one time adverbial, or *have*, or both, or neither. All combinations are included. Rules with a domain larger than a sentence, which allow interpretation of those configurations marked Incomplete, are given at the end of the list.

List B accounts for sentences with complements; list C, for sentences with two time adverbials.

Model configurations are given to the left and semantic representations to the right. All the examples and configurations deal with specifying sentences: frequency adverbials are not included in these rules.[26]

A. *Sentences with one time adverbial*

1. $_S$[pres   ] $_S$[Incomplete]
2. $_S$[pres have   ] $_S$[RT = ST ET ← RT]
3. $_S$[pres $_{Temp}$[P Pres]   ] $_S$[RT = ST: Pres ET P RT]
4. $_S$[pres $_{Temp}$[P Past]   ] $_S$[RT ← ST: Past ET P RT][27]
5. $_S$[pres $_{Temp}$[P Future]   ] $_S$[RT → ST: Future ET P RT]
6. $_S$[pres $_{Temp}$[P Unanch]   ] $_S$[RT → ST: Unanch ET P RT]
7. $_S$[pres have $_{Temp}$[P Pres][28]   ] $_S$[RT = ST ET ← RT   ]
8. $_S$[pres have $_{Temp}$[P Unanch][29]   ] $_S$[RT = ST ET ← RT
                                                              ET: Unanch]

9. $_S$[past   ] $_S$[Incomplete]
10. $_S$[past have   ] $_S$[Incomplete]
11. $_S$[past $_{Temp}$[P Past]   ] $_S$[RT ← ST: Past ET P RT]
12. $_S$[past $_{Temp}$[P Unanch]   ] a. $_S$[RT ← ST:
                                                          Unanch ET P RT]
                                                      b. $_S$[Incomplete]
13. $_S$[past $_{Temp}$[P Future]   ] $_S$[Incomplete]
14. $_S$[past $_{Temp}$[P Pres]   ] $_S$[Incomplete]
15. $_S$[past have $_{Temp}$[P Pres]   ] $_S$[Incomplete]
16. $_S$[past have $_{Temp}$[P Past]   ] a. $_S$[RT ← ST:
                                                          P Past ET ← RT]
                                                      b. $_S$[Incomplete]
17. $_S$[past have $_{Temp}$[P Unanch][30]   ] a. $_S$[RT ← ST: P Unanch
                                                                ET ← RT]
                                                      b. $_S$[Incomplete]

Configurations with complete interpretations of the incomplete sentences above are given in this list. The incomplete sentences appear as S_2 in the configurations. The facts are undoubtedly more complicated and more fluid, allowing more than one order and a certain amount of intervening material. As noted above, these particular configurations are merely schematic since not enough is known about configurations of this type to allow a complete presentation.

18. (includes 1).
$[_{S_1}$ [pres $_{Temp}$[Pres]] $_{S_2}$[pres]]
$$[_{S_1}[RT = ST \; ET = RT]_{S_2} [RT = ET_1 \; ET = RT]]$$
19. (includes 1).
$[_{S_1}[$ pres $_{Temp}[$ P$\begin{Bmatrix} Future \\ Unanch \end{Bmatrix}]$] $_{S_2}[$ pres]]
$$[_{S_1}[RT \rightarrow ST \; ET \; P \; RT]_{S_2}[RT = ET_1 \; ET = RT]]$$
20. (includes 9).
$[_{S_1}[$ past $_{Temp}[$ P$\begin{Bmatrix} Past \\ Unanch \end{Bmatrix}]$] $_{S_2}[$ past]]
$$[_{S_1}[RT \leftarrow ST \; ET \; P \; RT]_{S_2}[RT = ET_1 \; ET = RT]]$$

In the interest of brevity and readability, the first S of configurations such as 18–20 will be represented simply as Past RT, Present RT, Future RT; the relation of ET to RT in the first S will be omitted in the semantic representation since it is not relevant to the interpretation of the incomplete sentence, S_2 in these configurations. The interpretation of these

incomplete, or dependent, sentences is consistently that RT is ET of a preceding sentence; recall that sentences share RT when the dependent sentence has the same tense as its matrix or independent anchoring sentence.

21. (includes 10).
$[_{s_1}[$ Past RT $]_{s_2}[$ past have $]]$ $[_{s_1}[$ RT $\leftarrow$ ST $]_{s_2}[$RT $=$ ET$_1$ ET $\leftarrow$ RT$]]$

22. (includes 12b).
$[_{s_1}[$ Past RT $]_{s_2}[$ past $_{Temp}[$ P Unanch$]]$
$\qquad [_{s_1}[$RT $\leftarrow$ ST $]_{s_2}[$RT $=$ ET$_1$ET $\leftarrow$ RT ET: P Unanch$]]$

23. (includes 13).
$[_{s_1}[$ Past RT$]_{s_2}[$ past $_{Temp}[$ P Fut$]]$
$\qquad [_{s_1}[$RT $\leftarrow$ ST $]_{s_2}[$RT $=$ ET$_1$ ET $\rightarrow$ RT ET: Temp$]]$

24. (includes 14).
$[_{s_1}[$ Past RT$]]_{s_2}[$ past $_{Temp}[$P Pres$]]$ $[_{s_1}[$ RT $\leftarrow$ ST$]_{s_2}[$RT $=$ ET$_1$ ET $=$ RT$]]$

25. (includes 15).
$[_{s_1}[$ Past RT$]_{s_2}[$ past have $_{Temp}[$P Pres$]]$
$\qquad [_{s_1}[$ RT $\leftarrow$ ST$]_{s_2}[$ RT $=$ ET$_1$ ET $\leftarrow$ RT$]]$

26. (includes 16b and 17b).
$[_{s_1}[$ Past RT$]]_{s_2}[$past have $_{Temp}[$P$\begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}]]$
$\qquad [_{s_1}[$ RT $\leftarrow$ ST $]_{s_2}[$RT $=$ ET$_1$ ET $\leftarrow$ RT ET: Temp$]]$

B. *Sentences with Complements*

These rules account for the semantic interpretation of complements, in sentences where the matrix S establishes RT, and there is one embedding. Complement sentences are interpreted as sharing the matrix RT when possible; when the two have different tenses and this interpretation is not possible, the complement is oriented to the matrix or to another sentence; when the two have different tenses and the complement has present tense, however, the orientation interpretation is not possible and the complement shares the tense of another sentence (a performative or a preceding sentence).

Matrix sentences that fail to establish RT are not included. Their interpretation will involve another sentence; the patterns of embedding and

dependency at this level of complexity are the same as those of multiple embedding, which is not different from single embedding in this respect.

As in the preceding rules involving more than one sentence, the matrix S will be represented simply as having Past RT, Present RT, or Future RT. Larger configurations required for interpreting the incomplete sentences are given after the rules for matrix sentences of each time period. To conserve space, temporal adverbials are labelled 'T', except when they are referred to in a semantic representation.

27. s_1[Present RT s_2[pres $_T$[P Pres]]]

s_1[RT = ET s_2 [RT = ET$_1$ ET = RT]]

28. s_1[Present RT s_2[pres have]] s_1[RT = ET s_2[RT = ET$_1$ ET ← RT]]

29. s_1[Present RT s_2[pres have $_T$[P Pres]]]^{31}

s_1[RT = ET s_2[RT = ET$_1$ ET ← RT]]

30. s_1[Present RT s_2[pres $_T$[P Past]]]

s_1[RT = ET s_2[RT = ET$_1$ ET ← RT ET: Temp]]^{32}

31. s_1[Present RT s_2[pres $_T$[P Fut]]]

s_1[RT = ET s_2[RT = ET$_1$ ET → RT ET: Temp]]

32. s_1[Present RT s_1[pres $_T$[P Unanch]]]

s_1[RT = ET s_2[RT = ET$_1$ ET → RT ET: Temp]]

33. s_1[Present RT s_2[past   ]] s_1[RT = ET s_2[RT ← RT$_1$]]

34. s_1[Present RT s_2[past $_T$[P Past]]]

s_1[RT = ET s_2[RT ← RT$_1$: Past ET P RT]]

35. s_1[Present RT s_2[past $_T$[P Pres]]] s_1[RT = ET s_2[Incomplete   ]]

36. s_1[Present RTs_2[past $_T$[P Unanch]]]

s_1[RT = ET s_2[RT ← RT$_1$: Unanch ET P RT]]

37. s_1[Present RT s_2[past $_T$[P Fut]]] s_1[RT = ET s_2[Incomplete]]

38. s_1[Present RT s_2[past have   ]] s_1[RT = ET s_2[Incomplete]]

39. s_1[Present RT s_2[past have $_T$[P Pres]]] s_1[RT = ET s_2[Incomplete]]

40. s_1[Present RT s_2[past have $_T$[P$\begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}$]]]

s_1[RT = ET s_2[Incomplete]]

Configurations with a larger domain than those above, which include the configurations marked Incomplete are given below. They all involve past tense complements of sentences with Present RTs; those that do not have RT combinations are dependent on separate Past sentences that establish RT for them.

41. (includes 35).
[s_1[Past RT] s_2[Pres RT s_3[past $_T$[P Pres]]]

[s_1 ... s_3[RT = ET$_1$ ET = RT]]

42. (includes 37).

$[s_1 [\text{Past RT}] s_2[\text{Pres RT} s_3[\text{past} _T[\text{P Fut}]]]$
$$[s_1 \ldots s_3[RT = ET_1 ET \rightarrow RT ET: \text{Temp}]]$$

43. (includes 38).

$[s_1 [\text{Past RT}] s_2[\text{Pres RT} s_3[\text{past have}]]] \quad [s_1 \ldots s_3[RT = ET_1 ET \leftarrow RT]]$

44. (includes 39).

$[s_1 [\text{Past RT}] s_2[\text{Pres RT} s_3[\text{past have} _T[\text{P Pres}]]]$
$$[s_1 \ldots s_3[RT = ET_1 ET = RT]]$$

45. (includes 40).

$[s_1 [\text{Past RT}] s_2[\text{Pres RT} s_3[\text{past have} _T[\text{P} \begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}]]]$
$$[s_1 \ldots s_3[RT = ET_1 ET \leftarrow RT ET: \text{Temp}]]$$

Past RT Matrix

46. $s_1[\text{Past RT} s_2[\text{pres} (_T[\text{P Pres}])]]$ $\qquad s_1[RT \leftarrow ST s_2[\text{Incomplete}]]$
47. $s_1[\text{Past RT} s_2[\text{pres have}]]$ $\qquad s_1[RT \leftarrow ST s_2[\text{Incomplete}]]$
48. $s_1[\text{Past RT} s_2[\text{pres have} _T[\text{P Pres}]]]$ $\qquad s_1[RT \leftarrow ST s_2[\text{Incomplete}]]$

49. $s_1[\text{Past RT} s_2[\text{pres} _T[\text{P} \begin{Bmatrix} \text{Past} \\ \hline \text{Unanch} \end{Bmatrix}]]$

$$s_1[RT \leftarrow ST s_2[RT \leftarrow RT_1 ET P RT ET: \begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}]]^{34}$$

50. $s_1 [\text{Past RT} s_2[\text{pres} _T[\text{P Fut}]]]$ $\qquad s_1[RT \leftarrow ST s_2[\text{Incomplete}]]$
51. $s_1[\text{Past RT} s_2[\text{past}]]s_1[RT \leftarrow ST \qquad s_2[RT = ET_1 ET = RT]]$
52. $s_1[\text{Past RT} s_2[\text{past} _T[\text{P Past}]]]$
$$s_1[RT \leftarrow ST s_2[RT = ET_1 ET P RT ET: \text{Past}]]$$
53. $s_1[\text{Past RT} s_2[\text{past} _T[\text{P Unanch}]]]$
a. $s_1[RT \leftarrow ST s_2[RT = ET_1 ET \leftarrow RT ET: \text{Temp}]]$
b. $s_1[RT \leftarrow ST s_2[RT = ET_1 ET \rightarrow RT ET: \text{Temp}]]$
54. $s_1[\text{Past RT} s_1[\text{past} _T[\text{P Fut}]]]$
$$s_1[RT \leftarrow ST s_2[RT = ET_1 ET \rightarrow RT ET: \text{Temp}]]$$
55. $s_1[\text{Past RT} s_2[\text{past} _T[\text{P Pres}]]] \quad s_1[RT \leftarrow ST s_2[RT = ET_1 ET = RT]]$
56. $s_1[\text{Past RT} s_2[\text{past have}]] \qquad s_1[RT \leftarrow ST s_2[RT = ET_1 ET \leftarrow RT]]$
57. $s_1[\text{Past RT} s_2[\text{past have} _T[\text{P Pres}]]]s_1[RT$
$$\leftarrow ST s_2[RT = ET_1 ET \leftarrow RT]]$$

58. $s_1[\text{Past RT} s_2[\text{past have} _T[\text{P} \begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}]]]$
$$s_1[RT \leftarrow ST s_2[RT = ET_1 ET \leftarrow RT ET: \text{Temp}]]$$

Configurations with a larger domain than the above, which include the configurations marked Incomplete are given below. They all involve

present tense complements of sentences with Past RTs; those that do not have RT combinations are dependent on separate (or superordinate performative) sentences that establish RT for them. The two possibilities will not be distinguished structurally here because the structure of a performative sentence and its relation to the sentence it dominates is not entirely clear; however, the immediately preceding sentences with Present RTs in these configurations could be performatives.

59. (includes 46).

$[_{S_1}$ [Present RT $]_{S_2}$[Past RT $_{S_3}$[pres($_T$[P Pres)]]]]

$$[_{S_1} \ldots s_3[RT = ET_1 \; ET = RT]]$$

60. (includes 47).

$[_{S_1}$ [Present RT $]_{S_2}$[Past RT $_{S_3}$[pres have]]]]

$$[_{S_1} \ldots s_3[RT = ET_1 \; ET \leftarrow RT]]$$

61. (includes 48).

$[_{S_1}$ [Present RT $]_{S_2}$[Past RT $_{S_3}$[pres have $_T$[P Pres]]]]

$$[_{S_1} \ldots s_3[RT = ET_1 \; ET \leftarrow RT]]$$

62. (includes 50).

$[_{S_1}$[Present RT] $_{S_2}$[Past RT $_{S_3}$[pres $_T$[P Fut]]]]

$$[_{S_1} \ldots s_3[RT = ET_1 \; ET \rightarrow RT \; ET: Temp] \,] \,]$$

Future RT Matrix

63. $_{S_1}$[Future RT] $_{S_2}$[Pres ($_T$[P Pres])]]

$$_{S_1}[RT \rightarrow ST \; _{S_2}[RT = ET_1 \; ET = RT]]$$

64. $_{S_1}$[Future RT] $_{S_2}$[pres have   ]] $_{S_1}$[RT $\rightarrow$ ST $_{S_2}$[RT = ET$_1$ ET $\leftarrow$ RT]]

65. $_{S_1}$[future RT] $_{S_2}$[pres have $_T$[P Pres]]]

$$_{S_1}[RT \rightarrow ST \; _{S_2}[RT = ET_1 \; ET \leftarrow RT]]$$

66. $_{S_1}$[Future RT] $_{S_2}$[pres $_T$[P Past]]]

$$_{S_1}[RT \rightarrow ST \; _{S_2}[RT = ET_1 \; ET \leftarrow RT]]$$

67. $_{S_1}$[Future RT] $_{S_2}$[pres $_T$[P$\left\{ {Fut \atop Unanch} \right\}$]]]

$$_{S_1}[RT \rightarrow ST \; _{S_2}[RT = ET_1 \; ET \rightarrow RT \; ET: Temp]$$

68. $_{S_1}$[Future RT] $_{S_2}$[past   ]] $_{S_1}$[RT $\rightarrow$ ST $_{S_2}$[RT $\leftarrow$ RT$_1$]]

69. $_{S_1}$[Future RT] $_{S_2}$[past $_T$[P$\left\{ {Past \atop Unanch} \right\}$]]

$$_{S_1}[RT \rightarrow ST \; _{S_2}[RT \leftarrow RT_1: \left\{ {Past \atop Unanch} \right\} ET \; P \; RT]]$$

70. $_{S_1}$[Future RT] $_{S_2}$[past $_T$[P Pres]] $_{S_1}$[RT $\rightarrow$ ST $_{S_2}$[Incomplete]]

71. $_{S_1}$[Future RT] $_{S_2}$[past $_T$[P Fut]] $_{S_1}$[RT $\rightarrow$ ST $_{S_2}$[Incomplete]]

72. $_{S_1}$[Future RT] $_{S_2}$[past have   ]] $_{S_1}$[RT $\rightarrow$ ST $_{S_2}$[Incomplete]]

73. s_1[Future RT] s_2[past have $_T$[P Pres]]] s_1[RT → ST s_2[Incomplete]]·

74. s_1[Future RT] s_2[past have $_T$[P$\begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}$]]]

$$s_1[\text{ RT} \rightarrow \text{ST } s_2[\text{ Incomplete }]]$$

Configurations with a larger domain than those above, which include the configurations marked Incomplete are given below. They all involve past tense complements of sentences with Future RT; those that do not have RT combinations are dependent on separate Past sentences that establish RT for them.

75. (includes 70).
$[s_1$ [Past RT]s_2[Future RT s_3[past $_T$[P Pres]]]]

$$[s_1 \ldots s_3[\text{ RT} = \text{ET}_1 \text{ ET} = \text{RT }]]$$

76. (includes 71).
$[s_1$ [Past RT]s_2[Future RT s_3[past $_T$[P Fut]]]]

$$[s_1 \ldots s_3[\text{ RT} = \text{ET}_1 \text{ ET} \rightarrow \text{RT ET: Temp}]]$$

77. (includes 72).
$[s_1$ [Past RT]s_2[Future RT] s_3[past have]]]]

$$[s_1 \ldots s_3[\text{ RT} = \text{ET}_1 \text{ ET} \leftarrow \text{RT }]]$$

78. (includes 73).
$[s_1$ [Past RT]s_2[Future RT s_3[past have $_T$[P Pres]]]]

$$[s_1 \ldots s_3[\text{ RT} = \text{ET}_1 \text{ ET} \leftarrow \text{RT }]]$$

79. (includes 74).

$[s_1$ [Past RT]s_2[Future RT s_3[past have $_T$[P $\begin{matrix} \text{Past} \\ \text{Unanch} \end{matrix}$]]]]

$$[s_1 \ldots s_3[\text{ RT} = \text{ET}_1 \text{ ET} \leftarrow \text{RT ET: Temp}]]$$

This completes the list of semantic interpretation rules for sentences with complements.

C. *Sentences with Two Adverbials*

The sentences interpreted below result from the Reduction Transformation, which inserts a time adverbial from one sentence into another. As noted above, the interpretation of such sentences is similar but not identical to that for complement sentences. RT is established by the first adverbial and tense; the second adverbial gives ET and its relation to RT. The construction is less flexible than the complement construction. See the brief discussion of the Reduction Transformation in the following section; I list here only the combinations that are clearly grammatical, although even such judgments as that are difficult to make in this shadowy area.

80. $_s[_{T_1}[\text{Pres}] \text{pres} _{T_2}[P\begin{Bmatrix} \text{Future} \\ \text{Unanch} \end{Bmatrix}] \;\;] \;\; _s[\text{RT} = \text{ST ET} \rightarrow \text{RT ET: Temp}_2]$

81. $_s[_{T_1}[\text{Pres}] \text{pres} _{T_2}[P\begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}]] \quad _s[\text{RT} = \text{ST ET} \leftarrow \text{RT ET: Temp}_2]$

82. $_s[_{T_1}[\text{P Past}] \text{past} _{T_2}[\text{P Fut }]] \quad _s[\text{RT} \leftarrow \text{ST: Temp}_1 \; \text{ET} \rightarrow \text{RT ET: Temp}_s]$

83. $_s[_{T_1}[\text{P Past}] \text{past (have)} _{T_2}[P\begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}]]$

$_s[\text{RT} \leftarrow \text{ST: Temp}_1 \; \text{ET} \leftarrow \text{RT Temp}_2]$

84. $_s[_{T_1}[\text{P Fut }] \text{pres} _T[\text{P Pres}]] \qquad _s[\text{RT} \rightarrow \text{ST: Temp}_1 \; \text{ET} = \text{RT}]$

85. $_s[_{T_1}[\text{P Fut }] \text{pres} _{T_2}[P\begin{Bmatrix} \text{Fut} \\ \text{Unanch} \end{Bmatrix}]]$

$_s[\text{RT} \rightarrow \text{ST: Temp}_1 \; \text{ET} \rightarrow \text{RT ET: Temp}_2]$

86. $_s[_{T_1} [\text{P Unanch}] \text{pres} _{T_2}[P\begin{Bmatrix} \text{Fut} \\ \text{Unanch} \end{Bmatrix}]]$

$_s[\text{RT} \rightarrow \text{ST: Temp}_1 \; \text{ET} \rightarrow \text{RT ET: Temp}_2]$

87. $_s[_{T_1}[\text{P Unanch}] \text{past} _{T_2}[P\begin{Bmatrix} \text{Fut} \\ \text{Unanch} \end{Bmatrix}]]$

$_s[\text{RT} \leftarrow \text{ST: Temp}_1 \; \text{ET} \rightarrow \text{RT ET: Temp}_2]$

88. $_s[_{T_1}[\text{P Unanch}] \text{past have} _{T_2}[P\begin{Bmatrix} \text{Past} \\ \text{Unanch} \end{Bmatrix}]]$

$_s[\text{RT} \leftarrow \text{ST: Temp}_1 \; \text{ET} \leftarrow \text{RT ET: Temp}_2]$

I now give a list of sentences to go with the rules of semantic interpretation. Only one version of each sentence is given here; that is, the schematic configurations for domains larger than a sentence do not have example sentences.

1. Jerry is repairing the spinnaker
2. Jerry has repaired the spinnaker
3. Jerry is repairing the spinnaker now
4. Hart won the election last year
5. Hart is leaving tomorrow
6. Hart is leaving on Wednesday
7. Hart has repaired the spinnaker now
8. They have eaten all the cookies while you were out
9. Greta Garbo starred in the film "Anna Karenina"
10. Burt Lancaster had starred in the film "The Killers"
11. Judy Garland starred in the film "A Star is Born" years ago
12. Della sent the proofs to the printer on Wednesday
13. Della was leaving tomorrow
14. Della was optimistic now

15. Della has sent the proofs now
16. Della had sent the proofs to the printer a week ago
17. Della had sent the proofs on Wednesday

27. Allan believes that the committee is supporting him now
28. Allan believes that the secretary has resigned
29. Allan believes that the committee has decided now
30. Historical Present (not covered in this paper)
31. Shirley thinks that the party starts in two hours
32. Shirley thinks that the semester begins on Thursday
33. Shirley thinks that the volcano erupted
34. Shirley thinks that it snowed yesterday
35. Shirley thinks that Mark was getting suspicious now
36. Shirley thinks that the semester began on Thursday
37. Shirley thinks that Tom was leaving in 3 days
38. The narrator says that the Fat Lady had left
39. The narrator says that the circus had closed now
40. The narrator says that the elephants had arrived $\left\{ \begin{matrix} \text{on Tuesday} \\ \text{yesterday} \end{matrix} \right\}$

46. The office announced yesterday that Professor Thrum is available now
47. The office announced yesterday that Professor Thrum has arrived
48. The office announced yesterday that Professor Thrum has retired now
49. Historial Present
50. The office announced yesterday that Professor Thrum leaves in 3 months
51. The office announced yesterday that Professor Thrum retired
52. The office announced yesterday that Professor Thrum retired last week
53. The office announced yesterday that Professor Thrum retired in April
54. The office announced yesterday that Professor Thrum was retiring in 3 months
55. The office announced yesterday that Professor Thrum was away now
56. The office announced yesterday that Professor Thrum had retired
57. The office announced yesterday that Professor Thrum had retired now
58. The office announced yesterday that Professor Thrum had retired $\left\{ \begin{matrix} \text{last week} \\ \text{on Wednesday} \end{matrix} \right\}$

63. The candidate will say next week that he is available (now)
64. The candidate will say next week that his opponent has been unreliable

65. The candidate will say next week that he has selected his running-mate now

66. Historical Present

67. The candidate will say next week that he announces his choice $\left\{\dfrac{\text{in 3 days}}{\text{on Thursday}}\right\}$

68. The candidate will say next week that he won the election last month

69. The candidate will say next week that he saw the documents in April

70. The candidate will say next week that he realized the difficulties now

71. The candidate will say next week that he expected to leave in 3 days

72. The candidate will say next week that he had overestimated the demand for hotdogs

73. The candidate will say next week that he had reserved judgment at this time

74. The candidate will say next week that he had seen the documents $\left\{\begin{array}{l}\text{last summer}\\ \text{in July}\end{array}\right\}$

80. Today, Harry leaves $\left\{\begin{array}{l}\text{in 3 weeks}\\ \text{on Tuesday}\end{array}\right\}$

81. Right now, Harry is leaving $\left\{\begin{array}{l}\text{3 weeks ago}\\ \text{on Tuesday}\end{array}\right\}$

82. Last week, Harry was leaving in 3 days

83. Last week, Harry had left $\left\{\begin{array}{l}\text{2 weeks ago}\\ \text{on Tuesday}\end{array}\right\}$

84. Next week, Harry leaves now

85. Next week, Harry leaves $\left\{\begin{array}{l}\text{in a month}\\ \text{on Tuesday}\end{array}\right\}$

86. On Tuesday, Harry leaves $\left\{\begin{array}{l}\text{on Sunday}\\ \text{in 5 days}\end{array}\right\}$

87. On Friday, Harry was leaving $\left\{\begin{array}{l}\text{in 3 days}\\ \text{on Tuesday}\end{array}\right\}$

88. On Monday, Harry had left $\left\{\begin{array}{l}\text{3 days ago}\\ \text{on Saturday}\end{array}\right\}$

3.3. *Syntactic Rules for Temporal Elements*

The syntactic rules relevant to this paper are few. They include phrase structure rules for time adverbials and the auxiliary, with the constraints on

co-occurrence discussed above; the transformation(s) of Adverb Move-
ment; the Reduction transformation; a Tense Copying transformation for
embedded adverbial sentences. Neither the auxiliary PS rule nor the Tense
Copying transformation will be discussed in this paper, but I shall give a
brief account of the others.

The time adverbial rules allow for a temporal adverbial and an habitual,
both of unbounded complexity. As shown in Part I, only one time adverbial
appears in a sentence. Time adverbials consist of prepositional phrases or
embedded sentences, or both; in principle there is no upper bound to the
possibilities, as the examples suggest:

(41)　　Lee arrived on Tuesday
　　　　　on Tuesday at 9 am
　　　　　in the morning at 9 on Tuesday
　　　　　in the morning at 9 on Tuesday in May
　　　　　in the morning at 9 on Tuesday in the first week of May . . .

(42)　　Lee arrived before Dennis left
　　　　　before Dennis left last week
　　　　　before Dennis left after Steve called for help
　　　　　before Dennis left after Steve called for help when he saw
　　　　　　　the burglars steal in as soon as the fire started.

Embedded adverbial sentences do not have independent tense, as noted
above; the Tense Copying Transformation copies the tense of the main
sentences into the adverbial sentence.

Frequency adverbials consist of a frequency and a temporal constituent.
The frequency constituent indicates the rate of recurrence per unit of the
relevant event or state; the unit must have an indefinite determiner:

(43)　　3 times a day
　　　 *3 times the day
　　　　 3 times that day (not habitual).

The temporal constituent of a frequency adverbial indicates the particular
time of recurrence, and may in principle have all the complexity of in-
dependent time adverbials, for instance:

(44)　　John swims every Friday before he goes home after he has
　　　　　played tennis.

The following phrase structure rules will generate the appropriate struc-
tures. Time adverbials are optional, of course, and their separate consti-
tuents need not appear together.

Time adverbial	$\rightarrow$ (Temporal)+(Habitual)
Temporal	$\rightarrow$ PP
PP	$\rightarrow P\begin{Bmatrix} NP \\ S \end{Bmatrix}$ (PP)
Habitual	$\rightarrow$ (Frequency)+(Temporal)
Frequency	$\rightarrow$ Number+Unit
Unit	$\rightarrow$ Indef Det+Noun

The Adverb Movement Transformation moves all or part of a temporal adverbial to another position in the sentence. Time adverbials appear in a number of positions, so that more than one rule may be necessary; other types of adverbials also move, so that the rule should perhaps not be restricted to time adverbials.

Generally, if part of an adverbial is moved and part left behind, it is the rightmost (in standard order the most general semantically) constituent, for example:

(45)   Pauline called at 2 pm on Sunday
(46)   On Sunday Pauline called at 2 pm
(47)   At 2 pm Pauline called on Sunday.

In spite of the oddity of (47), I think that all combinations should be allowed; one can find an appropriate environment – emphasis, or a preceding question – for combinations that are odd in isolation.

The Reduction Transformation applies to two sentences and results in one sentence. Schematically, it looks like this:

S_1: [ProS] V TempAdv
          1   2   3 $\rightarrow$ 4, 1
S_2: NP V X TempAdv
          4

Since this is a syntactic transformation, the temporal adverbials are specified syntactically, allowing all possible combinations of tense and adverbials. Recall that in sentences resulting from this transformation the first adverbial and the tense establish RT, and the second adverbial specifies ET. The analysis is the same as for sentences with complements that share RT with their matrix sentences; not all combinations, then, are interpretable. For instance, sentences in which the tense and first adverbial do not form an RT combination must be blocked; (48) and (49) exemplify:

(48)   *Last week, Bill is tired now
(49)   *Next month, Alma left yesterday.

The semantic interpretation rules can block sentences such as (48) and (49), since the tense and first adverbial are not RT combinations. There are other uninterpretable combinations also, however:

(50)   *Next week, Bill is tired now.

The formulation of principles to block sentences like (50) awaits further understanding of the construction, and of temporal specification across sentences in English.

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NOTES

[1] The discussion is limited to tense, time adverbials, frequency adverbials, and auxiliary *have*. Not included in the analysis at this time are conditional and contrary-to-fact sentences, aspect, modals, relative clauses, temporal NPs such as *former president*, and adverbial sentences.

I would like to thank Lauri Karttunen, and the other members of the informal syntax discussion group of the University of Texas, Department of Linguistics, for helpful discussions of the topics covered in this paper.

[2] Reichenbach outlines his system in Reichenbach (1947).

[3] In this section I discuss only time adverbials that are not habitual, so that frequency adverbials are excluded. Frequency adverbials are discussed in Section 3.

[4] With a different word choice, the sentence would probably be taken as ambiguous. For instance, *I left on Thursday* or *I was leaving on Thursday* might be taken as a Future-in-Past, that lacked RT. See below for this second interpretation; it is facilitated by imperfect aspect.

[5] Some speakers accept such sentences; for instance, see Hornstein (1975).

[6] The 'already' reading, in which John read the article some time previous to three weeks ago, is not intended here.

[7] Adverbials that can occur in this construction are strictly limited; the matter is discussed in Smith (1976a).

[8] See Hofmann (1966) for a different analysis of such sentences.

[9] See Braroe (1976) for discussion of some of the problems involved.

[10] Sentences in which matrix and complement have the same tense, and are taken as simultaneous, exhibit Sequence of Tense. The phenomenon is discussed by Jespersen, among many others. Ross (1967) proposes a transformational rule to account for it; Smith (1976b) and Riddle (1976) argue against such an analysis (from different points of view).

[11] For some speakers and in some contexts, anchored adverbials may be dependent on a time not mentioned in a sentence at all, but understood or appearing elsewhere in the discourse.

[12] Certain sentences must be understood as having a complex ET: these cases where the complement refers to more than one point in time, e.g. *Bill said yesterday that Tom had already left 3 days earlier.*

[13] These facts are noted by Braroe (1974); Kiparsky and Kiparsky (1970) argue that factivity is the relevant property but do not consider a wide range of examples.

[14] The notion of an underlying performative sentence is due to Sadock (1969) and (1974). A superordinate performative associated with each sentence would also be quite plausible.

[15] See Smith (1976a).

[16] Lawler (1972) discusses this type of sentence.

[17] 'Incomplete' sentences are frequently uttered and written, and almost always are understood without difficulty. This is due to the contribution of context, I believe, and to principles

of interpretation according to which speakers choose that interpretation requiring the fewest assumptions or additional information. I plan to state these principles – which are strategies, essentially – in a forthcoming paper.

[18] Following a suggestion of Kiparsky (1968), McCawley (1971) and Gallagher (1970) suggest a generative semantic treatment.

[19] I omit discussion of the Historical Present, as in the preceding sections.

[20] A third rule would also be needed to account for tense in adverbials with embedded sentences, perhaps as suggested in Smith (1975a).

[21] Sentences with tense alone are not complete semantically and therefore are not independent.

[22] This combination is that of the Historical Present and recurs, of course, throughout the rules. It will be noted but not discussed.

[23] This notation, introduced in Part I, represents that Past RT is anterior to ST, Present RT simultaneous with ST, and Future RT posterior to ST. Arrows will be used throughout the rules to indicate anteriority or posteriority, and the equals sign will represent simultaneity.

[24] Complements will be interpreted by the Sharing Principle when this interpretation is possible, or by the Extended Sharing Principle, according to the rules of application developed in Part I.

[25] Anchored adverbials play two roles in sentences like this: they indicate the relation between ET and RT, and specify ET.

[26] Frequency adverbials would present no problem for the rules; they have been discussed in the preceding part of this paper. They are omitted here because they present problems of recognition rather than analysis, and do not require separate treatment in terms of RT from the sentences analyzed here.

[27] Historical Present.

[28] Only a very few prepositions appear with explicitly Present adverbials.

[29] No other adverbials will appear in such sentences because of restrictions on *have*.

[30] See preceding note.

[31] See preceding note.

[32] Historical Present.

[33] This sentence is odd semantically because the deictics are contradictory.

[34] Historical Present.

[35] Historical Present.

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