DISCOURSE MODELS AND THE ENGLISH TENSE SYSTEM

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It is shown how Reichenbach's (1947) tense system is a direct consequence of the interaction of some straight-forward and independently motivated semantic rules for the English tense operators (past, present, future, perfect and prospective) and of the knowledge partitioning framework (Dinsmore, 1987), used in representing and structuring discourse knowledge. This account treats the semantics and pragmatics of temporal operators in a coherent and integrated way, and provides additional evidence for the viability of the theory of knowledge partitioning.

1. INTRODUCTION

A central observation in the study of the English verb system is that many tense forms apparently cannot be distinguished truth-conditionally yet differ in some intuitive way pragmatically. A significant and recurrent idea is that the distinctions between the past and the present perfect, for instance, have something to do with the perspective from which an event is viewed. Reichenbach (1947) introduces the term reference time (R) as distinguished from event time (E) and speech time (S) to refer to this temporal perspective. Bull (1960) corrects some mistakes in Reichenbach's system and it is actually Bull's revision with which we will be concerned. The relations among R, E, and S below correspond to the following verb forms.

Past:	R = E < S
Past perfect:	E < R < S
Past prospective:	R < S, R < E
Present:	R = E = S
Present perfect:	E < R = S
Present prospective:	R = S < E
Future:	S < R = E
Future perfect:	S < R, E < R
Future prospective:	S < R < E

There seems to be a concensus, articulated for instance by Taylor (1977), that the pragmatic aspects of the English tense system must be strictly distinguished from the semantic aspects on the basis of truth conditions. In this paper I will oppose this idea and argue that Reichenbach's tense system is a consequence of the semantics of the operators involved, along with the independently motivated underlying discourse model used in representing and structuring discourse knowledge. This is the knowledge partitioning framework developed by Dinsmore (1987). Familiarity with this framework is presupposed in the present paper.

1. A SEMANTICS FOR THE ENGLISH TENSE SYSTEM.

To indicate in the semantics that expression S is true of time t, I will write T(t,S). The following rules are proposed.

(Pres) T(t,pres(S)) iff T(t,S) and t = now.
(Past) T(t,pa(S)) iff T(t,S) and t < now.
(Fut) T(t,fut(S)) iff T(t,S) and t > now.
(Perf) T(t,perf(S)) iff there is a time t' such that T(t',S) and t' < t.
(Pros) T(t,prosp(S)) iff there is a time t' such that T(t',S) and t < t'.

It can be shown that a variety of facts about cooccurence of the tense forms with various adverbials, the truth conditions of complex sentences using non-finite forms of Perfect and Prospective, and the interaction of the tense forms with temporal adverbs can be predicted from these rules (Dinsmore 1981, 1982).

2. THE STRUCTURE OF DISCOURSE MODELS

In knowledge Partitioning the information communicated in a discourse is distributed over a large set of spaces, each of which defines a local domain of reasoning. Spaces are related by contexts, each of which provides a mapping of knowledge belonging to one space into another. A number of logical constraints are imposed on the way spaces are set up and connected.

The following notational conventions have proved helpful in discussing knowledge partitioning: "base" represents the real world. "S | P" means that S is true in space S. "S0 | f [S1]" means that f is a context that maps knowledge of S1 onto knowledge of S0. For instance, to represent George's beliefs, we might use the context base | "George believes that [s1]", then put every proposition P that George believes to be true in s1 as s1 | P. We can always use the mapping to derive base | "George believes that P".

Perhaps the primary implication of this model for natural language discourse processing is that at any point in a discourse some space is in focus. A discourse sentence is rarely assumed to be true in any absolute sense, but contributes knowledge about the current focus space.

3. USING SPACES WITH THE ENGLISH TENSE SYSTEM

Knowledge partitioning in discourse involves the distribution of temporally constrained knowledge over many spaces, each of which could be the focus space at some point in a discourse. It is shown in this section how the tense system serves to refer to *temporally bound knowledge from the perspective of different focus spaces.*

Within base, the occurance of things like events and states can be expressed by statements of the form base | at(t,P), "P happens at time t". The following describes the semantics of at.

(At) For any time t and sentence P, at(t,P) is true iff T(t,P).

Within the knowledge paritioning framework we may derive temporal spaces as follows. First, observe that the environment at(t,___) is entailment preserving, so by the restriction on legal contexts, whenever we have base | at(t,p) we may derive base | at(t,[s]) and s | p, where s is a previously unused space symbol. Second, observe that if at(t,___) is entailment preserving. This means that by the distributive constraint if we have base | at(t,[s]) and base | at(t,p) we should infer s | p. In Dinsmore (in press) the rule involved here is known as space augmentation. A temporal space is any space S with a context of the form S' | at(t,[S]), for some space S' and time t. Like any other space, a temporal space may be the focus space at some point in a discourse.

Reichenbach's tense system follows immediately if we define reference time as follows:

(RefTm) t is the reference time at a point p in a discourse iff for some space S, S is the focus space at p and base | at(t,[S]).

Reichenbach's observation is that the difference between the reference time and the event time corresponds to the use of perfect, prospective, past and present forms. We can predict this as follows. Suppose that an event E occurs at some past time t2. This can be expressed as base | at(t2,E). Further, suppose that times t1, t3, t4, and t5 are such that

$t1 < t2 < t3 < t4 = now < t5.$

We define spaces s1 through s5 such that base | at(ti,[si]) for $1 \leq i \leq 5$. Consider what sentences that mention E would be true in each of these spaces:

For s1: From $t1 < t2$ and base | at(t2,E) we have base | at(t1,prosp(E)). From this and $t1 < now$ we have base | at(t1,pa(prosp(E)). By space augmentation we have s1 | pa(prosp(E)).

For s2: From $t2 < now$ and base | at(t2,E) we have base | at(t2,pa(E)), and by space augmentation s2 | pa(E).

For s3: From $t3 > t2$ and base | at(t2,E) we have base | at(t3,perf(E)). Since $t3 < now$, base | at(t3,pa(perf(E))). By space augmentation, s3 | pa(perf(E)).

For s4: From $t4 > t2$ and base | at(t2,E) we have base | at(t4,perf(E)) and since $t4 = now$ base | at(t4,pres(perf(E))). By space augmentation, s4 | pres(perf(E)).

For s5: From $t5 > t2$ and base | at(t2,E) we have base | at(t4,perf(E)). Since $t5 > now$, base | at(t4,fut(perf(E))). By space augmentation, s5 | fut(perf(E)).

In this way a complete account of reference time emerges. Now we are in a position to see why whe have Perfect and Prospective at all: Without them we would not be able to refer to E while maintaining s1, s3, s4, or s5 as the focus space. A number of implications of this account for the use of the past and the

perfect are discussed in Dinsmore (in press).

4.CONCLUSION

This account bridges the gap between the semantics and the pragmatics of the English tense system by showing how the discourse use of English verb forms is related to their semantic interpretations, which may be derived in the usual compositional way. It is well integrated into the knowledge partitioning model of natural language discourse processing.

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