FOREWORD

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1 INTRODUCTION

The phenomena of tense and aspect have long been of interest to linguists and philosophers. Linguists have tried to describe their interesting morphological, syntactic, and semantic properties in the various languages of the world, while philosophers have tried to characterize formally their truth conditions. (For some recent collections of papers, the reader is referred to Tedeschi and Zaenen 1981; Hopper 1982; Dahl 1985; and LoCasio and Vet 1985.) Recently, computational linguists have joined in the act, their interest being sparked by a desire to characterize—at the level of processing—how we understand and describe complex events in a changing world. Here, two kinds of questions converge—one concerning the problem of encoding event descriptions, the other to do with manipulating references to events. In approaching the first question, researchers of all linguistic stripes (computational linguists, philosophers of language, psycholinguists, and linguists of the "unmarked case") have begun to turn their attention from how languages convey information about individuals (or sets of individuals) and their properties to how they convey information about events and situations changing over time. In approaching the second question, computational linguists have become interested in developing systems that can converse with users about events and situations (e.g., for planning) or can process accounts of events and situations (e.g., for summarizing and/or integrating messages). Last year, following the appearance of a number of papers on this topic at the 1987 Conference of the Association for Computational Linguistics at Stanford, it was suggested that a special issue of *Computational Linguistics* should be devoted to the topic of tense and aspect, in order to examine what appeared to be an emerging consensus on these questions within the computational-linguistics community. This issue is the result of that suggestion, and many of the papers collected below constitute extensions of the papers presented at the Stanford meeting.

The papers demonstrate both practical and theoretical advances in our understanding of tense and aspect. With respect to those approaches that have been implemented (cf. Hinrichs, Passonneau), the papers demonstrate how far we have come in developing general methods for extracting and representing event-related information from text and embedding those methods in question-answering and text-processing systems. With respect to theoretical issues involved in how we understand and describe events in a changing world (a subject of all the papers included here), the papers demonstrate the significance of ideas of processing, knowledge representation, and common-sense reasoning drawn from artificial intelligence and computational linguistics. It is these ideas that are computation's unique contribution to our understanding of tense and aspect, augmenting existing contributions from linguistics and philosophy.

2 REICHENBACH'S TYPOLOGY OF TENSE

Many of the papers collected here build upon Hans Reichenbach's 1947 account of the underlying structure of the English tense system. Reichenbach started from the observation that the collection of English tenses[1] could not be explained either (a) simply in terms of the absolute time of an event or (b) in terms of the relative time of that event to the (purported) time of utterance of the tensed clause. Rather, he proposed that the interpretation of tense requires three separate sense-semantic entities: point of speech (S), point of the event (E), and point of reference (R).[2] The interpretations of S and E are self-evident. R is the time "talked about" or "focused upon" (or, equivalently, the "temporal perspective" from which the described event is viewed). It may be the same as S, as in present perfect (Example 1a) or simple present tense (Example 1b).

1. a. John has climbed Aconcagua and Mt. McKinley. (E < R = S)
   b. John is in the lounge. (E = R = S)

(Here, "<" indicates "temporally prior to".) It may be the same as E, as in the simple past tense (Example 2a) or simple future tense (Example 2b).

2. a. John climbed Aconcagua. (E = R < S)
   b. John will climb Aconcagua. (S < E = R)

It may be in between E and S, as in the past perfect:

3. John had climbed Aconcagua. (E < R < S)

or following both E and S (looking back to them), as in the future perfect:

4. John will have climbed Mt. McKinley. (S < E < R)

Reichenbach's account is imprecise in some cases, incomplete in some, and only seductively suggestive in others. While all the authors in this volume have taken

Reichenbach's account as their starting point, they differ in what they attempt to flesh out, pin down, or correct, and in the details of how they do so. Nevertheless, there is a remarkable degree of agreement across these accounts. If together they do not yet provide a complete solution to the problem of how we understand and describe events, they may still comprise a new stage from which further progress may be made.

3 Overview

There are five papers included in this issue: by Erhard Hinrichs (now at the University of Illinois), by Marc Moens and Mark Steedman (University of Edinburgh), by Sasha Nakhimovsky (Colgate University), by Becky Passoneau (UNISYS) and by myself (University of Pennsylvania). All the papers have gone through extensive revision in response to internal exchange among the authors, in addition to the usual process of external review.

Hinrichs describes a meaning-representation language (MRL) for temporal expressions based on higher-order Intensional Logic, that is being used in the JANUS system, a natural-language understanding and generation system under joint development at BBN Laboratories and ISI. He shows how this MRL, which employs temporal indices based on Reichenbach's points of speech, event, and reference, avoids problems that classical tense logics have with even basic temporal adverbials like "yesterday", with negation, with quantification, and with multiple-clause sentences describing multiple events. He also shows how this MRL permits accurate description of discourse entities evoked by tensed clauses, for use in resolving anaphoric noun phrases (NPs) and other context-sensitive expressions.

Moens and Steedman propose and argue for a tripartite ontology of events based more on notions of causation and consequence than on purely temporal primitives. Their proposal allows a simple solution to what has been called "the imperfective paradox", to the semantics of "when" clauses, and to the changing sense of an event description as various temporal adverbials are added to it. They also propose Reichenbachian-style analyses for the various "future tenses" in English—those constructions used to describe events that are expected, possible, or intended subsequent to speech time. In that, they fill in a gap in Reichenbach's own analysis, which considers only the simple future tense and is equivocal even on that.

Nakhimovsky describes how our common-sense knowledge of events manifests itself in language and how this knowledge is used in understanding narratives. Nakhimovsky discusses three types of common-sense knowledge involved in how we describe events and how, in turn, we understand event descriptions: knowledge of the internal structuring of events, knowledge of their duration and the durations of their various subparts, and knowledge of how events can be viewed. (The first and third types of knowledge link with discussions in Moens and Steedman and in Passonneau.) At a practical level, Nakhimovsky shows how such knowledge could be stored in the lexicon.

Passonneau describes temporal processing in PUNDIT, a natural-language text understanding system developed by researchers at UNISYS. Its purview is clauses that describe actual events such as are frequently found in status reports. In particular, it addresses the problem of processing the distinctive contributions of those linguistic elements used in describing events of different types. For each clause describing an actual event, Passonneau characterizes the temporal structure of that event and its temporal location vis-à-vis speech time or, when relevant, the event described in an adjoining temporal adverbial. Like Moens and Steedman, Passonneau employs a tripartite structure for events in characterizing temporal structure. This paper makes beautifully clear many of the factors involved in correctly characterizing the internal temporal structure of events.

Finally, I focus on the discourse-related properties of tensed clauses and show that they are very similar to those of anaphoric definite NPs. Specifically, they depend on our knowledge of plausible relations between events (as anaphoric definite NPs depend on our knowledge of plausible relations between entities), and they respond in somewhat similar fashion to a listener's perceptions of discourse structure. In demonstrating the former dependency, I employ a tripartite event structure drawn from the work of Moens and Steedman and from Passonneau. This paper contributes to a long-standing discussion in linguistics as to whether tense should be classified as an anaphor, as well as identifying additional knowledge and mechanisms needed for processing reports and other narrative texts.

References

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Notes

1. Reichenbach regarded simple past, present, and future, and past, present, and future perfect as tenses. While others have considered the perfect and the future as belonging to the systems of aspect and modality, rather than tense, Reichenbach's usage remains a convenient shorthand.
2. Reichenbach points out in a footnote that Jespersen, more than 20 years before, proposed a related three-point semantics for past perfect and future perfect but did not extend a similar analysis to the other English tenses.