

Temporal Interpretations of Sentences with Complement Clauses

Hsiu-Hui Lee

Graduate Institute of Computer Science and Information Engineering
National Taiwan University
Taipei, Taiwan 10764, R.O.C.
hh_lee@csman.csie.ntu.edu.tw

Abstract

This paper concerns temporal interpretations in those sentences with complement clauses. A central fact about temporal reference is that it involves orientation or anchoring to some time. Many temporal expressions (such as tense, time adverbials) are not interpretable if one does not know how they are anchored. How to identify the anchor (i.e. the antecedent of temporal anaphora, or temporal antecedent) is important especially in the sentences that describe multiple events. We present an extension of tense theory to accommodate the sequence-of-tense (SOT) phenomena and propose a identification method for temporal antecedent. Then according to the temporal antecedent, the temporal meaning for the verb form of a complement clause can be assigned and its interpretation is accurately obtained.

1. Introduction

This paper concerns temporal interpretations in those sentences with complement clauses. A central fact about temporal reference is that it involves orientation or anchoring to some time [9]. Many temporal expressions (such as tense, time adverbials) are not interpretable if one does not know how they are anchored. This anchor is usually the speech time (S). However, there are cases that might have some anchor other than the speech time. This dependency between temporal references which can be considered as *temporal anaphora* [2, 5, 10]. How to identify the anchor (i.e. the antecedent of temporal anaphora, or *temporal antecedent*) is important especially in sentences that describe multiple events. For example,

(1) John said that Mary was in New York.

One accepts an interpretation that Mary was in New York when John uttered. Past tense is always interpreted as it anchors to the speech time (S) and it is earlier than S. However, past tense in the complement clause of (1) can be interpreted as: it anchors to the time of the matrix clause and it is treated as present tense. That means the time of Mary's being in New York is simultaneous with John's saying. On the other hand,

(2) John said that Mary is in New York.

carries the interpretation that Mary is in New York when (2) is uttered. Present tense in the complement of (2)

anchors to S, not to John's utterance time, and it is simultaneous with S. If the tense used by the matrix clause is changed to non-past as (3),

(3) John will announce that Mary is in New York.
this sentence is ambiguous. It has two readings: one is that Mary is in New York at the utterance time of (3) as a whole; the other is that Mary will be in New York when the time John announces tomorrow.

2. Sequence of Tense (SOT) and Temporal Antecedent

The grammar book [7] says: *In direct/indirect speech translation, when the time of the original utterance no longer applies at the time that the utterance is reported, it is often necessary to change the tense forms of the verbs.* Such a change of verb forms in indirect speech is termed *backshift*. The resulting relationship of verb forms in the reporting and reported clause is known as the sequence of tense (SOT) [3, 6]. Those sentences with complement clauses are called SOT constructions. The use of the tense forms in texts is somewhat different from their use in isolated clauses. In anterior contexts, for example, the present is often replaced by the past and the future by the conditional. In pronominal anaphora, one expression is dependent on information in another expression. The above dependency between temporal references can also be considered as a type of anaphora [2]. Researches of anaphora are interested to the problem "where is the antecedent?" Respect to time, we call it temporal antecedent (TA). In the discourse, TA of the independent clause is the speech time; whereas in dependent clause, its TA may be the speech time or some other time of reference which has been mentioned in preceding or dominating clause. Thus, the determination of temporal antecedent is of importance since the tense meaning of the complement clause is based on it. How to identify the temporal antecedent of a clause is a complex matter. Below we will try to use the two factors: the verb forms of the matrix clause and the complement clause to identify the temporal antecedent.

3. Extended Theory of Time

Most of world on time relations of tenses is based on Reichenbach's three entities of time: speech time (S), event time (E) and reference time (R) [8]. The tense meaning and the aspect meaning of a sentence are described by these three time intervals and the relations among them [1]. However, this is not adequate. For the analysis of those sentences with complements, this should be extended. Besides the above three time intervals, the *perspective time* (denoted by P) which is introduced. For any clause *i*, there will be one perspective time (Pi) and one reference time (Ri). If the clause is the main clause, then its perspective time is the time of speech (S). Otherwise the perspective time can be the reference time of the preceding clause or the speech time. The perspective time P is specified by the temporal antecedent of the clause. Now, the tense meaning is generalized to describe the temporal relation between R and P and the aspect meaning of the clause still describes the relation between E and R. As to detailed definitions of various tense meanings and aspect meanings, they are presented in [4]. This extended theory provides a framework for the temporal analysis of the types of finite clauses, whether embedded or not, whether isolated or in context.

4. Interpretations of Complement Clauses

4.1 Anterior Contexts

In the isolated clauses, we use the verb form together with the situation type to assign its corresponding tense meaning and aspect meaning [4]. Table 1 only lists some of the verb forms.

Table 1 Temporal Meaning Assignment for Verb Forms of Isolated Clauses.

Verb Form	Situation Type	Tense Meaning	Aspect Meaning
simple past	momentaneous event protracted event activity	{anterior}	{perfective}
	state	{anterior}	{durative}
simple present	momentaneous event protracted event activity	{posterior}	{perfective}
	state	{simultaneous}	{durative}
present progressive	momentaneous event	{simultaneous, posterior}	{prospective}
	protracted event activity	{simultaneous}	{durative}
present perfect	momentaneous event protracted event	{simultaneous}	{retrospective}
	activity	{simultaneous}	{retrospective, terminative}
	state	{simultaneous}	{terminative}

Because of SOT phenomena, we have to reinterpret the verb forms of the complement clauses. The tense meaning and the aspect meaning for each verb form of complements are reassigned as Table 2. According to our analysis, in anterior contexts only the verb forms listed in Table 2 can have R_{mat} as their temporal antecedents. Otherwise the temporal antecedent of the complement is

S. If the temporal antecedent is S, its corresponding temporal meaning is the same as that in isolated clauses listed in Table 1. For example, the temporal antecedent of the complement clause in (1) can be R_{mat} . But that of the complement clause in (2) can be S. Note that the tense meaning and the aspect meaning of a given verb form listed in Table 2 are not the same as those listed in Table 1.

Table 2 Temporal Meaning Assignment for Verb Forms of Complement Clauses.

Verb Form	Situation Type	Tense Meaning	Aspect Meaning
simple past	momentaneous event protracted event activity	{anterior, simultaneous}	{perfective}
	state	{anterior, simultaneous}	{durative}
past progressive	momentaneous event	{anterior, simultaneous, posterior}	{prospective}
	protracted event activity	{anterior, simultaneous}	{durative}
past perfect	momentaneous event protracted event	{anterior}	{perfective}
		{simultaneous}	{retrospective}
	activity	{anterior}	{perfective}
		{simultaneous}	{retrospective, terminative}
past perfect progressive	protracted event activity	{anterior, simultaneous}	{terminative}
simple conditional	momentaneous event protracted event activity	{posterior}	{perfective}
	state	{posterior}	{durative}
conditional progressive	protracted event activity	{posterior}	{durative}
conditional perfect	momentaneous event protracted event	{posterior}	{retrospective}
	activity	{posterior}	{retrospective, terminative}
	state	{posterior}	{terminative}
conditional perfect progressive	protracted event activity	{posterior}	{terminative}

Now, we consider sentence (1). It is ambiguous and has two distinct readings: (i) John said that Mary had been in New York (before the time of John's saying); (ii) John said that Mary was in New York at the time of his saying. Here, we will show our interpretation mechanism. By looking up Table 2, the complement clause in (1) with "state" situation in simple past can have R_{mat} as its antecedent and have the following two temporal meaning assignments. One has "anterior" tense meaning and "durative" aspect meaning; the other one has "simultaneous" tense meaning and "durative" aspect meaning. They correspond to different interpretations. For these two interpretations, their temporal relations of E_{mat} (the event time of the matrix clause) and E_{com} (the event time of the complement clause) can be shown in Figure 1 and Figure 2 respectively.

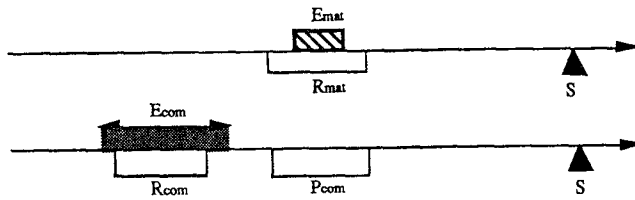


Figure 1 First Interpretation of *John said that Mary was in New York.*

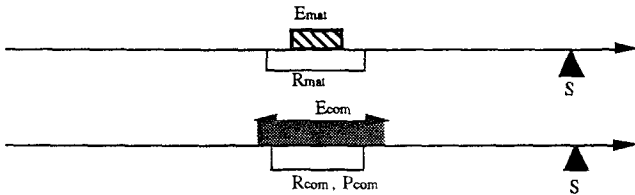


Figure 2 Second Interpretation of *John said that Mary was in New York.*

They can be further disambiguated by paraphrasing to direct speech or by associating appropriate the time adverbials with the complement clauses. (4) and (5) correspond to the first and the second interpretations respectively.

- (4) a 'Mary was in New York', John said.
 b John said that Mary was in New York three days earlier.
- (5) a 'Mary is in New York', John said.
 b John said that Mary was in New York at that time.

Again, we consider sentence (2). Since the complement clause is simple present, we cannot find the corresponding entry in Table 2. This means its antecedent is S , not R_{mat} . Therefore, we look up Table 1 to get the tense meaning and the aspect meaning. (2) has the only one interpretation. That is, Mary is in New York now. Figure 3 shows the relation between E_{mat} and E_{com} .

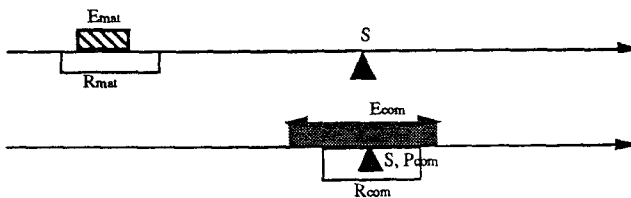


Figure 3 Interpretation of *John said that Mary is in New York.*

4.2 Non-Anterior Contexts

In English, complements in non-anterior context (that is, complement clauses appearing in sentences with non-past tensed matrix clause) can also have the shifted reading, but have no verbal morphology changes [3]. Therefore, their temporal antecedents can be S or R_{mat} and the values of their temporal meanings remain the the same. We need not redo the temporal meaning assignment for non-anterior context. Table 1 can be used. If the antecedent is R_{mat} , the tense meaning is relative to

R_{mat} ; if the antecedent is S , the tense meaning is relative to S . Consider sentence (3). Since its antecedent can be S or R_{mat} , (3) can have the two interpretations. These two interpretations can also be further distinguished by combining appropriate time adverbials as (6) and (7) respectively.

- (6) John will announce tomorrow that Mary is in New York now.
 (7) John will announce tomorrow that Mary is in New York then.

5. Conclusion

Since the distribution of temporal expression is apparently different for complements and independent sentences, the temporal interpretation of complement is somewhat problematic. We adopt the concept of temporal antecedent and extend the theory of time. Then the verb forms of the matrix clause and the complement clause are the two factors to determine the temporal antecedent. Based on this, a unified account of complement clauses has been given.

References

- [1] F. van Eynde, "The Analysis of Tense and Aspect in EUROTRA," *Proceedings of COLING'88*, 699-704, 1988.
- [2] E. W. Hinrichs, "Tense, Quantifiers and Contexts," *Computational Linguistics*, 14(2), pp. 3-14, 1988.
- [3] N. Hornstein, *As Time Goes By: Tense and Universal Grammar*, MIT Press, Cambridge, MA, 1990.
- [4] H. H. Lee, I. P. Lin, and C. P. Wu, "Temporal Constraints and Their Interpretations in Natural Language." *Proceedings of IEEE 4th International Conference on Tools with Artificial Intelligence*, 301-305, 1992.
- [5] M. Moens and M. Steedman, "Temporal Ontology and Temporal Reference," *Computational Linguistics*, 14(2), pp. 15-28, 1988.
- [6] T. Ogihara, "Temporal Reference in English and Japanese," Indiana University Linguistics Club, Technical Report, 1992.
- [7] R. Quirk, S. Greenbaum, G. Leech, and J. Svartvik, *A Comprehensive Grammar of the English Language*, Longman, 1985.
- [8] H. Reichenbach, *Elements of Symbolic Logic*, University of California Press, The Free Press, New York, 1966. (Reprint of 1947).
- [9] C. Smith, "The Syntax and Interpretation of Temporal Expressions in English," *Linguistics and Philosophy*, 2, pp. 43-100, 1978.
- [10] B. Webber, "Tense as Discourse Anaphor," *Computational Linguistics*, 14(2), pp. 61-73, 1988.