XII. Semantics of intensional contexts

57. Tense

Abstract

Tense is an extremely important ingredient of natural language in that a tense morpheme or some other expression carrying temporal information is virtually a required element in matrix sentences. It is clear that the temporal information conveyed by an entire sentence involves both an existential quantifier and contextual restriction to a salient past interval. However, it is not easy to provide a precise semantic contribution made by tense morphemes themselves because they interact with various types of temporal adverbials and quantificational expressions. The previous research suggests that overt or covert temporal adverbials (e.g., once, every Sunday, in the past) are carriers of temporal information and not tense morphemes themselves. Turning to embedded clauses, this chapter argues for the position that a verb complement clause denotes a property, i.e., a set of individual-time-world triples. The last section briefly discusses the interaction of tense and modality. Although tense and modality are largely independent of each other, there are some circumstances in which their interaction is undeniable. As an instance, the case of be going to is presented as a hybrid form involving both temporal and modal ingredients.

1. Introduction

Tense is an important ingredient of natural language, and it normally takes the form of a verbal affix. For example, English has a tense morpheme *-ed* that indicates temporal anteriority. It is referred to as a past tense morpheme. In general, one uses this morpheme to describe an event or state that took place in the past although using present perfect is also a possibility. For example, in order to describe a completed event of closing the door by John, one uses (1a) or (1b). Using sentences like (1c) or (1d) would not be able to describe the said situation.

(1) a. John closed the door.
    b. John has closed the door.
    c. (#) John closes the door.
    d. (#) John will close the door.

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There are some important differences between (1a) and (1b). But they are both capable of indicating situations that are located wholly in the past, and (1a) and (1b) are both acceptable in the situation under discussion. On the other hand, the simple present tense in (1c) and the future tense in (1d) are incapable of indicating a past event as in the said situation. For the purpose of this chapter, I will concentrate upon the past tense morpheme, ignoring the perfect. The perfect is normally considered to be a construction that conveys some aspectual information. For example, (1b) not only indicates a past event of John's closing the door but also suggests the existence of a current state that results from the event (i.e., the state of the door's being closed or, in some cases, John's experience that resulted from closing the door). Although it is not an easy task to characterize the English present perfect in precise terms, it seems safe to assume that its main semantic role is not to locate an event or state described by the verb at a particular past time.

The fact that each matrix clause is tensed in many natural languages including English and Japanese indicates the importance of tense. This in turn suggests the importance of temporal information in natural language since tense is associated with it. In this sense, tense is different from locative expressions (e.g., *in Seattle*) and manner adverbials (e.g., *quickly*, *slowly*). They are never obligatory in the sense that their presence is not required to make the sentence in question grammatical. This is true even when the event in question obtains at a particular location and in a particular manner. For example, (2) shows that even if John ate a bag of popcorn quickly in the movie theater, the information about the manner (quickly) or the location (in the movie theater) does not have to be mentioned in the sentence. Nevertheless, a tense morpheme is obligatorily included in the sentence.

(2) John ate a bag of popcorn.

In this chapter, I shall discuss how tense interacts with other important expressions within the sentence such as events, temporal adverbials and modality. I shall discuss the behavior of tense in embedded clauses as well.

2. Theories of tense

Having stressed the importance of tense for natural language semantics, let us turn to some possible means of formalizing the semantic effects of tense. In the tradition of tense logic (Prior 1957, 1967), tense is understood to correspond to an existential quantifier over a set of times. Prior (1957, 1967) introduces operators **P** ("it has been the case that α") and **F** ("it will be the case that α"). This approach is adopted in Montague's work (1973) as well, though Montague employs **H** for the present perfect, and **W** for the future modal *will*. The operators **H** and **W** receive existential quantifier interpretations in that they mean "there is a past time at which..." and "there is a future time at which...", respectively. Despite the fact that Prior and Montague deal with the English present perfect in their systems, it is generally assumed that **P** (or **H**) corresponds to the past tense morpheme (i.e., *-ed*). Partee (1973), Enç (1987) and Kamp & Reyle (1993) (among others) show that the English simple past cannot be described in terms of the semantics associated with **P** or **H**. If we assume that **P** means *-ed*, then (3a) receives the interpretation given informally in (3b).

(3) a. John saw Mary.
b. ∃t [t is earlier than now ∧ John sees Mary at t]

This purely existential analysis of the past tense morpheme *-ed* is inadequate for many reasons. But I shall postpone this discussion and move on to an analysis of tensed sentences that is substantially different from that of tense logic.

Davidson's (1967) analysis of declarative sentences gives us another way of looking at tensed sentences. Davidson claims that a declarative sentence involves an existential assertion about an event. In this system, events are primitive entities. Davidson himself was not concerned so much about how tense-related information is formalized within his system. However, it is relatively straightforward to extend his system to incorporate the information associated with tense. For example, (4a) can be symbolized as in (4b). "Time" in (4b) indicates that function that maps an event to its "temporal trace" (temporal trace function), which is the time that the event occupies.

(4) a. Jones buttered the toast.
b. ∃e[Time(e) < now & butter (Jones, the toast, e)]

Davidson's approach can be used to account for the behavior of adverbs, among others. Prior's approach (as interpreted by some linguists) and this particular extension of Davidson's approach (which includes an analysis of tense in terms a temporal trace function) share the view that tensed sentences involve an existential assertion. They both amount to the claim that a sentence in the past tense is used to assert that there is a past time at which a relevant situation obtains.

This straightforward application of tense logic to the English past tense morpheme has problems. The same criticism applies to Davidson's approach as long as its semantics is given in terms of simple existential quantification over past times. Partee (1973) points out that a sentence in the past tense is used to talk about a particular past time under discussion, not to claim the existence of a past time that satisfies some descriptive content. Partee's example involves negation as shown in (5a). The scenario is that the speaker utters it while driving on the freeway after leaving home. The point of (5a) is that it cannot receive the interpretation in (5b) or the one in (5c). What (5a) really means is that the speaker failed to turn off the stove before leaving home. Partee claims that the correct interpretation is represented as in (5d), where the free variable *t* receives an appropriate value from the context. The free variable *t* is presupposed to denote a past time. Just as a free pronoun is used to indicate a particular individual supplied in the context of use with the added presupposition about the gender of the individual, tense is claimed to involve the existence of a free variable with an added presupposition.

(5) a. I didn't turn off the stove.
b. There is a past time t such that I do not turn off the stove at t.
c. It is not the case that there is a past time at which I turn off the stove.
d. It is not the case that I turn off the stove at t. (where the value of t is provided by the context and t is presupposed to be a past time)

The important point in (5d) is that it does not involve existential quantification over (past) times. The upshot of Partee's discussion is that (5a) shows that past tense does

not make an existential claim about times. Past tense is like a free time variable with a presupposition that its value must be a past time. The value of the free variable is supplied by the context. Partee's contention makes a valid point, and it clearly shows that simple (i.e., unrestricted) quantification over past times does not accurately represent the meaning of past tense.

It is important for me to discuss Reichenbach's (1947) analysis of tense here in connection with Partee's proposal about tense. Reichenbach proposes that a correct account of tense in natural language involves three temporal concepts: speech point (S), event point (E), and reference point (R). Intuitively, R represents the time salient at a particular point in discourse. Recall that in Partee's (1973) account the denotation of the free temporal variable is determined by the context, and this interval is considered to be one that is salient in the context. It is natural to construe Reichenbach's reference point as the denotation of the free variable in Partee's account. Reichenbach persuasively argued for the idea that the crucial difference between the simple past (e.g., (6a)) and the past perfect (e.g., (6b)) is the relationship between R and E. As the diagrams in (6) indicate, (6a) requires that R and E be co-temporal, whereas (6b) requires that E precede R.

(6) a. John left Seattle. R,E ___ S
b. John had left Seattle. E ___ R ___ S

Reichenbach's analysis is incorporated in Kamp & Reyle's (1993) Discourse Representation Theory analysis of tense. This will be discussed below.

The discussion so far establishes that the interpretation of tense cannot be accounted for in terms of simple existential quantification over past times and is context sensitive. But this is hardly the whole story. Partee (1984) concedes that a simple free variable analysis of tense has its own problems. Free pronouns are used to denote individuals that are salient in the context. For example, (7) shows that under its most natural interpretation the pronoun *he* that occurs in the second sentence refers back to John. In other words, the pronoun *he* denotes the same individual that *John* refers to. On the other hand, the time of John's sitting down is understood to be shortly *after* the time of his entering the room. So the case of temporal anaphora is not completely parallel to that of nominal anaphora. This point will be elaborated below when we discuss Discourse Representation Theory.

(7) John entered the room. He sat down.

Another problem with the free variable analysis of past tense is that an event sentence often requires existential quantification over times and contextual restriction upon the quantificational force. Consider the example in (8).

(8) A: Did you know that Mary was in Seattle last year as a visiting scholar? Mary told me that she and you met in London ten years ago and that she wanted to see you again. Did you see her?
B: Yes, I did. As a matter of fact, we did a research project together.

Given that A knows that B first met Mary ten years ago, A's question *Did you see her?* cannot be taken to involve simple existential quantification over past times. It must be about a specific time interval, the last academic year. However, A's question clearly does

not talk about a specific moment within the year in question either. B's answer *Yes I did* is truthful only if there was an event of B's seeing Mary within the time frame in question. This means that B's positive answer is taken to have the interpretation symbolized as in (9), in which the time of seeing is restricted to the appropriate time frame. Here, the verb *see* is analyzed as a three-place predicate involving two individuals and a time interval. The intuitive truth condition of **see (B, Mary, t)** is that B sees Mary at t. The notation used here is that of Ogihara (1996), which slightly differs from Dowty (1979) in that a predicate like *see* contains an extra argument place for a time. Dowty, by contrast, used an **At** operator to introduce a temporal variable into the logical language. The subset symbol is used in (9) to indicate a "subpart" relation between two intervals. This notation is based upon the assumption that an interval is defined as a set of instants with "no gaps". The reader is referred to Dowty (1979) and Ogihara (1996) for technical details.

(9) $\exists t[t \subseteq \text{last-academic-year} \wedge \text{see}(B, \text{Mary}, t)]$
Paraphrase: there is a time t such that t is within the last academic year and B sees Mary at t.

The same is true of Partee's example (5a). In this case, the contextually specified time is shorter than the case of the above scenario. Nevertheless, there would be some interval any part of which is suitable for turning off the stove in this situation as well. Although it is important to turn off the stove soon after cooking, there is no particular moment when this has to happen. As long as the stove is turned off soon enough, everything is fine. So (5a) should receive the interpretation symbolized in (10). This in turn shows that (5a) too requires both existential quantification and contextual restriction.

(10) $\neg\exists t[t \subseteq i \wedge \text{turn-off}(\text{the speaker}, \text{the stove}, t)]$
where i indicates the interval that starts when the cooking is finished and lasts for a minute (say).

Having established that an accurate account of the tense must involve both existential quantification and contextual restriction, I now move on to a survey of the analysis of tense within Discourse Representation Theory (abbreviated as DRT). Kamp & Reyle (1993) present a proposal within DRT which employs Reichenbach's (1947) concept of Reference point. The role of Reference time (which roughly corresponds to the value of the free time variable in Partee's (1973) analysis) is conceptualized in a dynamic way in DRT in that each sentence in a discourse updates it for the next sentence. This mechanism partly depends upon the aspectual nature of the sentence in question. When the sentence in question is an event sentence, the event it describes is understood to be located after the current Reference point, and the time of the event becomes the new Reference point to be used by the following sentence. On the other hand, when the sentence in question is a state sentence, the state being described contains the current Reference time, and the current Reference time is used again for the next sentence in the discourse. (11) shows the difference between events and states in a narrative discourse.

(11) a. E1: John arrived at the airport. S1: Mary was (already) at the ticket counter. E2: He apologized for being late.
b. E1: John arrived at the airport. E2: He immediately went to the ticket counter. E3: The airline agent greeted him.

E indicates an event, S a state. (11a) is a discourse that consists of an event sentence, a state sentence, and another event sentence. Note that S1 overlaps E1. This is because the new Reference point that is introduced by the first sentence for the second sentence (which equals E1) is contained within the time of S1. Thus, S1 is understood to overlap E1. E2, which the third sentence describes, is then understood to follow E1. This is shown graphically in (12a). On the other hand, (11b) produces a different semantic effect. (11b) consists of three event sentences, and each of them moves the narrative time forward. Thus, E1 is followed by E2, which is in turn followed by E3.

(12) a. _____E1___E2_____
S1
b. _____E1_E2_E3_____

The above discussion shows that a situation described by the sentence in question is not usually simultaneous with the current Reference point. In the case of an event, the event in question is placed slightly after the current Reference point; in the case of a state, it (generally) includes the Reference point. This suggests that DRT's use of Reference point deviates slightly from the way Reichenbach employs it. But DRT's account is a refinement of Reichenbach's and preserves the basic intuitions behind it.

Let me make one side remark here about the status of events and times in semantic theory. Kamp & Reyle (1993) follows Davidson in presuming that events are primitive entities and then define an instant as a maximal set of pairwise overlapping events. This means that instants are derived from events. The idea here is that positing events as primitive entities is better than deriving intervals or events from durationless instants. Kamp & Reyle's position is that it is not plausible that we recognize durationless instants in the same way that we recognize regular individuals such as humans and objects. Although this is definitely a viable position, it is not easy to settle the question of the relationship between times and events empirically one way or the other. For example, if we assume that events are primitives, we must ask some difficult questions such as the following: (i) Can the same event be described in many different ways? (ii) Is the same event found across different worlds? Thus, it is arguable that events may be derived from intervals, if not from instants. These are extremely interesting but difficult issues. Accordingly, I shall not take a stand on this controversy. I believe that we can discuss the semantic issues of tense without taking a stand on the ontological questions about times and events.

3. Tense morphemes, adverbials, and quantification

In Section 2, I discussed some problems with the view that tense involves simple existential quantification over times. After discussing Partee (1973, 1984), Davidson (1977), etc., I tentatively concluded that both reference to a particular interval (contributed by an overt or covert adverbial) and existential quantification are needed. In this section, I shall discuss sentences in which overt temporal adverbials occur. Let me start with a relatively straightforward case which involves an adverbial making reference to a specific interval such as *in 1985*. One could write a predicate logic formula (containing a variable for times) of the form given in (13b) to represent the meaning of (13a).

(13) a. John left the U.S. in 1985.
b. $\exists t[t < \text{now} \wedge \text{leave}(\text{John}, \text{the U.S.}, t) \wedge t \subseteq 1985]$

Assuming that *1985* denotes (the interval that corresponds to) the year 1985, and that the preposition *in* indicates a sub-part relation between the time of John's leaving and the interval denoted by 1985, one can represent as in (13b) the meaning attributed to (13a). A similar representation is possible with an event variable and a temporal trace function. (13b) shows that both existential quantification and contextual restriction are needed to account for the semantics conveyed by (13a), which involves both past tense and a temporal adverbial.

We need to discuss how the reading represented in (13b) is obtained in a compositional way. We also need to discuss sentences containing multiple adverbials or some special frequency adverbials like *exactly twice*. Let me discuss them in turn.

First, if we assume that a VP that contains past tense is interpreted as in (14a), then there is no way that an adverbial could be added in a compositional way because (14a) can only be combined with the meaning of a name (like *John*), and an adverbial would have to be left unprocessed. This means that (14b) cannot be processed compositionally if we assume that (14a) indicates the denotation of *left*.

(14) a. $\lambda x \exists t\ [t < now\ \&\ leaves\ (x, t)]$
b. John left yesterday.

To correct this problem, Dowty (1979) introduces a proposal that works as follows: (i) any tensed sentence obligatorily contains a (covert or overt) temporal adverbial; (ii) the adverbial has as part of its meaning an existential quantifier; (iii) each adverbial is classified into three types (past, present and future), and combines with a tenseless sentence to yield a tensed sentence containing a desired tense morpheme. For example, *yesterday* is a past tense adverbial, and it combines with a tenseless sentence like *John take a walk* to yield a past tense sentence *John took a walk yesterday*. For example, (15) is analyzed semantically as in (16). (16) is in the spirit of Dowty's (1979) analysis except that times are introduced as arguments of verbs as in Ogihara (1996). P_t and Q_t indicate variables ranging over sets of times.

(15) John left yesterday.

(16) 1. $\text{John leaves} \Rightarrow \lambda t[\text{leaves}(j, t)]$
2. $\text{yesterday} \Rightarrow \lambda P_t\ \exists t[P_t(t) \wedge t \subseteq \text{yesterday}]$
3. $\text{John left yesterday} \Rightarrow \lambda P_t\ \exists t[P_t(t) \wedge t \subseteq \text{yesterday}](\lambda Q_t\ \lambda t''[t'' < \text{now} \wedge Q_t(t'')](\lambda t'[\text{leaves}(j, t')]))$
4. $\lambda P_t\ \exists t[P_t(t) \wedge t \subseteq \text{yesterday}](\lambda t''[t'' < \text{now} \wedge \text{leaves}(j, t'')])$
5. $\exists t[t < \text{now} \wedge \text{leaves}(j, t) \wedge t \subseteq \text{yesterday}]$

According to this approach, some temporal adverbials such as *today* belong to multiple types because they are compatible with more than one tense morpheme.

According to Dowty's system, each English sentence contains exactly one temporal adverbial that introduces an existential quantifier and a restriction on the domain of quantification. Thus, Dowty needs a special provision for sentences which do not contain temporal adverbs. That is, his system has a rule which introduces an existential quantifier in the semantics when there is no overt temporal adverbial in the sentence. Put informally, this is like positing a covert adverb *at least once*. Dowty's proposal does not

account for cases in which multiple adverbials occur in single sentences as exemplified by (17).

(17) John left in August in 2008.

This problem is solved in Stump's (1985) proposal in which an existential quantifier is introduced as part of a truth definition. In this proposal, even after a tense morpheme is introduced, the resulting expression is a function from times into truth values. Until the matrix-clause-level existential quantifier is introduced by the truth definition, the "sentence" is semantically a temporal abstract (a function from times into truth values). This allows it to be combined with any number of temporal adverbials, which are "temporal abstract modifiers" (functions of type <<i,t>,<i,t>>). Thus, Stump can explain the fact that multiple adverbials can occur in the same sentence. At the matrix level, the truth definition says this: the sentence is true iff there is a time t such that F (t) = 1, where F indicates the temporal abstract denoted by the entire sentence. In this way, Stump does not need to posit a covert adverbial 'at least once' because this semantic role is satisfied by the truth definition. (18) shows how Stump's proposal deals with (17).

(18) 1. John left $\Rightarrow \lambda t\ [t < now \wedge leaves(j, t)]$
2. in August $\Rightarrow \lambda P_t\ \lambda t_2\ \exists t_3[P_t\ (t_2)\ \&\ t_2 \subseteq t_3 \wedge August(t_3)]$
3. in 2008 $\Rightarrow \lambda P_t\ \lambda\ t_2\ [P_t\ (t_2) \wedge t_2 \subseteq 2008]$
4. John left in August $\Rightarrow$
$\lambda t\ \exists t_1[t < now \wedge leaves(j, t)\ \&\ t \subseteq t_1 \wedge August(t_1)]$
5. John left in August in 2008 $\Rightarrow$
$\lambda t\ [\exists t_1[t < now \wedge leaves(j, t) \wedge t \subseteq t_1 \wedge August(t_1)] \wedge t \subseteq 2008]$
6. The sentence is true iff there is a time t_3 such that
$[\![\lambda t[\exists t_1[t < now \wedge leaves(j, t) \wedge t \subseteq t_1 \wedge August(t_1)] \wedge t \subseteq 2008]]\!]\ (t_3) = true$

Stump's account is not without problems. Bäuerle (1978) shows that special frequency adverbials like *exactly three times* are not compatible with a separately introduced existential quantifier. In other words, if an existential quantifier must be introduced in addition to overt frequency adverbials like *exactly three times*, we cannot account for the semantics of sentences like (19a). This is shown in (20a, b). Note here that $\exists_3!$ is defined as a special existential quantifier that indicates the existence of exactly three objects. (20a), which Stump's theory predicts, gives us the wrong truth condition because even when (19a) is true, one can choose an interval t within yesterday such that t contains exactly two events of John's sneezing. In other words, we would incorrectly predict that (19a) entails (19b) because (20a) entails (20b). On the other hand, (20c) is never true because when there is at least one event of John's sneezing yesterday, there are infinitely many times t within yesterday such that an event of John's sneezing occurs within t.

(19) a. John sneezed exactly three times yesterday.
b. John sneezed exactly twice yesterday.

(20) a. $\exists t[\exists_3!t'[t < now \wedge t' \subseteq t \wedge sneeze(j, t') \wedge t \subseteq yesterday]$
b. $\exists t[\exists_2!t'[t < now \wedge t' \subseteq t \wedge sneeze(j, t') \wedge t \subseteq yesterday]$
c. $\exists_3!t'[\exists t[t < now \wedge t \subseteq t' \wedge sneeze(j, t) \wedge t' \subseteq yesterday]$

In order to account for its semantics correctly, one needs to suppress the existential closure operation. Ogihara's (1996) solution is to "nullify" the existential quantifier force of the external existential quantifier in (20a) by equating **t′** and **t** as shown in (21).

(21) $\exists_3!t'[\exists t[t < \text{now} \wedge t=t' \wedge \text{sneeze}(j, t) \wedge t' \subseteq \text{yesterday}]$

This works, but it is admittedly ad hoc. In addition, this account is untenable under Stump's theory because an existential quantifier is introduced as part of the truth definition and is required to be the outermost quantifier.

Ogihara (1994) notes another potential problem that involves adverbials, which is that NPs (or PPs) that quantify over temporal intervals do not have scope over tense morphemes (assuming that tense introduces an existential quantifier over past times). The relevant examples are given in (22).

(22) a. John dated Mary every Sunday.
b. John got up at 6 a.m. every morning.

The problem is that (22a) cannot mean that every Sunday t is such that t is within the contextually salient past time T and John dates Mary at t. This is simply because not every Sunday is located in the past of the utterance time. In order to provide a good truth condition, one must assume that the adverbial *every Sunday* denotes a set of Sundays that are located in the past. One possible explanation of this fact is to adopt the view that any DP denotation is restricted by the contextual information. This is the view expressed by von Fintel (1994), Stanley & Szabó (2000) and others. The DP *every student* in (23) does not involve all students in the world on its most natural reading. Similarly, *every Sunday* in (22a) should be interpreted in such a way that it involves a relevant set of past Sundays. The idea is that in order for (22a) to be true, the relevant Sundays have to be located in the past. This is the only way to make sense of the claim made by (22a).

(23) Every student passed the test.

Ogihara (2006) notes, however, that even in examples like (24), the relevant meetings have to be restricted to past ones and that this fact cannot be accounted for in terms of pragmatics alone. For example, assume that the context restricts the relevant meetings to a set of some future meetings. Assume further that there is a past event of Mary's kissing John. If so, it is true that for each relevant meeting, there is an event of Mary's kissing John prior to it and (24) is predicted to be true on this scenario. However, this is not consistent with our intuitions. This indicates that a temporal adverbial in a sentence in the past tense is somehow required to describe past times even if this is not absolutely necessary to make the sentence true. But, then, the question is how we ensure that this happens in a principled manner.

(24) Mary kissed John before every meeting.

Ogihara's (2006) solution is to provide a covert adverbial *in the past* as the anchor of a cascade of temporal adverbials. For example, (22a) is assumed to have an underlying sentence of the form in (25). In reality, the relevant Sundays must be more restricted in

that they are presumably a proper subset of the set of Sundays in the past. But the point is that a covert or overt adverbial that restricts the denotation of *Sunday* must be one that indicates a past interval.

(25) John dated Mary every Sunday (in the past).

This proposal stems from the fact that overt adverbials like *in the past* do occur in English sentences in the past tense as in (26). (26) is found on the web (http://www.nineplanets.org/mars.html). The bold-facing is due to the present author.

(26) However, data from Mars Global Surveyor indicates that Mars very likely did have tectonic activity sometime **in the past**.

Assuming that *in the past* means what it literally means, we wonder what the past tense morpheme itself means. If past tense also meant 'in the past', then we would have two expressions that have the same (or almost the same) interpretation in sentences like (26). Depending upon how the two sources of anteriority interact, it is possible that this redundancy could result in the wrong truth conditions. Thus, Ogihara (2006) concludes that the past tense morpheme itself does not produce a past time information. The way anteriority information is introduced is that there is an overt or covert adverbial *in the past*. In (22a) the temporal PP *every Sunday* is followed by a covert adverbial *in the past*, which would correct the problem mentioned above. As for the role of tense morphemes, they require the presence of relevant temporal adverbials. For example, we can entertain the hypothesis that a past tense morpheme has no semantic contribution to make and, instead, requires the presence of a past-oriented temporal adverbial. This is presumably accomplished by a syntactic feature. For example, one could require that a past tense morpheme have a [+past] feature that must agree with a temporal adverbial that bears the same feature. This is similar in sprit to Bäuerle's discussion of adverbials like *exactly once*. It is also arguable that Dowty's (1979) strategy of introducing a tense syncategorematically (see above) formalizes the same idea that I am proposing here.

4. Tense in embedded contexts

Tense morphemes in embedded contexts behave in different ways in different languages. Among the many different types of embedded clauses, verb complements and relative clauses have been dealt with extensively in the literature. In this section, I shall concentrate upon verb complements. Regarding the behavior of tense morphemes in other types of embedded clauses, the reader is referred to such works as Abusch (1997) and Ogihara (1996).

Enç (1987) argues with Partee (1973) that the time a verb complement clause talks about is a particular time in the same sense that a referential pronoun denotes a particular individual. For example, (27a) is analyzed as in (27b) in the syntax. The important point here is that the matrix clause tense and the verb complement tense are occurrences of the same tense (i.e., past) and are coindexed. As a result, the coindexed tenses denote the same time.

(27) a. John said that Mary was pregnant.
b. John said$_1$ that Mary was$_1$ pregnant.

According to Enç, the embedded past tense *was* (or its index 1) denotes a contextually salient time located earlier than the utterance time. Enç argues for the view that a past tense morpheme in English is either indexical (i.e., denoting a past time in relation to the utterance time) or anaphoric (i.e., refers to the same time as a "local" tense). The term indexical is used to describe an expression whose denotation depends upon the context of use. This hypothesis makes the right prediction with examples like (27a, b). Since the matrix clause tense with index 1 obtains its denotation in relation to the utterance time, the embedded past tense with the same index 1 also denotes a time prior to the utterance time. This reading is intuitively acceptable and is referred to as a **simultaneous reading**. On the other hand, examples like (28), which contain multiple embeddings with a future auxiliary *would* in the intermediate clause, defy an indexical analysis of English tenses. The example is due to Abusch (1988) and is inspired by a similar example in French discussed by Kamp & Rohrer (1984).

(28) Mary decided a week ago that she would say to her mother in ten days at breakfast that they were having their last meal together.

On the most natural interpretation of (28), the time of their having their last meal together is cotemporaneous with the time of her saying to her mother. Given the adverbials in the sentence, this time is located later than the utterance time. Nevertheless, a past tense occurs in the lowest clause, which describes the time of their last meal. Thus, the lowest past tense (i.e., *were*) is not an indexical past tense. If the *would* in the intermediate clause is the past tense form of the future auxiliary, which we assume it is, the past tense is presumably coindexed with the matrix clause tense. This analysis is reasonable assuming that the tense on *would* indicates the time from which the future meaning of the auxiliary computes its meaning. That is, we predict that the time of her saying to her mother is located later than the deciding time. But the lowest past tense morpheme in (28) cannot possibly be indexical or anaphoric because it does not denote a time prior to the utterance time and cannot denote the same time as the time of deciding. Thus, the natural interpretation of (28) is not accounted for by Enç's proposal.

Before we discuss a solution to the problem, we shall turn to some relevant Japanese data. Unlike English, Japanese verb complement clauses have present tense (or perhaps no tense) for simultaneous readings even when the matrix clause is in the past tense. This is shown in (29a). In (29a) the complement clause is in the present tense, and the entire sentence receives a simultaneous interpretation. This is surprising from the viewpoint of English because a past tense is used in the same circumstance in English for the same meaning. But the verb complement clause in (29a) is not a quotation. Note that the embedded clause contains a reflexive pronoun *zibun* 'self' which can (and must) refer back to the matrix subject *Taro* in this instance, and yet, it cannot be used in a direct quote to indicate the speaker as shown in (29b). The correct direct discourse form is given in (29c). Thus, we should assume that the complement clause is an indirect discourse form on a par with an English sentence like (27a).

(29) a. Taroo-wa zibun-ga byooki-da to it-ta.
Taro-TOP self-NOM be-sick-PRES that say-PAST
'Taro said that he (himself) was sick.' (simultaneous)

b. # Zibun-ga byooki-desu.
self-NOM be-sick-PRES
Intended: 'I am sick.'

c. Watasi-wa byooki-desu.
I-TOP be-sick-PRES
'I am sick.'

It should be clear to the reader by comparing Japanese and English verb complement clauses that a present tense occurs in Japanese where a past tense is required in English. Traditionally, the fact that past tenses occur "in sequence" in examples like (27a) and (28) is referred to as a sequence-of-tense phenomenon. From the descriptive point of view, the basic issue is how to account for the discrepancy in tense forms between direct discourse and indirect discourse in English when the matrix clause is in the past tense. For example, (27a) expresses the same temporal relations as the direct discourse variant in (30). Note that in (30) the complement clause is in the present tense rather than in the past tense.

(30) John said, "Mary is pregnant."

Traditional grammarians explain the above facts in terms of an implicit conversion process that changes a present tense in the direct discourse variant to a past tense in the indirect discourse variant. This enables us to obtain indirect discourse forms from direct discourse forms. This also gives us a hint as to how to deal with the semantics correctly. We can (and in fact should) assume that direct discourse forms are primary and suited for semantic interpretation, and indirect discourse forms are derived forms which are required for non-semantic (perhaps syntactic) reasons. This is indeed the view that Ogihara (1996) espouses in his treatment of English and Japanese tense phenomena. This view is in agreement with Abusch's (1988, 1997) proposal about the semantics of attitude verbs such as *believe* and *think* (though there are some differences in detail). The basic idea is that the tense forms of verbs in verb complement clauses in English are not directly subject to semantic interpretation. Technically, the discrepancy between English and Japanese regarding tense forms in verb complements is dealt with by a sequence-of-tense rule in English, which deletes in the syntax a tense morpheme under identity with the immediately higher tense. This can be shown in (31), which indicates how the sequence-of-tense rule applies to (28). In (31), the future auxiliary is indicated by the form *woll*, which is assumed to be the underlying form shared by *will* and *would*.

(31) 1. Mary decided a week ago that she would say to her mother in ten days at breakfast that they were having their last meal together.
2. Mary PAST decide a week ago that she PAST woll say to her mother in ten days at breakfast that they PAST be having their last meal together.
3. Mary PAST decide a week ago that she ~~PAST~~ woll say to her mother in ten days at breakfast that they ~~PAST~~ be having their last meal together.

The two PASTs that are struck through are assumed deleted. The deleted tenses are understood to be "null tenses" and are interpreted as such. How exactly this is done

is shown in the rest of this section. The reader is also referred to Higginbotham (1995, 2002), who also deals with the sequence-of-tense phenomena and presents a view that slightly diverges from the position discussed above.

Let us now turn to the various accounts of the semantics of attitude reports. The semantic study of attitude verbs has played an important role in the development of formal semantics. It is clear that an attitude verb creates an intensional context in that the verb's denotation cannot be a relation between individuals and truth values. Otherwise, we would not be able to account for the fact that given two true statements, one and the same individual can have different attitudes toward them. For example, it is possible for (32a) and (32b) to have different truth values.

(32) a. John believes that Washington, D.C. is the capital of the U.S.
b. John believes that Austin is the capital of the State of Texas.

So it was proposed that we need the proposition associated with the complement clause (i.e., its intension) as the object of the attitude (Frege 1892). A proposition could be formalized either as a set of worlds or a set of world-time pairs in more recent work in formal semantics. If the time specified by the past tense in the complement clause is assumed to be a referential expression and denotes a particular time as in Enç's (1987) proposal, then it would be sufficient for the object of attitude to be a set of worlds. Let us repeat the example (27) as (33) here and discuss its semantics. Assuming that (33a) is indexed as in (33b), Enç's proposal leads to an analysis of (33b) in which John stands in the saying relation to the proposition given in (33c) at $g_c(1)$ (where g_c is the assignment function provided by the context) in the actual world. The assumption is that $g_c(1)$ is a past time that is salient in the context.

(33) a. John said that Mary was pregnant.
b. John said_1 that Mary was_1 pregnant.
c. $\{w \mid \text{Mary is pregnant at } g_c(1) \text{ in } w\}$

It is now important to specify truth conditions for sentences like (33b). Hintikka (1969) proposes that the attitude holder (i.e., the subject) at any world-time pair has access to a specific set of worlds. For example, in the case of the verb *believe*, the attitude holder has access to a set of possible worlds that are intuitively those that are consistent with what s/he believes in the actual world. Since the verb used in (33a) is *say*, this must be adjusted in the following way: the attitude holder has access to a set of possible worlds that are intuitively those that are consistent with what s/he says in the actual world. This type of semantic adjustment must be made for each complement-taking verb being used, e.g., *think*, *doubt*, *hear*, etc. According to this analysis, the content of what the subject said in the actual world at t_1 can be paraphrased as follows: Mary is pregnant at t_1 in all worlds that are consistent with what John says at t_1. Supposing that the content of what John said at t_1 in the actual world is indeed consistent with what is actually the case at t_1, we can conclude that Mary is pregnant in the actual world at t_1. Although this result appears satisfactory at first glance, it could be problematic when it is tested against some complex examples, such as the following (Ogihara 1996):

(34) When John woke up at 3 a.m., he thought that it was 6 a.m.

According to the account presented above, the pronoun *it* refers to 3 a.m., and the content of John's thinking at 3 a.m. should be presented as follows: 3 a.m. = 6 a.m at 3 a.m in all worlds consistent with what John thought at 3 a.m. Since this is a contradiction, John could not possibly think the world was that way, and so we must find a better way of analyzing the semantics of attitude verbs.

A more recent account of propositional attitude verbs that builds on Hintikka's semantics relies on Lewis' (1979) idea about attitudes. Lewis contends that expressing an attitude means self-ascribing a property. This clearly departs from the traditional idea that verbs like *believe* express "propositional attitudes" because according to Lewis, such verbs express relations between individuals and properties. Lewis himself was concerned with examples that involve properties of individuals such as (35).

(35) Heimson believes that he is Hume.

(35) describes a belief of a madman named Heimson, who thinks that he himself is Hume, which he is not. If we regard the pronoun *he* in the complement clause as a referential pronoun denoting Heimson, then the embedded proposition is a contradiction: Heimson = Hume. If the object of belief is indeed a contradiction (i.e., necessarily false proposition), then we must conclude that Heimson believes all other contradictions as well. This is clearly an undesirable conclusion and is parallel to the problem found above with (34). To correct this problem, Lewis (1979) proposes that the object of an attitude is a property and that having an attitude should be described in terms of the subject's self-ascribing a property. This type of attitude is referred to as *de se* attitude. Ignoring times, one can define a property as a set of world-individual pairs. (35) could be accounted for if we assume that Heimson stands in the belief relation to the following property: {<w,x> | x is Hume in w}. This enables us to say that Heimson stands in the belief relation to this property but not to some other property like {<w,x> | x is Aristotle in w}.

Ogihara (1996) extends Lewis' view to attitudes involving times. The account starts with the assumption (as mentioned above) that the tense morphemes found in Japanese verb complement clauses provide the "right forms" for semantic interpretation. First, let us look at the Japanese example (36). It is analyzed as in (37).

(36) Taroo-wa Hanako-ga byooki-da to it-ta.
Taro-TOP Hanako-NOM be-sick PRES that say-PAST
'Taro said that Hanako was sick' (simultaneous reading only)

(37) At some relevant past time t_1 in the actual world, Taro stands in the saying relation to the following set of world-time pairs (or "property of times"): {<w,t> | Hanako is sick at t in w}

(37) shows that the complement clause denotes a proposition which is not about a particular time. The intuition that the time of Hanako's being sick is simultaneous with the time of Taro's saying is not captured directly. Instead, we adopt Lewis' idea about *de se* attitudes, and think of a set of world-time pairs as a "property of times". (37) is then reanalyzed in terms of Taro's self-ascribing the property in question. If Taro self-ascribes the property of being located at a world-time pair <*w,t*> such that Hanako is sick at *t* in *w*, and if we assume furthermore that Taro spoke the truth, then Hanako would indeed

be sick at the time Taro spoke. To do this more technically, we should assume that in the actual world at the time of his saying, Taro has access to {<w,t> | <w, t> is compatible with what Taro says in the actual world at the time of his saying}. For Taro to self-ascribe the property of being located at a world-time pair in {<w,t> | Hanako is sick at t in w} means that this set must completely contain the set of world-time pairs to which Taro has access. If Taro spoke the truth at the time of his saying, this means that {<w,t> | <w, t> is compatible with what Taro says in the actual world at the time of his saying} contains the pair consisting of the actual world and the time of Taro's saying. On this assumption, we can conclude that Hanako would indeed be sick in the actual world at the time of Taro's saying. This accounts for the reading of (36).

We now turn to the English case, which is exactly the same except that we posit a sequence-of-tense rule that deletes past tense morphemes under identity with closest c-commanding tenses. That is, (27a) (repeated here as (38)) is analyzed as in (39). Since each lower past tense has been deleted by the time the structure is semantically interpreted, the semantic component can deal with the complement clause in (39) in the same way as the corresponding Japanese example in (36). That is, the embedded clause is a tenseless clause in (39) and is understood to denote the set of world-time pairs indicated there. If at the time of his saying John indeed has the property that he self-ascribes, then Mary is pregnant at the time of John's saying in the actual world. This is the desired simultaneous interpretation.

(38) John said that Mary was pregnant.

(39) LF: John PAST say that Mary ~~PAST~~ be pregnant
Interpretation: At a particular past time in the actual world, John talks as if he self-ascribes the property of being located at {<w,t> | Mary is pregnant at t in w}

There are cases in which a property (i.e., a set of world-time-individual triples) is needed as the denotation of the embedded clause. The case in point is (40), which presents a situation in which the agent is doubly confused in that he self-ascribes a property he does not have and that he also locates himself at the wrong time (Ogihara 1996). Suppose that Mark Chapman came to believe that if he killed John Lennon he would become John Lennon. Chapman tried to kill John Lennon by means of a time bomb and set it so that it would go off at 10 p.m. in Lennon's apartment. At 9 p.m., Chapman somehow thought that it was 10 p.m. and thought "I am now John Lennon". (40) is a report of this attitude. The property, which is the object of Chapman's thought, is given in (41). This analysis provides the right semantics for (40).

(40) At 10 p.m., Mark Chapman thought with great satisfaction that he was (finally) John Lennon now that it was 9 p.m.

(41) {<w,t,x> | x is John Lennon at t in w and t = 10 p.m.}

Let us lastly turn to a substantially different view on propositional attitude reports. Schlenker (1999, cf. article 61 (Schlenker) *Indexicality and de se)* and Anand & Nevins (2004), among others, discuss various issues involving propositional attitudes referring to languages like Zazaki, Slave and Amharic. In these languages, some nominal indexicals

such as first and second person pronouns could occur in verb complements to refer to the speaker and the hearer of the event described by the complement clause, rather than those of the utterance event depicted by the entire sentence. That is, the first and second person pronouns that occur in a verb complement clause are reinterpreted in the attitude event context as if the "speech act context" is shifted to the one in the past. This is attested in (42). In (42a) the first person pronoun is interpreted as the agent in the context of John's saying, namely John. In (42b) the first and second person pronouns are interpreted in the (fictitious) context of the window's saying to the speaker of the entire sentence. So the first person is the window and the second person is the agent of the speech act associated with the entire sentence.

(42) a. john Jägna näNN yt-lall
John hero I-am says-3 sg.m
'John says that he is a hero'

b. mäskotu al∂kkäffät∂ll∂NN alä
window I-won't-open-for-you said
'The window wouldn't open for me'

According to Schlenker (1999), Japanese is like Amharic with regard to tense morphemes in that the present and past tenses are interpreted in relation to the attitude event being reported. This is reasonable assuming that present and past tense morphemes in Japanese are (shiftable) indexical expressions. That is, Japanese present and past are indexicals (sensitive to the utterance context), and when they appear to measure their denotations from the time of the higher predicate, they are in fact interpreted in relation to the attitude context. However, a question remains as to why first or second person pronouns (*watasi* 'I', *anata* 'you', etc.) in Japanese are not shiftable.

Schlenker's proposal is based upon the idea that a so-called propositional attitude verb is a relation between individuals and contexts, though other formulations of the analysis of shiftable indexicals and logophors such as von Stechow (2002) are more similar to my proposal. According to Schlenker's proposal, *John said that* ϕ is true iff at the salient past time all contexts that are compatible with what John said are contexts in which ϕ is true. This semantic proposal for "propositional attitude verbs" manipulates contexts and are "monsters" in Kaplan's terms (1977). But then this account faces a challenge from the familiar phenomena in English and other European languages, namely sequence-of-tense and "sequence-of-person" phenomena. That is, instead of the tense morpheme and indexical pronouns that are interpreted in relation to the embedded context, English employs tense morphemes and pronouns that appear to be "anaphoric" to higher tenses and nominals, and this fact cannot be dealt with by Schlenker's proposal. It is arguable that von Stechow's proposal, which deletes presuppositions associated with indexicals, accounts for the data more naturally.

Although the monster-based approach has some intuitive appeal, it has problems, too. Ogihara (2006) discusses some of them. First, if attitude verbs are true manipulators of contexts, then we expect all relative indexicals to behave in the same way. However, even in Amharic many occurrences of indexicals are ambiguous between absolute and relative uses. For example, (43) is ambiguous between the two readings because the Amharic first person pronoun 'I' is interpretable either as the speaker of the embedded context or the speaker of the entire utterance.

(43) Situation: John said 'I like X', but Mary (she) didn't hear what the X was
m ∂ n ∂ wädalläx^{w} ∂ ndaläalsämac ∂ m
what I-like that-he-said she-didn't-hear
'She didn't hear what he_i said he_i liked' or
'She didn't hear what he_i said I liked'

This seems to weaken Schlenker's argument because this shows that only some occurrences of indexicals are shiftable. If the semantics of attitude verbs truly involves quantification over contexts, this restriction seems to be an artificial property which requires explication. This also means that even when two indexical expressions occur in the same minimal clause, it is possible for only one of them to be shifted. I made a similar point above regarding Japanese when I said that Japanese tense morphemes are arguably shiftable indexicals but first and second person pronouns are not.

Anand & Nevins (2004) propose two interesting restrictions upon "monsterous" operations in some languages:

(44) a. *Shift-Together*: The indexicals in Zazaki and Slave show shifting under certain modal verbs, but cannot shift independently.
b. Within-language variation in indexical shifting: In Slave, the same indexical shifts obligatorily, optionally, or not at all, depending on the modal verb it is under.

(44a) requires that a shifting of the context behaves like an operator in that all indexicals in structurally lower positions are affected by it. This means that a configuration given as (45) is disallowed. This point is also summarized in article 61 (Schlenker) *Indexicality and de se*.

(45) *[... attitude verb δ [... shifted indexical attitude verb ... [non-shifted indexical]]]

Although this proposal makes an interesting prediction about the behavior of nominal indexicals, it is not clear what prediction this proposal makes for tense morphemes. For example, the Japanese tenses are "shifted" in attitude contexts. For Anand & Nevins, this presumably means that the Japanese present receives a "shifted context time" reading under attitude verbs. On the other hand, the English present is assumed to refer to the utterance time even in such contexts. This appears to mean that in English tenses are not shiftable. Prima facie, this makes (44a) untestable regarding tense. In addition, the interpretation of a non-shifted tense morpheme embedded under a tensed attitude verb is not straightforward and produces what is often referred to as "double-access" interpretations as discussed by Ogihara (1995, 1996) and Abusch (1988, 1991, 1997). An example is given in (46). The verb *is*, the present tense form of *be*, occurs in the verb complement clause in (46). It does not receive a purely simultaneous reading, unlike (36). But this does not mean that the present tense verb *is* is just an unshifted indexical; the reading in question does not concern Taro's claim about Hanako's sickness obtaining at the utterance time. The reading in question, a "double-access" reading, concerns both the time of Taro's saying and the utterance time of (46). This reading requires a complex analysis, and a monster-based proposal does not seem to contribute a new perspective to this topic.

(46) Taro said that Hanako is sick.

The above discussion shows that a more traditional system in which attitude verbs quantify over a relevant set of tuples (involving such entities as worlds, times and individuals) is at least empirically adequate and is possibly superior to a monster-based approach.

Lastly, if only attitude verbs allow (some) indexicals to be interpreted in relation to shifted contexts, then it would be hard to explain the behavior of Japanese tense morphemes in relative clauses as shown in (47). The preferred reading of (47) is that the time of the man's crying is simultaneous with the time of Taro's seeing him.

(47) Taroo-wa nait-e iru otoko-o mi-ta.
Taro-TOP cry-PROG-PRES man-ACC see-PAST
'Taro saw a man who was crying.'

Since a relative clause is not embedded under an attitude verb, there is no reason that the alleged "present tense morpheme" in Japanese could be interpreted in relation to the time of Taro's seeing. As shown above, the proposal presented by Ogihara (1996) is different from Schlenker's in that Japanese present tense always means "relative present". By interpreting tenseless sentences in relation to immediately higher tenses, one can account for the "relative reading" of the relative clause tense. In sum, the recent proposals about the semantics of attitude verbs, which involve quantification over contexts, are very interesting but have some non-trivial problems.

5. Tense and modality

The interaction of tense and modality is undoubtedly an interesting area of research. The reader is also referred to article 58 (Hacquard) *Modality*. In straightforward cases, the question of possibility/probability/likelihood (modality-related issues) is independent of the question of temporal location (tense-related issues). So one could say this of any of the three in (48).

(48) a. It is possible that Mary was in the room.
b. It is possible that Mary is in the room.
c. It is possible that Mary will be in the room.

The periphrastic form *be possible* is used in (48) for an epistemic modal meaning. The speaker could be ignorant about the past, present, or future. But could she be confident or ignorant about them in the same way? Some say yes. Others are not so sure. So this is where people's opinions differ. For example, Enç (1987) assumes that *will* is a modal auxiliary and not a tense morpheme. In terms of distribution, it patterns with other modal auxiliary verbs such as *can*, *must*, etc. But more importantly, the issue here is whether natural language deals with the future in the same way as the past. Enç's (1997) position is that natural language treats the future in a way different from the past. Essentially, the future auxiliary (*will*/*would*) is understood as a mixed modal-temporal operator. According to this viewpoint, it is possible that people know about the past and the present because the facts have been established, but people cannot be sure about the future because it is not knowable. Thus, one cannot assert that something definitely

happens at a future time. This is a view influenced by pragmatic considerations and is controversial. Truthconditionally, it is arguable that the future is no different from the past. That is, a future tense sentence is true iff the state of affairs described by the sentence takes place in the future (either at a particular time or at some future time). Montague (1973) straightforwardly encodes this view.

As far as the interaction of full-fledged modal auxiliary verbs (e.g., *may, must, can*) and past tense is concerned, their interaction depends on various factors including the type of modal meaning involved and the idiosyncratic properties of each modal verb. It appears that as far as epistemic interpretations are concerned, tense forms of modal verbs do not affect the Reference time, i.e., the time under discussion. For example, *may* has what may be referred to as its past tense form, i.e., *might*; but using *might* instead of *may* does not shift the temporal location of the contextually salient time to the past. For example, (49a) and (49b) both concern the epistemic possibility that concerns the utterance time. The only difference is that (49b) makes a weaker claim than (49a). In order to talk about a past time, one must indicate the pastness in terms of the perfect as in (49c). In the case of *must*, there is no past tense form in the first place. Thus, just as in *may*, *must* requires the perfect in order to indicate a past time. (49e) concerns a salient time in the past. Turning to *can*, we also find the same pattern as shown in (49f, g, h).

(49) a. John may be around.
b. John might be around.
c. John may/might have been around.
d. John must be around.
e. John must have been around.
f. John can be around.
g. John could be around.
h. John could have been around.

On the other hand, deontic readings of modals produce different results. (50a) is impossible if it is to receive a deontic interpretation. (50b) is equally anomalous. Instead, we must use a sentence like (50c) or (50d).

(50) a. # John might smoke here. (Intended: John was allowed to smoke here.)
b. # John may/might have smoked here. (Intended: John was allowed to smoke here.)
c. John was allowed/permitted to smoke here.
d. John could smoke here.

But some future-oriented constructions lead us to suspect that tense and modality are not as independent as one hopes. I present a couple of examples that show that the way natural language encodes future information is intertwined with the way it encodes possibility and probability. First, the progressive aspect is arguably a temporal-modal operator as argued for by Dowty (1979). See also article 49 (Portner) *Perfect and progressive* about the progressive and the perfect. Dowty claims that progressive sentences like (51a, b) involve probability assessment in that a progressive sentence is true at t iff in all worlds that are exactly like the actual one up to t and develop in expected ways (called "inertia worlds") there is a time "surrounding" t at which a corresponding

sentence without the progressive is true. When the speaker sees John, who is walking on a crosswalk and moving toward the other side of the street, she can say (51a) truthfully, according to our intuitions. However, even when (51a) is true, it does not guarantee that John eventually reaches the other side of the street. As shown in (51b), John's attempt to cross the street may be interrupted by an external force. Since John was hit by the bus, he presumably did not get to the other side of the street.

(51) a. John is crossing the street.
b. John was crossing the street when he was hit by the bus.

Given the data like (51a, b), Dowty presents a theory of the progressive which is influential to this day. More recent accounts of the progressive such as Landman (1992) incorporate the temporal-modal ingredients of Dowty's proposal though some new ideas have also been incorporated.

One could say that the progressive is an aspectual operator and aspects should be distinguished from tenses. However, the special progressive form *be going to* is used to indicate a future situation as in the first sentence in (52a), which is very close in meaning to (52b). It is arguable that *be going to* is a "future tense" that offers an alternative way of talking about the future. But when the whole situation shifts to the past, a clear difference between *would* and *was going to* emerges as shown in (52c, d).

(52) a. John is going to attend the meeting.
b. John will attend the meeting.
c. John was going to attend the meeting, but the weather prevented him from doing so.
d. ?? John would attend the meeting, but the weather prevented him from doing so.

(52c) is perfectly acceptable and conveys that John intended and planned to attend the meeting. But the first sentence in (52d) conveys something more definitive. Given a contextually salient past time *t*, there is a time later than *t* at which John attends the meeting. In fact, this time must be earlier than the utterance time. For instance, for (53) to be true, the child's becoming King must be earlier than the utterance time. This shows that the interaction between modality and future-oriented thoughts is extremely complicated to say the least.

(53) A child was born who would be king.

It seems that the behavior of *would* in (52d) and (53) is consistent with the view that future tense is a tense and not a modal expression. By contrast, (52c) seems to show that *be going to* is a temporal-modal expression just like regular *be V-ing* expressions used for the progressive interpretation. This supports Dowty's (1979) view on the progressive. For a detailed analysis of *be going to*, the reader is referred to Wulf (2000).

This chapter is indebted to the following survey articles that have a similar purpose in mind: Enç (1996), Kuhn, Steve and Paul Portner, (2002). I also thank Paul Portner for his comments on an earlier version and Laurel Preston for her help with proofreading and editing.

6. References

Abusch, Dorit 1988. Sequence of tense, intensionality and scope. In: H. Borer (ed.). *Proceedings of the Seventh West Coast Conference for Formal Linguistics (= WCCFL)* 7. Stanford, CA: CSLI Publications, 1–14.

Abusch, Dorit 1991. The present under past as *de re* interpretation. In: D. Bates (ed.). *Proceedings of the Tenth West Coast Conference for Formal Linguistics (= WCCFL)* 10. Stanford, CA: CSLI Publications, 1–12.

Abusch, Dorit 1997. Sequence of tense and temporal *de re*. *Linguistics and Philosophy* 20, 1–50.

Anand, Pranav & Andrew Nevins 2004. Shifty operators in changing context. In: K. Watanabe & R. B. Young (eds.). *Proceedings from Semantics and Linguistic Theory (= SALT) XIV*. Ithaca, NY: CLC Publications, 20–37.

Bäuerle, Rainer 1978. *Temporale Deixis, temporale Frage*. Tübingen: Narr.

Davidson, Donald 1967. The logical form of action sentences. In: N. Rescher (ed.). *The Logic of Decision and Action*. Pittsburgh, PA: University of Pittsburgh Press, 81–95.

Davidson, Donald 1977. The method of truth in metaphysics. In: P. A. French, T. E. Uehling Jr. & H. K. Wettstein (eds.). *Midwest Studies in Philosophy 2: Studies in the Philosophy of Language*. Morris, MN: University of Minnesota Press, 244–254. Reprinted in D. Davidson. *Inquiries into Truth and Interpretation*. Oxford: Clarendon Press, 2001, 199–214.

Dowty, David 1979. *Word Meaning and Montague Grammar: The Semantics of Verbs and Times in Generative Semantics and in Montague's PTQ*. Dordrecht: Reidel.

Enç, Mürvet 1987. Anchoring conditions for tense. *Linguistic Inquiry* 18, 633–657.

Enç, Mürvet 1996. Tense and modality. In: S. Lappin (ed.). *The Handbook of Contemporary Semantic Theory*. Oxford: Blackwell, 345–358.

Fintel, Kai von 1994. *Restrictions on Quantifier Domains*. Ph.D. Dissertation. University of Massachusetts at Amherst.

Frege, Gottlob 1892. Über Sinn und Bedeutung ('On sense and denotation'). *Zeitschrift für Philosophie und philosophische Kritik* C, 25–50.

Higginbotham, James 1995. Tensed thoughts. *Mind and Language* 10, 226–249.

Higginbotham, James 2002. Why is sequence of tense obligatory? In: G. Preyer & G. Peter (eds.). *Logical Form and Language*. Oxford: Clarendon Press, 207–227.

Hintikka, Jaako 1969. Semantics for propositional attitudes. In: J. Davis, D. J. Hockney & W. K. Wilson (eds.). *Philosophical Logic*. Dordrecht: Reidel, 21–45.

Kamp, Hans & Christian Rohrer 1984. *Indirect Discourse*. Ms. Austin, TX, University of Texas at Austin and Stuttgart, Universität Stuttgart.

Kamp, Hans & Uwe Reyle 1993. *From Discourse to Logic: Introduction to Modeltheoretic Semantics of Natural Language, Formal Logic and Discourse Representation Theory*. Dordrecht: Kluwer.

Kaplan, David 1977. *Demonstratives: An essay on the semantics, logic, metaphysics, and epistemology of demonstratives and other indexicals*. Ms. Los Angeles, CA, UCLA. Published in J. Almog, J. Perry & H. Wettstein (eds.). *Themes from Kaplan*. Oxford, New York: Oxford University Press, 1989, 481–614.

Kuhn, Steve & Paul Portner 2002. Tense and time. In: D. Gabbay & F. Guenthner (eds.). *The Handbook of Philosophical Logic, Volume VI*, 2nd edition. Dordrecht: Reidel, 277–346.

Landman, Fred 1992. The progressive. *Natural Language Semantics* 1, 1–32.

Lewis, David 1979. Attitudes *de dicto* and *de se*. *The Philosophical Review* 88, 513–543.

Montague, Richard 1973. The proper treatment of quantification in ordinary English. In: J. Hintikka, J. M. E. Moravcsik & P. Suppes (eds.). *Approaches to Natural Language. Proceedings of the 1970 Stanford Workshop on Grammar and Semantics*. Dordrecht: Reidel, 221–242. Reprinted in R. H. Thomason (ed.). *Formal Philosophy: Selected Papers of Richard Montague*. New Haven, CT, London: Yale University Press, 1974, 247–270.

Ogihara, Toshiyuki 1994. Adverbs of quantification and sequence-of-tense phenomena. In: L. Santelmann & M. Harvey (eds.). *Proceedings from Semantics and Linguistic Theory (= SALT) IV*. Ithaca, NY: CLC Publications, 251–267.

Ogihara, Toshiyuki 1995. Double-access sentences and reference to states. *Natural Language Semantics* 3, 177–210.
Ogihara, Toshiyuki 1996. *Tense, Attitudes, and Scope*. Dordrecht: Kluwer.
Ogihara, Toshiyuki 2006. Tense, adverbials and quantification. In: R. Zanuttini, H. Campos, E. Herburger & P. Portner (eds.). *Crosslinguistic Research in Syntax and Semantics: Negation, Tense, and Clausal Architecture*. Washington, D.C.: Georgetown University Press, 231–247.
Partee, Barbara H. 1973. Some structural analogies between tenses and pronouns in English. *The Journal of Philosophy* 70, 601–609.
Partee, Barbara H. 1984. Nominal and temporal anaphora. *Linguistics and Philosophy* 7, 243–286.
Prior, Arthur N. 1957. *Time and Modality*. Oxford: Oxford University Press.
Prior, Arthur N. 1967. *Past, Present, and Future*. Oxford: Oxford University Press.
Reichenbach, Hans 1947. *Elements of Symbolic Logic*. New York: Macmillan.
Schlenker, Philippe 1999. *Propositional Attitudes and Indexicality: A Cross-Categorial Approach*. Ph.D. Dissertation. MIT.
Stanley, Jason & Zoltan Szabó 2000. On quantifier domain restriction. *Mind and Language* 15, 219–261.
Stechow, Arnim von 2002. *Binding by Verbs: Tense, Person and Mood under Attitudes*. Ms. Tübingen, Universität Tübingen.
Stump, Gregory 1985. *The Semantic Variability of Absolute Constructions*. Dordrecht: Reidel.
Wulf, Douglas 2000. *The Imperfective Paradox in the English Progressive and Other Semantic Course Corrections*. Ph.D. Dissertation. University of Washington.

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58. Modality

Abstract

Modality is the category of meaning used to talk about possibilities and necessities, essentially, states of affairs beyond the actual. This article reviews the approach to modals inherited from modal logic, in terms of quantification over possible worlds, with particular attention to the seminal work of Angelika Kratzer. In addition, it introduces more recent work on the interaction of modals with other elements, in particular with tense and subjects, which challenges classical approaches, and present new directions.