

The interpretation of tense —

I didn't turn off the stove

Toshiyuki Ogihara — University of Washington

Ogihara@uw.edu

Kiyomi Kusumoto — Kwansei Gakuin University

kusumoto@kwansei.ac.jp

Abstract

This chapter examines Partee's (1973) celebrated claim that tenses are not existential quantifiers but pronouns. In the first half of the chapter, we show that this proposal successfully accounts for the behavior of tense morphemes regarding deixis, anaphora, and presupposition. It is also compatible with cases where tense morphemes behave like bound variables. In the second half of the chapter, we turn to the syntax-semantics interface and propose some concrete implementations based on three different assumptions about the semantics of tense: (i) quantificational; (ii) pronominal; (iii) relational. Finally, we touch on some tense-related issues involving temporal adverbials and cross-linguistic differences.

Keywords

tense, pronoun, quantification, bound variable, referential, presupposition, temporal adverbial (7 key words)

1. Introduction

This article discusses the question of whether the past tense morpheme is analogous to pronouns and if so how tense is encoded in the system of the interfaces between syntax and semantics. The languages we will deal with in this article have tense morphemes that are attached to verbs. We use

this type of language as our guide and model. Whether tense is part of natural language universals, at least in the area of semantic interpretation, is debatable.¹

Montague's PTQ (1973) introduces a formal semantic system that incorporates some tense and aspect forms in natural language and their model-theoretic interpretation. It introduces tense operators based on Prior's (1957, 1967) work on tense logic. (1a, b) are sentences in Montague's Intensional Logic (IL) adopted in PTQ.

- (1) a. H [Arrive (m)] — There is a past time t such that Mary arrives at t
b. W [Arrive (m)] — There is a future time t such that Mary arrives at t

As shown in English paraphrases, the semantic interpretation of (1a) involves unrestricted existential quantification over past times. Similarly, (1b) involves unrestricted existential quantification over future times. In PTQ, the operator H in (1a) translates the present perfect form in English, and the operator W in (1b) translates the future auxiliary form (*will*).

Despite the fact that Montague adopts the operator H to account for the meaning of the English present perfect, it is often assumed in the linguistics literature that an operator approach to tense translates the English past tense morpheme (*-ed*). Let us, therefore, assume for the sake of argument that (2a, b) are translated as in (1a, b) and see if this hypothesis is empirically justifiable.²

- (2) a. Mary arrived.

¹ The reader is referred to Bittner (2005), Matthewson (2006), Lin (2006, 2012), Bohnemeyer (2009), Tonhauser (2011, 2015), Mucha (2012), and the Tenselessness article in this volume for relevant works.

² In published work, Montague's operator H is often replaced by P and is assumed to translate the English past tense morpheme *-ed*. Dowty, Wall and Peters (1981) use P instead of H without changing its semantics.

b. Mary will arrive.

We would like to make a side remark here about past tense. The anteriority meaning associated with past tense sentences is inherently relational in that we regard some time as a past time only with regard to some other time, which we might call an EVALUATION TIME. The default ‘evaluation time’ is of course the utterance time of the sentence under consideration. Suppose that Mary’s arrival occurs at 3:00 p.m., May 26, 2014 and no other time. Knowing this alone does not let us decide whether (2a) is true. In order to determine its truth value, we need to know when this sentence is uttered. If it is uttered in June 2014, it is true. On the other hand, if it is uttered in April 2014, it is false. That is, no time is inherently past, present, or future. This point is especially important for a theory that assumes that tense morphemes are referential expressions denoting times and that their temporal orientation information (past, present, or future) is presuppositional. The reader is referred to Section 6 for discussion of this topic.

Montague’s formalization of tense operators suggests that H and W are mirror images of each other, and a sentence in the present is simply a sentence with no tense operator. This is hardly the standard view regarding natural language tense morphemes, however. For the purpose of this article, we will concentrate on languages that have overt tense morphemes, and, moreover, we will focus on past tense. Regarding the future, we ask that the reader refer to the article in this volume on ‘Reference to future events: Sea battles.’

Some examples of past tense sentences in English indeed appear to receive a simple existential quantifier interpretation.³ For example, (3a) can be used to introduce Kent to someone and to show that Kent has a very appealing educational background. Similarly, (3b) is used to show who discovered America, rather than paying attention to when that happened. For example, (3b) could answer the question: Who discovered America? In both cases, no particular past time is

³ It will be shown later that German sentences in the past tense do not receive existential quantifier interpretations.

under discussion, and (3a, b) introduce the two relevant past events "out of the blue" without specifying exactly when they took place.⁴ (3c) indicates multiple events of creation, and there is no definite reference to a past time.⁵

- (3) a. Kent graduated from Harvard.
b. Columbus discovered America.
c. God's children were created evil.

It is arguable that the examples (3a-c) receive interpretations representable with unrestricted existential quantification over past times. However, we also find many example sentences in English that cannot be accounted for by this analysis, which led some linguists (e.g. Partee (1973, 1984), Enç (1986, 1987) and Zagona (2002)) to claim that tense morphemes are like pronouns and not like tense operators.

In Sections 2 through 5, we will first examine several alleged parallels between pronouns and tenses without paying attention to the formal details of compositional semantics. In so doing, we will try to come to a tentative conclusion about how tense morphemes should be analyzed semantically, taking into consideration the similarities and differences between pronouns and tense morphemes. Having done that, we will turn to a search of an optimal syntax-semantics interface set-up for the past tense morpheme. Section 7 briefly discusses the interaction of tense morphemes and temporal adverbials. Finally, we will examine cross-linguistic issues.

2. Deictic uses of tenses and pronouns

What is the semantic contribution of a tense morpheme (in particular, a past tense morpheme)?

⁴ Kuhn and Portner (2002) cite (3b) (among others) to make the point that some sentences in the simple past tense do not necessarily make a definite reference to a past time.

⁵ We thank a SemCom reviewer for calling our attention to (3c).

How is a tensed sentence interpreted? These questions were asked by many authors in the past and are still being asked by modern researchers as well. Partee's (1973) example in (4) led her to claim that tense morphemes in English are like pronouns.

(4) I didn't turn off the stove.

According to Partee's scenario, (4) is uttered by the speaker while driving on the turnpike and conveys her sudden realization that she left home without turning off the stove. Partee points out that the intuitive interpretation of (4) cannot be obtained by assuming that a past tense sentence involves unrestricted existential quantification over past times. In other words, the semantic interpretation of *H* in Montague's PTQ directly applied to the English past tense morpheme does not account for the intuitive interpretation of (4). (5a, b) show the two possible interpretations that are based on this assumption. We adopt here the symbol *P* for corresponding to past tense, instead of *H* used by Montague.

(5) a. *P* [NEG [turn-off (I, the-stove)]]

'There is some past time at which I did not turn off the stove.'

b. NEG [*P* [turn-off (I, the-stove)]]

'It is not the case that there is a past time at which I turned off the stove.'

(5a) shows that Past has scope over negation and is trivially true because nobody spends every second of their life turning off the stove. (5b) indicates the structure in which the negation has scope over Past. This is presumably false because the reading can be paraphrased informally as 'I have never turned off the stove in my entire life'. This is very unlikely to be true. Even if it is true, it does not correspond to the reading that (4) receives in the situation under discussion. Intuitively, (4) means that the speaker should have turned off the stove shortly before she left home but she failed to do so. Partee assumes that the past tense morpheme denotes a time and indicates the time

of the event or state indicated by the verb. On this assumption, the past tense morpheme behaves like a pronoun in that the time it denotes is a specific past time assigned by the context of utterance.

To make clear the point made by Partee in a more straightforward fashion, let us use a past tense sentence without negation and compare it with a simple sentence containing a deictic pronoun as in (6a, b).

- (6) a. He is cute!
b. I saw my mom!

Assume that the pronoun *he* in (6a) is used deictically. For example, the speaker can utter this sentence when she points at an attractive male person walking by her car. In this case, the pronoun *he* clearly refers to the attractive male passerby.

Regarding (6b), consider the following scenario. When the speaker was in his classroom at a local elementary school, he suddenly saw his mother through the window but she walked away without looking at him. He did not expect to see his mother at school. So he uttered (6b) to express his surprise. In this situation, the speaker was clearly referring to the moment shortly before the utterance time, and he is not making an existential assertion about past times. Assuming that the speaker lives with his mother, there are countless past moments when he saw his mother. Thus, it is not reasonable to make an existential assertion about a past time of his seeing his mother. It is more reasonable to assume that the speaker is implicitly referring to a particular moment *t* shortly before the utterance time (perhaps given by the context of utterance) and asserts that he saw his mother at *t*. Technically, in both (6a) and (6b), the expression in question is a free variable and obtains its denotation from the information available from the context. Schematically, (6a, b) are represented semi-formally as in (7a, b).

- (7) a. *x* is cute (where *x* denotes a male individual and the denotation of *x* is given by the utterance context)

- b. I see my mom at t (where t denotes a past time and the denotation of t is given by the utterance context)

The context assigns an appropriate value to x in (7a) and to t in (7b). The main difference is that the variable x in (7a) receives a person as its value, whereas the variable t in (7b) obtains a time interval as its value. The information contained in parentheses in (7a, b) is generally regarded as a presupposition. That is, pronouns convey information about gender and this is often assumed to be a presupposition. Similarly, the past tense morpheme must denote a past time, and this is also assumed to be a presupposition. This issue will be discussed at length in Section 6.

Partee (1973) cites the example in (8) to show that so-called “deictic pronouns” do not have to involve a pointing action to make some relevant entity salient and argues that the use of the past tense morpheme in (4) is similar.

- (8) [Uttered by a man sitting alone with his head in his hands]: She left me.

According to Partee, when (4) is uttered in an out-of-blue situation, the time referred to by the past tense morpheme is determined in a way analogous to the pronoun in (8). The time when the speaker should have turned off the stove but did not is salient in the context and is denoted by the past tense morpheme. Partee argues that the past tense morpheme in (4) is a deictic expression though no pointing action is involved.

If tense morphemes are really like pronouns, then we should also be able to find anaphoric uses of tense morphemes like anaphoric pronouns. We also predict that just like bound variables pronouns, tense morphemes can be bound by quantifiers and operators. We will discuss alleged anaphoric uses of tense in Section 3 and bound variable uses of tense in Section 4.

There is no doubt that Partee (1973) made a very important theoretical and empirical point. (4) does not receive a reading associated with an *unrestricted* existential quantifier over past times as indicated by (5a) and (5b) above. In order to obtain a correct interpretation of a past tense

sentence such as (4), one must restrict attention to a specific past tense interval, rather than all past times. The information about the salient past interval must be supplied by the utterance context. These points are valid and non-controversial. However, it is premature for us to conclude from the above discussion that tense morphemes are exactly like pronouns. We will compare tense morphemes and pronouns in detail in Sections 3 through 5.

3. Anaphoric uses of tenses and pronouns

In this section, let us consider cases in which pronouns and tense morphemes allegedly obtain denotations through linguistic antecedents (i.e., through anaphora). Kamp and Rohrer's work on tense in discourse (Kamp and Rohrer, 1983) made an important contribution regarding this issue. The reader is also referred to Hinrichs (1986), Kamp and Reyle (1993), and Altshuler (2010) for more recent work. The basic idea behind their work is that the interpretation of tense in a particular sentence is obtained through the information available from the discourse in which it is embedded.

First, consider the pronoun examples given in (9a, b). Each short discourse contains an occurrence of a pronoun in the second sentence that refers back to a name in the first sentence. In (9a), *him* refers to John; in (9b), *she* refers to Mary. That is, the denotation of each pronoun is exactly the same as that of its antecedent. In other words, we can say literally that each pronoun is co-referential with its antecedent.

- (9) a. **John** entered the room. Mary looked at **him**.
 b. **Mary** is kind. **She** takes care of all of her siblings.

We shall show that alleged instances of tense anaphora are substantially different from those involving pronouns. Kamp and Rohrer made clear that in a typical narrative discourse an event sentence “moves the narrative time forward” in that the event it (or its tense morpheme) indicates is located slightly after the one indicated by the previous sentence, whereas a state sentence “does not move the narrative time forward” in that it temporally overlaps the event given by the previous

sentence. This is shown in the discourse example in (10) cited by Partee (1984). In (10), e_1 through e_5 indicate events, and s_1 through s_3 states. For example, e_1 indicates John's getting up, and e_2 indicates his going to the window, etc. Events and states are not time intervals themselves but have temporal extensions.⁶ The idea here is that the tense morpheme in a sentence denotes a time which is the temporal extension of the event or state that the sentence describes, and this information is obtained through the anaphoric relation between the time in question and the time referred to by the tense morpheme in the preceding sentence. If so, the interpretation procedure is similar to that of nominal anaphora.

(10) John got up, went to the window, and raised the blind. It was light out.

e_1 e_2 e_3 s_1

He pulled the blind down and went back to bed.

e_4 e_5

He wasn't ready to face the day. He was too depressed.

s_2 s_3

In (10), e_2 is understood to follow e_1 . To be more concrete, John's going to the window occurs after his getting up occurs. Since we assume that the past tense in *got* denotes a particular past time (or event), we would expect the past tense in *went* to refer to the same time as the time of John's getting up. However, this is not the case. The time of going to the window is immediately after the time of getting up. The major point here is that there is no strict co-reference between occurrences of past tense morphemes in discourse unlike the case of anaphoric pronouns. Thus, we must add a caveat to Partee's (1973) idea about the similarity between pronouns and tenses. Partee (1984)

⁶ The temporal extension of an event or state is the (maximal) interval that it occupies. We can alternatively use the terms *temporal duration* or *temporal trace* of an event or state to represent the same idea.

acknowledges this difference between pronouns and tense morphemes and says that the behavior of tense morphemes is such that “it would be as if pronouns referred to the father of the last mentioned individual.”

A related point that Kamp and Rohrer (1983) and Hinrichs (1986) made is that the ways in which tense morphemes obtain their denotation from the context depend partially on the distinction between event and state sentences. When the sentence in question is an event sentence, the new time associated with the past tense morpheme is normally a time that is just after the time given by the preceding sentence. On the other hand, when the sentence in question is a state sentence (a sentence that describes a static situation), the time in question is understood to overlap the time of the preceding sentence. For example, the relationship between s_2 and s_3 in (10) is such that their temporal extensions overlap. Thus, if the temporal location of an event or state is indicated by the denotation of the tense morpheme, we must conclude that there are two different ways in which tense anaphora works. An event sentence refers to the time immediately after the time indicated by the preceding sentence, whereas a state sentence refers to a time that overlaps the time indicated by the preceding sentence. This is not what we find with pronouns. The use of a pronoun is not affected by the aspectual property of the sentence of which it is part.

In fact, we believe that the crucial difference between pronouns and tense morphemes in anaphoric (and non-quantificational) cases is that pronouns always refer back to entities that are already introduced, whereas tense morphemes “float” or “move” in that they usually introduce eventualities (events or states) whose temporal extensions are not the same as those of preceding eventualities. With this short summary, let us temporarily leave the topic of anaphora in pronouns and tenses and shift our attention to bound-variable cases.

4. Pronouns and tenses as bound variables

The proposal made by Kamp and Rohrer (1983) and Hinrichs (1981) is couched in a discourse-based semantic theory called Discourse Representation Theory (DRT) (Kamp 1981,

Heim 1982). For example, the discourse (10) is represented as in (11) (cited again from Partee 1984).

(11)

e_1	e_2	e_3	e_4	e_5	s_1	s_2	s_3	r_s
$e_1 < e_2 < e_3 < e_4 < e_5 < r_s$								
John get up (e_1)								
:								
John go back to bed (e_5)								
$s_1 \circ e_3$								
$s_2 \circ e_5$								
$s_3 \circ e_5$								
It be light out (s_1)								
:								
John be too depressed (s_3)								

The symbol r_s indicates the utterance time. The symbols e and s with subscripted numbers indicate event and state discourse referents.

(11) is semantically interpreted in such a way that the event and state variables introduced in it are mapped to actual events and states that satisfy the temporal precedence and overlap relations (indicated by $<$ and \circ , respectively) specified in it. Since the mapping function has the effect of introducing *some* relevant entity that satisfies all the conditions imposed on each variable, this is tantamount to having an existential quantifier if translated into a traditional logical system. Since both pronouns and eventuality variables (events and states) are mapped to actual entities in a

parallel fashion, DRT formally establishes a parallel between pronouns and variables: they are variables that could be bound by covert existential quantifiers.

There are some occurrences of anaphoric pronouns that are clearly not referential. DRT's formalism makes a great deal of sense in such cases because they can be accounted for as instances of two occurrences of the same variable existentially closed at the discourse level. This is shown by the example in (12). If this is the beginning of a novel, the reader knows of no specific individual that serves as the protagonist. It feels as if the indefinite DP *a man* introduces an actual and specific male person, but this is more impressionistic than real. Despite the absence of a concrete individual that the DP denotes, we are allowed to use the pronoun *he*, which is anaphorically linked to a *man*.

(12) **A man** entered the tavern. **He** ordered a beer.

DRT represents (12) as in (13). The indefinite DP *a man* introduces a new variable x , and this variable is picked up by the pronoun *he*, which occurs in the next sentence. The representation (13) must be verified in that we have to find individuals corresponding to x and y that satisfy the conditions specified in (13). This process amounts to introducing an existential quantifier over the variables x and y .

(13)

x y
man (x)
enter (x , the_tavern)
x ordered y
beer (y)

The representation in (13) mirrors the intuitions of native speakers well since it simultaneously represents the anaphoric nature of the pronoun *he* and the existential quantifier interpretation of the pronoun (as well as the indefinite description *a man*). Tense morphemes could also receive existential quantifier interpretations as we saw above. However, even in such cases, “tense anaphora” is not exactly like that of pronouns in that tense morphemes rarely indicate the same time referred to by the tense morpheme in the preceding sentence.

We can also find examples in which pronouns and tenses are caught by universal quantifiers. Consider (14a, b).

- (14) a. **Every boy** looked at **himself** in the mirror.
b. Whenever I **went** to D.C., I **visited** the Smithsonian Museum.

The examples in (14a, b) are arguably similar. However, unlike the pronoun case in (14a), each event of my going to D.C. and the matching event of my visit to the Museum in (14b) may not have exactly the same temporal extension. Again, the analogy between pronouns and tenses is only loosely valid. We can find clearer examples of temporal mismatches between the antecedent event and the consequent event with cases like (15a, b), which feature the temporal conjunctions *before* and *after*.

- (15) a. Mary always called Bill before she paid him a visit.
b. Mary always cried after she saw a sad movie.

With *before* and *after* clauses, each pair of events must be ordered with respect to each other and cannot have the same temporal extension. This does not happen with pronouns. Thus, the existence of examples like (15a, b) confirms subtle but genuine differences between pronouns and tense morphemes (assuming that they behave like temporal variables). Examples like the above are discussed by Partee (1984) herself.

5. Tenses and pronouns as presupposition-bearing expressions

Another alleged parallel between tense morphemes and pronouns is that they both carry presuppositions. It is often assumed that the gender information about pronouns is presuppositional. For example, consider (16).

(16) Scenario: The new employee is female. John knows that, but Bill thinks that the new employee is male. John thinks that she is coming today.

Bill: I would like to meet our new employee. Is he coming today?

John: # No, I don't think he is coming today.

Bill is not asking John to answer whether the following is true: x is male and x is coming today (where x receives as its value the new employee). Rather Bill assumes (i.e., presupposes) that the new employee is male and asks whether the following is true of this individual: x is coming today. Therefore, it is reasonable to interpret John's answer in the following way: (i) John accepts Bill's assumption that the new employee is male, and (ii) he expresses his opinion which is that this new employee (who is assumed to be male) is not coming today. If the new employee is coming today, but this individual is female, John must answer in a different way. For example, (17) is one possibility. John should correct Bill's misunderstanding first, and then try to answer the question that Bill intended to ask.

(17) John: Actually, the new employee is female. But, yes, she is coming today.

Formally, we could say following Heim and Kratzer (1998) that (i) she_I , for example, has a denotation only if for the assignment g_c provided by the context c , $g_c(1)$ is female, and (ii) if this condition is met, she_I denotes $g_c(1)$.

If tense morphemes are temporal variables and the information having to do with their temporal orientation is presuppositional, we can encode this information in a similar manner. For example, one can say that (i) a past tense morpheme $-ed_2$ has a denotation only if $g_c(2)$ is a past time, and (ii) when the condition given in (i) is satisfied, $-ed_2$ denotes $g_c(2)$.

Let us discuss a concrete example. (18a) is syntactically analyzed as in (18b). (18b) presupposes that $PAST_1$ denotes a past time. Formally, $g_c(1) < \text{now}$. When this condition is satisfied, it is true *iff* Mary arrives at the time denoted by $PAST_1$. Formally, Mary arrives at $g_c(1)$.

- (18) a. Mary arrived.
b. [$PAST_1$ [Mary arrive]]

We can test this presuppositionality hypothesis by using a question/answer pair. Consider the conversational exchange between Sue and Karen in (19).

- (19) Scenario: Sue thinks that Karen planned to give Mary a surprise present last night. In fact, the plan was and is that Karen will give Mary a surprise present tomorrow.
Sue: How was it? Was Mary pleased with your present?
Karen: # No, she wasn't.

The conversational exchange in (19) is odd. If the anteriority of the event being described in the sentence is not presupposed, then Sue's question can be understood as in (20).

- (20) If **yesterday evening** is the value of t in the following sentence, is it true?
 t is before now & Mary is pleased with Karen's present at t

Karen's answer should then be a natural and true response to Sue's question. However, Karen's response is actually nearly anomalous in the scenario assumed here. Thus, we assume that (19)

must presuppose that there be a particular past time under discussion and that this cannot be part of its assertion.

If past tense is like a pronoun and carries with it an anteriority presupposition, this presupposition is preserved when the tense (i.e., the time variable) is bound by a quantifier. This is shown through the example (21).

(21) Mary arrived at some time.

Here, we rely on the general presupposition projection rule for a quantificational structure suggested by Heim (1994): everything that verifies the restriction must also satisfy the presupposition of the nuclear scope. This is described concretely in (22).

(22) $\llbracket \text{some time } \lambda t \llbracket \text{PAST}_1 \llbracket \text{Mary arrive} \rrbracket \rrbracket \rrbracket^{g_c}$ is defined only if for any time t_3 such that $\llbracket \text{time} \rrbracket^{g_c}(t_3) = 1$, $\llbracket \lambda t \llbracket \text{PAST}_1 \llbracket \text{Mary arrive} \rrbracket \rrbracket \rrbracket^{g_c}(t_3)$ is defined.

$\llbracket \lambda t \llbracket \text{PAST}_1 \llbracket \text{Mary arrive} \rrbracket \rrbracket \rrbracket^{g_c} = \lambda t: t \in D_i \text{ and } \llbracket \text{PAST}_1 \llbracket \text{Mary arrive} \rrbracket \rrbracket^{g_c[1 \rightarrow t]}$ is defined . $\llbracket \text{PAST}_1 \llbracket \text{Mary arrive} \rrbracket \rrbracket^{g_c[1 \rightarrow t]}$

This is equivalent to:

$\lambda t: t \in D_i \text{ and } \llbracket \llbracket \text{Mary arrive} \rrbracket \rrbracket^{g_c[1 \rightarrow t]}(\llbracket \text{PAST}_1 \rrbracket^{g_c[1 \rightarrow t]})$ is defined .

$\llbracket \text{PAST}_1 \llbracket \text{Mary arrive} \rrbracket \rrbracket^{g_c[1 \rightarrow t]}$

This is equivalent to: $\lambda t: t \in D_i \text{ and } t \text{ is a past time . } \llbracket \text{PAST}_1 \llbracket \text{Mary arrive} \rrbracket \rrbracket^{g_c[1 \rightarrow t]}$

Given the above condition about the presupposition projection, this means that $\llbracket \text{some time } \lambda t \llbracket \text{PAST}_1 \llbracket \text{Mary arrive} \rrbracket \rrbracket \rrbracket^{g_c}$ is defined only if every t such that $\llbracket \text{time} \rrbracket^{g_c}(t) = 1$ is a past time.

This is possible only if $\llbracket \text{time} \rrbracket^{g_c} = \lambda t: t \in D_i . t < \text{the time of the context } c$ (= the utterance time of the sentence). If this condition is satisfied, the entire sentence is true iff Mary arrives at a past time.

(22) shows that the presuppositional analysis of the anteriority meaning of past tense is compatible with a situation where a sentence in the past tense makes an existential claim about a past time.

We would like to add a cautionary remark about the suggested parallel between tenses and pronouns regarding presuppositions, however. The presupposition about pronouns concerns gender, which is a property associated with people and animals (in English), and is not relational or context-sensitive. For example, in order to check whether some person is male or not, one usually only needs to examine the physical characteristics of this individual. By contrast, the alleged presupposition of tense morphemes has to do with temporal orientation information such as anteriority or posteriority, and this information is inherently relational and context-sensitive. For example, we cannot decide by examining the properties of a particular interval whether it is a past time, a current time, or a future time. For example, to decide whether January 1st of 2001 is a past time or not, one must know the “evaluation time” in relation to which it is evaluated. The “evaluation time” is normally the utterance time of the sentence in question. In this sense, the nature of presupposition is different in the two cases, and the parallel is again incomplete.

6. The syntax-semantics interface

Before proceeding to give formal semantic content to what we have discussed so far, we would like to touch upon issues regarding the syntax-semantics interface. In the literature on syntax, a tensed sentence is analyzed as a tense head T taking a tenseless VP:

(23) [TP ... T ... [VP ... V ...]]

Under this assumption, the following past tensed sentence has a structure in which the verb *loved* is decomposed into the past tense morpheme (represented as *-ed*) and the bare verb stem *love*.

(24) a. John loved Mary
b. [TP *-ed* [VP John love Mary]]

Considering the semantic difference between the above sentence and the present tensed sentence *John loves Mary*, it seems uncontroversial to assume that the tense morphemes are responsible for the difference in the temporal ordering; the meaning of anteriority in the interpretation of (24) is brought by the presence of the past tense morpheme.

This seems to be also true of Japanese.

- (25) a. Taroo-ga Hanako-o aisi-tei-ta/ru.
 Taroo-NOM Hanako-ACC praise-PROG-PAST/PRES
 ‘Taroo loved/loves Hanako’
- b. [TP [VP Taroo-ga Hanako-o aisitei] -ta/-ru]

Whether we locate the state of Taroo’s loving Hanako in the past or now is dependent solely on the choice of the tense morphemes *-ta* or *-ru*.

Most linguists assume that the present and past tense morphemes have different meanings and they are responsible for the interpretation of tensed sentences. But this is not a necessary assumption for the proper understanding of tenses. Stowell (1995) for instance argues that the present and past tense morphemes in English are semantically vacuous and the relevant interpretations of ‘pastness’ and ‘presentness’ comes from phonetically null elements. He further argues that morphological tenses are like polarity sensitive items in that they are licensed only when they occur in the proper environment. Specifically, the present and past tense morphemes, *pres* and *past*, must be c-commanded by the phonetically null semantic tenses, *PRES* and *PAST*. This licensing condition prevents structures like (26c, d) below from being generated, which in turn accounts for the fact that present tensed sentences such as *John loves Mary*, for instance, do not mean the same as *John loved Mary*.

- (26) a. PRES [pres [VP]]

- b. PAST [past [VP]]
- c. * PRES [past [VP]]
- d. * PAST [pres [VP]]

Stowell's motivation for this move is mainly based on the behavior of the past tense in embedded contexts in English, i.e., what is called the sequence-of-tense phenomenon. English is classified as a sequence-of-tense language, as English embedded past tenses sometimes behave as if they are semantically vacuous. That is, the sentence *John said that Mary was happy* has what is called a simultaneous interpretation according to which what he actually said was something like "Mary is happy". Under Stowell's theory, this phenomenon can be accounted for by assuming that the embedded clause contains a morphological past but not a semantic PAST as in the following:

(27) PAST [past [VP [past [VP]]]]

Both occurrences of *past* are licensed as they are c-commanded by PAST in the matrix clause. As the morphological past is assumed to be semantically vacuous, the one in the embedded clause gives rise to a simultaneous interpretation. In non-sequence-of-tense languages like Japanese, past-under-past constructions do not yield a simultaneous interpretation but necessarily gives rise to what is called a back-shifted interpretation.

- (28) a. Taroo-ga [Hanako-ga siawase-dat-ta to] it-ta.
 Taroo-NOM Hanako-NOM happy-COP-PAST COMP say-PAST
 'Taroo-said that Hanako had been happy'
- b. Taroo-ga [Hanako-ga siawase-da to] it-ta.
 Taroo-NOM Hanako-NOM happy-COP COMP say-PAST
 'Taroo said that Hanako was happy (at the time of Taro's saying)'

The back-shifted interpretation can be paraphrased as Taroo said, “Hanako was happy”. In order to claim that Taroo said, “Hanako is happy”, Japanese uses a present tense as in (28b).

In those languages, representations like (27) are not allowed due to a locality condition of the licensing of morphological tenses. Each morphological past has to have a local licensor, as shown below:

(29) PAST [past [_{VP} PAST [past [_{VP}]]]]

For more discussion on this phenomenon, the reader should refer to the chapter ‘sequence of tense’ in this volume.

For our purpose, we take a simpler view and assume that the meaning of anteriority in a past-tensed sentence comes from the past tense morpheme itself. We believe the analysis presented below can be easily translated into views like Stowell’s.

7. Formal semantic analyses

In this section, we will present compositional analyses of tensed sentences on the basis of three different views on the semantic contributions of past tense.

We will first present a compositional semantic analysis of the past tense morpheme in English based on Prior’s analysis of tense. Prior’s (1957, 1967) system in Tense Logic served as an antithesis for Partee’s pronominal analysis of tense morphemes. For our purposes, let us assume that Prior’s operator analysis applies directly to English. That is, past tense sentences in English receive an existential quantifier interpretation with no restriction. For example, *Mary ran* is true if and only if there is some past time at which Mary ran, and this time can be any time before the time of evaluation (usually the utterance time). In our presentation, temporal adverbials (discussed in Section 5) will be ignored.

We will then turn to a pronominal analysis of tense morphemes due to Partee (1973, 1984) and Enç (1986, 1987), among others. According to this view, tenses are like pronouns and thus can be free or bound. Just like the interpretation of pronouns is determined by a variable assignment function, pronoun-like tenses are interpreted with respect to such variable assignments. Under this view, there is no quantificational force involved in the interpretation of tense morphemes themselves. When we find existential force in the interpretation of past tensed sentences, it comes from something else, a covert quantifier corresponding to *sometime* or existential closure (as defined as part of the truth definition). This possibility was briefly discussed in Section 4.

There are many other proposals that fall somewhere between these two extreme positions. Let us take up a ‘truly’ relational analysis of tenses, proposed in von Stechow (1995) and Stowell (1995, 1996) among others, as a third option. Under this view, tenses are analyzed as two-place predicates like transitive verbs and relational nouns. We believe that Dowty (1979), Stump (1985) and Ogihara (1996) can be classified as relational analyses in that they recognize the relational nature of tense but do not incorporate existential quantifier force into the semantics of tense morphemes themselves.

Before formalizing these three views, some assumptions are in order. We assume a type-driven semantics: In addition to basic types e for individuals and t for truth values, we add type i for times (or intervals). Stated in terms of types, a quantificational view takes the past tense $PAST^Q$ to be of type $\langle\langle i, t \rangle, t \rangle$, analogous to the generalized quantifier type over individuals $\langle\langle e, t \rangle, t \rangle$. A pronominal view treats $PAST^P$ as of type i , and a relational view assumes $PAST^R$ of type $\langle i, \langle i, t \rangle \rangle$, analogous to the type of transitive verbs and relational nouns, $\langle e, \langle e, t \rangle \rangle$. Now let us look at the three views in detail.

7.1 Quantificational view

Montague (1973) adopts Prior's proposal (1967) and uses tense operators which are prefixed to tenseless sentences to yield tensed ones.⁷ In this system, the denotation of each expression is given in relation to a time index indicated outside of the interpretation $\llbracket \cdot \rrbracket$. We interpret tenseless sentences in the following way:

(30) For any tenseless sentence ϕ and time t , $\llbracket \phi \rrbracket^t = 1$ iff ϕ is true at t .

The semantics of the past tense is given below:

(31) $\llbracket \text{PAST}^Q \phi \rrbracket^t = 1$ iff $\exists t' : t'$ is before t & $\llbracket \phi \rrbracket^{t'} = 1$.

Montague himself does not give a type-based analysis of the past tense morpheme, but translating into our framework, it denotes a function of type $\langle \langle i, t \rangle, t \rangle$; it takes properties of times and gives truth-values. To compare the three systems within the same notation, we make another small change here, and let the past tense be interpreted in relation to the speech time given by the context index c , which we represent as 'now'.

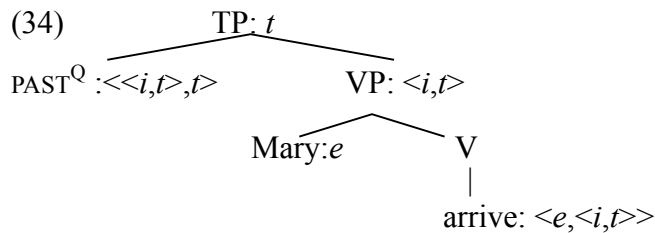
(32) $\llbracket \text{PAST}^Q \rrbracket^c = \lambda p \in D_{\langle i, t \rangle} . \exists t' : t'$ is before now & $p(t') = 1$.

This yields an unrestricted existential interpretation for past tensed sentences. We can modify this semantics to accommodate contextual restrictions on the existential quantified time. One way to do so is to allow the context index c to introduce a contextually salient interval C .

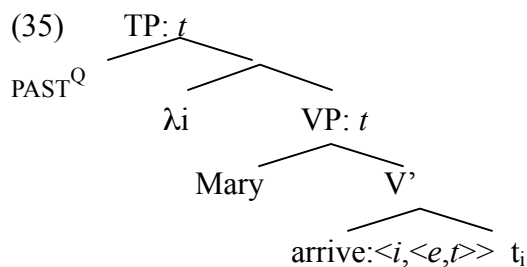
⁷ Montague's tense operators are W for future and H for present perfect. He does not give the semantics of past tensed sentences. As his semantics of H introduces existential quantification over past times relative to the evaluation time, we treat H and Prior's P on a par.

$$(33) \quad \llbracket \text{PAST}^Q \rrbracket^c = \lambda p \in D_{\langle i, t \rangle}. \exists t': t' \text{ is before now} \ \& \ t' \subseteq C \ \& \ p(t') = 1.$$

We have two options here regarding the semantics of “tenseless clauses”. We can assume that the VP is of type $\langle i, t \rangle$, the right type as an argument of the tense, which allows the tense to combine with the VP via Functional Application. This is given in (34):



Alternatively, we could assume a movement that resembles Quantifier Raising for nominal quantifiers. The past tense quantifier originates in the time argument position of the verb. Because of the type mismatch, it moves and leaves behind a trace of type i . The movement also creates a lambda abstractor over the same type as the trace left behind, i.e., over the type i . After the movement, we obtain the LF structure shown below:



Here the time variable t_i saturates the time argument slot of the predicate *arrive* and as a result, it represents the event time of the VP. The VP is of type t and with lambda abstraction over the type i , it is the right type for the past tense.

7.2 Pronominal view

In the pronominal theory of tense, the past tense is interpreted on a par with individual-denoting pronouns. Assuming that the interpretation of a pronoun is dependent on its own index and determined by the variable assignment function, we claim that the same mechanism is at work for pronominal tenses. Let us assume that g_c is a variable assignment function provided by the context. We can define the semantics of the past tense in the following way:

- (36) $\llbracket \text{PAST}^P_i \rrbracket_c^g$ is defined only if $g_c(i)$ is before now.
When defined, $\llbracket \text{PAST}^P_i \rrbracket_c^g = g_c(i)$.

Here we take the meaning of anteriority to be presuppositional, just like gender information on pronouns is considered to be presuppositional. See the discussion in section 6 of this chapter.

Both versions of the semantics of tenseless VPs presented above are compatible with this analysis. When tenseless VPs denote properties of times (i.e., functions from times to truth-values), the pronominal past tense saturates the time argument position of such VPs. The sentence *Mary arrived* has the following structure, and is true when Mary arrives at $g(i)$, which is presupposed to precede now.

- (37) $[_{TP} \text{PAST}^P_i [_{VP} \text{Mary arrive}]]$

Alternatively, we can adopt a movement analysis similar to (38):

- (38) $[_{TP} \text{PAST}^P \lambda i [_{VP} \text{Mary arrive } t_i]]$

When left free, the pronominal past tense receives its value from an assignment function provided by the context. We can also allow it to be bound by a covert existential quantifier.⁸

$$(39) \quad [\exists i \text{ } [_{TP} \text{ PAST}^P_i \text{ } [_{VP} \text{ Mary arrive}]]]]$$

Assuming the following semantics of the existential quantifier, which is the same as PAST^Q introduced above, the structure in (39) yields the same truth conditions as the one with PAST^Q .

$$(40) \quad \llbracket \exists \rrbracket^c = \lambda p \in D_{\langle i, t \rangle}. \exists t' : t' \text{ is before now} \ \& \ t' \subseteq C \ \& \ p(t') = 1.$$

7.3 Relational view

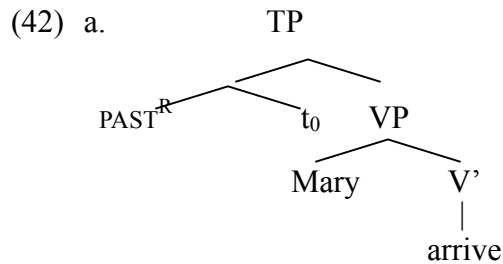
Lastly, let us consider a relational theory of tense. Under this theory, the past tense relates two times without introducing any quantificational force. Just as transitive verbs and relational nouns take two individual arguments and represent their relations, a relational past tense takes two time arguments and gives an order between them. The denotation of the relational past tense looks like the following, according to which it relates two intervals in terms of temporal anteriority:

$$(41) \quad \llbracket \text{PAST}^R \rrbracket = \lambda t. \lambda t'. t' \text{ is before } t.$$

This kind of theory poses a problem as to the syntax-semantics interface. In the quantificational theory of tense, tenses operate on tenseless VPs. In other words, tenses are functions that take VPs as their argument. In the pronominal theory of tense, on the other hand, VPs are functions that take

⁸ Alternatively, we can assume that existential force comes from some other element, for instance, aspectual heads such as Perfective and Imperfective, as proposed in Kratzer (1998) among others. See a brief discussion in section 9 in this chapter.

tenses as their argument. Under the relational theory, however, tenses simply relate two times and we need a mechanism to guarantee that one of them is the time denoted by the VP. One way to do so is to say that tenses are modifiers. Let us assume that the relational past tense in the matrix clause takes the evaluation time variable t_0 , which denotes the local evaluation time. Since the sentence under discussion is a matrix sentence, it denotes the speech time of the sentence.



- (43)
- a. $\llbracket \text{Mary arrive} \rrbracket = \lambda t. \text{Mary arrives at } t.$
 - b. $\llbracket \text{PAST}^R t_0 \rrbracket = \lambda t. t \text{ is before } t_0.$
 - c. $\llbracket \text{PAST}^R t_0 \llbracket \text{Mary arrive} \rrbracket \rrbracket = \lambda t. t \text{ is before } t_0 \text{ and Mary arrives at } t.$

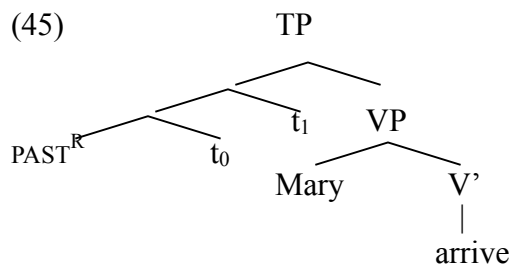
We combine the two denotations in (43a, b) by set intersection to derive (43c). But this cannot be the end of the story. If we stop here, we are unable to judge whether the sentence is true or not. The entire sentence denotes the set of times before the evaluation time at which Mary arrives. We need to close off the unbound time variable, and to do so, we can assume an existential closure at the sentence level.

(44) $\llbracket \exists \llbracket \text{TP} \llbracket \text{PAST}^R t_0 \rrbracket \llbracket \text{VP Mary arrive} \rrbracket \rrbracket \rrbracket$

This again yields the same result as the quantificational past tense, assuming the semantics of the existential quantifier as in (44).

One concern with the above implementation is that only one of the two times being related is visible in the syntax. Since one of the reasons that the relational view is popular is the ease with which temporal anaphora is indicated in the syntax, it is better for both time variables to be represented in the syntax.

Von Stechow (1995) presents an analysis of tense morphemes which he describes as a relational semantics of tense. Von Stechow's account does not let the tense morphemes themselves denote a relation between times. However, his translation language allows both the evaluation time and the time of the event to be overtly represented; they are related via the precedence relation. In order to adopt this type of analysis without resorting to a translation language, we can propose the following alternative.⁹ On this proposal, all times are represented overtly in the object language (English for our purposes), unlike in the system assumed so far in this article. The following is the syntactic structure being assumed, and (45) indicates the proposed lexical semantics of the relational past tense.



(46) $[[\text{PAST}^R]] = \lambda t. \lambda t'. \lambda p_{\langle i, t \rangle}. t' \text{ is before } t \ \& \ p(t') = 1.$

⁹ There are two views as to how LF syntactic structures of the object language are interpreted and given truth conditions. One advocated in Montague's PTQ is to use a formal language as a mediator between syntax and semantic interpretation. An expression in a natural language is translated into a language called Intensional Logic (IL) by translation rules, and then the translated IL denotation is given a semantic interpretation by semantic rules. The intermediate stage is not a necessary one, and we can directly interpret natural language expressions, as we do in this chapter.

Here, for simplicity and convenience, we deviate slightly from the truly relational type (i.e., $\langle i, \langle i, t \rangle \rangle$) and propose a semantics for $PAST^R$ that is of type $\langle i, \langle i, \langle \langle i, t \rangle, t \rangle \rangle \rangle$. This allows the $PAST^R$ and the VP to be combined via functional application. Assuming that the VP denotes a temporal abstract of type $\langle i, t \rangle$ (i.e., the set of times at which Mary arrives) we can obtain a correct specification of the truth conditions for the sentence. If an existential quantifier is needed for its interpretation, an existential closure can be applied at the top TP level to bind the time variable that saturates the time argument slot of the verb.

$$(47) \quad [\exists i [_{TP} [[_{PAST^R} t_0] t_1] [_{VP} \text{Mary arrive}]]]$$

The compromise that this proposal contains is that the denotation of $PAST^R$ is not a relation but is more complicated than that. However, if we wish to let $PAST^R$ denote a relation per se, then the rest of the semantic composition becomes rather awkward. Thus, we think this is an acceptable compromise.

Stump (1985) and Ogihara (1996) present analyses which are actually very similar to von Stechow's except that the order of the semantic arguments is reversed. Details aside, a past tense morpheme has an interpretation given in (48).

$$(48) \quad \llbracket PAST^{R\text{-variant}} \rrbracket = \lambda p_{\langle i, t \rangle}. \lambda t. \lambda t'. t' \text{ is before } t \ \& \ p(t') = 1.$$

One major advantage of this approach is that it allows unlimited temporal adverbials to be added to the sentence in question.

We have spelled out three theories of tenses in formal semantic terms. How are they different? Are they merely notational variants of each other? If not, where do they make empirically different predictions? All three theories account for the contextually restricted anaphoric behavior of tenses. Contextual information can be built into the semantics of a

quantificational tense. Pronominal and relational theories may be supplemented with a covert existential closure. In this regard, the only difference between a quantificational theory on the one hand, and pronominal and relational theories on the other, is whether quantificational force, if any, comes from the semantics of past tense itself or some other element. This difference may truly distinguish the former and the latter two theories. Under a quantificational theory of tense, there is no occurrence of tense without existential quantification over times. The other two theories allow tenses to occur without existential closure.

8. Tenses vs. temporal adverbials

Let us now turn to a slightly different topic. As mentioned earlier in this chapter, Partee (1973) convinces us that the temporal reference of a sentence in the past tense is normally restricted to a contextually salient past interval and not to the set of all past times. However, it is arguable that temporal adverbials, and not tense morphemes, directly refer to times. Consider (49).

(49) I arrived at the airport at 10 a.m. Sue was already there waiting for me then.

It appears that in (49), the time 10 a.m. is introduced by the PP *at 10 a.m.*, and the expression *then* clearly refers back to this time in the second sentence. This suggests that *then* is like a pronoun and is anaphoric to the temporal NP *10 a.m.* mentioned in the first sentence. If this is correct, Partee's original claim may have to be modified; temporal anaphora may involve temporal adverbials such as *at 10 a.m.* and *then* in (49), and not tense morphemes *per se*.

The question that concerns the relationship between tense morphemes and temporal adverbials leads to a very sticky issue of how to work out a compositional semantic system when natural language sentences involve both tense morphemes and temporal adverbials. For example, Bäuerle and von Stechow (1980) show that when a frequency adverbial like *exactly three times* occurs in a past tense sentence, an existential quantifier analysis of past tense suffers from undesirable empirical consequences.

- (50) a. Mary sneezed exactly three times yesterday.
 b. Mary sneezed exactly twice yesterday.

Assuming that the past tense morpheme in each sentence generates an existential quantifier, let us consider four interpretive possibilities in (51). The special existential quantifiers $\exists_{3!}$ and $\exists_{2!}$ mean ‘there are exactly three ...’ and ‘there are exactly two ...’, respectively. We also employ the set-theoretic subset symbol \subseteq for this very meaning in the representation language.

- (51) a. $\exists_{3!} t_2 [t_2 < \text{now} \ \& \ t_2 \subseteq \text{yesterday} \ \& \ \text{Mary sneezes at } t_2]$
 b. $\exists_{2!} t_2 [t_2 < \text{now} \ \& \ t_2 \subseteq \text{yesterday} \ \& \ \text{Mary sneezes at } t_2]$
 c. $\exists t_1 [t_1 < \text{now} \ \& \ t_1 \subseteq \text{yesterday} \ \& \ \exists_{3!} t_2 [t_2 \subseteq t_1 \ \& \ \text{Mary sneezes at } t_2]]$
 d. $\exists t_1 [t_1 < \text{now} \ \& \ t_1 \subseteq \text{yesterday} \ \& \ \exists_{2!} t_2 [t_2 \subseteq t_1 \ \& \ \text{Mary sneezes at } t_2]]$

(51a, b) represent the intuitive interpretation of (50a, b), respectively. However, if past tense contributes an existential quantifier and the temporal adverbial *exactly three times* also provides a special existential quantifier as shown in (51c), the entire formula yields the wrong interpretation for (50a). This can be shown by the fact that (51c) actually entails (51d), which presumably indicates the interpretation of (50b). This is clearly the wrong prediction because (50a) intuitively does not entail (50b). Since this chapter is not about temporal adverbials, we will not pursue the topic of the interaction between tense and temporal adverbials. We only wish to suggest here that even if a sentence in the past tense receives an existential quantifier interpretation, quantificational force may come from temporal adverbials, rather than from tense morphemes.

Reichenbach’s (1947) proposal about tense and aspect forms in English can be regarded as a model that distinguishes between the contribution of covert or overt temporal adverbials and that of tense morphemes because he introduces R (Reference Time) in addition to E (Event Time) and S (Speech Time). Klein’s (1994) topic time is similar to Reichenbach’s R. If accepting multiple

temporal entities such as E and R is reasonable, it is hard to deny that we should pay attention to the behavior of overt or covert temporal adverbials. In particular, R is not always the time of the event or state indicated by the verb, and it is often indicated by a temporal adverbial. DRT (Kamp and Rohrer 1983, Kamp and Reyle 1993) incorporates some essential ideas of Reichenbach's proposal. For details of the interaction between tense and temporal adverbs, please refer to the article on tense and temporal adverbs in this volume.

9. Cross-linguistic perspectives

The literature on tense has provided a fruitful discussion on cross-linguistic variations on tense interpretations. Languages differ whether they have an overt morphological tense marking or not. Those that do not have one differ whether they have no tense node at all or they have a covert tense.¹⁰ Languages also differ in whether they exhibit the sequence-of-tense phenomenon,¹¹ whether they have a bound present tense or not, whether they have 'tenses' in the nominal domain¹², etc.

In this section we examine cross-linguistic perspectives regarding the three different theories of tense we have discussed: quantificational, pronominal, and relational theories. Linguists and philosophers have presented evidence for and counter-examples against a particular theory of tense, trying to find the proper theory of tense.

Kratzer (1998) supports the pronominal view of tenses, providing more analogies between pronouns and tenses. She presents examples from German and argues that the simple past tense in German is truly pronominal in that it cannot be used in an out of blue context, as is shown below:

¹⁰ See 'Tenselessness' article in this volume.

¹¹ See 'Sequence of tense' article in this volume.

¹² See 'The temporal interpretation of noun phrases' in this volume.

- (52) a. * Wer bau-te diese Kirche?
 who.NOM build-PAST this.ACC church.ACC
 ‘Who built this church?’
 Borromini bau-te diese Kirche.
 Borromini build-PAST this.ACC church.ACC
 ‘Borromini built this church.’
- b. Wer ha-t diese Kirche ge-bau-t?
 who.NOM has-PRES this.ACC church.ACC PTCP-build-PTCP
 ‘Who has built this church?’
 Borromini ha-t diese Kirche ge-bau-t.
 Borromini has-PRES this.ACC church.ACC PTCP-build-PTCP
 ‘Borromini has built this church.’

Instead, German uses a present perfect construction to introduce a contextually unspecified past event. English on the other hand allows a simple past sentence in such a context.

- (53) Who built this church? Borromini built this church.

Kratzer claims that tenses are universally pronominal and existential quantification is introduced by aspectual operators such as Imperfective, Perfective, and Perfect. Languages differ in what tense-aspect combinations surface as morphological past tense or present perfect constructions. According to her analysis, both (52b) in German and (53) in English have the same tense-aspect combination, namely, the present tense and Perfect aspect. The present tense denotes the speech time and serves as an evaluation time and the Perfect aspect locates a building event prior to it. This combination surfaces as a present perfect in German and a simple past in English. What

surfaces as a simple past tense in German is a combination of the past tense and Imperfective/Perfective aspect. The past tense is pronominal and hence is not defined unless the context supplies a salient past time. This is why (52a) is not acceptable as an out of blue question.

Recently, Ogihara and Sharvit (2012) and Sharvit (2014) argue that there is a parametric difference among languages as to whether they have a pronominal tense or a quantificational tense. For instance, according to Sharvit (2014), Japanese has a pronominal tense whereas English has a quantificational tense. These languages differ crucially in the behavior of tense in *before*-clauses. Japanese does not allow past tense in *before*-clauses even when the matrix clause is past tensed, as shown below:

- (54) Hanako-ga kae-ru/*ta maeni Taro-wa kaet-ta
Hanako-NOM leave-PRES/PAST before Taro-TOP leave-PAST
'Taro left before Hanako leaves'

English exhibits the opposite behavior.

- (55) John left before Mary left/*leaves.

Sharvit argues that this difference is not related to the fact that English is a sequence-of-tense language while Japanese is not. That is, the difference of the tense distribution in *before*-clauses cannot be explained by assuming that English embedded past tense can be semantically vacuous whereas Japanese present tense can be 'bound' by the past tense. This is because other non-sequence-of-tense languages such as Polish and Hebrew behave like English in the tense choice in *before*-clauses.

Details aside, Sharvit argues, following Beaver & Condoravdi (2003), that the semantics of *before-p* is roughly translated as 'before the earliest time (within the contextually salient time interval) at which *p* is true'. When *p* is a clause that has a pronominal tense without existential

closure as below, *before Mary arrived* roughly means ‘before the earliest time t such that Mary arrived at t ’.

Due to its presuppositional semantics, the definite article *the* in the phrase *the earliest time* has to pick out a unique time. This is possible under the pronominal analysis. It compares all times at which Mary arrived within the contextually salient interval and picks up the one that precedes all other times of Mary’s arrival. When p contains a quantificational tense, *before Mary arrived* means something like ‘before the earliest time t such that there is a time t_1 which is before t and Mary arrived at t_1 ’. This results in presupposition failure, due to the existential quantification introduced by the past tense.

Sharvit concludes that English allows a past tense in a *before*-clause since it is a pronominal tense and it can be interpreted without giving rise to presupposition failure, whereas Japanese has a quantificational past tense and using it in a *before*-clause results in presupposition failure. See Sharvit (2013) and Mucha (2015) for more discussion.

10. Concluding remarks

There has been a long debate as to whether tense is quantificational or pronominal since Partee’s famous ‘stove’ example. We have examined similarities and differences between pronouns and tenses. One difference is that temporal features on tenses are inherently relational whereas gender features on pronouns are not. Therefore, the notion of the evaluation time has to be built into the semantics of tense in some way or it has to appear syntactically as a time variable. This difference, however, does not seem to argue for or against a pronominal view. Empirical data presented in the literature for a pronominal view can also be explained under a quantificational view, taking into consideration contextual restrictions. Lessons we learn from Kratzer’s discussion is that we need to take a closer look at tense, aspect and perhaps modal combinations in order to fully understand the semantics of tense. Cross-linguistic variations in tense systems are another issue. Sharvit argues that we do not have to make a choice between a quantificational view or a pronominal one for all natural languages. Her argument is based on the behavior of tenses in *before*-clauses. As she

notes, it still has to be investigated whether such an analysis extends to other temporal clauses and to other types of embedded clauses. Whether there is one proper theory of natural language tense, or languages vary as to what type of tenses they have is still an open question.

References

- Altshuler, Daniel. 2010. *Temporal Interpretation in Narrative Discourse and Event Internal Reference*. New Brunswick: Rutgers University. (Doctoral dissertation.)
- Bäuerle, Rainer, and Arnim von Stechow. 1980. Finite and Non-Finite Temporal Constructions in German. In Christian Rohrer (ed.), *Time, Tense, and Quantifiers*, 375-421. Tübingen: Niemeyer.
- Beaver, David & Cleo Condoravdi. 2003. A Uniform analysis of before and after. In R. Young and Y. Zhou (eds.), *Proceedings of SALT XIII*, 37-54. Ithaca NY: CLC Publications.
- Bittner, Maria. 2005. Future Discourse in a Tenseless Language, *Journal of Semantics* 23. 339-387.
- Bohnenmeyer, Jürgen. 2009. Temporal anaphora in a tenseless language. In Wolfgang Klein, and Ping Li (eds.), *The expression of time in language*, 83–128. Berlin: Mouton de Gruyter.
- Dowty, David. 1979. *Word Meaning and Montague Grammar*. Dordrecht: Kluwer Academic Publishers.
- Dowty, David, Robert Wall, and Stanley Peters. 1981. *Introduction to Montague Semantics*, D. Reidel.
- Enç, Mürvet. 1986. Towards a referential analysis of temporal expressions. *Linguistics and Philosophy* 9. 405-426.
- Enç, Mürvet. 1987. Anchoring conditions for Tense. *Linguistic Inquiry* 18. 633-657.
- Klein, Wolfgang. 1994. *Time in Language*. London: Routledge.
- Heim, Irene. 1982. *The Semantics of Definite and Indefinite Noun Phrases*. Ph.D. dissertation, Amherst, MA: University of Massachusetts, Amherst. (Doctoral dissertation.)

- Heim, Irene. 1994. Comments on Abusch's theory of tense. In H. Kamp (ed.), *Ellipsis, tense and questions*, 143-170. DYANA deliverable R2.2.B. Amsterdam: University of Amsterdam.
- Heim, Irene and Angelika Kratzer. 1998. *Semantics in Generative Grammar*. Malden, MA: Blackwell.
- Hinrichs, Erhard. 1981. Temporal Anaphora im Englischen, Unpublished Zulassungarbeit, University of Tübingen.
- Hinrichs, Erhard. 1986. Temporal Anaphora in Discourses of English. *Linguistics and Philosophy* 9. 63-82.
- Kamp, Hans. 1981. A Theory of Truth and Semantic Interpretation. In Jeroen A. G. Groenendijk, T. M. V. Janssen, and Martin B. J. Stokhof (eds.), *Formal Methods in the Study of Language*, 275-322. Amsterdam, Mathematical Centre Tract 135.
- Kamp, Hans and Uwe Reyle. 1983. *From Discourse to Logic*. Dordrecht: Kluwer.
- Kamp, Hans and Christian Rohrer. 1983. Tense in Texts. In R. Bauerle, C. Schwarze, A. von Stechow (eds.), *Meaning, Use, and Interpretation of Language*, 250-269. Berlin: de Gruyter,
- Kratzer, Angelika. 1998. More Structural Analogies between Pronouns and Tenses. In Devon Strolovitch and Aaron Lawson, *Proceedings from SALT VIII*, 92-110. Ithaca NY: CLC Publications.
- Kuhn, Steven and Paul Portner. 2002. Tense and time, In D. Gabbay and F. Guentner (eds.), *Handbook of Philosophical Logic*, 277-346.
- Lin, Jo-Wang. 2006. Time in a Language Without Tense: A Case of Chinese, *Journal of Semantics* 23. 1-53.
- Lin, Jo-Wang. 2012. Tenselessness. In Robert Binnick (ed.), *The Oxford Handbook of Tense and Aspect*, 669-695. Oxford and New York: Oxford University Press.
- Montague, Richard. 1973. The Proper Treatment of Quantification in Ordinary English. In Jaakko Hintikka, Julius Moravcsik, Patrick Suppes (eds.) *Approaches to Natural Language*, 221-242. Dordrecht: Reidel.

- Mucha, Anne. 2013. Temporal interpretation in Hausa. *Linguistics and Philosophy* 36. 371-415.
- Mucha, A. 2015. *Temporal interpretation and cross-linguistic variation*. Potsdam: University of Potsdam. (Doctoral dissertation.)
- Ogihara, Toshiyuki. 1996. *Tense, Attitude and Scope*. Dordrecht: Kluwer.
- Ogihara, Toshiyuki and Yael Sharvit. 2012. Embedded Tenses. In Robert Binnick (ed.), *The Oxford Handbook of Tense and Aspect*. Oxford and New York: Oxford University Press, 638-668.
- 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. 1957. *Time and Modality*. Oxford: Clarendon Press.
- Prior, Arthur. 1967. *Past, Present, and Future*. Oxford: Clarendon Press.
- Reichenbach, Hans. 1947. *Elements of Symbolic Logic*. New York: Macmillan.
- Sharvit, Yael. 2014. On the Universal Principles of Tense Embedding: The Lesson from Before. *Journal of Semantics* 31, 263-313.
- von Stechow, Arnim. 1995. On the Proper Treatment of Tense. In Mandy Simons and Teresa Galloway (eds.), *Proceedings from SALT V*, 362-386. Ithaca NY: CLC publications.
- Stowell, Tim. 1995. The Phrase Structure of Tense. In Johan Roorick and Laurie Zaring (eds.), *Phrase Structure and the Lexicon*, 277-292. Dordrecht: Kluwer Academic Press.
- Stump, Gregory. 1985. *The Semantic Variability of Absolute Constructions*. Dordrecht: Reidel.
- Tonhauser, Judith. 2011. Temporal reference in Paraguayan Guaraní, a tenseless language, *Linguistics and Philosophy* 34. 257-303.
- Tonhauser, Judith. Cross-linguistic temporal reference. *Annual Review of Linguistics* 1:129-154.
- Zagona, Karen. 2002. Tenses and anaphora: Is there a tense-specific theory of coreference? In Andrew Barss (ed.) *Anaphora: An Overview*, 140-171. Oxford, UK and Cambridge, MA: Blackwell Publishers.