*Tense, Adverbials and Quantification

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1. Introduction

This paper addresses the issue of how to account for the interaction of tense morphemes and temporal PPs (henceforth, tPPs) in a compositional manner. The main focus of the paper is the behavior of quantified tPPs such as *during every meeting*, *on a Sunday*. This is a response to Pratt and Francez (2000) and von Stechow (2002), who are both concerned with the same issue. I will contend that past tense sentences like (1a) contain a covert adverbial (e.g. *on Monday last week, in the past*) that restricts the extension of the tN *meeting* to a past interval. That is, when (1a) is interpreted at LF, it looks like (1b). This guarantees that the meetings in question are restricted to past meetings. I shall argue that this account is preferable to an alternative according to which tense directly restricts the meeting times.

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(1) a. John kissed Mary during every meeting.

b. John kissed Mary during every meeting in the past.

I will also show that in order to account for the behavior of quantified tPPs, it is not sufficient to assume that the denotation of each common noun is restricted by the context. At first sight, it appears that we can simply assume that the inherent restriction upon the denotation of each noun accounts for the semantics of (1a). For example, the noun student in (2a) is understood to mean the set of students under discussion, and not the set of all students in the world. Similarly, it seems natural to assume that the noun *meeting* in (1a) denotes the set of meetings under discussion (i.e., those that occurred within a particular past interval), not the set of all meetings with no contextual restriction. We can then say that the meetings in question must be past meetings because the sentence would be necessarily false otherwise.

(2) a. Every student passed the exam.

Despite the initial plausibility of this hypothesis, it turns out that it is not tenable. This point will be elaborated later in the paper. With this rough outline of this paper in mind, let us start with some fundamental issues having to do with tense and adverbials.

What is the source of the existential quantification over past times in a declarative sentence in the past tense? Is it the past tense morpheme, an (overt or covert) adverbial, or some other independently available mechanism? The traditional view due to Prior (1967) is that the source is the past tense morpheme. (3) is rendered as in (3b) in Prior's tense logic. In tense logic, a predicate only has nominal arguments, and there are no temporal arguments or predicates. (3c), on the other hand, is expressed in a different logical language that explicitly represents existential quantification over times. That is, temporal variables and constants are used overtly in this system.

(3) a. John graduated from Harvard.[1]

b. P [graduates_from_Harvard(j)]

c. ∃t [t < now ∧ graduates_from_Harvard(j, t)]

With appropriate interpretations of the predicates used in (3b) and (3c), we can make sure that (3b) and (3c) are semantically equivalent. But it has been shown by Dowty (1979) and others that the system used in (3c) is preferred over the one used in (3b). For example, natural language has constants that refer to intervals (or instants) such as *2004* (the name of the year), *January*, *today*, etc. Temporal quantifiers abound (e.g., *always*, *often*, *sometimes*, *every time*). Although it is not impossible to use systems in which quantification is represented in the metalanguage, it is more convenient for us to adopt a system that yields formulas like (3c) because essential temporal meanings can be read off logical formulas. I thus adopt a system yields formulas like (3c).

Prior's logical system about tense has been challenged by many researchers. By citing the famous stove example in (4a), Partee (1973) claims that tense is more like a free pronoun than an existential quantifier. The scenario assumed here is that (4a) is uttered when the speaker is driving on the freeway after leaving her house without turning off the stove.

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

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[1] For (3a) to receive a purely existential reading, we need a context like the one given in (i). The idea is that B's utterance is used to show that John is smart (or that is what people expect from Harvard graduates). B does not intend to assert that John's graduation from Harvard falls within a particular past interval.

(i) A: Is John smart?

B: Well, he graduated from Harvard.

b. $\exists t$ [t < now $\wedge \neg$ I turn off the stove at t]

c. $\neg\exists t$ [t < now $\wedge$ I turn off the stove at t]

d. t_R < now $\wedge \neg$ I turn off the stove at t_R (t_R = reference time)

According to Partee, (4a) should be rendered as (4d) rather than as (4b) or (4c). t_R here represents what can be referred to as a reference time (due to Reichenbach (1947)) — a contextually salient time. The idea is that in (4a) the tense morpheme behaves like a free pronoun that refers to a contextually salient past time. (4d) says that a particular contextually salient time indicated by t_R lies before now and that the speaker fails to turn off the stove at t_R. The past tense morpheme is like a free variable in that its denotation is recovered from the context. In this case, it refers to the time when the stove should have been turned off.

English has adverbials like *then*, and *right at that moment* that appear to refer to moments. When such adverbials are used as in (5a–b), it seems that positing an existential quantifier for the tense is counterintuitive or at least redundant. This supports Partee's (1973) argument.

(5) a. John arrived at the room then.

b. Right at that moment, the bell rang.

On the other hand, most declarative sentences in the past tense appear to involve existential quantification. As shown by Ogihara (1996), past tense sentences in general must involve existential quantification over times even if a particular salient past interval is involved in determining their interpretation.[2] Consider (6).

(6) John: Did you eat lunch?

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[2] A similar point is made in Kuhn and Portner (2002).

Bill: Yes, I did.

Bill's answer in (6) is taken to mean that he ate lunch *within* some salient past interval, say the lunch hour (12:00 - 1:00). It is certainly not required for him to use up all of his lunch hour to eat his lunch. He could have eaten a sandwich in 10 minutes within this period, and he can still utter the sentence truthfully. This means that an existential quantifier is necessary in order to represent the right semantic content of Bill's utterance as in (7).

(7) $\exists t\,[t < \text{now} \;\&\; t \subseteq t_R \;\&\; \text{Bill eats lunch at } t]$

Some comments are in order here. Even if we accept the contention that Bill's utterance in (6) requires existential quantification over past times, this does not necessarily mean that an existential is part of the lexical meaning of the past tense morpheme. The following alternative accounts come to mind: (i) adopt a default truth definition that introduces an existential quantifier (Stump 1985) or an embedding function as in DRT (Kamp and Reyle 1993); (ii) change the semantic interpretation of a temporal term used in a time-sensitive predicate as in (8).

(8) When interpreting a time sensitive predicate (e.g. verbs, adjectives, common nouns), the semantic contribution of its temporal argument is understood in such a way that whatever is being described holds *within* the time in question rather than *at* that time.

According to (8), $[\![\text{eats\_lunch(John, t)}]\!]^g = 1$ just in case an event of John's eating lunch takes place *within* g(t) (where *g* is an assignment). This interpretation has an implicit existential quantifier though this is not obvious from the formula. Partee (1984) acknowledges that an existential quantifier reading is required with most past tense sentences, which I believe is the most empirically accurate position regarding the semantics of tense.

2. Some Scope-related Issues

From the discussion in Section 1, it seems fair to say that most English declarative sentences in the past tense semantically require existential quantification over past times though the quantificational force is often restricted by overt or covert adverbials. Assuming for the sake of argument that a past tense sentence involves existential quantification, we still need to determine what is responsible for it. Bäuerle and von Stechow (1980) show that having two existential quantifiers (one contributed by the tense morpheme, the other by the adverbial) in the interpretation of a single clause would yield the wrong semantic result. For example, consider (9a) and (9b). If (9b) is taken to mean (10a), then it is never true because as soon as there is at least one relevant hitting event, there are an infinite number of times that contain this event. In other words, the truth condition stated in (10a) is never satisfied. On the other hand, assuming that (9b) means (10b) is also problematic. If (10b) is satisfied, then (10c) is also satisfied. This would mean that (9b) entails (9a), which is clearly undesirable.

(9) a. John hit the target exactly twice.

b. John hit the target exactly three times.

(10) a. There are exactly three times $t <$ now such that there is a time t' within t such that John hits the target at t'.

b. There is a time $t <$ now such that there are exactly three times t' within t & John hits the target at t'.

c. There is a time $t <$ now such that there are exactly two times t' within t & John hits the target at t'.

One could perhaps correct the first problem by stipulating that the three times must be non-overlapping. But that would still not be good enough because each non-overlapping interval could contain more than one event of John's hitting the target. Thus, the prediction is that (9b) is true

when John hits the target more than three times. Thus, Bäuerle and von Stechow (1980) conclude that an existential quantifier is not contributed by a tense morpheme or a default truth definition. Rather an existential is contributed by an overt or covert adverbial. When there is no overt frequency adverbial, a covert adverbial meaning *at least once* yields an existential quantifier meaning.

Dowty (1979) independently arrived at approximately the same conclusion. Dowty discusses examples like (11a). In Dowty's system (11a) translates as in (11b).[3]

(11) a. John cried yesterday.

b. $\exists t\,[t < \text{now} \wedge \text{John cries at } t \wedge t \subseteq \text{yesterday}]$

Dowty's (1979) proposal has it that a tense and an adverbial are introduced simultaneously. The resulting translation contains an existential quantifier over times. This appears to represent the idea that a tense and an adverbial jointly introduce an existential, which is possible in a system like Dowty's. Dowty's proposal accommodates sentences in which frequency adverbials like *exactly twice* or *exactly three times* occur. That is, we can maintain that *exactly twice* denotes either (12a) or (12b). Roughly put, (12a) corresponds to "past ... exactly twice", and (12b) to "future ... exactly twice". Just as *today* is three ways ambiguous in Dowty's proposal, *exactly twice* is at least two ways ambiguous between (12a) and (12b).

(12) a. $\lambda P_t\, \exists_{2!} t\,[t < \text{now} \wedge P_t(t)]$

b. $\lambda P_t\, \exists_{2!} t\,[\text{now} < t \wedge P_t(t)]$

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[3] Strictly speaking, this notation differs slightly from Dowty's original, but the differences do not give rise to any interpretive differences.

Note: $\exists_{2!}$ t reads 'there are exactly two distinct times t such that ...' P_t is a variable for predicate of times.

Since Dowty introduces an adverbial and tense simultaneously in the syntax, he does not have to commit himself to the source of the existential quantifier. However, Dowty's proposal suffers from the general problem of not being able to have multiple temporal adverbials. Therefore, sentences like (13) are problematic for him.

(13) John coughed exactly three times yesterday.

Stump's (1985) proposal enables us to introduce multiple adverbials in a sentence, which solves the problem with Dowty's proposal. In Stump's proposal, existential quantifiers are not introduced by adverbials or tense morphemes. Stump posits a rule for existential closure, which introduces an existential quantifier at the top level after all adverbials have been processed. Stump's proposal still does not account for examples like (13). This is because if *exactly three times* is an existential quantifier, which we assume it is, we end up with two existentials. Stump's proposal may be rescued, however, by adopting the idea is that frequency adverbials like *exactly three times* are not quantifiers. It may be a modifier of event predicates as suggested by Krifka (1989).

Let us now turn to yet another controversial scope-related issue associated with tense and adverbials. This issue, which was discussed by Ogihara (1994), concerns quantificational temporal prepositional phrases (tPPs) such as *during every meeting* and is very important for the purpose of this paper. For example, in (14a), if *every Sunday* has maximal scope, and the past tense is understood to involve existential quantification over past times (or events), then we get the wrong interpretation. That is, (14a) is understood to mean (14b). (14b) gives us the wrong interpretation because no future Sunday contains past times. How is this "wrong reading" obtained compositionally? We first of all assume that *every Sunday* means 'on (i.e., within) every Sunday' and that the invisible preposition *on* justifies the "part of" relation. If we adopt Bäuerle and von

Stechow's position that each sentence involves a covert or overt frequency adverbial (an existential one, that is), then we could say that (14a) actually contains a covert adverbial that means *at least once*, which occurs overtly in (14c). If we furthermore assume that *every Sunday* is scoped over *at least once* then (14a) is interpreted to mean (14b). On the other hand, letting *at least once* and the essential meaning of past tense (i.e., t < now) have scope over *every Sunday* would not provide us with the right result as shown in (14d). (14d) means that there is a past time *t* which every Sunday contains and at which John cries, which is clearly the wrong reading.

(14) a. John cried every Sunday.

b. $\forall x[\text{Sunday}(x) \rightarrow \exists t\,[t < \text{now} \wedge t \subseteq_{\text{TIME}}(x) \wedge \text{John cries at } t]]$

c. John cried at least once every Sunday.

d. $\exists t\,[t < \text{now} \wedge \forall x[\text{Sunday}(x) \rightarrow [t \subseteq_{\text{TIME}}(x) \wedge \text{John cries at } t]]]$

Note: TIME is the temporal trace function from event individuals into intervals. For example, TIME(x) means 'the temporal duration of the event x'.

In order to obtain the right reading, we would need an additional existential quantifier within the scope of *every Sunday* as in (15a) and (15b), which are two alternative ways of symbolizing the reading that (14a) actually has. The trouble is that we do not know where the narrow scope existential comes from. Also problematic is the fact that you need an inclusion relation between the past time variable t_1 and the time of *x*. The source of this inclusion relation is not clear.

(15) a. $\exists t_1\,[t_1 < \text{now} \wedge \forall x[[\text{Sunday}(x) \wedge \text{TIME}(x) \subseteq t_1] \rightarrow \exists t\,[t \subseteq \text{Time}(x) \wedge \text{John cries at } t]]]$

b. $\forall x[[\text{Sunday}(x) \wedge \text{Time}(x) \subseteq t_R \wedge t_R < \text{now}] \rightarrow \exists t\,[t \subseteq \text{TIME}(x) \wedge \text{John cries at } t]]]$

One might object to the above line of reasoning by pointing out that the denotation of any noun is restricted by the context of use and that this is sufficient to account for the above data.[4] For example, (16a) almost never means that every student in the world had a good time. The common noun *student* as used in (16a) refers to the set of all students that are salient in the context. In general, the actual denotation of a common noun is a proper subset of its lexical meaning. The idea can be symbolized as in (16b). *C* is assumed to be the set of contextually salient individuals. This is the notation used by von Fintel (1994: 31). (16b) as whole says that every student that is salient in the context had a good time.

(16) a. Every student had a good time.

b. ⟦every student had a good time⟧ = 1 iff
⟦⟦every⟧(⟦student⟧∩ *C*)⟧(⟦had a good time⟧)

The idea that contextual restriction upon the quantificational domain is needed for any quantifier is argued for by many researchers (e.g., Fintel (1994), Stanley and Szabó (2000)). If (16a) is uttered suddenly by someone you do not know, then you have no idea what *C* is. This means that the determination of *C* is made solely in terms of the information available in the context. If we extend this idea to time-sensitive nominal expressions such as *every Sunday*, we can assume that (17a) is rendered as in (17b).

(17) a. Mary kissed John (on) every Sunday.

b. ⟦[[every Sunday]$_1$[Mary kissed John (on) t$_1$]] ⟧ = 1 iff

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[4] Hotze Rullman, Ora Matushansky, and Paul Portner (personal communication) independently suggested this possibility.

⟦every⟧(⟦Sunday⟧∩ *C*)(λx . there is a time t_1: Mary kisses John at t_1 & t_1 < now & $t_1 \subseteq$ TIME(x))

C is understood to be the contextually salient set of intervals. (17a) is like (16a) except that *C* must be a set of past intervals. That is, (17a) can only be uttered in a context in which *C* is already restricted to past intervals. This appears to be an unnatural restriction. Enç (1985) shows that temporal properties of time sensitive nouns do not always go with the tense. For example, (18) shows that *fugitive* must denote a set of fugitives at a past time in order to avoid a necessary false statement.

(18) Every fugitive is now in jail.

Thus, the fact the relevant Sundays in (17a) can only include past Sundays must be explained. The simplest account would be that for (17a) to be true, the relevant Sundays must be restricted to past Sundays. In other words, it seems that it is sufficient to appeal to the pragmatic principle that the speaker avoids necessary false statements.

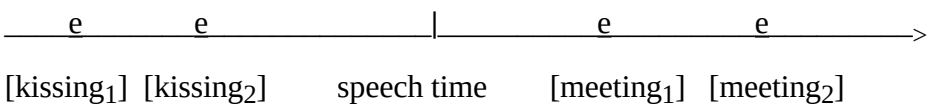
Unfortunately, this proposal too suffers from some empirical problems. Consider (19a).

(19) a. Mary kissed John before every meeting.

b. ⟦[[every meeting]$_1$[Mary kissed John before t_1]] ⟧ = 1 iff
⟦every⟧(⟦meeting⟧∩ C)(λx . there is a time t_1: Mary kisses John at t_1 & t_1 < now & t_1 < TIME(x))

Our intuition says that the relevant meetings in (19a) must all be located in the past of the utterance time. However, according to (19b) if the restriction upon the meaning of *meeting* is imposed by the context alone (and not by the tense form), then *C* could contain a future interval and (19a) could still be true. In fact, (19a) can be true in a context in which *C* consists solely of future intervals. Let me

show why this is the case. In the proposal under discussion, the only requirement for the truth of (19a) is that each relevant meeting is preceded by a past event of Mary's kissing John. It is therefore possible that all relevant meetings take place in the future of the utterance time, whereas all relevant kissings take place in the past of now. According to the scenario depicted in (20), for each meeting, there is an earlier kissing event that occurred in the past of now. Thus, despite the fact that [[meeting]]$\cap$ C is a set of future meetings, (19a) is predicted to be true in this situation. This is counterintuitive.

(20) 

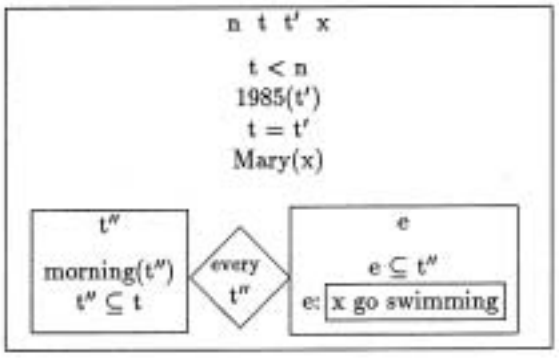
The actual interpretation of (19a) requires that the meetings be restricted to past meetings. Moreover, for each meeting, a relevant "before interval" must be defined because for each meeting, a relevant kissing must be found within an interval that is relatively short and immediately precedes the meeting. Obviously, it is not sufficient to restrict the relevant meetings to those meetings that occur within a particular past interval. For example, a natural reading of (19a) involves meetings that concern a particular project and occurred within a particular past interval. What is important here is that (19a) requires that the relevant meetings be restricted to past meetings. This fact cannot be accounted for by the idea that the speaker always avoids uttering a necessary false sentence. Thus, we must posit something in addition to the default assumption that the denotation of each noun is contextually restricted. Under the traditional account, the scope problem mentioned above is indeed a problem. A satisfactory account of the semantic relation between tense and tPP requires a new proposal.

The semantics of tPPs is discussed in Discourse Representation Theory as well. For example, Kamp and Reyle (1993) describe all relevant readings correctly in their discourse representation structures, but it is not clear what contributes the inclusion relation that occurs in the translation of the universal NP and why it has access to the salient past time. For example, (21a) is represented by

the Discourse Representation Structure given in (21b). In this particular example, one could argue that the subpart relation between t″ and t (i.e., t″ ⊆ t) given in the antecedent box stems from the preposition *in* in *in 1985*. However, the same subpart relation must hold even when there is no such tPP that denotes a definite interval, as in (21c); the mornings in question must be restricted to past mornings.

(21) a. In 1985 Mary went swimming every morning.

b.



c. Mary went swimming every morning.

Thus, from the viewpoint of compositionality, Kamp and Reyle's analysis needs some improvement.

3. Adverbial Clauses and Adverbs of Quantification

Lewis (1975) shows that what he calls adverbs of quantification (e.g., *always, sometimes, often*) are often used as quantifiers over "cases" rather than over times *per se*. Lewis formally analyzes them as unselective quantifiers. This idea was adopted by Kamp (1981) and Heim (1982) and was incorporated into Discourse Representation Theory.

This short section discusses the import of Lewis's analysis of quantificational adverbs in connection with quantificational tPPs (e.g., *every Sunday*). Following Lewis's analysis, all

sentences containing adverbs of quantification require (at least semantically) a restrictive clause and a consequent clause. Since an adverb of quantification is regarded as an unselective quantifier, it does not always quantify over times. For example, in (22a) *always* is said to quantify over farmer-donkey pairs. On the other hand, in (22b), *always* quantifies over times (or events) since there is no other free variable in the antecedent clause.

(22) a. If a farmer owns a donkey, he always beats it.
b. When Mary thinks about his friends, she always calls him in advance.

But the situation is a little more complicated when the sentence in question is in the past or future tense. When the antecedent clause contains a tense morpheme as in (23a), one could gather that this is why *always* quantifies over past times of John's thinking about his friends. However, the antecedent clause does not always have a tense morpheme as shown in (23b, c).

(23) a. When John thought about his friends, he was always happy.
b. When thinking about his friends, John was always happy.
c. When thinking about his friends, John will always be happy.

The time of thinking about his friends in (23b) is restricted to past times, and this information can only come from the past tense in the matrix clause. On the other hand, the time of thinking about his friends must be restricted to future times in (23c). This is clearly determined by the future tense in the matrix clause. This means that when the restrictive clause contains a time-sensitive expression, its correct interpretation requires access to the matrix tense. But it is not easy to do this in a compositional manner. This problem is quite similar to the case of tPPs discussed above in that both constructions involve quantified temporal adverbials.

Let us now turn to Pratt and Francez's discussion of how to deal with quantified tPPs such as *during every meeting*.

4. Pratt and Francez (2001)

We now tackle the sticky problem of how to make sure in a compositional way that the meaning of the tPP with widest scope is restricted by the past reference time for the sentence. Since we do not know in advance which tPP receives a widest scope interpretation, Pratt and Francez (2001) set up their system in such a way that each time-sensitive predicate contains what they call a temporal context variable (as part of its lexical meaning), which could then assume the value of the "reference time" when the expression in question has widest scope. (24) shows through an example how Pratt and Francez's system works. That notation here is that of Heim and Kratzer (1998).

(24) Mary kissed John during every meeting.

1. $[\![\text{during every meeting}]\!] = \lambda P \in D_{<i,t>} . [\lambda I \in D_i$. every meeting x such that TIME(x) $\subseteq$ I is such that P(TIME(x)) = 1]
2. $[\![\text{Mary kissed John}]\!] = \lambda t \in D_i$. an event of Mary's kissing John occurs within t
3. $[\![\text{Mary kissed John during every meeting}]\!] = \lambda P \in D_{<i,t>} . [\lambda I \in D_i$. every meeting x such that TIME(x) $\subseteq$ I is such that P(TIME(x)) = 1] ($\lambda t \in D_i$. an event of Mary's kissing John occurs within t)
4. $\lambda I \in D_i$. every meeting x such that TIME(x) $\subseteq$ I is such that an event of Mary's kissing John occurs within TIME(x)

After applying 4 in (24) to a contextually salient past interval $PAST_R$, we get the following truth condition for the sentence: every meeting *x* such that TIME(*x*) $\subseteq PAST_R$ is such that an event of Mary's kissing John occurs within TIME(*x*). This is the right interpretation. The most important feature of Pratt and Francez's proposal is that the translation of each event-denoting noun involves a temporal context variable (i.e., I in (25)) and that the event associated with the predicate is required

to occur within this contextually salient time as in (25). Let us refer to this assumption as **Assumption 1**.

(25) $[\![\text{meeting}]\!] = \lambda x \lambda I[\text{meeting}(x) \wedge \text{TIME}(x) \subseteq I]$

The second important assumption (**Assumption 2**) made by Pratt and Francez is that there are two sources of existential quantification. One is a quantifier (existential or universal) induced at the matrix clause level by an adverbial (such as a tPP), and the other is an existential quantifier over event variables. The latter implements Davidson's (1967) idea. When a quantificational adverbial (e.g., *during every meeting*) is there, the existential over the main predicate events is scoped under it. When there is no adverbial, the existential over the main predicate events is the only temporal quantifier in the sentence. Let us discuss these two points one by one.

I object to **Assumption 1** for two reasons. First, adoping this assumption does not seem to provide a fully compositional semantics to tPPs such as *during the meeting* because the meaning that is intuitively associated with *during* is already expressed by the lexical meaning of *meeting*. It would be like saying that *meeting* itself means 'meeting during', and *John kisses Mary* means 'John kisses Mary during'. Second, adopting this assumption means that we accept a fundamental difference between (regular) individual arguments and temporal arguments. For example, in (25) for any individual a_1 and interval i_1 if $[\![\text{meeting}]\!](a_1)(i_1) = 1$ then for any interval i_2 such that $i_1 \subseteq i_2$ $[\![\text{meeting}]\!](a_1)(i_2) = 1$. However, for any group individual a_2 such that a_1 is part of a_2, $[\![\text{meeting}]\!](a_2)(i_1) = 1$ does not necessarily hold. **Assumption 2** (assuming two sources of existential quantification) would produce the same problem that Bäuerle and von Stechow (1980) present with regard to frequency adverbs such as *exactly three times*. (This was discussed in Section 2.) Note also that there are overt existentials like *sometime between 5 and 6*. Therefore, it seems wise to attribute the existential quantifier to an adverbial.

Pratt and Francez propose **Assumption 1** primarily because they want the inclusion relation between the time of the event and the (past) time specified by the context. For example, in (14a)

(repeated here as (26a)) every relevant Sunday must be **part** of the salient past time and must not be equivalent to it. Otherwise, we would get the wrong interpretation as shown in (26b, c). If an existential quantifier associated with the past tense has widest scope and this time is **equivalent** to the time of crying, we obtain the reading in (26a). This is the wrong interpretation because it forces us to think about a set of Sundays that take place at the same time. On the other hand, if the existential quantifier is scoped under the universal quantifier, then (26a) is predicted to mean (26c). It entails, among other things, that every Sunday is in the past. Either way, we obtain the wrong result. Thus, the "part of" relation is crucial.

(26) a. John cried every Sunday.

b. $\exists t [\ t < \text{now} \wedge \forall x [[\text{Sunday}(x) \wedge \text{TIME}(x) = t\ ] \rightarrow \exists t_1 [\text{John cries at } t_1 \wedge t_1 \subseteq t]]$

c. $\forall x [\text{Sunday}(x) \rightarrow \exists t [\ t < \text{now} \wedge \text{TIME}(x) = t \wedge \exists t_1 [\text{John cries at } t_1 \wedge t_1 \subseteq t]]]$

Pratt and Francez's (2001) idea is to make such a contextual restriction part of the lexical meaning of each event noun so that the time of each relevant event is *within* the value of this temporal variable. This enables us to obtain interpretations like (15a, b) for (26a), and this is why Pratt and Francez wish to adopt **Assumption 1**. However, the correct empirical result is obtained by positing a major difference between "regular individuals" and temporal individuals as suggested above.

Prima facie, it would be better if we could make the same empirical prediction without positing this type of asymmetry between individual arguments and temporal arguments. The proposal I defend does just that.

5. Toward a More Compositional Account of Quantified Temporal Adverbials

In this section, I propose an account of the data discussed by Pratt and Francez (2001) that avoids the use of temporal context variables. My account is based upon von Stechow's (2002) proposal

and resembles it in many ways including the way in which syntactic movements at LF are exploited in the semantics. However, it contains what I consider to be an important new idea: an overt or covert tPP *in the past* or some other adverbial that denotes a specific part of the entire past interval such as *during last Summer* must occur in a past tense sentence. Unlike Pratt and Frances (2001) or von Stechow (2002), my proposal posits no temporal context variable in the lexical meaning of a verb or time-sensitive common noun. The idea is that the anteriority meaning associated with a past tense sentence is borne by an appropriate overt or covert past-oriented adverbial and not by the tense morpheme.[5]

First and foremost, we should note that tPPs like *in the past* do occur in tensed sentences as in (27a, b), which are found on the web.

(27) a. **In the past**, because of its size and fragility, and the modest artistic aspirations of many of its composers, sheet music **was** often considered ephemera by music libraries and seldom formed a part of their permanent collections.

b. **At some time in the past** there was clearly some sort of fluid on the surface.

Given these examples, one needs only a small extra step to conclude that when no such tPP is overtly present in a past tense sentence, a covert one with the same semantic content is there.[6] This

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[5] As far as the existential quantifier meaning associated with a tensed sentence, I follow Bäuerle and von Stechow (1980) in assuming that a frequency adverbial such *as at least once* (overt or covert) is responsible for it.

[6] Portner (2003) supports this idea indirectly by arguing for the view that the present perfect requires an extended now interval (or an adverb that denotes an extended now interval) not that the present perfect itself denotes this type of interval.

enables us to provide a more natural way of accounting for the behavior of tPPs in past tense (or future tense) sentences than Pratt and Francez (2001) or von Stechow (2002). The main points of my proposal are summarized in (28).[7]

(28) a. A sentence abstract (a tensed sentence with no temporal adverbials) is of type <i,t> (set of intervals).

b. A temporal preposition (e.g. on, in, during) is of type <e, <<i,t>,t>>
E.g., $[\![\text{on}]\!] = \lambda x \in D_e . [\lambda P \in D_{<i,t>} . [\text{there is } t \in D_i . P(t) \& t \subseteq \text{TIME}(x)]]$

c. A temporal PP (tPP) is of type <<i,t>,t>

d. A cascade of tPPs (a tPP that possibly embeds some additional tPPs) (e.g. *during every meeting on a Sunday*) is anchored by an overt or covert tPP that indicates a definite past time (e.g. *in the past*) when the sentence in question is in the past tense. (Similarly for future tense sentences.) A tPP α is an anchor iff there is no tPP β such that α contains β.

Given this proposal, the past tense looks as though it is semantically empty. It is assumed in the traditional account that tense carries an anteriority meaning. However, the proposed account posits an adverbial that conveys that information. Thus, I contend with Vlach (1993) that the past tense morpheme has no meaning of its own; it instead syntactically requires that an overt or covert past-oriented tPP such as *in the past* be present in the same clause. An exact syntactic mechanism that brings about this effect is left for another occasion, but I hope the idea is clear. This is analogous to Bäuerle and von Stechow's (1980) view about the existential quantification meaning associated with a past tense sentence, which was discussed above.

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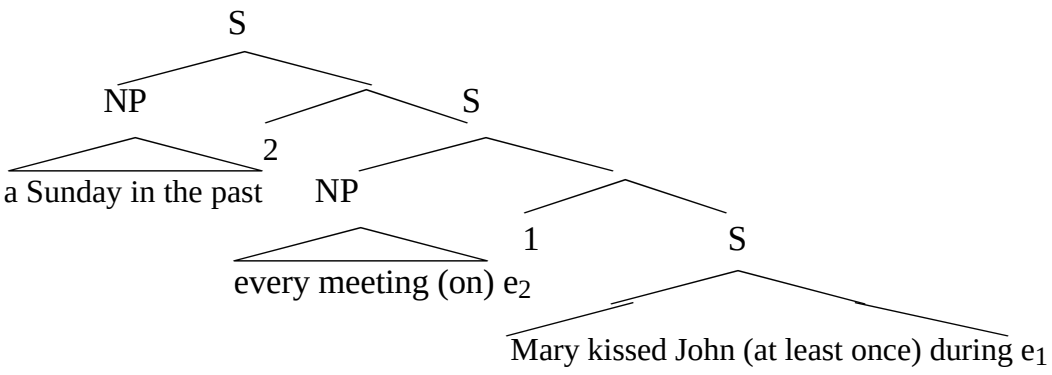
[7] The type system I assume here is the standard one: type *e* for individuals; type *t* for truth values; type *i* for intervals.

In the proposal being defended, statements like **TIME(e) ⊆ t** are not part of the lexical meaning of any verb or noun. Thus, Pratt and Francez's **Assumption 1** is rejected. All quantifiers are introduced by adverbials, and therefore, their **Assumption 2** is also abandoned. (30) shows how the sentence (29a) with the LF structure (29b) is interpreted compositionally in the system being proposed.

(29) a. Mary kissed John during every meeting on (a) Sunday (in the past)

b. LF: $[_S\ [_{NP}$ a Sunday in the past$]_2\ [_S[_{NP}$ every meeting (on) $e_2]_1\ [_S$ Mary kissed John (at least once) during $e_1]]]$



(30) 1. $[\![$Mary kissed John$]\!] = \lambda t \in D_i$. Mary kisses John at t

2. $[\![$during $e_1]\!] = \lambda P \in D_{<i,t>}$. there is a $t \in D_i$ such that $P(t) = 1$ & $t \subseteq$ TIME(x_1)

3. $[\![$Mary kissed John (at least once) during $e_1]\!]$ = there is a time t & Mary kisses John at t & $t \subseteq$ TIME(x_1)[8]

4. $[\![$meeting$]\!] = \lambda x \in D_e . \lambda t \in D_i$. x is a meeting at t

5. $[\![$on $e_2]\!] = \lambda P \in D_{<i,t>}$. there is a time t such that $P(t) = 1$ & $t \subseteq$ TIME(x_2)

6. $[\![$meeting on $e_2]\!] = \lambda y \in D_e$. $[\![$on $e_2]\!]$ ($[\![$meeting$]\!](y)$)

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[8] Following Bäuerle and von Stechow (1980) that the existential quantification over times originates in the covert adverbial *at least once*.

= $\lambda y \in D_e$. [there is a $t \in D_i$ such that y is a meeting at t & $t \subseteq$ TIME(x_2)]

7. [[every]] = $\lambda f \in D_{<e,t>}$. $\lambda g \in D_{<e,t>}$. every $z \in D_e$ such that f(z) = 1 is g(z) = 1
8. [[every meeting on e_2]] = $\lambda g \in D_{<e,t>}$. every $z \in D_e$ such that $\exists t$ such that z is a meeting at t & $t \subseteq$ TIME(x_2) is g(z) = 1
9. [[[every meeting on e_2] 1[Mary kissed John during e_1]]] =
   every meeting $z \in D_e$ such that there is a time t such that TIME(z) = t & $t \subseteq$ TIME(x_2) is such that there is a time t_1: Mary kisses John at t_1 & $t_1 \subseteq$ TIME(z)
10. every meeting $z \in D_e$ such that TIME(z) $\subseteq$ TIME(x_2) is such that there is a time t_1: Mary kisses John at t_1 & $t_1 \subseteq$ TIME(z)
11. [[the past]] = {t | t < now}
12. [[a Sunday in the past]] = $\lambda g \in D_{<e,t>}$. there is a Sunday $z \in D_e$ such that TIME(z) $\in$ {t | t < now} & g(z) = 1
13. [[[a Sunday in the past] 2[every meeting on e_2] 1[Mary kissed John during e_1]]] =
    $\lambda g \in D_{<e,t>}$. there is some Sunday $z \in D_e$ such that TIME(z) $\in$ {t | t < now} & g(z) = 1
    (λx_2 . every meeting $y \in D_e$ such that TIME(y) $\subseteq$ TIME(x_2) is such that there is a time t_1: Mary kisses John at t_1 & $t_1 \subseteq$ TIME(y))
14. There is a past Sunday $z \in D_e$ such that every meeting y that takes place within TIME(z) is such that Mary kisses John within TIME(y)

The line 14 in (30) provides the right interpretation of (29a) with the LF structure (29b). Note that the past tense morpheme has no semantic content.

What I attempt to accomplish in this paper is much more restricted in scope than Pratt and Francez (2001) or von Stechow (2002). But I believe that the basic idea I propose here is novel and is worth pursuing. I assume that certain syntactic features are responsible for the occurrence of desired tPPs in tensed English sentences.

6. An Alternative Account

It is often assumed in the literature that the contribution made by tense is a presupposition and not an assertion. For example, Kratzer (1998) assumes what is given in (31).

(31) $[\![\text{past}]\!]^{g,c}$ is only defined if c provides an interval t that precedes t_0 (the utterance time). If defined, $[\![\text{past}]\!]^{g,c} = t$.

I do not believe that the anteriority meaning associated with a past tense sentence is always presuppositional. But I concede that this is true most of the time. If I had so wished, I could have translated (31) into my proposal. For example, one could say that the phonetically null temporal NP (i.e., tNP) is presupposed to denote the entire past interval. Thus, I could go along with Kratzer's idea without agreeing that the tense morpheme carries this presupposition.

We could, alternatively, adopt Kratzer's proposal and assume that past tense is presupposed to denote some past interval and this constrains the denotation of the main verb. Then we could perhaps account for the fact that the temporal interpretation of any tPP harmonizes with the coocurring tense morpheme in terms of presupposition project as suggested by Heim (1997). Heim's (1997) idea is this: the presupposition imposed upon a time argument by a semantic tense is projected to a time argument occurring in the restriction of a temporal quantifier that binds this variable. Heim's suggestion is not formalized. But suppose it is. Then, this account would allow us to keep the standard assumption that tense only regulates the time of the verb obligatorily. Therefore it is prima facie a very promising hypothesis. To examine its consequences, let me present a simple example. Consider (32a).

(32) a. When watching TV, Mary always sat on the sofa.

b. always_t [PRO watches TV at t][Mary sits on the sofa at t]

c. always_t [PRO watches TV at t & t < now][Mary sits on the sofa at t & t < now]

When interpreting (32a), we must restrict our attention to past events of Mary's watching TV. This is explained in terms of Heim's account as follows. Her semantic representation of (32a) would be (32b). The tense imposes the restriction upon the variable *t* that occurs in the nuclear scope of *always*, which is that $[\![t]\!]^g$ is defined only if $g(t) <$ now (where *g* is an assignment). Heim's idea is that the same restriction is imposed upon the occurrences of the same variable *t* in the antecedent clause. Given this presuppositional analysis of the variable t in (32b), (32b) is essentially equivalent to (32c) (ignoring the difference between presupposition and assertion). This results in an empirically correct result. As von Stechow (2002) says, this may be the right approach, but the presupposition in question is often represented overtly by an adverbial. So it seems better to posit a covert adverbial rather than positing a presupposition projection mechanism that is sometimes redundant.

7. Some Residual Issues

In addition to the conceptual problem addressed above, Pratt and Francez's (2001) proposal suffers from some empirical problems. When discussing the semantics of *before* and *after*, Pratt and Francez specify the truth condition of (33a) as in (33b).

(33) a. Mary kissed John before the meeting.

b. The meeting x within $PAST_R$ is such that there is an event e of Mary kissing John & e occurs before x and within $PAST_R$.

By extending this analysis to (34a), Pratt and Francez would obtain (34b) as its interpretation.

(34) a. Mary kissed John before every meeting.

b. Every meeting x within $PAST_R$ is such that there is an event e of Mary kissing John & e occurs before x and within $PAST_R$.

(34b) is subject to the problem discussed by Ogihara (1995). That is, (34b) predicts that (34a) is true even when there is only one event of Mary's kissing John that precedes all relevant meetings as long as this kissing event falls within the contextually salient past interval indicated by $PAST_R$. Since this goes against our intuitions regarding (34a), we must make the interpretation of *before every meeting* even more context sensitive. (34a) is analyzed syntactically as in (35a, b), and the semantic interpretation of (35b) is obtained as in (36).

(35) a. Mary kissed John before every meeting (in the past).

b. LF: $[_S\ [_{NP}$ every meeting in the past]1 $[_S$ Mary kissed John before $t_1]]$

(36) 1. $[\![$Mary kissed John before $t_1]\!]$ = there is a time t such that Mary kisses John at t & t $\subseteq$ BEFORE(x_1)

2. $[\![$every meeting in the past$]\!] = \lambda P \in D_{<e,t>}$. every meeting x such that TIME(x) < now is such that P(x) = 1

3. $[\![[_S\ [_{NP}$ every meeting in the past]1 $[_S$ Mary kissed John before $t_1]]]\!] = \lambda P \in D_{<e,t>}$. every meeting x such that TIME(x) < now is such that P(x) = 1 ($\lambda y \in D_e$. there is a time t such that Mary kisses John at t & t $\subseteq$ BEFORE(y))

4. Every meeting x such that TIME(x) < now is such that there is a time t such that Mary kisses John at t & t $\subseteq$ BEFORE(x)

The important point here is that BEFORE is a context dependent choice function from individuals (i.e., events) to intervals which supplies a "before interval" for any event x. This interval is understood to be the interval within which a relevant kissing event occurs in relation to the meeting in question. The assumption is that each interval provided by this function for an event is a relatively short interval that precedes and abuts this event. This practically eliminates the possibility that one

kissing event that precedes all the relevant meetings would make (35a) true. This solution could be incorporated into Pratt and Francez's proposal as well. So this issue having to do with the semantics of *before* is independent of the choice between mine and theirs.

Finally, note that the temporal conjunction *before* gives rise to a different type of problem discussed in Ogihara (1995). It is a problem associated with non-factual *before* exemplified by (37a–b). (37a) does not entail that there is a past time at which he committee suicide. Similarly for (37b).

(37) a. Mary always came to his rescue before he committed suicide.
b. John died before he saw his grandchildren.

The proposal defended here can be augmented by the modal analysis of non-factual *before* presented in Ogihara (1995).

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