

A SCOPE THEORY OF TENSE AND ADNOMINAL MODIFIERS

TOSHIYUKI OGIHARA
*University of Washington**

1. An Operator Analysis of Tense and Enç's Analysis of Nouns

In the tradition of formal semantics (e.g., Montague's PTQ), tense morphemes are assumed to be sentential operators. For example, (1a) is analyzed as in (1b), where **P** is a past tense operator.

- (1) a. Every student left.
b. $\mathbf{P}[\forall x[\text{student}(x) \rightarrow \text{leaves}(x)]]$
c. There is some past time t such that every student x at t leaves at t .

P is interpreted as a quantifier over past times, but times are not directly referred to in the object language in PTQ. Each expression is interpreted with respect to a world and a time (called indices), and a tense operator shifts the time index away from the original index. An important empirical prediction that this system makes is that **P** affects the temporal interpretation of each non-logical constant in its scope. (1b) is interpreted as in (1c). In this case, **P** has scope over STUDENT and LEAVES. (1a) can also receive an interpretation that is symbolized as in (2a) and is interpreted as in (2b), in which case the predication time of STUDENT is the utterance time since it escapes the scope of **P**.

- (2) a. $\forall x[\text{student}(x) \rightarrow \mathbf{P} \text{leaves}(x)]$
b. Every x such that x is a student now is such that there is a past time t such that x leaves at t .

In any case, the fact remains that according to the operator approach the temporal interpretation of a noun is determined by the closest c-commanding tense, if any.

Enç (1981, 1986) argued against an operator analysis of tense (or a scope theory of tense) by citing examples like (3a–b). (We will discuss the difference between an operator analysis and a scope analysis below.)

- (3) a. Every fugitive is now in jail.
b. John will meet every hostage at the president's party.

(3a) does not mean that every current fugitive is now in jail. It means that every former fugitive is now in jail. This interpretation, however, is not predicted by the traditional analysis. (3b) can mean that John will meet all ex-hostages at the president's party. However, the traditional system only permits two possibilities: the relevant persons are hostages now or are hostages in the future when John meets them. On the basis of such data, Enç concludes that both nouns and verbs are indexicals in that their interpretations are not determined by higher operators. Enç considers the possibility that tense morphemes are operators unlike nouns. However, Enç claims that there is no evidence for a scope theory of tense, and there is some evidence that tense

morphemes are referential expressions (e.g., Partee 1973). Thus, Enç concludes we should regard both nouns and verbs as indexicals.

2. What a Scope Theory of Tense is

One representative system that employs an operator approach is Montague's PTQ system (1973). Although the tense operator approach has many merits, it does not provide enough tools to represent all relevant temporal data in natural language. For example, it cannot represent adverbials naturally; it cannot describe how the quantificational force of the operator is restricted in many cases. Note that the operator approach to tense comprises three independent ideas.

- (4) a. A tense introduces an existential quantifier for times.
- b. The domain of quantification is either past times (for past tense) or future times (for future tense). (No other restrictions are imposed.)
- c. A tense determines the temporal interpretation of all expressions that are structurally subordinate.

These three characteristics of the operator analysis of tense can be represented separately in a system that represents times overtly in the object language. This also means that it is possible to set up an intermediate system in which only one or two of the three ingredients are incorporated. As the inflexibility of the operator approach became clear, some alternative systems have been developed which employ temporal arguments in the object language. For example, (1a) can be translated into (5a) or (5b) (among others), depending upon how times are represented in the object language.

- (5) a. $\exists t[t < \text{now} \wedge \text{AT}(t, \forall x[\text{student}(x) \rightarrow \text{leaves}(x)])]$ (à la Dowty (1979))
- b. $\exists t[t < \text{now} \wedge \forall x[\text{student}(x, t) \rightarrow \text{leaves}(x, t)]]$ (Ogihara (1996))

(5a) is closer to the sentential operator approach (in terms of empirical predictions) than (5b). Both systems allow us to add information provided by temporal adverbials easily. For example, (6a) is represented as in (6b) or (6c).

- (6) a. Every student left yesterday.
- b. $\exists t[t < \text{now} \wedge t \subseteq \text{yesterday} \wedge \text{AT}(t, \forall x[\text{student}(x) \rightarrow \text{leaves}(x)])]$
- c. $\exists t[t < \text{now} \wedge t \subseteq \text{yesterday} \wedge \forall x[\text{student}(x, t) \rightarrow \text{leaves}(x, t)]]$

For now, I group together the above three approaches to the semantics of tense and will use the term SCOPE THEORY OF TENSE to refer to them. The characterization of "scope theory of tense" will be refined further in a later section.

It has been pointed out in the literature that a simple existential quantifier approach to tense is incorrect. For example, Partee's example (7a) is used to show that neither (7b) nor (7c) represents its intended interpretation. **P** represents a past tense operator. (7a) is uttered by the speaker when she is driving on a highway after leaving home. She utters this sentence because she realizes that she failed to turn off the stove before she left home.

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

- b. $\neg P$ [I turn off the stove]
- c. $P \neg$ [I turn off the stove]

(7b) means that the speaker has never turned off the stove in her life. (7c) means that there was a past time at which I failed to turn off the stove. The former is too strong a truth condition for the sentence; the latter is too weak. Thus, a simple existential quantifier theory of tense fails. I agree with this result completely. However, this does not mean that a referential theory of tense is any better. For example, (8a) does not represent the right interpretation despite its appearance. As long as the negation is interpreted as a sentential operator, (8a) simply means that the speaker fails to be in the extension of the predicate *turn off the stove* at the time indicated by the variable t . But given an interval based semantics, the fact that the speaker fails to be in the extension of this predicate at i does not guarantee that the same is true of all of i 's subintervals. Unless we say something special about negation, we must use an existential quantifier after all to capture the reading in question. That is, (8b) is the right translation.

- (8) a. \neg [I turn off the stove at $t \wedge t < \text{now}$]
- b. $\neg \exists t$ [$t < \text{now} \wedge t \subseteq t_R \wedge$ I turn off the stove at t]

Note: t_R is the “reference time,” i.e., the interval during which the speaker could have turned off the stove.

Even in non-negated declarative sentences, it is extremely rare to find instances in which a true referential use of a tense completely determines the predication time of the verb without being aided by an existential quantifier. For example (9a) is rendered as in (9b).

- (9) a. John bought a book yesterday.
- b. $\exists t$ [$t < \text{now} \wedge t \subseteq \text{yesterday} \wedge$ John buys a book at t]

Thus, it is fair to say that English sentences in general require an existential quantifier for their correct temporal interpretation.

As we shall see in a later section, however, many researchers contend that the existential quantifier is not contributed by the tense morphemes itself (Bäuerle 1978, von Stechow 1995a, 1995b). Anticipating this refinement of the treatment of tense, I shall clarify at this point what I mean by “scope theory of tense.” When I use this term, I refer to any proposal according to which the temporal variables associated with all time sensitive expressions (or all time-sensitive nominal expressions — a weaker version) in the same minimal clause are co-bound by higher scope bearing expressions, such as existential quantifier, universal quantifier, or lambda abstractor. It is not important whether tense itself is analyzed as a scope-bearing expression. On this view, Bäuerle’s proposal according to which the adverb *once* introduces an existential quantifier also counts as a scope theory of tense since all relevant temporal variables are co-bound by a higher operator. For now, let us not worry too much about how the contribution of tense is characterized precisely or how it interacts with such intricate factors as frame adverbials and adverbs of quantification.

3. Adnominal Modifiers and Their Temporal Properties

Enç's argument about the temporal properties of nouns clearly presents a very strong case against a very simple picture that the operator approach to tense paints. However, it is not obvious that tense has no scopal properties. Note that if common nouns have temporal arguments that are obligatorily occupied by free variables, then the scope theory of tense is at least harmless. In this section, I should like to contend that a scope theory of tense is viable by drawing examples involving relative clauses in Japanese and adnominal modifiers in English. For simplicity, let us assume that common nouns carry free temporal variables somehow guaranteed by the syntax. I argue that for everything other than common nouns, tense behaves as if it has scopal properties.

In my earlier work (Ogihara 1989, 1996), I argued that tense does exhibit operator-like behavior at least in Japanese by citing examples involving relative clauses. For example, (10) can receive the reading indicated by the English gloss. With an appropriate adverbial (such as *ima* 'now'), the time of the man's crying can be understood to be the utterance time. But the simultaneous reading is the preferred reading for it.

- (10) Taroo-wa [NP nait-e iru otoko]-ni at-ta.
Taro-TOP cry-PROG-PRES man-DAT meet-PAST
'Taro met a man who was crying (at the time of the meeting)'

I accounted for these two possibilities in terms of a scope theory of tense. If the NP in question is in the scope of the matrix tense, then the time of the man's crying is predicted to be simultaneous with the meeting time; if the NP is outside the scope of the matrix tense, then the time of the man's crying is the utterance time.

However, some arguments have been advanced against this position. First, English relative clauses seem to show that a scope theory of tense is not required (to say the least).

- (11) a. John met a man who is crying (over there).
b. John met a man who was crying.

The time of the man's crying must be the utterance time in (11a) and can be any past time in (11b) (if appropriate adverbials are supplied). This seems to show that tense morphemes in relative clauses are interpreted as if unembedded, and this in turn suggests that a scope theory of tense is not called for. Second, Japanese is said to be an exception with regard to the behavior of the present tense morpheme in relative clauses (Kusumoto 1998, Schlenker 1998). For example, Russian patterns with Japanese with regard to the behavior of tense morphemes in verb complements. However, as far as relative clauses are concerned, Russian patterns with English. Third, if Enç is correct about the temporal properties of nouns, then it is natural to hypothesize that NPs in general do not behave as if they are "in the scope" of the closest c-commanding tense.

In order to support the view that the scope theory of tense is viable and that DPs as a whole behave as if they are in the scope of the closest c-

commanding tense, I would like to draw on English data. English adnominal modifiers provide support for the view that tense morphemes have scopal properties — i.e., determine the temporal properties of expressions in structurally subordinate positions in a systematic way.

- (12) a. ?? Every fugitive crying for joy is now in jail.
b. # The professor crying at home waiting for her parents has three children now.
c. # The man singing on the stage is now drinking beer in the bar.

(12a) almost certainly cannot mean that every ex-fugitive who was crying for joy (when they were fugitives) is now in jail. (12b) just cannot mean that the current professor who used to cry at home when she was a small child has three children now. (12c) cannot mean that the man who was singing on the stage is now relaxed in the bar drinking beer. It appears that the present participle is forced to indicate the utterance time, which is indicated by the main clause tense. Similar examples can be constructed with past participles with adjectival interpretations.

- (13) a. ?? Every fugitive protected at home is now in jail.
b. # The professor overly protected by her mother is now a great scholar.

When the temporal interpretation of the noun and the modifier coincide in the intended interpretation as in (12a) and (13a), the sentences seem to sound a bit better, but they are still not very good. I believe that the same generalization extends to other adnominal modifiers. Consider (14).

- (14) ?? Every miserable child is now happy.

When the main clause is in the past tense, then the modifier can refer to a past time co-temporal with the time of the main predicate as in (15a) and can also refer to the utterance time as in (15b).

- (15) a. The man singing on the stage was smiling at us.
b. The man singing on the stage used to be a cab driver.

Of course, the presence of an overt indicator of the temporal location of the modifier can change things. However, when unmodified, the modifiers being discussed seem to be controlled by local c-commanding tenses. Some additional examples are presented here:

- (16) a. John found a shop to be closed in five days.
b. Last month Professor Jones assigned a research project to be completed in a week.
c. John saw a man crying in despair.
d. I saw a man looking tired from the day's work.
e. Yesterday, I went to the police station and talked to the officer on duty.
f. I shook hands with an actor standing on the stage.

The above English data provide evidence for a scope theory of tense.

This means that a scope theory of tense is viable. This also provides support for my proposal with regard to the Japanese tense system in general and relative clauses in particular. Also we now know that the so-called present

tense morpheme in Japanese is very much like present participles in English, which are clearly tenseless, in that it is interpreted in relation to the closest c-commanding tense.¹

4. Some Refinements for a Scope Theory of Tense

In section 3, I showed that a scope theory as it was characterized in section 2 is viable given the behavior of adnominal modifiers. However, as mentioned earlier, the characterization given above needs some refinements. Bäuerle (1978) and von Stechow (1995a, 1995b) argue that a simple existential quantifier analysis of tense makes the wrong predictions when we take into consideration the interaction of tense, frame adverbials, and temporal adverb of quantification. Von Stechow argues against both the traditional existential quantifier approach (Montague 1973) and the referential analysis of tense (Enç 1987). Von Stechow (1995a, 1995b) adopts a hybrid approach suggested by Bäuerle (1978) and Kratzer (1978).

The problem with the traditional existential quantifier analysis of tense is brought out by examples like (17a–c).

- (17) a. John coughed exactly three times yesterday.
 b. John coughed exactly twice yesterday.
 c. Yesterday, Fido always barked when someone visited our house.

If the truth condition for (17a) is given as in (18a), then it wrongly predicts that (17a) entails (17b) because (17b) would translate as in (18b). This is clearly problematic, and the source of the problem is also clear: the outermost existential quantifier that is assumed to be an integral part of the meaning of past tense. The same point can be made with (17c). If it is translated as in (18c), then it fails to show that Fido's behavior described by the sentence covers all day yesterday. It is sufficient to find a tiny portion of yesterday during which Fido had the property in question. This is again the wrong prediction.

- (18) a. $\exists[t < \text{now} \wedge t \subseteq \text{yesterday} \wedge \exists_{\text{exactly}3} t' [t' \subseteq t \wedge \text{John coughed at } t']]$
 b. $\exists[t < \text{now} \wedge t \subseteq \text{yesterday} \wedge \exists_{\text{exactly}2} t' [t' \subseteq t \wedge \text{John coughed at } t']]$
 c. $\exists[t < \text{now} \wedge t \subseteq \text{yesterday} \wedge \forall t' [t' \subseteq t \wedge \text{someone visits our house at } t'] \rightarrow \text{Fido barks at } t']]$

Note: $\llbracket \exists_{\text{exactly}3} t \phi \rrbracket^g = 1$ iff there are exactly three (non-overlapping) intervals i such that $\llbracket \phi \rrbracket^{g[i/t]} = 1$. Similarly for $\exists_{\text{exactly}2}$.

Von Stechow concludes that we need Kratzer's (1978) definite theory of tense. According to this theory, PAST denotes the maximal time stretch before the speech time. (17a) is then translated as in (19a), and (17c) as in (19b).

- (19) a. $\exists[t = \text{Max } t' [t' < \text{now} \wedge t' \subseteq \text{yesterday}] \wedge \exists_{\text{exactly}3} t_2 [t_2 \subseteq t \wedge \text{John coughs at } t_2]]$
 b. $\exists[t = \text{Max } t' [t' < \text{now} \wedge t' \subseteq \text{yesterday}] \wedge \forall t_2 [t_2 \subseteq t \wedge \text{someone visits our house at } t_2] \rightarrow \text{Fido barks at } t_2]]$

Note: $\llbracket \text{Max } t \phi \rrbracket^g =$ the maximal interval i such that $\llbracket \phi \rrbracket^{g[i/t]} = 1$.

Now a question arises as to how a “normal” sentence without a temporal adverb of quantification can be represented within this proposal. Here, I think we can adopt Bäuerle’s proposal and say that a covert temporal adverb of quantification *once* is supplied. Although von Stechow seems to think that this is not absolutely necessary, I believe that the lexical semantics of various expressions would be messed up if we do not introduce an existential quantifier. Let us look at a concrete example here. (20a) should be rendered as in (20b).

- (20) a. John saw her mother today.
 b. $\exists t[t = \text{Max } t'[t' < \text{now} \wedge t' \subseteq \text{today}] \wedge \exists t_2[t_2 \subseteq t \wedge \text{John sees his mother at } t_2]]$

The past tense is a definite description and an existential is introduced to locate the time of John’s seeing his mother within the maximal interval picked up by the tense. The existential with narrow scope can be understood as a covert temporal adverb of quantification originally proposed by Bäuerle (1978). I believe that the above cases cover almost all representative cases of how tense and adverbs interact at the matrix clause level. As can be seen from the above examples, the temporal variable associated with the main verb is bound by a higher operator: either an existential or a universal.

Turning to embedded clauses, we also find that the temporal variable associated with the verb is bound by a higher operator, usually a lambda operator. For example, according to my earlier proposal about verb complement clauses (Ogihara 1996) and the above proposal about tense in the matrix clause, (21a) translates as in (21b).

- (21) a. Last month, John said that Mary was pregnant.
 b. $\exists t[t = \text{Max } t'[t' < \text{now} \wedge t' \subseteq \text{last month}] \wedge \exists t_2[t_2 \subseteq t \wedge \text{say}(t_2, j, \hat{\lambda}t\lambda x[\text{pregnant}(t, m)])]]$

The temporal variable t indicating the time of Mary’s pregnancy is bound by a lambda operator. Thus, in all cases that I know of, the time variable indicating the predication time of the verb ends up being bound by some operator. Thus, for temporal variables responsible for predication times for nouns, there are always higher operators around to bind them. My main contention here is that these temporal variables associated with adnominal modifiers get bound by the closest c-commanding operator. It is not my concern here how this result is guaranteed in a fully formalized system. The easiest way of guaranteeing that the time of the verb and the time of an adnominal modifier that occurs in the same minimal clause as the verb co-vary is to let the two temporal variables in question be bound by a higher operator. And in order to guarantee this result, the NP as a whole must be in the scope of the higher operator when it is interpreted.

Let us see how an example with an adnominal modifier is analyzed in the revamped system. (22a) (cited earlier as (13a)) is translated into (22b). For simplicity, I adopt Enç’s proposal here and leave the temporal variable t_2 free although it is in the scope of the existential quantifier.

- (22) a. ??Every fugitive protected at home is now in jail.
 b. $\exists t[t = \text{Max } t'[t' \text{ overlaps now} \wedge t' \subseteq \text{tR}] \wedge$

$$\forall x[[\text{fugitive}(t_2, x) \wedge \text{protected-at-home}(t, x)] \rightarrow \text{in-jail}(t, x)]^2$$

I hope to have shown that the scope theory of tense can account for the cotemporality of the verb and the adnominal modifier in (22a) without predicting that the temporal variable associated with the common noun is also bound by the existential quantifier.

5. Musan (1995) and Temporal Properties of Nouns Revisited

Although it is not the main purpose of this paper to propose a system that predicts the predication time of common nouns, I would like to explore some possibilities here in this section. Enç’s proposal merely says that the time is determined by the context. This in principle means that the time could be any time whatsoever as long as the interpretation is what the context wants. This seems too liberal in many cases.

Musan (1995) shows that the temporal interpretation of a cardinal NP is (in most cases) dependent upon the interpretation of the verb.

- (23) a. In the forties, professors were young. (Musan 1995: 75)
 b. There were many homeless people at the rally. (Musan 1995: 81)

In examples like (23a–b), the underlined cardinal NPs receive temporally dependent interpretations. On the other hand, examples like (3a–b) contain “presuppositional” NPs — roughly, NPs with strong determiner (e.g., *every fugitive*, *every hostage*) — and can receive temporally independent interpretations, as Enç claimed. Musan tries to account for this distinction in the following way: (i) determiners are quantifiers over stages of individuals, rather than over individuals in their whole temporal extendedness; (ii) presuppositional NPs are mapped into the restrictive clause, whereas cardinal NPs are mapped into the nuclear scope. The semantic difference is that a non-intersective meaning of *and* (i.e., a mereological sum operation indicated by \oplus) is used in the restrictive clause to combine the contextual restriction represented by the resource domain variable and the meaning of the noun, whereas the normal intersective meaning of *and* is used in the nuclear scope. For example, (24a) is interpreted as in (24b), and (24c) as in (24d).

- (24) a. Most students were sick.
 b. Most maximal stages x_{st} such that there is an x_{st1} and x_{st2} and $x_{st1} \oplus x_{st2} = x_{st}$ and x_{st1} is a C stage (i.e., stage consistent with what the resource variable C provides) and x_{st2} is a student stage contain as a part a stage of being sick.
 c. There were many homeless people at the rally.
 d. Many maximal C stages x_{st} (i.e., stage consistent with what the resource variable C provides) contain a stage v_{st} that is a homeless person’s stage and is a stage of being at the rally.

Even if Musan is correct about how temporally dependent interpretations of nouns are derived, adopting her proposal is not sufficient since it does not predict the observed behavior of adnominal modifiers. If we adopt Musan’s proposal about the predication time of common nouns, then it seems possible to dispense with a temporal argument for a common noun. If we do that, we

can say quite simply that each free time variable in the same minimal clause are bound by the locally available operator.

I can think of some alternative means of dealing with the temporal properties of common nouns. For example, it seems plausible that whether or not someone is in the extension of a common noun at some time t is dependent upon whether some type of event took place before t . For example, I think it is reasonable to determine the extension of the noun *murderer* in the following manner: *for any time t , $\llbracket \text{murderer} \rrbracket(t) = \{x \mid \exists y \exists t' : x \text{ murders } y \text{ at } t' < t\}$.* We can perhaps define the extension of *hostage* in the following way: *for any time t , $\llbracket \text{hostage} \rrbracket(t) = \{x \mid \exists t' : x \text{ is held hostage at } t' \leq t\}$.* On this analysis, common nouns are completely on a par with other time sensitive expressions.

Yet another possibility is to translate a common noun as having its own tense. For example, when the word *hostage* is used, it is used to mean *someone who used to be a hostage*. According to this method, (25a) is translated as in (25b).

- (25) a. Every hostage will be at the party next week.
 b. $\exists t[t = \text{Max } t'[\text{now} < t' \wedge t' \subseteq \text{next week}] \wedge \exists t_2[t_2 \subseteq t \wedge \forall x[\exists t_3[t_3 < t_2 \wedge \text{hostage}(t_3, x)] \rightarrow \text{be-at-the-party}(t_2, x)]]]$

Both of these approaches to tense require the predication time of the main verb in order to determine the time of the predication time of the noun. To the extent our claim is valid, this further supports the scope theory of tense.

6. Remaining Problems

In my earlier work, I appeal to NP's scopal properties to account for the fact that a Japanese relative clause in the present tense can always refer back to the utterance time. However, even if the NP in question is deeply embedded, this possibility remains intact. If it is true that the scope of NPs is clause bounded, then this is unexpected. For example, in (26) the time of the man's dancing can be the utterance time, the time of Taro's saying, or the time of Hanako's hearing.

- (26) Butai-de odot-te iru otoko-ga izen-ni sakka-datta
 stage-at dancing-PRES man NOM before novelist was
 to Hanako-ga sit-ta to Taro-ga it-ta.
 that Hanako-NOM learn-PAST that Taro-NOM say-PAST
 'Taro said that Hanako found out that the man singing on the stage used to be a novelist.'

I am not sure if the same is true of the English counterpart (i.e., the gloss). We may need to move NPs for *de re* interpretations anyway and this may not be a problem after all, but this question must be investigated in detail before we can say anything definitive.

NOTES

* The ideas expressed in this work were previously presented at Nanzan University (June 11, 1999) and at Chronos (a conference on Tense, Aspect,

and Mood held in Thermi, Greece) in July 1999. I thank Yasuaki Abe, Mamoru Saito, Uli Sauerland, Tim Stowell, James Higginbotham, and other participants of these events.

¹ Let me add some caveats. The c-commanding relation in question must be checked at the level at which semantic interpretation occurs (LF at Chomsky's model). When the entire relativized DP is scoped out, then it is evaluated in relation to the utterance time. In addition, the present tense morpheme in Japanese can receive a future-oriented reading, unless present participles in English.

² tR 'reference time' indicates an interval that is contextually salient.

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