Temporal Interpretation of Non-finite
Adjuncts in English

Sungbom Lee

There are adjunct clauses in English that have no overt tense morphology. For example, the underlined parts of the sentences - No one knows what Joe did before coming to this town or While painting the old house, they thought they saw a ghost rambling in the basement, are non-finite adjuncts. The matrix clauses in English exhibit tense morphology and thus have direct access to the time of utterance for temporal interpretation. In contrast, non-finite adjuncts contain "no component sensitive to the time of utterance" (Richards 1982: 67), and fail to have direct access to the speech time. They must be linked in some way to the matrix tense to get temporally interpreted. This paper addresses to the question of how such NFA's are interpreted temporally. The paper will show that neither the operator analysis nor the deletion analysis is successful in handling the temporal interpretation of NFA's. Adopting Enç's binding analysis of tense that treats tenses as referential expressions that denote times, I will propose a set of interpretation rules of NFA's. In doing so I will examine Enç's claim that the interpretation of tenses is subject to syntactic conditions that are reminiscent of the binding conditions for the interpretation of anaphors and pronominals. I will show that NFA's are interpreted in terms of semantic inclusion and that this semantic relation is not subject to any significant syntactic constraints.

1. Introduction

The purpose of this paper is to provide an account of the temporal interpretation of non-finite adjuncts in English. First, it aims to show that the traditional quantificational analysis of tense fails to capture the temporal relation between a matrix sentence and a non-finite adjunct. Second, I will argue that a non-finite adjunct cannot be derived from a finite adjunct clause by a deletion rule in the spirit of Ogihara (1995). Third, the referential

analysis of tense proposed by Partee (1973) and Enç (1986, 1987) that treats tense as denoting intervals of time is extended to cover the non-finite adjuncts as well as finite adjuncts. In so doing, I will propose that the notion of semantic inclusion proposed by Enç (1987) will play a crucial role in accounting for the temporal interpretation of non-finite adjuncts. However, I will argue that Enç's idea that syntactic conditions govern the interpretation of tenses is too rigid to deal with non-finite adjuncts and that the semantic inclusion need not be subject to any significant syntactic constraints.

2. Adjuncts in English

There can be many different types of adjuncts in English, depending on how we classify them. For our purpose, however, we will assume that there are three types of adjuncts in English. First, some adjuncts have overt tense morphology in their own clause boundary. We will call them 'finite adjunct clauses'. For instance, every underlined part of the sentences in (1) is a finite adjunct clause:

(1) Finite Adjunct Clauses
   a. John visited his uncle <u>when he was in London</u>.
   b. <u>Because you have always wanted to see the tower,</u> I'll take you there first.

Just as the matrix clauses in English exhibit tense morphology and thus have direct access to the time of utterance for temporal interpretation, so the finite adjunct clauses contain overt tense morphology. Thus, they pose no serious problem for the classical Reichenbachian analysis of tense. For example, (1a) can be interpreted as true at the moment of utterance t iff there is a time t' such that t' temporally precedes t and John's visiting his uncle and his being in London are both true at t'.

The second type of adjuncts in English lack overt tense morphology as illustrated in (2). They are called non-finite adjunct clauses (henceforth, NFAs):

(2) Non-finite Adjunct Clauses
   a. <u>After interviewing the candidates,</u> the reporter will fly to Arizona.
   b. <u>While painting the old house,</u> they saw a ghost rambling in the attic

    c. Sam died <u>waiting for Godot</u>.

    d. Elaine's winking at Roddy was fruitless, <u>he being a confirmed bachelor</u>.[1]

NFAs are usually paraphrased as finite adjunct clauses as in (3), when the context permits the recovery of information needed for paraphrasing.

(3) a. <u>After she interviews the candidates</u>, the reporter will fly to Arizona.

    b. <u>While they were painting the old house</u>, they saw a ghost rambling in the attic.

    c. Sam died <u>while he was waiting for Godot</u>.

    d. Elaine's winking at Roddy was fruitless, <u>because he was a confirmed bachelor</u>.

Thus, it may be argued that NFAs are derived from finite adjunct clauses by a deletion rule, since the tense in the adjunct clause is semantically empty. Korean examples also seem to support the deletion approach. The adjunct clauses in (4a) and (4b) do not contain tense morpheme. They parallel the tenseless complement clauses in the so-called sequence-of-tense phenomena: they are interpreted as cotemporal with the matrix tense.

(4) a. Chelsu-nun Mina-ka   ilpon-ey   iss-ul-tongan   mikwuk-ey

              TOP   NOM Japan-in be-REL-while   America-in

      iss-ess-ta.

      be-PST-DEC

      'Chelsu was in America while Mina was in Japan.'

    b. John-i   ka-ul-ttay   Mary-to   ka-ess-ta.

        NOM go-REL-time   also go-PST-DEC

      'When John left, Mary left too.'

In an analysis of the sequence-of-tense phenomenon, Ogihara (1995) proposes a tense deletion rule that serves to delete a past tense morpheme c-commanded by another past tense.

(5) A tense morpheme α can be deleted if and only if α is locally c-commanded by a tense morpheme β (i.e., there is no intervening tense

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[1] This example is from Reuland (1983).

morpheme between α and β), and α and β are occurrences of the past tense morpheme.

This deletion rule is posited to account for the ambiguity in an example like (6):

(6) John said that Mary was sick.

As Enç (1987) argues, (6) is ambiguous between "shifted reading" and "simultaneous reading." For the simultaneous reading, the deletion rule applies to the underlying structure of (6) given in (7a), yielding (7b). This deletion occurs at LF before the semantic interpretation of the sentence takes place in order to guarantee no shift of the evaluation time away from the time at which the matrix sentence is evaluated. On the other hand, since the rule is optional, it may not apply to (7a) and then a shifted inter-pretation results.

(7) a. John PAST say that Mary PAST be sick.
    b. John PAST say that Mary φ be sick.

We may adopt Ogihara's tense deletion approach to embedded tense in analyzing adjunct tense. The tense deletion rule given in (5) needs to be revised in order to apply in the case of adjunct tense. For example, it will delete the subject NP of the adjunct as well as the tense morpheme. In any case, the resultant adjunct tense deletion rule can map an NFA as in (8a) to a finite adjunct clause as in (8b):

(8) a. While they were playing cards in the hotel, they watched football.
    b. While playing cards in the hotel, they watched football.

However, Korean adjuncts pose a problem for this deletion rule. First, the adjunct tense deletion rule seems obligatory to block sentences like (9b) in Korean:

(9) a. Sam-un   Godot-lul   kitali-myense   cwuk-ess-ta.
           TOP   ACC   wait-while   die-PST-DEC
       'Sam died while waiting for Godot.'

    b. *Sam-un   Godot-lul   kitali-ess-myense   cwuk-ess-ta.
            TOP   ACC   wait-PST-while   die-PST-DEC

The verb stem *kitali-* 'wait' in (9b) cannot have a past tense morpheme affixed, although it describes a past event. On the other hand, examples (10a) and (10b) illustrate that the rule should be optional:

(10) a. John-un   London-ey iss-ul ttay,   samchon-ul pangmwunha-ess-ta
             TOP   in be-REL when uncle-ACC visit-PST-DEC
     b. John-un   London-ey iss-ess-ul ttay,   samchon-ul
             TOP   in be-PST-REL when uncle-ACC
        pangmwunha-ess-ta.
        visit-PST-DEC
        'When John was in London, he visited his uncle.'

Moreover, some NFAs in English are not cotemporal with the matrix clause as exemplified in the examples in (11):

(11) a. Rudy has been quite different, since coming back from Moscow.
     b. After having rung the bell, he retired into the shade.
     c. Before talking to the astronauts in a moment, the president is chatting with his aides.

No deletion-under-identity at LF is involved in the examples in (11), because their adjunct tense is not identical to the matrix tense.

If we do not adopt a transformational operation like adjunct tense deletion, then NFAs do not have direct access to the speech time, simply because they contain no component sensitive to the time of utterance. Then the question that arises is how NFAs are linked to the moment of utterance via matrix tenses. In other words, how does a speaker or hearer relativize non-finite temporal adjuncts to a particular interval denoted by the tense of the neighboring matrix clauses? We will address to this question later in this paper.

Finally, adjuncts may not be clausal but they may occur inside a VP as a modifying phrase as in the examples in (12).

(12) Adjunct Phrases:
     a. Don't leave home without your VISA.
     b. Paula will meet the president during her stay in New York.

This type of adjuncts will pose no problem for temporal interpretation because they are only affected by the matrix tense. We will be concerned

with the second type of adjuncts, since the temporal interpretation of the other types of adjuncts is fairly straightforward. We will first examine if the traditional operator analysis of tense is a viable option in treating the temporal interpretation of NFAs.

3. An Operator Analysis of NFAs?

The tense operator in the classical analysis of tense is based on the assumption that tense affects everything in its scope in temporal interpretation. Under this analysis tenses are operators on propositions that manipulate indices of a model. Thus, as argued by Enç (1987), tenses shift the ordinary truth conditions of an untensed sentence to a different point in time. For example, where ϕ is a sentence, PAST ϕ is true iff there is a time t' such that $t' < t$ and ϕ is true at t'.

Then, can we apply the traditional operator analysis to the interpretation of NFAs? Let us begin with an example:

(13) We sang Itsy Bitsy Spider while playing the game

Since the adjunct should be interpreted cotemporal with the matrix tense, the same tense operator PAST will have the entire sentence in its scope. (14) is a rough translation of (13).

(14) $\exists t [t < n$ & We sing Itsy Bitsy Spider at t & We play the game at t]

Using the set-theoretic devices of model theory of semantics, we can determine the truth-condition as follows: the denotation of sing Itsy Bitsy Spider is the set of individuals who sang the song at a past interval and the set is included by the set of individuals who were playing the game at the same past interval. If the individuals denoted by the expression *We* are found in these sets, the sentence is true.

The classical analysis of tense seems useful for the temporal interpretation of NFAs. One of the basic ideas of the analysis is that tense is a sentential operator, applying to an entire sentence, affecting temporally every element within its scope. However, as pointed out by Enç (1986), the interpretation of NPs is often temporally independent of the tense. For example, sentences like (15) whose subject is a non-rigid designator can be ambiguous with respect to the relative scope of tense and the subject NP:

(15) The president was a fool.

Either the tense has wide scope over the subject NP or the subject NP has wide scope over the tense. This shows that the tense may not have the entire sentence as its scope.

The situation would be little helped by having a 'local' tense operator. To see this, consider an example by Enç (1986) as in (16):

(16) Every member of our investment club will buy a house.

The two possible translations of (16) along the lines of Priorian tense logic are represented in (17).

(17) a. $\forall x$ [member(x) --> F buy(x, a house)]
     b. $F\forall x$ [member(x) --> buy(x, a house)]

However, (17a) and (17b) are not all the possible readings of (16). For example, (16) can be used to describe the situation where every member, present or future, will buy a house, whether or not he is a member at the time of the purchase. No complete representation is available in the classical analysis without introducing any ad hoc devices.

Moreover, as pointed out by Dowty (1982), there is a problem of embedding temporal expressions in a sentence. For example,

(18) While driving home yesterday, I chatted with Marcie.

the semantics of (18) cannot involve embedding the time adverbial under tense as in (19a) or embedding tense under the time adverbial as in (19b).

(19) a. PAST (⋯ YESTERDAY ⋯ chat-with(I, Marcie))
     b. YESTERDAY (PAST ⋯ chat-with(I, Marcie))

Finally, as we saw in the previous section the temporal sequence between matrix sentence and NFA is not fixed: some NFAs such as in the examples in (11), which are repeated in (20) below, are not in the scope of the matrix tense, whereas other non-finite adjuncts like (21d) are in the scope of the matrix tense:

(20) a. Rudy has been quite different since coming back from Moscow.
     b. After having rung the bell, he retired into the shade.

    c. Before talking to the astronauts in a moment, the president is chatting with his aides.

    d. The soldiers were marching through the town, singing *La Marseillaise* cheerfully.

The events described in (20a–c) are specifically ordered. The ordering relations in these examples are closer to what ter Meulen (1995) calls intersentential binding of tense than intrasentential binding of tense. They will not be captured properly by means of tense operators. This problem is not limited to adjunct tense interpretation, but is also true of temporal sequences in narration. Thus Nerbonne (1986: 83) notes that "even the simplest textual structure is problematic in a treatment in which tense is interpreted indefinitely, as it is e.g. in those systems using Priorian tense operators." The reference time of a narrative and its organization throughout the text requires a totally different approach to temporal sequence. Adjuncts and narratives are similar in this respect, but we will focus on the temporal aspects of adjuncts.

    To sum up, the crucial assumptions on tense operators in the classical analysis of tense are that 1) every tense operator allowed in the semantic representations of the sentences of a natural language corresponds to a syntactic tense, which in turn corresponds to a tense morpheme found in the surface forms of that language and that 2) a tense operator is introduced into the semantic representation of a sentence only if the corresponding tense is present in the syntactic structure of the sentence and the surface form contains the appropriate tense morpheme. We have seen in this section that these assumptions put a strong and inadequate constraint on the semantics of tense.

4. A Referential Analysis of Tense

    Based on some analogies between tenses and pronouns, Partee (1973) proposed a referential theory of tense interpretation. In this theory tenses and time adverbials are referential expressions and denote intervals of times. Enç (1987) goes one step further and argues that tenses can be interpreted if they are 'anchored' in one way or another. The temporal interpretation of sentences is governed by the syntactic conditions called 'Anchoring Conditions':

(21) Anchoring Conditions (Enç 1987)

    a. Tense is anchored if it is bound in its governing category, or if its local COMP is anchored. Otherwise, it is unanchored.

    b. If COMP has a governing category, it is anchored if and only if it is bound within its governing category.

    c. If COMP does not have a governing category, it is anchored if and only if it denotes the speech time.

As a result, temporal interpretation of a sentence is configurationally constrained by the syntactic conditions that are reminiscent of the binding conditions for the interpretation of anaphors and pronominals. To see how the referential analysis of tense works, let us consider the following example:

(22) John heard that Mary was in jail.

As we saw earlier, Enç (1987) argues that (22) is ambiguous between "simultaneous reading" and "shifted reading." On the simultaneous reading, the time of John's hearing the news and Mary's being in jail overlaps. On the other hand, the state described by the complement precedes the event described by the matrix clause on the shifted reading. The complement tense can be anchored in two ways in Enç's model: 1) anchored by being directly bound by the matrix tense or 2) anchored through its local COMP. The first possibility will yield the simultaneous reading, while the second the shifted reading. The syntactic structures of (22) are represented in (23) in terms of GB syntax:

(23) a. $[COMP_0 \ [NP \ [PAST_i \ [V \ [COMP \ [NP \ [PAST_i$: simultaneous reading

    b. $[COMP_0 \ [NP \ [PAST_i \ [V \ [COMP_i \ [NP \ [PAST_j$: shifted reading

      where $j < i < 0$ ('$<$' means temporally precedes)

The matrix COMP denotes the speech time and the matrix tense denotes a time prior to the speech time. The governing category of the complement tense is the entire sentence, and thus it can be anchored by being directly bound by the matrix tense, to yield the simultaneous reading. On the other hand, if the complement COMP is bound by the matrix tense, as is allowed by the system, the subordinate COMP denotes the same past interval as the matrix tense. The complement PAST in turn denotes a time interval prior to the time denoted by its local COMP, to yield the shifted reading, as the indexing in (23b) shows.

Thus, the referential analysis of tense provides a way of interpreting tensed sentences in terms of indexed syntactic structures, eliminating an ad hoc rule of sequence-of-tense that has no syntactic motivation. Let us turn to how it can be extended in interpreting non-finite adjuncts.

5. Adjunct Tense Interpretation in Enç's Anchoring Model

In Enç's theory, adjunct clauses headed by *when* or *although*, as in (24a) and (24b) below, are sisters of I'.

(24) a. John visited his uncle when he was in London.
     b. John lived in London then, although he lives in Chicago.

Such adjuncts are treated as "temporal free relatives" and the S'(= CP) in the adjunct is dominated by an NP. Thus, (24a) and (24b) share the structure in (25):

(25) [COMP$_0$ [$_{IP}$ NP [$_{I'}$ INFL$_i$ VP] [$_{CP}$[$_{NP}$[$_{C'}$ COMP$_j$ [$_{IP}$ NP [$_{I'}$ INFL$_i$ VP

The governing category of the adjunct tense is the matrix clause, but the matrix tense is not high enough to be a possible antecedent. Therefore, the adjunct tense cannot be anchored by being bound directly. The present tense in the adjunct clause in example (24b), for example, is independent of the matrix past tense, since the NP dominating the adjunct blocks the government of the COMP in the adjunct. The adjunct tense is anchored indirectly by having COMP within its clause denoting the speech time. In example (24a) also, the only way the adjunct tense can be anchored is through its COMP. Thus, "the adjunct tense is not related to the matrix tense by anchoring." (Enç 1987: 655)

The only way that the adjunct is interpreted temporally in Enç's model is by denoting the interval yielded by its local tense in the adjunct clause. However, the NFAs that we are concerned with do not contain the local tense (e.g., the adjunct in *John fell asleep while reading the novel*), since we do not assume an adjunct tense deletion rule at LF. As a result, the adjunct clause will not be anchored by any means, because it cannot be bound by the matrix tense (as we saw earlier, the government of the COMP in the adjunct by the main clause is blocked).

The problem lies in the attempt to isolate an adjunct clause from its main

clause in temporal anchoring. Contrary to Enç's claim, some adjuncts in English, which we call NFAs, are dependent on the matrix tense for their temporal interpretation and must be linked in some way to it. Her model may be adequate at least for the interpretation of finite adjunct clauses, since there is always a tense in this type of adjuncts that can denote the time interval necessary for the interpretation. However, the temporal inter-pretation of NFAs is impossible, because they cannot be related to the matrix tense in this model.

Before constructing the semantic rules for the temporal interpretation of NFAs, let us focus on the type of conjunctions or prepositions that introduce adjuncts. First, there are conjunctions in English that require the following adjuncts to be finite. Let us call them Class 1 adjunct introducers.

(26) Class 1: *because, as, although, for, ...*
    a. John couldn't get there in time, because he {departed / *departing} too late.
    b. As the girl {was watching / *watching} TV, she could not hear him sneak into the room.

Class 1 adjunct introducers do not contribute to the temporal link between matrix clauses and adjuncts. Since they fail to link between the clauses, no non-finite verb form is allowed in the adjuncts, as illustrated in the examples in (26). The adjunct itself denotes the time interval due to the presence of the adjunct tense without being bound by any element in the matrix clause.

Second, there are some conjunctions called Class 2 adjunct introducers that seem to be able to mediate the temporal relation between the adjunct clause and the matrix clause.[2]

(27) Class 2: *before, after, while₁, since₁, ...*
    a. While {she was swimming / swimming} in the pool, Jody had a cramp in the leg.
    b. Harry has been different, since {he came / coming} back from Moscow.

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[2] The preposition on is semantically a Class 2 introducer, since it can occur in a non-finite adjunct as in *On arriving in New York, I called him.* However, it is different from other Class 2 introducers in that it can not be followed by a finite verb, e.g., * *On I arrived in New York, I called him.*

Unlike Class 1 adjunct introducers, Class 2 introducers denote an interval in time as time adverbials and complementizers do in the referential theory of tense. Since they can link between matrix clauses and adjunct clauses, non-finite verb form is allowed in the adjuncts, as in the examples in (27).[3] It should be noted that it is not the whole CP but a COMP alone that denotes an interval in time under the referential theory of tense. Likewise, an NFA like *While swimming in the pool* in (27a) does not denote a certain time interval. Rather, it is the adjunct introducer *while* that denotes a time interval and describes a temporal relation between one event in the adjunct and another in the matrix clause. Our Class 2 adjunct introducers are treated as temporal adverbials in ter Meulen (1995), who argues that this kind of adjunct introducers "explicitly describe temporal relations between states or events." They can participate in the semantic inclusion relation for temporal interpretation that we will turn to in the next section.

Some conjunctions like *since* may behave differently with respect to the finiteness of the following clause, and thus may belong to different classes. For example, it allows an NFA when it indicates a point in time as in (27b). However, it does not allow a non-finite verb form when it is used in the sense of reason as in (28):

(28) Harry went to Thailand, since {he wanted/*wanting} to be a Buddhist.

Thus, homophonous *since* may belong to either Class 1 or Class 2, depending on its semantics. Similarly, when the adjunct introducer while is used in a non-temporal sense as in (29), the verb in the adjunct cannot be non-finite.

(29) Mr. Johnson is American, his girlfriend is German, while his boss {is / *being} Canadian.

Finally, there are adjunct introducers that belong in neither Class 1 nor Class 2. They are prepositions rather than conjunctions in traditional grammars. Thus, they do not introduce tense elements, nor denote anything temporal.

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[3] The adjunct introducer until as in *John was reading a book until the clock {struck/*striking} two* appears to be an exception to this. It describes a temporal relation between the matrix clause and the adjunct. However, it cannot have a non-finite verb in the adjunct clause. Compare this with on under footnote 2.

(30) Class 3: *because of, during, on account of, without, ...*
    a. The man came to see me during {my absence / *I was absent}.
    b. She didn't come to school on account of {illness / *she was ill}.

Class 3 introducers are different from Class 1 introducers in that the adjuncts headed by a Class 3 introducer are not sisters of the main clause, but dominated by a VP, subject to the tense denoted by the head verb. Thus, as in the case of Class 1, they are inactive with respect to tense interpretation, albeit for a different reason.

From the observations so far, it is only the Class 2 adjunct introducers that can enter into the temporal relation by denoting time intervals on their own. Based on this, let us see how the linkage between matrix clauses and NFAs is obtained.

6. Temporal Interpretation Rules for NFAs

The temporal interpretation of a sentence is an outcome of the interaction between the temporal expressions of the sentence. For instance, *Mary went to the movie last night* is true if the time of Mary's going to the movie is included in last night. In other words, the denotation of the past tense must be included in the denotation of the time adverbial. Extending this concept of inclusion in tense interpretation, we see that all intervals relevant to the interpretation of NFAs are the denotations of 1) the matrix tense, 2) time adverbials, if there are any, and 3) NFA introducers.

Non-finite adjuncts are further classified into the three types, depending on the time-adverbials within the adjuncts. To begin with, in Type 1 NFAs, there is no time adverbial and the matrix tense must serve as the antecedent of the NFAs.

(31) Type 1: [[$_{NFA}$ ... V-ing ...][... INFL[+Tns] ...]]
    a. While playing basketball, he often sprained his finger.
    b. While playing basketball, he often sprains his finger.

Enç's anchoring conditions cannot apply to NFAs, since the matrix tense fails to bind the adjunct tense. The adjunct verb cannot carry indices that allow them to enter an inclusion relation with the matrix tense, since it is untensed. Instead, as we have seen in section 4, an adjunct introducer like *while* denotes an interval and its inclusion relation with the interval denoted

by the matrix tense will be determined by the following semantic rule:

(32) Adjunct Tense Rule for Type 1 NFAs

Let T be a set of moments t of time, and let $[x]$ be the denotation of a temporal expression x, which is identical to T_x, and let '$t_1 > t_2$' mean 't_1 follows t_2 in temporal order.' Then, in a construction $[[\alpha...]$ $[... \gamma ...]]$, where γ is the matrix tense,

a) if α is *while*, then $T_\alpha \supseteq T_\gamma$;

b) if α is *before*, then for any $t_1 \in T_\alpha$ and any $t_2 \in T_\gamma$, $t_1 > t_2$;

c) if α is *after*, then for any $t_1 \in T_\alpha$ and any $t_2 \in T_\gamma$, $t_2 > t_1$;

d) if α is *on*, then for any $t_1 \in T_\alpha$ and any $t_2 \in T_\gamma$, $t_2 \geq t_1$ and there is no t_3 such that $t_2 > t_3 > t_1$.

Let us see how the rule in (32) work by way of examples in (33):

(33) a. While swimming in the pool, Joe was seized with a cramp in the leg.

b. Before swimming in the pool, Joe was seized with a cramp in the leg.

c. After swimming in the pool, Joe was seized with a cramp in the leg.

d. On swimming in the pool, Joe was seized with a cramp in the leg.

In (33a) the denotation of the matrix tense should be included by the denotation of the adjunct introducer. This will guarantee that the time of Joe's being seized with a cramp is included by the time set by the adjunct clause, but not vice versa. The time intervals denoted by the adjunct introducer *before* in (33b) and *after* in (33c) stand in the opposite inclusion relations with the time interval denoted by the matrix tense. Finally, in (33d) the interval denoted by the adjunct introducer *on* is immediately followed by the interval denoted by the matrix past tense. The same result will be obtained as for other adjunct introducers like *right after* or *immediately after* in place of *on* in (33d).

We have so far seen a subset of NFAs where there is no time adverbial inside the adjuncts. In this type of adjuncts the denotations of the adjunct introducer and the matrix tense stand in an inclusion relation as dictated by the tense interpretation rule. There are also NFAs that contain a time adverbial that can provide the temporal reference of the NFAs. They are further classified into two different types, depending on what kind of time

adverbials they have. First, deictic time adverbials like *now, this morning, tomorrow, a week ago*, etc. can be found in this type of NFAs.

(34) Type 2: [[$_{NFA}$ ... V-ing ... DTA ...][... INFL[+Tns] ...]],
　　　　where DTA is a deictic time adverbial.
　　a. While playing basketball this morning, he sprained his finger.
　　a'.*While playing basketball this morning, he'll sprain his finger.
　　b. While playing basketball tomorrow, he'll sprain his finger.
　　b'.*While playing basketball tomorrow, he sprained his finger.

Tense is redundant in this type of constructions, since the deictic time adverbial determines the time of event relative to the time of utterance. For example, the time interval denoted by *playing basketball* in (34a) is fixed by the adverbial *this morning*. (34a) is true if the time of *sprain his finger* is included in *this morning*. In other words, the denotation of the matrix past tense must be included in the denotation of the time adverbial.

On the other hand, when there are relative time adverbials like *in the morning, three hours later, at the same time*, etc. in NFAs, they must refer to the matrix tense to have a proper interpretation.

(35) Type 3: [[$_{NFA}$ ... V-ing ... RTA ...][... INFL[+Tns] ...]],
　　　　where RTA is a relative time adverbial.
　　a. While playing basketball in the morning, he sprained his finger.
　　a'. While playing basketball in the morning, he'll sprain his finger.
　　b. While playing basketball on Tuesday, he'll sprain his finger.
　　b'. While playing basketball on Tuesday, he sprained his finger.

Compared to the type 2 NFAs, the interval denoted by the time adverbial in this type of adjuncts is not fixed until the matrix tense determines the event time. The adjunct introducers in this type of NFAs determine anteriority, simultaneity, or posteriority of the event described by the adjunct with respect to the event described by the matrix tense.

We need to revise the adjunct tense rule in (32) to accommodate the time adverbials.

(36) Adjunct Tense Rule (revised version)
　　　　Let T be a set of moments t of time, and let $\llbracket x \rrbracket$ be the denotation
　　　　of a temporal expression x, which is identical to T_x, and let '$t_1 > t_2$'
　　　　mean 't_1 follows t_2 in temporal order.' Then, in a construction [[a...

β...][... γ ...]], where γ is the matrix tense and β is a time adverbial,

a) if α is *while*, then $[\![\beta]\!] \supseteq [\![\alpha]\!] \supseteq [\![\gamma]\!]$;

b) if α is *before*, then for any $t_1 \in T_\alpha$ and any $t_2 \in T_\gamma$, $t_1 > t_2$, $[\![\alpha]\!] \subseteq [\![\beta]\!]$;

c) if α is *after*, then for any $t_1 \in T_\alpha$ and any $t_2 \in T_\gamma$, $t_2 > t_1$, $[\![\alpha]\!] \subseteq [\![\beta]\!]$;

d) if α is *on*, then for any $t_1 \in T_\alpha$ and any $t_2 \in T_\gamma$, $t_2 \geq t_1$, $[\![\alpha]\!] \subseteq [\![\beta]\!]$ and there is no t_3, such that $t_2 > t_3 > t_1$,

e) if there is no adjunct introducer α, the temporal interpretation of the NFA is contextually determined.

No inclusion relation is given between the matrix tense and the time adverbial when the adjunct introducer is not *while*, because their inclusion relation cannot be predicted.[4] In addition, when there is no adjunct introducer, the context will determine the interpretation of the NFA, because no inclusion relation is possible without the denotation of the adjunct introducer. In most cases, they are interpreted as temporally overlapping with the interval denoted by the matrix tense as in (37a). However, the temporal relation depends on the aspectual classes of verbs in NFAs, when there is no adjunct introducer.

(37) a. The soldiers were marching through the town, singing *La Marseillaise* cheerfully.

b. Sam died waiting for Godot.

c. Having finished her homework, she went out for a walk.

We have constrained our attention to non-finite adjuncts, and have not discussed temporal adjunct phrases like *during the war* in (38).

(38) He died during the war.

Note, however, that we may devise a rule for temporal adjunct phrases

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[4] As an anonymous reviewer points out, no temporal relation is fixed between the time adverbial in the adjunct and the matrix tense. For example, in *After swimming in the pool this morning, Joe was seized with a cramp in the leg*, the time interval denoted by *this morning* can either precede or overlap the time interval denoted by the matrix tense *seized*. Therefore, their inclusion relation remains unspecified in the NFA interpretation rule except when the adjunct introducer makes the inclusion relation explicit in the case of *while*.

when they are headed by a preposition of duration like *during* or *for.* The adjunct phrase in (38) has the distribution of adverbs like *tomorrow.* If we assume that *during* can denote a time interval, its denotation can include the denotation of the matrix tense, in the same manner that the adverb like *yesterday* in (39) does.

(39) He died yesterday.

The semantic inclusion relation between an NFA and its matrix clause is not subject to any significant syntactic constraint such as c-command relation, unlike the cases that Enç (1987) deals with. Unlike the sequence-of-tense phenomena, the temporal interpretation of non-finite adjuncts does not require a syntactic operation like tense deletion. The sequence in which the temporal expressions are interpreted is not sensitive to their configuration.

9. Conclusion

A semantic interpretive rule that accounts for the temporal interpretation of NFAs has been proposed. By having tenses, time adverbials and temporal adjunct introducers like *while, before,* etc. all denote time intervals, a systematic temporal relation between the matrix and the adjunct is accounted for without positing a deletion rule. The key role is played by the adjunct introducers which are regarded as specifiers of non-finite verbs in the adjunct. They play the same role of COMP in finite complements in tense interpretation. However, the role of syntax in the temporal interpretation of NFAs is kept minimal, which is contrary to Enç's binding analysis of tense anchoring.

The present analysis of non-finite adjuncts may extend to the analysis of derived nominals such as *the enemy's destruction of the city* which can be related to either *the enemy destroys the city* or *the enemy destroyed the city* or even *the enemy will destroy the city.* The precise time reference of such a nominal non-finite construction has to be deduced from the context, however, due to the absence of the time denoting elements like adjunct introducers in the case of NFAs.

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Dept. of English
Sogang University
Seoul, Korea
e-mail: sblee@ccs.sogang.ac.kr