"Double-Access" Sentences and Reference to States*

Toshiyuki Ogihara

Department of Linguistics, GN-40

University of Washington

Seattle, WA 98195

Abstract:

This article deals with the semantics of "double-access" sentences. They are defined as English sentences which have a past tense morpheme in the matrix clause and a present tense morpheme in a subordinate clause in the immediate scope of the matrix past tense. They receive a very peculiar interpretation, which we will refer to as a "double-access interpretation". The episode described in the embedded clause makes reference to two times: the time referred to by the matrix predicate and the utterance time of the whole sentence. Previous studies on this construction are largely descriptive and do not attempt to analyze it with a formal tool, with one important exception. Abusch (1991) addresses the problems connected with the construction and proposes that double-access interpretations involve *de re* attitudes about intervals. Her proposal contains an important insight and provides one possible account of the double-access construction. My proposal was independently developed at approximately the same time as Abusch's and offers an alternative explanation for the phenomena. I consider a series of hypotheses and conclude that double-access readings involve *de re* attitude reports about state individuals. This account is couched in an eventuality-based framework and employs the techniques proposed by Cresswell and von Stechow (1982). In order to yield the desired reading, the tense must first adjoin to the complement S then to the matrix S, leaving two traces in the process.

1. Introduction

This paper discusses the semantics of "double-access" sentences in English and its theoretical consequences. For the purpose of this paper, double-access sentences are defined as English sentences that have a present tense morpheme in a clause embedded in the immediate scope of a past tense in the matrix clause. For the most part, I will be concerned with examples that involve verb complement clauses. But I will also touch upon sentences that involve causative clauses (i.e., *because*-clauses).

It has been noticed that when a present tense morpheme occurs in a verb complement clause in the immediate scope of a past tense morpheme in the main clause, the entire sentence receives a peculiar interpretation. Consider the following examples:

(1) a. I am ill.
b. John said that he was ill.
c. John said that he is ill.

Suppose that John utters (1a) at some time *t*. (1b) and (1c) are among the possible ways of reporting at a later time what John says at *t*. However, (1b) and (1c) are not interchangeable. (1b) has a simultaneous interpretation in that the time at which John is allegedly ill is simultaneous with the time of John's saying, whereas (1c) seems to convey something more complex.[1] There are circumstances in which (1b) is true, but (1c) is not. Sentences like (1c), which we will refer to as double-access sentences, have been discussed by various researchers in the literature, but usually in passing. According to Comrie (1985:115), (1c) is used "when the speaker is reporting a (real or imaginary) illness which he believes still has relevance". Smith (1978:66) says, "the speaker is responsible, as it were, for the complement's being true or relevant at ST [speech time]. More precisely, they [double-access sentences] indicate that the same event or state referred to holds at the time referred to

in the matrix and at ST". As Comrie and Smith indicate, one important characteristic of double-access sentences is that the situation described by the embedded clause seems to have "access" to both the past time referred to by the matrix predicate (e.g., the time of John's saying in (1c)) and the utterance time of the report, hence the nickname "double-access sentences". However, to say that the embedded clause has access to the two times does not make precise the semantic contribution made by double-access sentences. Some questions immediately arise. Does (1c) mean that the state described by the embedded clause actually obtains throughout an interval that encompasses the time of John's saying and the utterance time of (1c)?[2] If not, what does it mean to say that the episode described by the embedded clause is "relevant" at the speech time of the report? My strategy in this article is to consider a series of hypotheses about the truth conditions of double-access sentences, thereby arriving at the right descriptive generalizations step by step. I will then go on to propose a framework in which an analysis of double-access sentences can be naturally embedded. At the same time, I will consider some recent proposals made in the literature about double-access sentences (Enç 1987, Abusch 1988, 1991) and discuss the similarities and differences between their proposals and mine.

2. Preliminaries

Before discussing double-access sentences, I will sketch my analysis of relatively unproblematic sentences involving verb complement clauses. In such "normal" cases, the verb complement clause is in the same tense as the matrix clause. Consider the following examples:

(2) a. John said that Mary was pregnant.

b. John said, "Mary is pregnant".

Let us concentrate upon the simultaneous reading of (2a), which (2b) entails. Despite the near synonymy of (2a) and (2b), (2a) has a *past* tense morpheme in the complement, whereas (2b) has a *present* tense morpheme in the quotation. The configuration given in (2a) is a representative example of the so-called sequence-of-tense (henceforth, SOT) phenomenon: it is a sentence that has a past tense morpheme in the main clause as well as in the verb complement clause and receives a simultaneous interpretation. Assuming a system in which the translation of a tensed declarative sentence involves existential quantification over intervals (with some contextual restriction upon the quantificational force)[3], we need some additional assumptions to obtain the desired interpretation of (2a). Just as in Ogihara (1989, 1993), I will adopt a variant of the so-called upside-down Y model (Chomsky and Lasnik, 1977) for the syntactic framework and posit a tense deletion rule to account for the SOT phenomenon. For our purposes, it suffices to say that the tense deletion rule applies when a past tense occurs in a position locally c-commanded by another past tense and, as a result, the lower sentence becomes tenseless by the time it is semantically interpreted.

Consider the sentence (3a). Assuming that (3b) is its underlying structure, the tense deletion rule serves to turn (3b) into its LF representation (3c):

(3) a. John said that Mary was pregnant.
b. John Past say that Mary Past be pregnant.
c. John Past say that Mary Ø be pregnant.

The symbol "Ø" represents an empty tense node, which results from the application of the tense deletion rule. According to the version of Intensional Logic I adopt in this paper, (3c) translates as (4):

(4) $\exists t\,[t < s^* \,\&\, say'\,(t, j, \wedge \lambda t_1\, \lambda x[be\text{-}pregnant'\,(t_1, m)])]$[4]

Some comments on my notational system and its interpretation are in order here. In terms of type theory, the logical language has three primitive types (i.e., *e, t, i*) and one "parasite" (i.e., *s*).[5] Intuitively, *e* indicates individuals, *t* truth values, *i* intervals, and *s* worlds. The formula $t < s^*$ reads '*t* temporally precedes now' and indicates the semantic contribution of the past tense morpheme. s^* is an indexical denoting the speech time. Unlike Montague's IL (Intensional Logic) employed in PTQ (Montague 1973), the "^" symbol designates abstraction over worlds, rather than over world-time pairs. Temporal terms (constants and variables) as well as normal individual terms are used in the object language, and an index only includes a world and no time. As a consequence, verbal predicates have an extra argument position reserved for temporal terms. For example, *say'* is a three-place predicate involving a temporal argument, a property argument, and an individual argument.[6] Properties are here denoted by expressions of the form $\wedge\lambda t \lambda x\, \phi$ where ϕ is a formula. The model-theoretic interpretation of logical formulas proceeds in the usual way. The model assumed in the first four sections of this paper consists of *A* (a set of individuals), *W* (a set of worlds), *M* (a set of moments of time), < (a linear ordering on *M*), and *F* (an interpretation function). *T* (a set of intervals of time) is defined in terms of *M* in the standard way.[7]

At this point, we need to say something specific about the lexical meaning of so-called propositional attitude verbs or indirect discourse verbs (e.g., *believe, say*). Although propositional attitude verbs and indirect discourse verbs have different properties, I will focus on their similarities and assume that the same semantic mechanism can account for both of them. Crudely put, *x says p* can be understood as meaning *'x talks as if x believes p'*. The definition of the lexical meaning of *say'* given in (5) incorporates Lewis' (1979) idea that so-called propositional attitudes should be regarded as an instance of *de se* attitudes, i.e., attitudes toward oneself. According to Lewis, so-called propositional attitudes can be

explained in terms of the subject's self-ascribing properties of various sorts. According to this analysis, a verb that takes a sentential complement denotes (in some world at some time) a relation between individuals and properties. The following definition of the lexical meaning of *say'* is my own adaptation of Cresswell and von Stechow's (1982) analysis of propositional attitudes, which is based upon Lewis' proposal:

(5) For any world w_0, property P_0 in $D_{<s,<i,<e,t>>>}$, individual a_0, and interval t_0, $[\![\text{say}']\!]_{w_0}(P_0)(a_0)(t_0)$ is true if and only if a_0 talks at $<w_0,t_0>$ as if a_0 self-ascribes the property P_0. That is, a_0 talks as if every doxastic alternative $<w',t',x'>$ of a_0 in w_0 at t_0 is an element of $\{<w'',t'',x''> \mid P_0(w'')(t'')(x'') = 1\}$.[8]

I assume an accessibility relation R between triples of the form $<w,t,a>$ (where $w \in W$, $t \in T$, and $a \in A$) and triples of the form $<w',t',a'>$ (where $w' \in W$, $t' \in T$, and $a' \in A$), and if $<<w,t,a>,<w',t',a'>> \in R$, this informally reads: $<w',t',a'>$ is a doxastic alternative of a in w at t. R can be defined in terms of self-ascription of properties as follows:

(6) $<<w,t,a>,<w',t',a'>> \in R$ iff $<w',t',a'>$ has every property which a self-ascribes in w at t.

We can then say that a believes a property P in w at t iff P is satisfied by every doxastic alternative $<w',t',a'>$ of a in w at t (Cresswell and von Stechow, 1982: 507). (4) is an example of the most straightforward case, where the property the subject self-ascribes corresponds to a proposition (i.e., a set of world-time pairs). In (4) the relevant property is denoted by the expression $\wedge \lambda t_1 \lambda x$ *[be-pregnant' (t_1,m)]*, which contains a lambda operator that does not bind a variable.[9] This expression denotes the property $\{<w,t,x> \mid x \in A$ and

Mary is pregnant in *w* at *t*}. The property is propositional in that individuals do not figure in characterizing it. To be slightly more formal, we can say the following:

(7) A property $P \in D_{<s,<i,<e,t>>>}$ is propositional iff there is a proposition $p \in D_{<s,<i,t>>}$ such that for every $w \in W$ and $t \in T$, if $p(w)(t) = 1$, then for every $x \in A$, $P(w)(t)(x) = 1$.

Thus, the above set of triples carries exactly the same information as the set of world-time pairs {<*w'*,*t'*> | Mary is pregnant in *w'* at *t'*}. The situation is different with "irreducible *de se"* attitudes and so-called *de re* attitudes. My proposal, which is a direct descendent of Lewis' analysis, treats *de re* attitudes as a special case of *de se* attitudes. I will take up attitudes that involve non-propositional properties below.

Now assume that (4) is true in the actual world w_0 at t_1 by virtue of the fact that t_0 is located earlier than t_1 and *say' (t, j,* $\wedge \lambda t_1$ *λx[be-pregnant' (*t_1*, m)])* is true in w_0 with respect to a value assignment *g'* such that $g'(t) = t_0$. For readability, let me posit a temporal constant t_0, which denotes t_0. In what follows, I will refer to the actual world as w_0 and the time of the attitude as t_0, unless otherwise noted. According to the above lexical meaning of *say'*, *say' (*t_0*, j,* $\wedge \lambda t_1$ *λx[be-pregnant' (m,* t_1*)])* is true in w_0 iff {<*w'*,*t'*, *x'*> | <*w'*,*t'*,*x'*> is a doxastic alternative of John in w_0 at t_0} is a subset of {<*w"*,*t"*, *x"*> | Mary is pregnant in *w"* at *t"*}. Now assume that John speaks the truth in w_0 at t_0; that is, John *does* have in w_0 at t_0 the property John self-ascribes in w_0 at t_0. In the system under consideration, this means that the triple <w_0, t_0, *John*> is an element of {<*w'*,*t'*,*x'*> | Mary is pregnant in *w'* at *t'*}. It now follows that Mary is pregnant in w_0 at t_0. I have shown that (4) has a simultaneous interpretation in that if it is true and John speaks the truth in some world *w* at some time *t*, then the embedded proposition is true in *w* at *t*.

Some readers might wonder why I let embedded clauses denote sets of world-time-individual triples, rather than sets of world-individual pairs. They might argue that any property that someone self-ascribes is temporally definite in the sense that it concerns the time at which the attitude is expressed. Suppose that John utters (8a). Whether or not the utterance includes the expression *now*, the property self-ascribed arguably includes reference to the speech time. Assuming with Kaplan (1977) that *now* is directly referential, we could claim that in uttering (8a), John self-ascribes a temporally definite property given in (8b):

(8) a. Mary is pregnant (now).
b. ^ λx [be-pregnant' (m, s*)]

(8b) denotes a set of world-individual pairs, and no times are involved in specifying it. If we adopted this view, indirect discourse verbs would also be treated in a different way. For example, the lexical semantics of *say'* could be defined as in (9):

(9) For any world w_0, property P_0 in $D_{<s,<i,<e,t>>>}$, individual a_0, and interval t_0, $[\![\text{say}']\!]_{w_0}(P_0)(a_0)(t_0)$ is true if and only if a_0 talks in w_0 at t_0 as if s/he self-ascribes the "property" $\{<w',x'> \mid P_0(w')(t_0)(x') = 1\}$. That is, a_0 talks as if every doxastic alternative $<w',x'>$ of a_0 in w_0 at t_0 is an element of $\{<w'',x''> \mid P_0(w'')(t_0)(x'') = 1\}$.

(9) defines the lexical meaning of *say'* in such a way that the time of the attitude (saying in this case) is supplied as the temporal argument of the embedded property. Consequently, the "property" that the subject self-ascribes is a set of world-individual pairs of the form $\{<w',x'> \mid P_0(w')(t_0)(x') = 1\}$. In this account, an attitude concerns a property that obtains

at a particular time (at the time of the attitude, to be more specific), and in this sense the property is temporally definite.

Given the sketch of the alternative analysis of temporal properties of verb complements, I now return to the question under consideration: why do we need the complex *de se* analysis I propose, instead of the alternative in which an embedded clause receives a temporally definite interpretation for its tense? Regarding the example we considered above, there seems to be no empirical difference between the two proposals. In fact, the alternative seems to account for the simultaneous reading of (3a) more straightforwardly; the lexical semantics of *say'* clearly says that the attitude makes an assertion about the time of the attitude. However, we should adopt my original analysis because some non-standard attitudes can only be captured by a *de se* analysis.

Perry (1977), Lewis (1979) and von Stechow (1984) present some examples of "irreducible *de se*" attitudes. Consider the following examples:

(10) a. The insomniac believes (now) that it is 2 a.m.

b. Heimson believes that he is Hume.

(10a) is a variant of an example Lewis (1979) discusses, and (10b) is due to Perry (1977: 487). Suppose that (10a) is uttered at 3 a.m. It describes a situation where the insomniac lays awake at night without keeping track of the time and believes now (at 3 a.m.) that it is 2 a.m. Then, under the assumption that the object of belief is a temporally definite property, we would be forced to conclude that the object of belief in (10a) is the empty property: {<w,x> | 3 a.m. = 2 a.m. in w}. This is counter-intuitive. Suppose, on the other hand, that an attitude is a relation between individuals and sets of world-time pairs. Then, we would not be able to account for (10b), which states that Heimson incorrectly believes himself to be Hume. Under the propositional account, the proposition in question is {<w,t> | Heimson =

Hume in w at t}, which is the empty proposition. By contrast, if we assume that an attitude is a relation between individuals and sets of triples involving worlds, times as well as individuals, we can account for the above examples, as in (11):

(11) a. believe' (3 a.m., the-insomniac', ^ λtλx[t = 2 a.m.])

b. believe' (s*, Heimson, ^ λtλx[x = Hume at t])[10]

(11a) says that at 3 a.m. the insomniac self-ascribes the property of being located in a world at 2 a.m. (11b) states that Heimson now self-ascribes the property of being Hume. Both (11a) and (11b) describe possible states of affairs and capture our intuition that the objects of belief in (11a-b) are contingent in the following sense: some triples of the form <*w,t,x*> satisfy the property, while others do not. Therefore, we need sets of triples of the form <*w,t,x*> as objects of attitudes.

Given this analysis of attitudes, let us now consider the following double-access sentence (12):

(12) John said that Mary is pregnant.

Unlike (3a), the verb complement clause of (12) is in the present tense, whereas its matrix clause is in the past tense. Since they are not occurrences of the same tense morpheme, the present tense is not deleted by the tense deletion rule and is visible at LF. Thus it is subject to the semantic interpretation rules. The question is how to account for the peculiar reading of (12) in a principled way. Two prima facie analyses fail. First, if present tense in English is interpreted in the same way as the null tense Ø, we predict incorrectly that (12) receives a simultaneous interpretation just like (3a).[11] Second, if we assume that the present tense in

the embedded clause in (12) denotes the speech time of the report even though it is embedded in the immediate scope of a past tense, we obtain (13):

(13) $\exists t\,[t < s^* \,\&\, \text{say}'(t, j, \hat{}\lambda t_1 \lambda x[\text{be-pregnant}'(s^*, m)])]$

(13) says that at some past time *t*, John self-ascribes the property {<*w*,*t*,*x*> | Mary is pregnant now in *w*}. As in the example (4), the constant *s** denotes the speech time of the report. The embedded clause denotes {<*w*,*t*,*x*> | Mary is pregnant at *s** in *w*}. This is a timeless property in that if some triple <w_1,t_1,x_1> is an element of this set, then for any time t_2, <w_1,t_2,x_1> is also in this set. In fact, since this property also is a propositional property in the sense defined above, it is equivalent in terms of semantic content to {*w* | Mary is pregnant at the speech time of the report in *w*}. Thus, (13) reads informally, "John talked as if every doxastic alternative of his is compatible with {*w* | Mary is pregnant at *s** in *w*}". The following hypothetical situation presumably satisfies the truth conditions I have just given: John utters (14) on January 1st (imagine that he is a psychic), and the report (12) is made at 3 p.m. on July 31st.[12]

(14) John: Mary will be pregnant at 3 p.m. on July 31st.

However, (12) is not an acceptable way of reporting (14). In addition, (15), which is the right way of reporting (14), is not synonymous with (12); they are appropriate in different situations.

(15) John said that Mary would be pregnant now.

Thus, the framework as it stands fails to capture the semantic interpretation of double-access

sentences exemplified by (12). As we shall see, the semantics of double-access sentences turns out to be much more complex and yet much more interesting.

3. Four Initial Hypotheses

I will try to obtain an adequate descriptive generalization before trying to provide a formal proposal. In order to simplify the following discussion, I will restrict my attention to cases where the matrix verb is *say*. There are more complex cases such as those involving *deny* or *doubt*, but I will not consider them in this paper. I believe that my proposal applies with some modification to such complex examples as well. In order to arrive at a descriptively adequate generalization, I will consider a series of hypotheses. Here is the first hypothesis:[13]

(16) Hypothesis 1: A double-access sentence is true if and only if (a) the subject of the attitude asserts at the time of his saying that the proposition denoted by the embedded clause is true at that time, and (b) the proposition denoted by the embedded clause is in fact true in the real world at an interval that includes the time of the matrix verb and the speech time of the report.[14]

The interpretation that I have in mind is the one predicted by the formula (17):

(17) $\exists t [t < s^* \ \&\ \text{say}' (t, j, \hat{}\lambda t''\lambda x[\text{be-pregnant}' (m, t'')]) \ \&\ \exists t'[t \subseteq t' \ \&\ s^* \subseteq t' \ \&\ \text{be-pregnant}' (t', m)]]$

(17) predicts that the subject's original attitude produces a simultaneous interpretation on a par with (3a). However, (12) carries an additional assertion that the embedded proposition is in fact true in the actual world at an extended interval that includes the time of the subject's

attitude and the speech time of the report. This view seems empirically correct if we restrict our attention to examples that contain a factive verb in the main clause:

(18) Kepler discovered that the earth revolves around the sun.

Hypothesis 1 predicts that (18) is true because (i) it is true that Kepler discovered that the earth revolved around the sun (at the time of his discovery), and (ii) the earth still goes around the sun now. I will henceforth refer to examples like (18) as factive double-access sentences.

I will demonstrate, however, that this position is empirically flawed. Consider the following example:

(19) John and Bill are looking into a room. Sue is in the room.

(a) John: (near-sighted) Look! Mary is in the room.

(b) Bill: What are you talking about? That's Sue, not Mary.

(c) John: I'm sure that's Mary.

One minute later, Kent joins them. Sue is still in the room.

(d) Bill: (to Kent) John said that Mary is in the room. But that's not true. The one that is in the room is Sue.

As this conversational exchange shows, the person in the room is *not* Mary and the sentence *Mary is in the room* is false in the real world both at the time of John's saying and also at the speech time. Nevertheless, (19d) is true in this situation. We must conclude then that the first hypothesis is untenable.

Let us move on to Hypothesis 2. It differs from Hypothesis 1 in that the claim made by the subject concerns an interval extended into the future of the time of John's saying, not just the time of his claim. Thus, the claim is not a purely simultaneous claim:

(20) Hypothesis 2: A double-access sentence is true if and only if the subject of the matrix sentence asserts at the time of his original statement that the proposition denoted by the embedded clause is true at an interval that encompasses the time of the original speech and the time of the report.

Hypothesis 2 predicts that (12) is true if and only if John claims at the time of his saying that Mary's pregnancy obtains at an interval extending from the time of his claim until the speech time of the report. The above informal description of Hypothesis 2 is subject to several formal interpretations. I will restrict my attention to a *de re* attitude report rendition of Hypothesis 2: there is an extended interval *t'* such that John said of *t'* that it is an interval at which Mary is pregnant. One possible symbolization of such a reading is (21):

(21) $\exists t\,[t < s^* \,\&\, \exists t'\,[s^* \subseteq t' \,\&\, t \subseteq t' \,\&\, \text{say}'(t, j, \hat{}\lambda t''\lambda x[\text{be-pregnant}'(t', m)])]]$

Let us refer to the actual world and the time of John's saying as w_0 and t_0, respectively. The speech time of the report is referred to as t_1. (21) is true iff there is an interval t_3 in w_0 which includes both t_0 and t_1 and John self-ascribes at t_1 the property $\{\langle w,t,x\rangle \mid$ Mary is pregnant at $t_3\}$. (21) is a controversial way of symbolizing a *de re* interpretation, and I employ it just for the purpose of showing unambiguously which interpretation I have in mind. I will discuss *de re* attitude interpretations in more detail later in connection with Abusch's (1991) proposal.

According to Hypothesis 2, the embedded clause of (19d) describes what John *claims* to obtain throughout an extended interval, not what *actually* obtains either at the time of John's original utterance or at the speech time of the report. Thus, we predict that what happens in the actual world after John utters (19a) does not affect in any way the truth conditions of (19d). However, this prediction fails. Consider the following example, which is based upon (19) but contains one important modification:

(22) John and Bill are looking into a room. Sue is in the room.

(a) John: (near-sighted) Look! Mary is in the room.

(b) Bill: What are you talking about? That's Sue, not Mary.

(c) John: I'm sure that's Mary.

Sue leaves the room. One minute later, Kent joins them.

(d) Bill: (to Kent) # John said that Mary is in the room.

Note that in this example, Sue leaves the room before Bill utters (22d). This is the only difference between (19) and (22). Therefore, it is clear that Sue's leaving the room after John's statement was made causes (22d) to be judged false. Since there is no difference between (19) and (22) up to the time when John made the original statement, it is improbable that John's claim concerns an extended interval in (19) but not in (22). A more reasonable conclusion would be that the acceptability of Bill's utterances in (19) and (22) depends (at least partially) upon how the events in the real world develop after John makes the original claim. To be more specific, the situation that gives rise to the subject's (possibly erroneous) belief must persist at least until the time of the report. Thus, the truth value of (19d) or (22d) is not entirely determined by the content of John's original claim. Hypothesis 2 therefore is empirically inadequate, at least in the version I have just considered.

Let us consider an alternative hypothesis:

(23) Hypothesis 3: A double-access sentence is true if and only if (a) the subject of the attitude asserts that the proposition denoted by the embedded clause is true at the time of his saying, and (b) if that individual were to express his attitude at any time between the time of his saying and the time of the report, he would be prepared to use the same words that he used at the time of his speech.

If we take (19) as an example, the idea is that John must maintain the same belief or claim about the identity of the person in the room throughout an interval that covers the time of his utterance and the time of the report. In other words, John believes throughout an extended interval that Mary is in the room. Roughly speaking, this means that the following formula must be true:

(24) $\exists t\,[t < s^* \,\&\, say'\,(t, j, \hat{}\lambda t_1\, \lambda x[be\text{-}in\text{-}the\text{-}room'\,(t_1, m)]) \,\&\, \exists t_2[s^* \subseteq t_2 \,\&\, t \subseteq t_2 \,\&\, \forall t_3\,[t_3 \subseteq t_2 \rightarrow believe'\,(t_3, j, \hat{}\lambda t_4 \lambda x[be\text{-}in\text{-}the\text{-}room'\ (t_4, m)])]]]$

Here is my reasoning. If Sue stays in the room, John presumably maintains the same belief because he falsely believes that the person in the room (i.e., Sue) is Mary. If she leaves the room, however, it is reasonable to conclude that John modifies his belief at that point. That is, even though John is near-sighted, he should be able to see Sue leave the room. Then he no longer has reason to believe that Mary is in the room. Therefore (22d) is judged to be false. In this way, we might hope to establish a connection between what happens in the real world and the subject's attitude (i.e., what John believes/claims). Unfortunately, this hypothesis is also empirically inadequate. Most of the native speakers that I consulted accepted the following dialogue:[15]

(25) John and Bill are looking into a room. Sue is in the room.

(a) John: (near-sighted) Look! Mary is in the room.

(b) Bill: What are you talking about? That's Sue, not Mary. Mary is not that tall.

(c) John: Yeah. You're right. That's Sue.

One minute later, Kent joins them. Sue is still in the room.

(d) Bill: (to Kent) John said that Mary is in the room.

(25d) is acceptable even though John modifies his belief about the identity of the person in the room before it is uttered, thereby invalidating Hypothesis 3.

One of the most intriguing features of double-access sentences is that some claim is made about the speech time of the report, but it is extremely difficult to say exactly what it is. In Hypothesis 1, I tried to claim that this has something to do with what actually obtains in the real world. In Hypotheses 2 and 3, I tried to characterize the semantics of double-access sentences in terms of the content of the original claim made by the subject. I would now like to reconsider Hypothesis 1, which has already been rejected: double-access sentences require that something *actually* obtain at an extended interval that includes the attitude time and the report time. Recall that when we restrict our attention to factive double-access sentences, Hypothesis 1 is empirically adequate. Let us briefly shift our attention to constructions that involve causative adverbial clauses. Consider the following examples, which are due to Hans Kamp (personal communication):

(26) a. John is relating what happened today.

John: I went out in my winter coat because it is very cold today.

b. John is writing a letter. Mary enters the room. She wants to talk to him. But since he is writing a letter, she goes out of the room. Five minutes

later, Bill describes what happened to Jim. John is still writing the letter.

Bill: Mary left because John is writing a letter.

Note that (26a-b) satisfy the definition of double-access sentences given at the beginning of this article: the matrix predicate is in the past tense, and the subordinate clause (a *because*-clause in this case) in the present tense. I will henceforth refer to this type of sentence as causative double-access sentences. Note further that their semantic behavior resembles that of factive double-access sentences. (26a) is true iff the following conditions are satisfied: (i) John went out in his winter coat at a past time because it was cold then; (ii) its being cold encompasses both the time of John's going out in his winter coat and the speech time of John's statement. The two conditions cannot be reduced to one. For example, in (26a) John's going out in his winter coat is not caused by its being cold at an extended interval that encompasses the time of his going out and the speech time. Similarly, (26b) is true iff Mary left because John was writing a letter then, and John's writing a letter obtains at an extended interval that includes the two relevant times.[16]

Furthermore, in order to make Bill's statement in (26b) true, the letter that John is now writing must be the same letter that he was writing when Mary came in and left. Intuitively, one and the same state must obtain throughout an extended interval in order to make causative double-access statements true. Note that factive double-access sentences also have to satisfy the same condition. Consider the following example:

(27) John found out that Mary is pregnant.

If Mary is pregnant at the time of John's finding out, gives birth to a child, and gets pregnant again shortly before the speech time of (27), it is false. This suggests that the truth of (27) requires that one and the same pregnancy obtain throughout an extended interval that accesses

both the time of John's finding out and the speech time of (27). The similarity of the two constructions is quite striking. To understand why these two constructions behave alike, let me compare the following two examples, which have a past tense morpheme in the subordinate clause.

(28) a. John found out that Mary was pregnant.
b. I went out in my winter coat because it was cold.

(28a-b) are non-double-access sentences and receive a simultaneous interpretation. (28a) is just like (27) except that the complement clause is in the past tense, not in the present tense; (28b) differs from (26a) in exactly the same way. (28a) and (28b) clearly have a similar property. They both guarantee the truth of the subordinate clause at the time indicated by the matrix verb. That is, the following entailment relations hold:[17]

(29) a. John found out that Mary was pregnant. |= Mary was pregnant (at the time of John's finding out).
b. I went out in my winter coat because it was cold. |= It was cold (when I went out).
[N.B., A |= B reads 'A semantically entails B'.]

(29a-b) show that complement clauses of factive verbs and causative adverbial clauses are similar in that they are required to be true in order for the entire sentence to be true. For the lack of a better name, I will refer to such clauses as CRTs (Clauses that are Required to be True). When a CRT occurs in the present tense and the matrix clause is in the past tense (i.e., in a "double-access configuration"), the characteristics of CRTs are preserved and extended in such a way that one and the same state denoted by the subordinate clause is

required to obtain at an extended interval that spans the time of the matrix verb and the speech time of the entire sentence. The configurations of three types of double-access sentences and the terms used to refer to them are summarized in (30a-c):

(30) a. [$_S$ ... Past V_1 ... [that [$_S$ ... Pres V_2 ...]]] (where V_1 is a non-factive verb) **"regular" double-access sentences**

b. [$_S$ ... Past V_1 ... [that [$_S$ ... Pres V_2 ...]]] (where V_1 is a factive verb) **factive double-access sentences**

c. [$_S$ ... Past V_1 ... [because [$_S$ ... Pres V_2 ...]]] **causative double-access sentences**

Sentences of the type (30b) or (30c) will be collectively referred to as **CRT double-access sentences** since they require that the embedded clause be a CRT. The semantics of double-access sentences involving CRTs (i.e., factive double-access sentences and causative double-access sentences) is described informally as follows:

(31) If S_2 of a sentence of the form [$_{S_1}$ ... Past V_1... [$_{S_2}$ ... Pres V_2 ...]] is a CRT, S_1 is true iff (a) [$_{S_1}$ ... Past V_1... [$_{S_2}$ ... Past V_2 ...]] (with a simultaneous reading) is true and (b) one and the same state described by [$_{S_2}$ ... V_2 ...] (tenseless) obtains at an interval that overlaps the time of the event denoted by V_1 and the speech time (of S_1).

I assume that as far as double-access sentences involving CRTs are concerned, the above descriptive generalization is correct. In what follows, I will pursue the hypothesis that any additional complications with "regular" double-access sentences stem from the fact that the embedded clause is not true in the real world. I assume that the condition (31a) is appropriate

for non-factive cases as well. However, the condition (31b) apparently is not satisfied by regular double-access sentences. It requires that the state described by the embedded clause obtain *in the real world* at an extended interval, and it is precisely this condition that non-factive clauses fail to satisfy.

However, there is reason to believe that (31b), albeit under slightly modified conditions, also applies to non-factive double-access sentences. (31b) requires that one and the same state obtain from the time of the original speech until the time of the report. The same type of condition is required of non-factive examples although the state in question is not the one described by the embedded clause. Consider the following example:

(32) John and Bill are looking into a room. Sue is in the room.

(a) John: (near-sighted) Look! Mary is standing in the room.

(b) Bill: What are you talking about? That's Sue, not Mary.

On the following day, Bill and Kent return to the same location and are now looking into the same room. Sue is standing there.

(c) Bill: #John said yesterday that Mary is standing in the room. But that's Sue, not Mary.

Let us assume that the room in question is in an office building. Assume also that after John utters (32a), Sue goes back home, spends the night there, and comes back to her office the following day. In this case, these two references to Sue's standing in the room concern two temporally discontinuous states, and the double-access sentence uttered by Bill is false. In order to make (32c) true, one continuous state of Sue's standing in the room must obtain from the time of John's saying until the time of the report. Thus, CRT and non-CRT double-access sentences share the condition that some relevant state must obtain at an extended interval. The problem, though, is that the states relevant to non-CRT cases are not the ones

described by embedded clauses. Since the sentence *Mary is standing in the room* is false in the actual world in the situation described by (32), I will pursue the possibility that it is true in some possible worlds at an interval that contains the time of the original speech and the time of the report. This line of reasoning points to a counterfactual analysis of double-access sentences, which I present here as Hypothesis 4:

(33) Hypothesis 4: A double-access sentence is true if and only if (a) the subject of the attitude asserts that the state described by the embedded clause is true at the time of his saying, and (b) if the state claimed to obtain by the subject of the attitude did in fact obtain at the time of the original claim, the state would obtain at an interval that encompasses the time of the attitude and the speech time of the report.

Let us analyze (19d) using Hypothesis 4. Suppose, counterfactually, that John's claim were true, i.e., that the person who is in the room were Mary, not Sue. Then, the hypothesis predicts that the state of Mary's being in the room would continue to obtain until the speech time of the report. But this proposal has no empirical content unless we provide a concrete way of evaluating counterfactual conditionals.

I adopt Lewis' (1973) proposal to give substance to Hypothesis 4. According to Lewis (1973: 13-14), in order to evaluate counterfactual conditionals, we should posit a similarity relation defined with respect to some particular world (e.g., the actual world). I adopt a simplified version of Lewis' original proposal here. The interpretation of counterfactual sentences can be defined as follows:

(34) $[\![\alpha \mathbin{\Box\!\!\rightarrow} \beta]\!]_w$ ("If it were the case that α, then it would be the case that β.") = 1 iff for the world(s) *w'* closest to *w* in terms of the similarity hierarchy among those in which α is true, β is also true in *w'*.

According to this proposal, (19d) is true iff the following counterfactual conditional is true in the actual world w_0:

(35) Mary is in the room at t_0 (i.e., the attitude time) $\Box\!\!\rightarrow$ Mary is in the room throughout an interval that encompasses t_0 and the speech time.

Which worlds should we examine in order to determine the truth value of (35)? In other words, which worlds are considered to be closest to w_0 among those in which Mary is in the room at t_0? I contend that we should examine the worlds in which Mary is in the room at t_0 and behaves as closely as Sue does in w_0. For example, if Sue leaves the room in w_0, Mary leaves the room in these possible worlds at the same time. This idea is plausible because under the situation under description, John would not be able to distinguish between w_0 and these "closest worlds".[18] On this analysis, (35) is true iff Mary continues to be in the room until the speech time in the world(s) in which Mary is in the room at t_0 and behaves as closely as Sue does in w_0. We can check whether this condition obtains by observing Sue's behavior in w_0 because Mary's behavior in these selected possible worlds is duplicated by Sue's behavior in w_0. Thus, the prediction is that if Sue continues to stay in the room until the speech time in w_0, then (19d) is true. This is the desired result. This proposal also accounts for CRT double-access sentences on the assumption that any world resembles itself most closely. That is, when the antecedent is true in the actual world w_0, it suffices to check whether the consequent is true in w_0.

Unfortunately, Hypothesis 4 turns out to be empirically inadequate. An anonymous referee suggests the following counter-example:

(36) Mary has a fixed habit of checking her productive status weekly with sensitive, infallible chemical tests, and terminating any pregnancies immediately. All fall, Mary has been overeating. John caught a glimpse of Mary on Nov. 5, and --- based on her size, something which was a product of her eating --- formed the belief that she was pregnant. On Dec. 5, Mary still is overweight, and the belief is reported with:

(i) John believed that Mary is pregnant.

The intuitions are as Ogihara describes them for (i), namely the sentence is true. But arguably, the counterfactual "if she had been pregnant on Nov. 5, she would be pregnant throughout the period Nov. 5 - Dec. 5" is false, because Mary always immediately detects and terminates pregnancies. To make things worse, let's suppose that Mary actually was pregnant on Nov. 5, detected the pregnancy that week and terminates it on Nov. 10, so that she was not pregnant on Dec. 5. I think this doesn't affect the truth of (a). But if we use Lewis's semantics, the counterfactual is false, for the set of most similar worlds satisfying the antecedent is the unit set of the base world, and there Mary is not pregnant on Dec. 5.

I agree with the referee's judgments. It is clear that the counterfactual theory makes the wrong prediction here.

4. *De re* Attitudes about Intervals

Abusch (1991) proposes a *de re* attitude account of double-access sentences. To be more precise, she claims that the interpretation of (19d) can be accounted for as a *de re* attitude report about an extended interval. Abusch's account is based upon Cresswell and von Stechow's (1982) proposal about *de re* attitudes. Therefore, I will first summarize the analysis of *de re* attitudes proposed by Cresswell and von Stechow. It is a direct descendent of Lewis' *de se* analysis of attitudes.

Quine (1956) points out that it is problematic to quantify into propositional attitude contexts by citing the celebrated example that involves Ralph and Ortcutt. Ralph has glimpsed Ortcutt on two separate occasions but does not realize that the individuals he has glimpsed are one and the same man. When Ralph sees Ortcutt in a brown hat, he believes that he is a spy. Ralph also glimpses Ortcutt at the beach, and he thinks that he is a pillar of the community. Thus, Ralph certainly does not believe that this person who he saw at the beach, Ortcutt, is a spy. It seems, then, that Ralph has two contradictory beliefs about Ortcutt. This is problematic for a theory that regards the object of an attitude to be a proposition.

According to Cresswell and von Stechow, a *de re* attitude analysis of (37a) can be given on the basis of the logical structure given here as (37b) in a λ-categorial language:

(37) a. Ralph believes that Ortcutt is a spy.

b. <Ralph, believes, <that, <λ,x, <x is a spy>>, Ortcutt>>

The idea is to split the embedded sentence into a property and an object to which this property is ascribed by the subject of the attitude, and to make these components available at a higher structural level. On the basis of this structure, semantic interpretation proceeds as follows. First, instead of saying simply that a *de re* attitude involves an object (*res*), this analysis

presents the *res* in terms of a "suitable relation". In other words, the subject is in touch with the *res* in some way in the actual world and the *res* is registered in the subject's mind as a unique object that satisfies a certain description. Moreover, the subject self-ascribes the property of bearing this relation uniquely to an object that has the property described by the predicate of the verb complement clause.

Following Abusch (1991), I will use a syntactic structure more familiar to linguists as a basis for semantic interpretation. For example, the structure we need for (37) is (38a), which then translates as (38b):

(38) a. $[_S$ Ralph $[_{VP}$ believes Ortcutt$_1$ $[x_1$ is a spy$]]]$

b. believe' (s*, Ralph, Ortcutt, ^λtλx[be-a-spy' (x)])

In (38b), *believe'* denotes a four-place relation involving a time, two individuals and one property; it reads 'Ralph now believes of Ortcutt that he is a spy' or 'Ralph now ascribes the property of being a spy to Ortcutt'. A *de dicto* belief that involves a propositional property requires that *believe'* denote a three-place relation among times, individuals and properties. Thus, this proposal presupposes that *believe'* and other related verbs belong to multiple syntactic categories. There are more elegant ways of accomplishing the same end, but this system is adequate for our purposes.[19] In my proposal, when a *de re* attitude is involved, the lexical semantics of *believe'* is described as follows:

(39) For any $w_0 \in W$, $P_0 \in D_{<s,<i,<e,t>>>}$, a_1, $a_2 \in A$, and $t_0 \in T$, $[\![\text{believe}']\!]_{w_0}(P_0)(a_1)(a_2)(t_0) = 1$ (which informally reads 'in w_0 at t_0, a_2 ascribes the property P_0 to a_1') iff there is a "suitable relation" $SR \in D_{<s,<i,<e,<e,t>>>>}$ such that (i) a_1 is the thing to which a_2 bears *SR* in w_0 at t_0 (formally: $\forall y[SR(w_0)(t_0)(a_1)(a_2) = 1 \leftrightarrow y = a_1]$), and (ii) for every doxastic alternative

$<w,t,x>$ of a_2 in w_0 at t_0, the thing to which x bears *SR* in w at t has property P_0 in w at t (formally: $\exists y[P_0(x)(t)(y) = 1 \ \& \ \forall z \ [SR\ (w)(t)(z)(x) = 1 \leftrightarrow z = y]$).

In the example (37), Ralph is related to Ortcutt in two different ways on two different occasions. (40) describes the truth conditions for the case in which Ralph glimpsed Ortcutt in a brown hat, whereas (41) gives the truth conditions for the one in which Ralph saw Ortcutt at the beach. Times are ignored in the following description of the truth conditions:

(40) (i) In the actual world w_0, there is a unique individual z to which Ralph bears the relation $\{<x,y> \mid x$ glimpsed at y in a brown hat$\}$, i.e., Ortcutt.
(ii) Every doxastic alternative of Ralph in w_0 is an element of the property $\{<w,x> \mid$ there is a unique y such that x glimpses y in a brown hat in w. Furthermore, this individual is a spy in $w\}$.

(41) (i) In the actual world w_0, there is a unique individual z to which Ralph bears the relation $\{<x,y> \mid y$ is a gray-haired man and x saw y at the beach$\}$, i.e., Ortcutt.
(ii) Every doxastic alternative of Ralph in w_0 is an element of the property $\{<w,x> \mid$ there is a unique y such that y is a gray-haired man and x sees y at the beach in w. Moreover, this object y is a pillar of the community in $w\}$.

Since (40) and (41) are distinct truth conditions, it is logically possible that only one of them holds. (40) and (41) still guarantee, on the other hand, that they involve the same *res*, i.e., Ortcutt, in the actual world.

Cresswell and von Stechow generalize this analysis of *de re* attitudes to objects other than normal individuals, such as predicates. Abusch (1991) employs this technique in her analysis of double-access sentences. She claims that double-access sentences involve *de re* attitude reports about intervals that satisfy "suitable relations". Her analysis starts with the logical structure (42b) of the sentence (42a):[20]

(42) a. John said that Mary is pregnant.

b. [$_S$ John [$_{VP}$ Past say [$_S$ Pres λt [$_S$ Mary be pregnant at t]]]

I translate (42b) into the version of IL that is used in this paper and show how the interpretation proceeds. This will facilitate the comparison between Abusch's proposal and my account to be presented below.

(43) ∃t[t < s* & say' (t, j, Pres, ^λt'λt" [Mary be pregnant at t"])]

The lexical meaning of *say'* is defined here for *de re* attitudes about intervals:

(44) For any $w_0 \in W$, $P_0 \in D_{<s,<i,<i,t>>>}$, $t_1 \in T$, $a_0 \in A$, and $t_0 \in T$, $[\![\text{say}']\!]_{w_0}(P_0)(t_1)(a_0)(t_0) = 1$ (which informally reads 'in w_0 at t_0, a_0 ascribes the property P_0 to t_1') iff there is a "suitable relation" $SR \in D_{<s,<i,<i,<e,t>>>>}$ such that (i) t_1 is the interval to which a_0 bears SR in w_0 at t_0, and (ii) a_0 talks in w_0 at t_0 as if for every doxastic alternative $\langle w,t,x\rangle$ of a_0 in w_0 at t_0, the interval to which x bears SR in w at t has the property P_0 in w at t.

According to (44), the truth conditions for (43) are stated as in (45).

(45) There is a suitable relation *SR* such that (i) the denotation of *Pres* is the interval to which John bears *SR* in w_0 at t_0, and (ii) John talks in w_0 at t_0 as if for every doxastic alternative $<w,t,x>$ of John in w_0 at t_0, Mary is pregnant in *w* at the interval to which *x* bears *SR* in *w* at *t*.

In her discussion of (42a), Abusch considers the following situation: John sees Mary's big belly, which is a product of her overeating, and forms the erroneous belief that she is pregnant. According to Abusch, *Pres* must denote an interval that contains the speech time of the report, and the suitable relation *SR* is $\{<w,t,t',x> \mid t'$ overlaps *t* in *w*, and t' is the maximal interval at which Mary has a swollen belly in $w\}$, where t' indicates the *res* to which the property in question is ascribed.[21] Given these assumptions, we can provide the truth conditions for (42a) when it is used in the context under discussion:

(46) (i) the denotation of *Pres* is the interval such that it overlaps t_0 in w_0 and it is the maximal interval at which Mary has a swollen belly in w_0, and (ii) John talks in w_0 at t_0 as if for every doxastic alternative $<w,t,x>$ of John in w_0 at t_0, Mary is pregnant in *w* at the interval t' such that t' overlaps *t* in *w* and t' is the maximal interval at which Mary has a swollen belly in *w*.

Abusch claims that this analysis provides an empirically satisfactory result. I believe that her account must be slightly modified in order to become fully satisfactory. First, Abusch employs the relation $\{<w,t,t',x> \mid t'$ overlaps *t* in *w*, and t' is the maximal interval at which Mary has a swollen belly in $w\}$ as a suitable relation. Note that the specification of the unique interval is made solely in terms of the "context time" *t*, not in terms of the subject *x*. As it stands, any individual bears the relation to the maximal interval of Mary's having a swollen belly as long as there is such an interval, and (45) therefore makes the wrong

predictions. Thus, to make clear the relation between the subject and the *res* and to make the right empirical predictions, we must instead employ the following relation as a suitable relation: {<*w*,*t*,*t'*,*x*> | *t'* is the maximal duration of the state of Mary's having a swollen belly that *x* observes in *w* at *t*}. On the basis of this revision of the suitable relation, the truth conditions for (42a) are restated as follows:

(47) (i) The denotation of *Pres* is the maximal interval of the state of Mary's having a swollen belly that John observes in w_0 at t_0, and (ii) John talks in w_0 at t_0 as if for every doxastic alternative <*w*,*t*,*x*> of John in w_0 at t_0, Mary is pregnant in *w* at the maximal interval of the state of Mary's having a swollen belly that John observes in *w* at *t*.

The revised truth conditions (47) for (42a) are empirically satisfactory. Since Abusch requires *Pres* to denote an interval that overlaps the speech time, the state of Mary's having a swollen belly overlaps both the time of the attitude and the speech time of the report in the actual world. After presenting my account of the double-access sentences in the following section, I will make a brief comparison between my proposal and Abusch's proposal as reinterpreted here.

Let me briefly touch upon another important previous attempt to understand how double-access sentences work. Enç (1987: 653) proposes that the embedded S' is moved at LF and is Chomsky-adjoined to the matrix sentence. I do not adopt her proposal partly because she does not make explicit what semantic import it has. For example, it is not clear how the variable left behind by the moved S' should be interpreted semantically. Moreover, her proposal seems to make some incorrect empirical predictions. Enç (1987: 654) suggests that (48a) can receive a bound-variable interpretation represented by the indicated co-indexing, whereas (48b) cannot:

(48) a. Every child$_j$ said that he$_j$ was tough.

b. *Every child$_j$ said that he$_j$ is tough.

[N.B., The judgment is Enç's.]

According to Enç's proposal, the embedded S' in (48b) is moved and adjoined to the matrix S at LF. Then, the pronoun *he* is outside the scope of the quantifier *every child* and cannot be interpreted as being bound by *every child*. Therefore, Enç predicts that (48b) is ungrammatical with the indicated co-indexing. However, many native speakers disagree with this judgment. That is, they find the bound-variable reading of (48b) acceptable. This is another reason to reject Enç's proposal. However, moving the embedded clause out of an opaque context seems to represent the native speaker's intuition that the semantic contribution of the embedded clause is partly independent of what the subject originally expresses. The proposal to be put forth in what follows incorporates the ideas contained in Enç's proposal but avoids the problems associated with it.

5. A New Proposal

Having considered four hypotheses and two previous proposals, I am now in a position to present my proposal. It is based upon an eventuality-based semantics, which claims that a declarative sentence is assumed to involve an existential assertion about an eventuality. An event-based system was originally proposed by Davidson (1967). Bach (1986) extends it to deal with various "action types" (or Aktionsarten) such as events, states and processes, and he refers to them collectively as "eventualities". My proposal posits two distinct eventuality types: events and states. Formally, I posit two sets of entities separately from A (a set of "normal" individuals): E for events, S for states.[22] Events and states are distinguished in the following way: I posit a function *Duration* from $A \cup E \cup S$ to the set of

intervals *T*. For example, for any element α of $A \cup E \cup S$, *Duration* (α) is the maximal interval that α occupies. The next step is to define the lexical semantics for $exist_{st'}$ (for states) and $exist_{ev'}$ (for events), which have different properties:

(49) a. $[\![\text{exist}_{st}']\!]_{w,g}$ (for any *w* and *g*) is that function from *S* to {*f* | *f* is a function from *T* to {0,1}} such that For any $s \in S$ and $t \in T$, $[\![\text{exist}_{st}']\!]_{w,g}$ (*s*) (*t*) = 1 if and only if $t \subseteq$ *Duration* (*s*)

b. $[\![\text{exist}_{ev}']\!]_{w,g}$ (for any *w* and *g*) is that function from *E* to {*f* | *f* is a function from *T* to {0,1}} such that For any $e \in E$ and $t \in T$, $[\![\text{exist}_{ev}']\!]_{w,g}$ (*e*) (*t*) = 1 if and only if *Duration* (*e*) = *t*.[23]

I leave out the subscripts on *exist'* when no confusion arises from this. The eventuality-based system that I propose follows Davidson's (1967) notation in that each verbal predicate has an extra argument position filled by an eventuality term.

I am now ready to discuss some of the empirical predictions that the new proposal makes. I assume that at LF any tense morpheme moves out of its surface position and adjoins to the minimal S within which it is originally located. As in the case of QR (Quantifier Raising) for NPs, we could assume that there is a semantic motivation for this tense movement.[24] That is, any tense morpheme translates as a generalized quantifier, and unless it moves out of its original position, it cannot be interpreted because of a type mismatch. When the tense moves out of its surface position, it leaves behind a variable of the lowest type possible. The sentence with a gap is then interpreted as a set abstracting over the gap. Let me show how the system works. Consider a simple sentence (50a):

(50) a. John took a walk.

b. John Past take a walk.

c. $[_S \text{Past}_1\ [_S \text{John}\ e_1\ \text{take a walk}]]$

(50b) is the S-structure of (50a), which further changes into (50c) at LF. Its translation into IL proceeds as follows:

(51) 1. $\text{Past}_1 \Rightarrow \lambda P_e\ \exists t[\exists e[t < s^* \ \&\ \text{exist'}\ (t, e)\ \&\ P_e\ (e)]]$

2. $[_S \text{John}\ e_1\ \text{take a walk}] \Rightarrow \lambda e_1\ [\text{take-a-walk'}\ (e_1, j)]$

3. $[_S \text{Past}\ [_S \text{John e take a walk}]] \Rightarrow$
$\lambda P_e\ \exists t[\exists e[t < s^* \ \&\ \text{exist'}\ (t, e)\ \&\ P_e\ (e)]]\ (\lambda e'\ [\text{take-a-walk'}\ (e', j)])$

4. $\exists t[\exists e[t < s^* \ \&\ \text{exist'}\ (t, e)\ \&\ \text{take-a-walk'}\ (e, j)]]$ [λ-conversion]

5. $\exists e[e < s^* \ \&\ \text{take-a-walk'}\ (e, j)]$ [simplification]

P_e represents a variable for sets of events. The final line says that there is a past event of John's taking a walk, which is the right interpretation.

Before we return to the discussion of double-access sentences, I need to discuss the special nature of English present tense. I assume with Enç (1987) that the interpretation of present tense in English is always linked directly to the speech time regardless of its structural position. This assumption is needed independently of double-access sentences. Consider the following example, which involves a relative clause:

(52) John hit a man who is crying.

The time of the man's crying must be the speech time in (52). This fact is surprising when we look at other languages, such as Japanese.[25] (52) literally translates into Japanese as (53):

(53) Taroo-wa [nai-te i -ru otoko]-o nagut-ta.
Top cry Prog Pres man Acc hit Past
'Taroo hit a/the man who was crying.' or
'Taroo hit a/the man who is (now) crying.'

As the English glosses show, (53) can receive two distinct interpretations. Note that its default interpretation is the simultaneous interpretation: the man's crying is co-temporal with Taroo's hitting him.[26] This means that present tense in Japanese can be interpreted either in relation to the time of the matrix predicate or independently. Everything else being equal, we should account for the fact that (53) has a simultaneous reading but (52) does not by imposing some restriction on the interpretation of present tense in English. I will assume that present tense in English translates as a generalized quantifier of states involving the speech time, i.e., $\lambda P_S \exists s$ [exist' (s*, s) & P_S (s)] or $\{X \mid X \subseteq S$ and there is a state s such that the speech time is part of *Duration* (s) and $s \in X\}$ in set-theoretic terms. (P_S represents a variable over sets of states.) On the basis of this assumption, (52) translates as (54):

(54) ∃e[e < s* & ∃x[man' (t, x) & hit' (e, j, x) & ∃s[exist' (s*, s) & be-crying' (s, x)]]]

(54) says that the state of the man's crying obtains at the speech time, not at the time of the hitting.[27] This is the desired result. I contend that the proposal outlined above combined with the special assumption about the present tense morpheme yields the right results for double-access sentences.

Let us go back to our main concern: double-access sentences. First, let me show that the new proposal can account for the example that we examined under various situations in the foregoing discussion, namely (55):

(55) John said that Mary is in the room.

(55) is syntactically analyzed as in (56a-b), following the aforementioned assumptions and rules:

(56) a. $[_S$ John Past say that $[_S$ Mary Pres be in the room]]

b. $[_S$ $Past_0$ $[_S$ John e_0 say that $[_S$ $Pres_1$ $[_S$ Mary s_1 be in the room]]]]

(56a) represents the S-structure of the sentence, and (56b) the structure after the application of the tense movement rule. At this point, the translation rules apply to (56b) and yield (57) as the output:

(57) 1. $Pres_2 \Rightarrow \lambda P_s [\exists s[exist' (s^*, s) \& P_s (s)]]$

2. $Past_0 \Rightarrow \lambda P_e \exists t \exists e[exist' (t, e) \& t < s^* \& P_e (e)]$

3. $[_S$ $Pres_1$ $[_S$ Mary s_1 be in the room]] $\Rightarrow$
$\exists s[exist' (s^*, s) \& be\text{-}in\text{-}the\text{-}room' (s, m)]$

4. $[_S$ John e_0 say that $[_S$ $Pres_1$ $[_S$ Mary s_1 be in the room]]] $\Rightarrow$
$say' (e_0, j, \wedge\lambda t \lambda x \exists s[exist' (s^*, s) \& be\text{-}in\text{-}the\text{-}room' (s, m)])$

5. $[_S$ $Past_0$ $[_S$ John e_0 say that $[_S$ $Pres_1$ $[_S$ Mary s_1 be in the room]]]] $\Rightarrow$
$\lambda P_e \exists t \exists e[exist' (t, e) \& t < s^* \& P_e (e)]$
$(\lambda e_0 [say' (e_0, j, \wedge\lambda t \lambda x \exists s[exist' (s^*, s) \& be\text{-}in\text{-}the\text{-}room' (s, m)])])$

6. $\exists e[e < s^* \& say' (e, j, \wedge\lambda t \lambda x \exists s[exist' (s^*, s) \& be\text{-}in\text{-}the\text{-}room' (s, m)])]$

In terms of structures, this translation is virtually the same as the formula given earlier as (13)

and is clearly empirically inadequate; (57) incorrectly predicts that (55) is nearly synonymous with (58):

(58) John said that Mary would be in the room now.

In order to rule out on principled grounds the reading (57) predicts, I propose the following informal restriction upon permissible attitude reports: any attitude report must be made in such a way that the temporal directionality of the original attitude as reported by the sentence agrees with the temporal directionality of the tense morpheme used in the verb complement clause. The temporal directionalities of tenses are given as follows: simple past tense is previous-time-oriented; simple present tense is current-time-oriented, and future auxiliary (*will* or *would*) is future-time-oriented. This constraint is a slightly revised version of what I call the "temporal directionality isomorphism" in Ogihara (1989). I contend here that (57) violates this constraint. In (57), the verb complement clause translates as a timeless property, but the property clearly is about the speech time because it concerns a state of Mary's being in the room that exists at the speech time. Since the subject expresses his attitude at a past time, the subject's original attitude as reported here is future-time-oriented. However, the object of this attitude is reported with a sentence in the simple present tense, which is current-time-oriented. This is a violation of the constraint described above. Hence, the final translation given in (57) is illicit.

In order to "rescue" (55), the present tense morpheme moves again and adjoins to the matrix S, leaving behind a trace, as in (59):

(59) $[_S \text{Pres}_2 [_S \text{Past}_0 [_S \text{John } e_0 \text{ say that } [_S s_2 [_S \text{Mary } s_1 \text{ be in the room}]]]]]$

This LF representation is appropriate for a *de re* interpretation about a state and translates into IL as (60):

(60) 1. $[_S\ Pres_2\ [_S\ Past_0\ [_S$ John e_0 say that $[_S\ s_2\ [_S$ Mary s_1 be in the room]]]]][28] $\Rightarrow \lambda P_s\ [\exists s[exist'\ (s^*, s)\ \&\ P_s\ (s)]]\ (\lambda s_2[\exists e[e < s^*\ \&$ say' (e, j, s_2, $\wedge\lambda t\lambda s_1$ [be-in-the-room' (s_1,m)])]])

2. $\exists s[exist'\ (s^*, s)\ \&\ \exists e[e < s^*\ \&$ say' (e, j, s, $\wedge\lambda t\ \lambda s_1$ [be-in-the-room' (s_1,m)])]]

In order to interpret the final formula, we must make clear the semantic mechanism presupposed. We can simply adopt the lexical meaning of *say'* proposed for *de re* attitudes about intervals given earlier as (44), except that we must now substitute eventualities for intervals:

(61) For any $w_0 \in W$, $P_0 \in D_{<s,<i,<st,t>>>}$, $s_0 \in S$, $a_0 \in A$, and $e_0 \in E$, $[\![$say'$]\!]_{w_0}$ $(P_0)(s_0)(a_0)(e_0) = 1$ (which informally reads 'in w_0, a_0 talks at the duration of e_0 as if a_0 ascribes the property P_0 to s_0') iff there is a "suitable relation" $SR \in D_{<s,<i,<st,<e,t>>>>}$ such that (i) s_0 is the state to which a_0 bears SR in w_0 at *Duration* (e_0), and (ii) a_0 talks in w_0 at *Duration* (e_0) as if for every doxastic alternative $<w,t,x>$ of a_0 in w_0 at *Duration* (e_0), the state to which x bears SR in w at t has the property P_0 in w at t.

According to (61), the translation given in (60) says that there exists a state *s* now such that John talks in the past as if he ascribes to *s* the property of being a state of Mary's being in the room. The state that satisfies this description in the actual world is, of course, Sue's being in

the room. To be more accurate, ascribing the property of being a state of Mary's being in the room to a state *s* can be explicated in terms of self-ascription of properties: (i) there is an acquaintance relation *SR* that relates John uniquely to some state in w_0 at t_0. The relation is that of "the situation that I am observing". The state in question is Sue's being in the room; (ii) John talks as if he self-ascribes the property of bearing this acquaintance relation uniquely to some state *s'*, which is Mary's being in the room. I believe that the acquaintance relation involved in this account is plausible. It simply says that the subject is acquainted with a unique state in w_0 at t_0 via *SR*. The only thing John needs to do in the above example is to recognize "the situation he is looking at" and to ascribe a property to it. Moreover, since this acquaintance relation requires the subject and the *res* to be present at the time of the attitude (i.e., t_0), this automatically guarantees that the *res*, i.e., the state, overlaps t_0. Since the state is the same state that obtains at the speech time, this analysis guarantees that Sue's being in the room spans both the time of John's saying and also the speech time of the report.

To see that this account of the double-access phenomena conforms to the temporal directionality isomorphism, compare (60) and (62b):

(62) a. John says that Mary is pregnant.

b. $\exists s[\text{exist}'(s^*, s) \& \exists e[\text{exist}'(s^*, e) \& [\text{say}'(e, j, s, \hat{}\lambda s_1 [\text{be-pregnant}'(s_1, m)])]]]$

(62b) is a translation of (62a) that yields a *de re* interpretation about a state. Since (62a) can only have a purely simultaneous reading, the "suitable relation" is that of "the situation that I am observing". Note here that, as far as the arguments of the attitude verb are concerned, (60) is exactly the same as (62b). This gives us a justification for adopting the same relation as a "suitable relation" for (60) as well. This means that John's attitude reported by (60) is

current-time-oriented. This conforms to the temporal directionality isomorphism because simple present tense in the verb complement clause is also current-time-oriented.

The example that Abusch discusses extensively, that of Mary's having a big belly, receives a new account under my proposal. The sentence (63a) is analyzed as having (63b) as its LF structure:

(63) a. John said that Mary is pregnant.

b. $[_S \text{Pres}_2\ [_S \text{Past}_0\ [_S \text{John } e_0 \text{ say } s_2\ [\text{Mary } s_1 \text{ be pregnant}]]]]$

(63b) translates into IL, as in (64):

(64) $\exists s[\text{exist' } (s^*, s) \ \&\ \exists e[e < s^* \ \&\ \text{say' } (e, j, s, \wedge\lambda t\ \lambda s_1[\text{be-pregnant' } (s_1, m)])]]$

(64) says that there is a state *s* now such that John talks in the past as if he ascribes to *s* the property of being a state of Mary's being pregnant. The state in the actual world that satisfies the description is Mary's having a swollen belly. Just as in the above example, this can be re-stated in terms of self-ascription of properties: there is a state *s* now and there is a suitable relation *SR* such that (i) *s* is the state to which John bears *SR* in w_0 at t_0, and (ii) John talks in w_0 at t_0 as if for every doxastic alternative $<w,t,x>$ of John in w_0 at t_0, the state to which *x* bears *SR* in *w* at *t* has in *w* at *t* the property of being a state of Mary's being pregnant. Note that even if Mary were pregnant when John believes, for the wrong reason, that she is pregnant, what happens to Mary's pregnancy later would not affect the truth conditions of the sentence in the new proposal. All that matters is whether Mary's having a swollen belly, the state that John is acquainted with in w_0 at t_0 via *SR*, still obtains at the speech time of the report. This is the desired result.

I now give an account of factive double-access sentences. As a representative example, let us consider the following example, which involves the expression *find out*:

(65) John found out that Mary is pregnant.

I posit (66) as the lexical meaning of *find-out'* designed for those cases that involve *de re* attitudes about state individuals. It was arrived at simply by combining (61) and the following two assumptions: (i) t_0 is an initial interval at which the subject bears *SR* to the *res*; (ii) the *res* has in w_0 at t_0 the property that the subject ascribes to the *res* in w_0 in t_0.

(66) For any $w_0 \in W$, $P_0 \in D_{<s,<i,<st,t>>>}$, $s_0 \in S$, $a_0 \in A$ and $e_0 \in E$, $[\![\text{find-out'}]\!]_{w_0}(P_0)(s_0)(a_0)(e_0) = 1$ (which informally reads 'in w_0, the duration of e_0 is an initial interval at which a_0 correctly ascribes the property P_0 to s_0') iff there is a "suitable relation" $SR \in D_{<s,<i,<st,<e,t>>>>}$ such that (i) *Duration* (e_0) is an initial interval at which a_0 bears *SR* to s_0 in w_0, and (ii) s_0 has the property P_0 in w_0 at *Duration* (e_0).

Armed with the lexical meaning of *find-out'* given in (66), let us consider the interpretation of (65). (67) provides the LF representation of (65) and its IL translation:

(67) Pres_3 [Past_1 [John e_1 find out that s_3 [Mary s_2 be pregnant]]] $\Rightarrow$
$\exists s[\text{exist'}(s^*, s) \,\&\, \exists e[e < s^* \,\&\, \text{find-out'}(e, j, s, \wedge\lambda t\, \lambda s_2[\text{be-pregnant'}(s_2, m)])]]$

The truth conditions for the LF formula are described as follows: there is a state *s* which overlaps now such that t_0 is an initial interval at which John is acquainted with *s* (and with

nothing else) in w_0 via some suitable relation and *s* is a state of Mary's being pregnant in w_0. This is exactly what we want.

Finally, let me discuss Enç's example (68a), given above as (48b). I propose (68b) as its translation:

(68) a. Every child said that he is tough.

b. $\forall x$ [child' (s*, x) $\rightarrow \exists s_2$[exist' (s*, s_2) & $\exists t_5$[t_5 < s* & $t_5 \subseteq t_{RT}$ & say' (t_5, x, s_2, $\wedge\lambda t\lambda x_4\lambda s_3$ [be-tough' (s_3, x_4)])]]]]

I posit the following lexical meaning for *say'* of type <<s,<i,<e,<st,t>>>>,<st,<e,<i,t>>>> to show how (68b) is interpreted:

(69) For any $w_0 \in W$, $P_0 \in D_{<s,<i,<e,<st,t>>>>}$, $s_0 \in S$, $a_0 \in A$, and $t_0 \in T$, $[\![\text{say}'_{<<s,<i,<e,<st,t>>>>,<st,<e,<i,t>>>>}]\!]_{w_0}(P_0)(s_0)(a_0)(t_0) = 1$ iff there is a "suitable relation" $SR \in D_{<s,<i,<st,<e,t>>>>}$ such that (i) s_0 is the state to which a_0 bears *SR* in w_0 at t_0, and (ii) a_0 talks in w_0 at t_0 as if a_0 self-ascribes the following property {<w,t,x> | there is a unique s to which x bears SR and P_0 (w)(t)(x)(s) = 1}.

According to (69), (68b) reads, "For every child y, there is a current state s_2 such that at some past time, y bears SR to s_2 and y self-ascribes the property of being x who bears SR to a unique s, which is a state of x's being tough". One advantage of my analysis with regard to (68a) is that it yields a reading in which there is a different state (i.e., *res*) for each child since it involves existential quantification over states. I think this is more intuitive than positing the same *res* for every child, which is predicted by giving the tense broader scope than *every child*.

6. A Comparison between Abusch's Proposal and Mine

My proposal and Abusch's are developed independently and at approximately the same time, and they have similar properties. As far as I can see, both of them are empirically satisfactory, and I do not find a decisive argument in favor of one over the other. Both proposals are encoded in terms of *de re* attitude reports. Abusch claims that double-access sentences involve *de re* attitudes about intervals, whereas I contend that they invoke *de re* attitudes about state individuals. I agree with Abusch that present tense in English must receive special treatment, as I stated above. I postulate that it always denotes a generalized quantifier of states intrinsically linked to the speech time, whereas Abusch assumes that it always denotes an interval that *contains* the speech time. Although our proposals regarding present tense in English are not exactly the same, let us grant that there is no disagreement between us regarding its special nature. Despite these similarities, however, there is one important difference between our approaches.

As explained earlier, I propose the temporal directionality isomorphism to account for the double-access phenomena. That is, when we make an attitude report, the temporal direction of the original attitude must be mirrored by the inherent temporal directionality of the tense morpheme used in the verb complement clause. In my account, the present tense that has been adjoined to the complement clause must move again in order to create a structure that conforms to the constraint. This structure is appropriate for a *de re* reading for a state. This reading predicts that the state in question overlaps both the time of the attitude and the time of the report. Abusch, on the other hand, accounts for the phenomena in a different way. She requires that a present tense morpheme denote an extended interval that includes the speech time. However, this requirement alone does not force the interval in question to overlap the original attitude time. Abusch accomplishes this effect by positing a suitable relation that requires that the interval in question overlap the original attitude time (in

her original formulation) or that the subject actually observe the state (in my re-interpretation). However, the question is why this type of relation is "suitable" for the given situation. It appears that Abusch's overall proposal does not provide a compelling explanation.

I think there is a way of justifying Abusch's proposal, however. Abusch implicitly claims that present tense in English as used in examples like (65) requires that it denote an interval that is "current" *both* with respect to the speech time *and* with respect to the original attitude time. Thus, a "suitable relation" must be chosen in such a way that this requirement is satisfied. This is tantamount to adopting the temporal directionality isomorphism. If we assume that the original attitude reported by a double-access sentence could concern a future interval in relation to the time of the original attitude, say an extended interval that contains the speech time of the report but is not extensive enough to cover the time of the original attitude, then there would be a discrepancy between the temporal directionality of the original attitude, which looks to the future, and the temporal directionality of the present tense, which is current-time-oriented. A relation is "proper" only if it forces the interval in question to overlap the attitude time, because this interval then counts as a "current interval" from the subject's point of view, in conformity with the temporal directionality isomorphism.

Returning to the discussion of Enç's example (68a), I am not sure whether Abusch's proposal would analyze it correctly. Given that the sentence has a quantificational subject NP *every child*, we can assume that there is no unique attitude time, nor is there any unique interval that is common to all relevant states for the children. Thus, it is not clear what is the right denotation of *Pres* for Abusch. Perhaps, the interval that completely contains all the relevant states for the children is the one she needs, but it is not obvious that this is the right analysis.

7. Conclusion

In this paper, I have discussed the "double-access" interpretation triggered by a present tense morpheme embedded in the immediate scope of a past tense morpheme. After examining various hypotheses, I have concluded that this interpretation is best captured by the idea that it involves a *de re* attitude report involving a state individual. The proposal is an application of Cresswell and von Stechow's (1982) ideas and techniques and is very similar to Abusch's (1991) proposal, which is based upon *de re* attitude reports about intervals. My proposal is based upon an eventuality-based approach in which events and states are primitive entities. This proposal interprets the embedded present tense as a generalized quantifier of states inherently linked to the speech time. The present tense morpheme moves twice at LF creating a logical structure appropriate for a *de re* attitude report about a state. I believe that the proposed system accounts for the behavior of double-access sentences in an empirically and conceptually satisfactory manner. I hope to investigate further empirical and theoretical consequences of my approach in comparison with Abusch's in the not so distant future.

REFERENCES

Abusch, Dorit: 1988, 'Sequence of Tense, Intensionality and Scope', *WCCFL* **7**, 1-14, Stanford Linguistics Association, Stanford University.

Abusch, Dorit: 1991, 'The Present under Past as *De Re* Interpretation', *WCCFL* **10**, 1-12, CSLI, Stanford University.

Bach, Emmon: 1986, 'The Algebra of Events', *Linguistics and Philosophy* **9**, 5-16.

Bennett, Michael and Barbara Partee: 1972, *Toward the Logic of Tense and Aspect in English*, Indiana University Linguistics Club, Bloomington.

Chomsky, Noam and Howard Lasnik: 1977, 'Filters and Control', *Linguistic Inquiry* **8**, 425-504.

Comrie, Bernard: 1985, *Tense*, Cambridge University Press, Cambridge.

Costa, Rachel: 1972, 'Sequence of Tenses in That-Clauses', *CLS* **8**, 41-51.

Cresswell, Maxwell J. and Arnim von Stechow: 1982, '*De Re* Belief Generalized', *Linguistics and Philosophy* **5**, 503-535.

Davidson, Donald: 1967, 'The Logical Form of Action Sentences', in N. Rescher, et al. (eds.), *The Logic of Decision and Action*, University of Pittsburgh Press, Pittsburgh, pp. 81-95.

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

Enç, Mürvet: 1986, 'Towards a Referential Analysis of Temporal Expressions', *Linguistics and Philosophy* **9**, 405-426.

Enç, Mürvet: 1987, 'Anchoring Conditions for Tense', *Linguistic Inquiry* **18**, 633-657.

Kaplan, David: 1977, 'Demonstratives: An Essay on the Semantics, Logic, Metaphysics, and Epistemology of Demonstratives and Other Indexicals', ms., published in Joseph Almog, et al. (eds.), *Themes from Kaplan*, 1989, Oxford University Press, New York, pp. 481-614.

Lewis, David: 1973, *Counterfactuals*, Harvard University Press, Cambridge, Mass.

Lewis, David: 1979, 'Attitudes *De Dicto* and *De Se*.' *The Philosophical Review* **88**: 513-43.

May, Robert: 1977, *The Grammar of Quantification*, unpublished Ph.D. dissertation, MIT.

Montague, Richard: 1973, 'The Proper Treatment of Quantification in Ordinary English', In J. Hintikka, J. Moravcsik, and P. Suppose (eds.), *Approaches to Natural Language*, D. Reidel, Dordrecht.

Needham, Paul: 1975, *Temporal Perspective*, Philosophical Studies 25, the Philosophical Society and the Department of Philosophy, University of Uppsala, Sweden.

Ogihara, Toshiyuki: 1989, *Temporal Reference in English and Japanese*, Ph.D. Thesis, Univ. of Texas at Austin, distributed by Indiana University Linguistics Club, 1992.

Ogihara, Toshiyuki: 1993, 'The Semantics of Tense in Embedded Clauses', ms., University of Washington; to appear in *Linguistic Inquiry*.

Partee, Barbara Hall and Mats Rooth: 1983, 'Generalized Conjunction and Type Ambiguity', In R. Bäuerle et al. (eds.), Meaning, Use and Interpretation of Language, de Gruyter, Berlin, pp. 361-383.

Perry, John: 1977, 'Frege on Demonstratives', *Philosophical Review* **86**, 474-97.

Quine, W. V.: 1956, 'Quantifiers and Propositional Attitudes', *Journal of Philosophy* **53**, 177-187.

Smith, Carlota: 1978, 'The Syntax and Interpretation of Temporal Expressions in English', *Linguistics and Philosophy* **2**, 43-99.

von Stechow, Arnim: 1984, 'Structured Propositions and Essential Indexicals', in Fred Landman and Frank Veltman (eds.), *Varieties of Formal Semantics, Groningen-Amsterdam Studies in Semantics* **3**, Foris Publications, Dordrecht, pp. 385-403.

NOTES

* The ideas contained in this article were originally developed in my Ph.D. dissertation (Ogihara, 1989). Some of the material discussed here was presented at the TIME conference held at MIT (March 1990), at USC, at McGill University, at the University of Stuttgart, at Sophia University, and at the University of Washington. The preparation of this article was supported in part by a University of Washington graduate school fund. I would like to thank the following individuals for discussions and comments on earlier versions of this paper: Irene Heim, Angelika Kratzer, Hans Kamp, Dorit Abusch, Mats Rooth, Ede Zimmermann, C.L. Baker, Mürvet Enç, and Manfred Krifka, and an anonymous referee for Natural Language Semantics. I alone am responsible for all the errors.

[1] If we add an appropriate temporal adverbial to (1b), it can also have a "shifted interpretation" as in (i):

(i) John said yesterday that he was sick the day before.

[2] The terms "event" and "state" will be used in an informal and pre-theoretical manner until they are characterized more precisely later.

[3] See Ogihara (1989, 1993) for the motivations for such an analysis. This type of approach stemmed from Needham (1975).

---

[4] This is a simplified version of my proposal presented in Ogihara (1989, 1993) in that the quantificational force associated with the existential quantifier is not restricted in an appropriate way. For example, (4) should officially be rendered as follows:

(i) $\exists t\,[t < s^* \,\&\, t \subseteq t_{R1} \,\&\, \text{say}'\,(t, j, \hat{}\,\lambda t_1 \lambda x\,[\text{be-pregnant}'\,(m, t_1)])]$

t_{R1} is a special temporal constant that receives as its value a contextually salient interval. This serves to represent the fact that the quantificational force of tense in natural language is restricted by a contextually salient interval. As reference times are irrelevant to the topics to be covered in this article, I will systematically leave them out from the formulas to be employed in this paper for the sake of readability.

[5] The recursive definition of the set of types is given as follows:

(i) *e* is a type; *t* is a type; *i* is a type (for intervals).
(ii) If α and β are types, then so is $<\alpha,\beta>$.
(iii) If α is a type, then so is $<s,\alpha>$.
(iv) Nothing else is a type.

[6] As I shall explain right below, this analysis of verbs like *say'* is based upon Lewis' (1979) idea that so-called propositional attitudes can be analyzed as relations between individuals and properties.

[7] For the purpose of the interpretation of temporal terms, I assume an interval-based approach (Bennett and Partee 1972, Dowty 1979), in which any temporal term denotes an

interval. The set of intervals is designated by *T*. An interval is defined as a convex subset of the set of instants *M*. That is, given any interval $i \in T$, for any $m, m' \in i$ and any $m'' \in M$, if $m < m'' < m'$, then $m'' \in i$.

[8] The phrase "talk as if" is needed because this allows for the possibility that the subject of the attitude lies or utters a sentence without intending to convey anything to anyone.

[9] Strictly speaking, an expression of the form $\wedge \lambda t \lambda x \phi$ (where ϕ is any expression) denotes a function-valued function. But, as is customary, this technical distinction between a function-valued function and a corresponding set of *n*-tuples is ignored.

[10] Since I adopt a *de se* analysis of any attitude, the truth conditions for the entire sentence should also be analyzed in terms of self-ascription of some property that involves worlds, times and individuals. That is, (11b) officially translates as (i):

(i) $\wedge\lambda t_1 \lambda y$[believe' ($t_1$, Heimson, $\wedge \lambda t \lambda x$[x = Hume at t])]

Then the truth definition says that an utterance of (11b) is true iff the property (i) denotes contains the triple $<w_0$, *now*, *the speaker*>. This truth definition is officially responsible for all occurrences of the expression *s**. This caveat applies to all IL translations that I will provide in the rest of the paper.

[11] This fact reveals an interesting difference between English and languages like Japanese. In Japanese, a present tense in a verb complement clause embedded in the scope of a past tense indicates a simultaneous interpretation. In fact, that is the only means of indicating

simultaneity of the matrix clause event and the embedded clause situation in Japanese. Consider the following examples:

(i) John-wa Mary-ga ninsinsi -te i -ru to it -ta.
Top Nom pregnant Prog Pres Comp say Past
John said that Mary was pregnant. [simultaneous reading only]

(ii) John-wa Mary-ga ninsinsi -te i -ta to it -ta.
Top Nom pregnant Prog Past Comp say Past
John said that Mary had been pregnant. [shifted reading only]

[12] The rendition given as (13) could be rewritten, if we so wish, in terms of acquaintance relations as we shall do so later.

[13] Costa (1972) claims this to be the right analysis.

[14] The expression *at an interval* is obviously not colloquial, but this expression indicates the temporal interpretation of sentences. I assume an interval-based theory in which the denotation of a temporal argument of any predicate is an interval. For example, (i) reads informally, "there is a past interval *t* at which John is in Seattle".

(i) $\exists t\ [t < s^* \ \&\ \text{be-in-Seattle}'(t, j)]$

---

[15] There were a small number of native speakers who did not accept the dialogue described in (25). I have no explanation for this disagreement among the native speakers regarding Hypothesis 3.

[16] Let me respond to two possible counter-arguments to my descriptive generalization. It may be contended that in the situation described in (26b) Mary left because she *expected* John to continue writing a letter for a long time. (In other words, she would have waited if she thought that he would be finished in 3 minutes, for example.) However, I take it that this situation cannot be described by (26b). Alternatively, it might be argued that Mary's leaving in (26b) was caused by John's writing a letter at an extended period (of which the time of Mary's leaving is *not* a final subinterval). I assume that this is not possible as backward causation is improbable. The same comment applies to (26a).

[17] I restrict my attention to cases where the sentences in (29) receive a simultaneous interpretation, though the entailment relations hold on a shifted interpretation as well.

[18] This point is due to Irene Heim (personal communication).

[19] Cresswell and von Stechow avoid this result by letting the complementizer *that* be ambiguous; *that* applies to the n-place property and its arguments, which collectively constitute a sentence, and yields a name of a sequence consisting of these expressions. This enables *believe* to denote a relation between two nominal objects. See Cresswell and von Stechow (1982) for details.

---

[20] Abusch slightly simplifies Cresswell and von Stechow's analysis and uses the structure of the form given in (i):

(i) $[_S$ NP TNS_1 $[_{VP}$ V $[_S$ TNS_2 $[_S$ λt S]]]]

[21] I added a world coordinate, which Abusch's original relation R_4 (1991: 6) does not contain.

[22] Accordingly, the set of types is re-defined as follows: (i) *e* is a type; *i* is a type; *t* is a type; *ev* is a type (for events); *st* is a type (for states); (ii) if α and β are types, so is $<\alpha,\beta>$; (iii) if α is a type, so is $<s,\alpha>$; (iv) nothing else is a type.

[23] I leave out a clause that concerns $exist_e'$, for "normal" individuals.

[24] QR is due to May (1977). See Partee and Rooth (1983) for a possible semantic motivation for QR.

[25] See Ogihara (1989, 1993) for the relevant discussion.

[26] The reading in which the time of the man's crying is the speech time is not salient without an accompanying adverbial like *ima* 'now' or *asoko-de* 'over there'.

[27] For the purpose of this article, I will not commit myself to the temporal properties of common nouns such as *man'* in (54). I simply assume here that common nouns have a

temporal argument position that is occupied by a free variable that receives a value from the context. See Enç (1986) for the relevant discussion.

[28] It is necessary for the translation rules to recognize that the most deeply embedded S of (59) translates as an abstract that binds the variable s_1. Since the original present tense morpheme is moved again and leaves a trace with a different index, this information cannot be retrieved from the index on the second variable. I assume that there exists some syntactic means of making this information available. One possibility is to co-index the sentence to which some moved expression is adjoined with its trace: $[_S \ldots X \ldots] \Rightarrow [_S X [_{S_n} \ldots e_n \ldots]]$.