Attitude Reports, Events, and Partial Models

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1. Introduction

Clausal complements of different kinds of attitude verbs such as *believe, doubt, be surprised, wonder, say*, and *whisper* behave differently semantically in a number of respects. For example, they differ in the inference patterns they display. This paper develops a semantic account of clausal complements using partial logic which accounts for such semantic differences on the basis of a uniform meaning of clauses. It focuses on explaining the heterogeneous inference patterns associated with different kinds of attitude verbs, but it contributes also to explaining differences among clausal complements of attitude verbs regarding the possibility of *de re* reference, anaphora support, presupposition satisfaction, and the distribution of subjunctive in certain languages. Moreover, it gives a new account of factivity.

The point of departure of this paper is the general observation that the failure of inferences from attitude reports is relative in that it depends both on the general type of attitude and on the particular instance of the attitude described. Thus, from *John is surprised that* P *and* Q one cannot infer *John is surprised that* P and *John is surprised that* Q, though this is possible with *believe*. Conversely, one can infer from *John believes that* P and *John believes that* Q, to *John believes that* P *and* Q, but only as long as the same belief state of John is involved.

In order to capture this dependency of inferences from attitude reports on a particular mental state or act, I propose an account on which clausal complements of attitude verbs (as well as independent sentences) characterize the intentional state or act described by the attitude verb in question, rather than referring to independent propositions. The semantic account of attitude reports of this paper can hence be called an '*event-based account*' of clauses.

Formally, the denotation of any sentence, both independent and embedded, is construed as a function mapping an intentional state or act to a function from situations (which form the content of the state or act) to truth values. The relation between such a function f and the mental state or act e consists in particular conditions that f(e) has to meet (that is, the assignment of truth values to the

situations in the content of e). For example, in the case of an attitude report with a verb of acceptance such as *John believes that Mary left, Mary left* must be evaluated as true in every doxastic alternative (a possible situation) that belongs to the content of John's belief state. Other types of attitude verbs, for instance *doubt* or *wonder*, may involve different conditions on how the clause characterizes the content of the described intentional act or state. Such conditions may involve existential, rather than universal, quantification over doxastic alternatives; and negative, rather than positive, evaluations in such alternatives. A crucial feature of the semantic account of clausal complements in this paper is that attitude verbs, unlike other relational expressions, may impose rather complex conditions on the evaluation of their complement with respect to an intentional state or act. Moreover, such conditions may not just be part of the lexical meaning of an attitude verb, but may be manifest in sentence meaning as well (for example in the case of factive verbs).

The general semantic approach in this paper is governed by the assumption that certain general conditions on semantic theory are fundamental and take priority over decisions of how to analyze particular constructions or expressions in particular contexts and of how to construe the meanings or semantic values of expressions. Unlike many other semantic approaches to attitude reports, the account of attitude reports in this paper presupposes a sharp distinction between semantic theory, in particular the 'level' of semantic values for expressions of natural language, and the 'philosophy of semantics', which includes questions of how to possibly explain certain notions assumed in the semantic theory in terms of other notions. This means, in the present case, that the semantic theory does not attempt to explain the components of the contents of mental states or acts it assumes, but rather restricts itself to characterizing their semantically relevant properties.

There are two fundamental conditions on a semantic theory of clausal complements. The first can be called the 'Uniformity Condition'; the second is Compositionality:[1]

(1) (i) *Uniformity Condition*

A semantic theory should assign uniform meanings to expressions in different
contexts, in particular, independent and embedded sentence and clauses embedded
under different kinds of attitude verbs.

(ii) *Compositionality*

A semantic theory should assign meanings to sentences based on the meanings
of their constituents.

The event-based account of clausal complements meets the Uniformity Condition for at least the meaning of sentences. Also it is able to fulfill compositionality - though this will not be elaborated explicitly at the subsentential level.

The paper is organized as follows. In Section 1, the basic account of attitude reports is motivated and outlined for verbs of acceptance. In Section 2, a number of complex, nonfactive attitude verbs are analyzed in detail by extending the account given in Section 1. Section 3 gives a further elaboration of the event-based account for 'verbs of explicit saying'. Section 4 develops an analysis of factive verbs and presents a reassessment of the notion of factivity, which gives indirect support for the event-based account. Section 5 discusses other phenomena of natural language that arguably involve mental states or acts as semantic objects, namely epistemic modals, conditionals, and certain generic sentences. An appendix briefly discusses the relation of the theory to dynamic semantic phenomena in attitude reports such as anaphora and presuppositions and shows how the *de re-de dicto* distinction and *de se* reference can be construed within the event-based account.

2. Attitude reports with predicates of acceptance

2.1. Motivation of the event-based account

In this section, I will motivate and introduce the event-based account of clauses with the most basic kind of attitude verbs, namely what I call 'verbs of acceptance' (following the notion of acceptance of Stalnaker 1984). The prototypical verb of acceptance is *believe*. Others include *think, assume, suppose*, *imagine*, *see*, *hear*, and *conclude*. Verbs of acceptance form a semantic class in that, as we will see, they pattern the same with respect to relevant types of inference. They, of course, also differ among each other in one or the other respect. For example they may differ in the degree to which the agent commits himself to the content of the mental state or act. Some predicates such as *be sure* impose a strong degree of justification for accepting the propositional content of their complement; others imply a particular source for the acceptance of the propositional content (such as *see*, *hear* and *conclude*). Furthermore, verbs of acceptance differ in the extent to which the acceptance is restricted to a particular context (*assume*, *suppose*, *imagine*) or to which the propositional content has to cohere with other beliefs (*belief* vs. *suppose* or *assume*). Finally, verbs of acceptance differ in whether they describe a state, that is, a mental state or disposition to act (*believe*, *know*, *assume*), or an occurrent thought (*imagine*, *think*).2

For distinguishing different attitude verbs, there are basically six inference patterns that are most important.3 Four among them are Conjunction Introduction, Conjunction Distribution, Disjunction Introduction, and Disjunction Distribution:

(2) a. <u>Conjunction Introduction</u>
   a V *that* S, a V *that* S' ==> a V *that* S & S'
   b. <u>Conjunction Distribution</u>

a V *that* S & S' ==> a V *that* S & a V *that* S'

c. <u>Disjunction Introduction</u>

a V *that* S v a V *that* S' ==> a V *that* S v S'

d. <u>Disjunction Distribution</u>

a V *that* S v S' ==> a V *that* S v a V *that* S'

Two other relevant inference types are Downward Entailment (inference from weaker to stronger propositional content) and Upward Entailment (inference from stronger to weaker propositional content):

(3) a. <u>Downward Entailment</u>

a V *that* S, S' -> S ==> a V *that* S'

b. <u>Upward Entailment</u>

a V *that* S, S -> S' ==> a V *that* S'

These two inference types, however, should be understood only in an appropriately restricted way. In the context of propositional attitudes, Downward Entailment should be considered only to the extent that it involves 'relevant logical consequences'. For example, one would want to exclude inferences to propositions involving entities the relevant agent did not conceive of or to those involving predicates for which the agent did not consider the relevant entities to be applicable. Upward Entailment should be restricted in the same way; it should only involve propositions about relevant entities.

It is a matter of dispute whether monotonicity properties (Upward and Downward Entailment) should be part of the subject matter of semantics at all.[4] Even with the restriction to relevant stronger or weaker propositions, usually there can still be counterexamples found in particular cases to whatever monotonicity property one might want to attribute to a verb. For example, in the case of *believe*, which appears to be upward entailing, it may be that John believes that P, but fails to believe that Q, even if Q is a relevant and rather obvious logical consequence of P (see Soames 1988 for detailed examples).

However, there is evidence that monotonicity properties are semantically relevant nonetheless (and thus, that such counterexamples may not be crucial). This evidence comes from attitude verbs like *believe* in the scope of negation and from 'negative verbs' like *doubt* and *deny*, which appear to be downward entailing, and as such would allow for the same sort of counterexamples as *believe*. Negated attitude verbs like *believe* and negative attitude verbs arguably are treated as downward monotone in natural language since they licence negative polarity items such as *ever* and *anybody*:

(4) a. John doubts / denies that he has *ever* been to France.

    b. John does not believe that *anybody* won the race.

On the account of negative polarity licensing of Ladusaw (1979), negative polarity items are licenced precisely in downward-entailing environments.[5] If *believe* in the scope of negation is downward entailing, then, clearly, *believe* itself must be upward entailing.

    So even though monotonicity properties may not hold strictly in particular cases, speakers may treat attitude verbs as if they were upward or downward entailing. That is, they may classify attitude verbs semantically (for instance for the purpose of negative-polarity licensing) under idealized circumstances, disregarding any lack in logical skills on the part of the agent. So under such premises, monotonicity properties appear to be semantically relevant properties of attitude verbs.

    Returning now to verbs of acceptance as a semantic class, we can observe the following behavior with respect to the inference patterns above, though a certain qualification has to be made concerning Conjunction Introduction:

Conjunction Introduction: OK[6]

(5) John believes that Mary left, and he believes that Bill arrived.

    John believes that Mary left and Bill arrived.

Conjunction Distribution: OK

(6) John believes that Mary left and Bill arrived.

    John believes that Mary left, and he believes that Bill arrived.

Disjunction Introduction: NO

(7) John believes that Mary left, or he believes that Bill arrived.

    John believes that Mary left or Bill arrived.

Disjunction Distribution: NO

(8) John believes that Mary left or Bill arrived.

    John believes that Mary left, or he believes that Bill arrived.

Upward Entailment (closure under 'relevant logical consequences'): OK

(9) John believes that a tall woman left.

    John believes that a woman left.

Downward Entailment (closure under 'relevant stronger propositions'): NO

(10) <u>John believes that somebody left.</u>

    John believes that Mary left.

Even though I have chosen the verb *believe*, the same observations hold for all verbs of acceptance.

   Conjunction Introduction is not always valid, and the way in which it fails will lead us to one of the central ideas of the semantic account of attitude reports of this paper.7 For example, John may believe that P, and he may, at the same time, believe that Q, without realizing that P and Q are mutually contradictory and in particular without believing that P and Q (and consequently that P and ¬ P). What goes on in this case is that there are two distinct belief states of John involved: one in which John believes that P and one in which he believes that Q. Thus, Conjunction Introduction will hold only as long as the premises involve the same concrete belief state.8

   The relativization of the attribution of an accepted proposition to a particular mental state or act also accounts for the possibility of change of belief or of the occurrence of different thoughts (at different times) with contradictory contents.

   In cases of different beliefs or thoughts at different times, though, it would still be sufficient to relativize the attitude reports to a particular time, rather than particular mental states or acts. The inferences then would hold just in case the premises are about the same time interval. However, there are other cases where the relativization to concrete mental states or acts is necessary. These are cases where accepting a proposition depends crucially on the context, as pointed out by Stalnaker (1984) (See also Lewis (1986), Chap. 1). For example, John may, in front of his friends, accept that smoking is OK, but in front of his children that smoking is bad. Rather than attributing to John a belief in a contradictory proposition, it is more plausible in this case that John has two (possibly) simultaneous states of acceptance: one which manifests itself when John is among his friends and one which manifests itself in front of his children.

   Thus, both the attribution of acceptance of a proposition to a person and the possibility of inferences of a certain kind should be relativized to a particular mental state or act. This mental state or act, in turn, can be considered an argument of the attitude verb, occupying an additional Davidsonian argument position (cf. Davidson 1967, Higginbotham 1985, Parsons 1990). I will henceforth assume that every (attitude) verb has such an additional event argument place. By convention, this will be the first argument place of the verb. Thus, *believe* now denotes a three-place relation between belief states, agents, and propositions.

   A bit more has to be said about the notion of mental state or act that I assume. The relevant notion is not that of a mental state or act that is individuated independently of its external environment and thus has a 'narrow' content, based on its internal properties only. Rather it is the more abstract notion of mental state or act which has a 'wide content' and whose identity may be depended on the environment. It basically corresponds to the notion of mental state or act of Stalnaker (1984, 1990).

The dependency of inferences from attitude reports on the particular mental state or act that is described leads to one of the central ideas of the semantic account of attitude report of this paper: the function of the complement clause of an attitude verb is to characterize the mental state or act which is the Davidsonian event argument of the attitude verb. Different mental states or acts that act as arguments of the same attitude verb may have different 'global' contents, and a complement clause will be evaluated with respect to the content of the mental state or act. More formally, every mental state and act is associated with its own set of partial models, and the *that*-clause with be evaluated in a particular way in such a set of partial models. For this purpose, the denotation of a clause will be construed as a function mapping an event (a mental states or act) and to a function from situations to truth values, or equivalently, a function mapping an event and a situation to a truth value.

There is another, to some extent equivalent, way of capturing the dependency of the meaning of the clause on the event. On this account, the clause does not contribute an independent argument to the relation denoted by the attitude verb, but rather expresses a property that is attributed to the event. This would yield a seemingly rather different view of the semantic function of clauses. For then, the clause would act semantically as a predicate, predicated of the event argument, rather than as an independent argument. (Note that this view does not imply that the clause syntactically must act as an adjunct to the verb, like as event predicates such as *today* in *John left today* (as in Davidson's (1967) account). Also adverbs that have the status of arguments, rather than adjuncts, would have to be treated as event predicates in a Davidsonian account, for example, *badly* in *John behaved badly*.)

A construal of a clause denotation as an event property would correspond to the logical form of (11a) in (11b), where [] is the denotation function. Here *believe* is, for the sake of simplicity, represented as a two-place relation between belief states and agents, though the proper denotation of *believe* should better be considered a three-place relation with the 'meaning postulate' in (11c) effecting the third argument being predicated of the first. [V]* is the relation between states or acts of acceptance of the sort specified by V and agents; thus [V]* is like [V] except that the third argument position is existentially quantified over.

(11) a. John believes that Mary left.

b. $\exists e([believe](e, [John])$ & $[that\ Mary\ left](e))$

c. Lexical condition on verbs of acceptance (event-predicational format)

For a verb of acceptance V, an event e, an entity x, and an event property P,

$[V](e, x, P)$ iff $[V]^*(e, x)$ and $P(e)$.

If the view that clauses express properties of the mental state or act argument is not adopted, then we would instead get an analysis of the lexical meaning of attitude verbs as in (12), where CH is some

condition relating the third argument of the belief-relation to the first (with the effect that the third argument appropriately characterizes the content of the first argument):

(12) <u>Lexical condition on verbs of acceptance (propositional format)</u>

For a verb of acceptance V, [V](e, x, F) iff [V]*(e, x) and CH(e, F).

I will call the view of the semantic structure of attitude reports given in (11c) the *'event-predicational format'*, and the one in (12) the *'propositional format'*. It is clear that the difference is rather notational. More precisely, the event-predicational format can be considered a special instance of the propositional format. The reason for me to adopt the propositional format is that with different kinds of attitude verbs, the clausal complement characterizes the content of the event argument in different ways. So different relations like CH have to be specified for different verbs, and this means that no uniform definition of a clause denotation as an event predicate can be given.

It is worthwhile, nonetheless, to give the event-predicational format some more general considerations. There are in principle a number of ways in which a clause could be considered an event predicate. Conceiving of clausal complements as predicates of the event argument of the embedding attitude verb allows for a compositional formulation of a number of proposals on which the evaluation of the clausal complement is, in some way, considered dependent on the intentional state or act described by the attitude verb.

For example, predicating a clause of an intentional state or act could mean that the clause, in some way or other, specifies the form of the intentional state or act. This corresponds to the view on attitude reports of, for example, Scheffler (1963) and perhaps Fodor (1986).[9] On this view, the meaning of (11a) could roughly be formulated as in (13):

(13) ($\exists$e)([*believe*](e, John) & [*that Mary left*](e)), whereby [*that Mary left*](e) only if e has the form given by *that Mary left*.

Alternatively, it could mean that the constituents of the clause will be matched with 'constituents' of the mental state or act. This would correspond to the account of attitude reports of Crimmins/Perry (1988) and Crimmins (1990). On this view, the meaning of (11a) could be formulated as in (14), where n is what Crimmins and Perry call the 'cognitive notion' of Mary and i what they call the 'cognitive idea' of leaving (both of which are 'unarticulated constituents'):

(14) ($\exists$e)([*believe*](e, John) & [*that Mary left*](e, n, i)), whereby [*that Mary left*](e, n, i) iff <Mary, leave> is the content of e and n is a part of e and corresponds to Mary in <Mary, leave> and i is a part of e and corresponds to the property of leaving

in <Mary, leave>.

The event-predicational format, thus, provides a general way in which the evaluation of the clausal complement can be made dependent on the concrete intentional state or act that is described.[10]

It should also be mentioned that an idea similar to the event-predicational format for attitude reports has been proposed for perception (the 'adverbial theory of perception) (cf. Tye 1984 and references therein).

The event-based account of clauses raises a general question that should be addressed at the outset. It concerns the status of the attitude report itself. Clearly, given the Uniformity Condition, independent sentences should be given the same denotation as embedded clauses. The question then is, with respect to which event they will be evaluated. We will see that there is an answer to this question in Section 4. For the sake of simplicity, I will disregard the event component of independent sentences until then, focusing only on the way embedded clauses should be treated.

Another general remark is required concerning the event argument of attitude verbs and the status of clauses as characterizing the content of that event. A clausal complement of a verb does not necessarily specify the content of a mental state or act. It may also specify the 'content', that is, the intended goal, of an action, as in *John tried to close the door*. Both mental and nonmental acts or states may have a content, or, in other words, may be 'intentional' acts or states. Thus, more generally, the clausal complement specifies the content of an intentional act or state. In this paper, however, I will focus on verbs describing mental states and acts and disregard other kinds of intentional verbs.

Given the event-based account of clauses, what the inferences from attitude reports tell us is that if certain properties hold of a particular belief state, then also other properties always hold or fail to hold of that same belief state, depending on whether the inference is valid or invalid. So if the premises specify the content of the same belief state e, then the conclusion again involves e; and it has to be seen that e supports the relevant conditions imposed by the conclusion. So Conjunction Introduction, in particular, will be valid only if the premises and the conclusion are about the same belief state.[11] The question that I will address in the next section is: how is the content of a belief state to be construed and how can the denotation of a clause be construed as a function from events?

2.2. Partial models and the content of intentional states or acts

2.2.1. The event-based account of clausal complementation

In order to account for the inferences above, the function of a *that*-clause is conceived as characterizing the content of the relevant mental state or act. What does this mean? For verbs of

acceptance, the central idea is that a clause characterizing an intentional state or act e means that the clause is true in what constitutes the 'mental model' or the *global content* of e. This global content determines what kind of further inferences are possible, given that the clause holds of that state or act. So on this view, it is only the content of the intentional state or act which determines the evaluation of the clause, not properties of its form. (Though we will later (Section 4) come to one exception to that, namely 'verbs of explicit saying' such as *say* or *whisper*. The clausal complement of such verbs will not only characterize the content of the act of saying, but also provide a property of its form. Thus, ultimately, the event-characterizing function of clauses will be exploited in two distinct ways.)

How should a global content of a mental state or act be formally construed? There are two general conditions it should satisfy. First of all, it should consist only of entities the agent conceives of or would be ready to conceive of, given the agent's particular mental state or act. Second, it should be capable to contain only partial information about such entities, again corresponding to the relevant mental state or act. Thus, such a model should specify the entities in the relevant domain with properties corresponding to that state or act.

Before turning to the formal modelling of the partial information content associated with a particular mental state or act, it is necessary to first say some more about the nature and the motivation of the domain of entities associated with such a mental state or act.

2.2.2. The domain for the content of mental states or acts

The way the domain associated with a mental state or act is conceived is motivated by the Uniformity Condition given in the Introduction. The Uniformity Condition implies in particular that NPs and pronouns in embedded contexts should have the same kind of semantic value as in nonembedded contexts. This implies that the domain for the content of a mental state or act may contain conceived 'nonexistent objects', which provide the semantic values for NPs such as *a ghost* and *it* in (15):

(15) John believes that there is a ghost in the room and that it frightens him.

Moreover, the view implies that the semantic values of NPs may be partial objects which may or may not correspond to (one or more) actual objects. This is required for examples such as (16):

(16) John believes that somebody entered the room.

Somebody in (16) may stand for an entity in John's belief domain which is specified only as a person

that entered the room and as nothing else.

Finally, the view implies that the domain may contain distinct partial objects that correspond to the same actual entity in order to account well-known puzzles with attitude reports. One such puzzle arises with terms that have the same meaning, as in (17a); another one arises with different occurrences of one and the same term, as in (17b) and (17c):

(17) a. John believes that Hesperus is not Phosphorus.

     b. John believes that London is ugly and Londres is pretty. (Kripke 1988)

     c. John believes that she is in danger and that she is not in danger. (Richard 1988)
       (speaking of the woman John is talking to on the phone and the (same) woman
       whom he sees standing in a phone booth being approached by a steamroller)

In (17a), the semantic value of *Hesperus* will be distinct from the one of *Phosphorus*. In (17c), *London* will have a semantic value distinct from *Londres*, and similarly for the first and second occurrence of *she* in (17d).

On the view of the examples in (17) that I adopt, it is the semantic values of the relevant NPs in an event-dependent model themselves that are distinct, rather than their forms or their denotations, which are always functions from mental states or acts (and situations) to semantic values. There are two ways one might conceive of the semantic value of an NP in an event-dependent model: the semantic value may either be a 'partial object' in itself (where different part objects may correspond to the same actual object), or it may be conceived of as a pair consisting of the actual object and a mode of presentation or 'cognitive notion' corresponding to that object.[12] On the latter view, Hesperus in (17a) would have as its semantic value a pair $<$Venus, $m_1>$ and Phosophorus a pair $<$Venus, $m_2>$, where m_1 and m_2 are different cognitive notions of Venus in John's believe state.[13]

On the first view, NPs might receive their value from an entirely internal 'mental domain', whereas on the second view, only part of the value would come from such a domain; another part would come from the actual world. The second view may be less problematic, though an in depth discussion of this issue leads away from the focus of this paper. What is crucial for the present concerns is only that whatever conception of such epistemic and doxastic objects one might adopt, it is necessary in any case that they are dependent - at least in part - on a particular mental state or act. Thus, under either view, the semantic value of, for example, *Hesperus* in (17a) should be made dependent on John's concrete belief state. Formally, the semantic value of *Hesperus* in (17a) will then be an element of a domain D(e), where e is John's belief state.

2.2.3. Construing the partial information content of mental states or acts

2.2.3.1. Two ways of construing partiality

There are two ways of construing partiality. Partial information can be represented either by a single incomplete partial object (for short '*partiality 1*') or by a set of several more complete objects ('*partiality 2*'). We will see that for modelling states or acts of acceptance, a combination of both ways is most adequate - this is in fact the situation-semantic treatment of attitude reports (Barwise/Perry 1982), as well as the view adopted by Muskens (1989a, b) (who gives a treatment of attitude reports equivalent to the one of Situation Semantics within Montague Grammar). Before introducing the representation of partial information for states or acts of acceptance that I will adopt, I first briefly discuss the problems that arise if either only partiality 1 is adopted or only partiality 2.

2.2.3.2. Partiality 1

On the basis of partiality 1 only, the content of a belief state would be identified with a single situation or partial model. Before discussing problems arising with this view on partiality, let me first introduce the notion of partial model, which will be needed anyway.

The notion of partial model that I will use is basically the one of Muskens (1989a, b). A partial model differs from a complete model mainly in that it involves two interpretation functions I+ and I- and a third truth value # (Undefined) besides 1 (True) and 0 (False). I+ assigns positive extensions to predicate symbols and I- negative extensions. The positive extension of a predicate consists of those n-tuples of entities for which the predicate is true; the negative extension of those for which it is false. There may also be n-tuples which are neither in the positive nor in the negative extension of the predicate. For these n-tuples, the predicate is undefined, or, equivalently, yields a third truth value #.

If the positive and negative extension are allowed to overlap, then this yields a way of representing contradictory contents of attitudes (simultaneous positive and negative specification of an entity for a predicate). In fact, contradictory contents are possible with at least certain attitude verbs, for example *assume, suppose* or *conclude*. However, overlapping positive and negative extensions require introducing a fourth truth value 'both true and false'. In order to keep matters simple, I will disregard the issue of contradictory contents and stipulate that positive and negative extensions are nonoverlapping.14

The notion of partial model for first order predicate logic is defined in (18a), with the truth definition given in (18b). From this definition, the truth conditions for disjunction and negative existential quantification in (19) can be derived:

(18) a. A (simple) partial model for a language of first order predicate logic L is an triple

$M = <D, I+, I->$ such that for any constant c in L, $I+(c) \subseteq D$ and $I+(c) = I-(c)$
and for any n-ary predicate symbol R, $I+(R) \subseteq D^n$ and $I-(R) \subseteq D^n$ and $I+(R) \cap I-(R) = 0$.

b. <u>Truth definition for partial predicate logic</u>

The value of a formula in a model $M = <D, I+, I->$ under an assignment a is defined as an element of $\{1, 0, \#\}$ as follows:

$[Rt_1...t_n]^{M,a}$ $= 1$ if $[t_1]^{M,a}, ...,[t_n]^{M,a}$ are defined and $<[t_1]^{M,a}, ...,[t_n]^{M,a}> \in I+(R)$.

$\qquad = 0$ if $[t_1]^{M,a}, ...,[t_n]^{M,a}$ are defined and $<[t_1]^{M,a}, ..., [t_n]^{M,a}> \in I-(R)$

$\qquad = \#$ otherwise.

$[\neg P]^{M,a}$ $= 1$ iff $[P]^{M,a} = 0$

$\qquad = 0$ iff $[P]^{M,a} = 1$

$\qquad = \#$ otherwise.

$[P \& Q]^{M,a}$ $= 1$ if $[P]^{M,a} = 1$ and $[Q]^{M,a} = 1$

$\qquad = 0$ if either $[P]^{M,a} = 1$ and $[Q]^{M,a} = 0$ or $[P]^{M,a} = 0$ and $[Q]^{M,a} = 1$

$\qquad = \#$ otherwise.

$[t_1 = t_2]^{M,a}$ $= 1$ if $[t_1]^{M,a}$ and $[t_2]^{M,a}$ are defined and $[t_1]^{M,a} = [t_2]^{M,a}$

$\qquad = 0$ if $[t_1]^{M,a}$ and $[t_2]^{M,a}$ are defined and $[t_1]^{M,a} = [t_2]^{M,a}$

$\qquad = \#$ otherwise.

$[\forall x P]^{M,a}$ $= 1$ if for every $d \in D$, $[P]^{M,a[d/x]} = 1$.

$\qquad = 0$ if for some $d \in D$, $[P]^{M,a[d/x]} = 0$, and for no $d \in D$, $[P]^{M,a[d/x]} = \#$

$\qquad = \#$ otherwise.

(19) a. $[P \lor Q]^{M,a}$ $= 1$ if either $[P]^{M,a} = 1$ and $[Q]^{M,a}$ $\{1, 0\}$ or $[P]^{M,a} \in \{1, 0\}$ and $[Q]^{M,a} = 1$.

$\qquad = 0$ if $[P]^{M,a} = [Q]^{M,a} = 0$

$\qquad = \#$ otherwise.

b. $[\neg \exists x P]^{M,a}$ $= 1$ if for some $d \in D$, $[P]^{M,a[d/x]} = 0$, and for no $d \in D$, $[P]^{M,a[d/x]} = \#$

$\qquad = 0$ if for every $d \in D$, $[P]^{M,a[d/x]} = 1$.

$\qquad = \#$ otherwise.

The assignment of positive and negative extensions to predicates and hence the distinction between three truth values is necessary in order to account for negation in attitude contexts, in particular negative existential quantification. In order for it to be true that John believes that Mary did not leave, it is not sufficient that Mary fails to be in the positive extension of *leave* in John's belief model; she also must be in the negative extension. (Otherwise, John might simply lack a belief about Mary's leaving.) Also, in order for it to be true that John believes that nobody left, it is not sufficient that there be nobody in John's belief model who is in the positive extension of *leave*. (In

this case, John may just not be sure whether anybody left.) Rather it also must be the case that every person in John's belief model is in the negative extension of *leave*.

If a mental state or act e has as its content a single partial model M, then the characterization of e by a clause S most naturally is understood as S being evaluated as true in M. So if an intentional state or act e is associated with a single partial model M(e), (11b) would have to be replaced by (20b) as the meaning of (20a):

(20) a. John believes that Mary left.

    b. $(\exists e)(<e, [John]> \in [believe]^* \ \& \ [that \ Mary \ left]^{M(e)} = 1)$

There are, however, serious problems with identifying the content of a mental state or act with a single partial model. One of them is the problem of disjunction. If *John believes that Mary arrived or Bill left* is true, then given that John's belief state corresponds to a single partial model, it follows that either that *Mary arrived* is true in John's belief model or that *Bill left* is true in John's belief model. But this means that either *John believes that Mary arrived* is true or that *John believes that Bill left* is true. That is, Disjunction Distribution would obtain, which is an undesired result.

A second, related problem arises with existential quantification. If John believes that somebody left, then it would follow that John believes that Mary left or that Sue left or that Max left, given that Mary, Sue and Max are the only people under consideration by John. Thus, representing the content of a mental state or act by a single partial model is inappropriate.

2.2.3.2. Partiality 2

On the basis of partiality 2 only, the content of an attitude would be identified with a set of possible worlds, the worlds compatible with what the agent believes ('doxastic alternatives'). This is the idea underlying Hintikka's (1969) semantics for attitude reports. On Hintikka's view, *believe* is construed as a sentence operator (analogous to modal operators) so that ' John believes that P' is formalized as '$B_j(P)$', which is true in a world w just in case P is true in every doxastic alternative of j in w.

With some modifications, such an account can be cast within the current terms as follows: the concrete described belief state e, that is, the Davidsonian event argument of *believe*, is correlated with a set of possible worlds, the set of doxastic alternatives of e. Instead of (20b), we then have (21), where M(e) is a model with a set W of possible worlds each of which corresponds to a complete model:

(21) $(\exists e)(<e, [John]> \ \ [believe]^* \ \& \ (\forall w)(w \in W^{M(e)} \ \text{-->} \ [that \ some \ woman \ left]^{M(e)} = 1))$

This account does not lead to the problem of disjunction and existential generalization mentioned above. If John believes that Mary arrived or Max left, then the set of John's doxastic alternatives consists of worlds in which either Mary arrived or Max left. If John believes that somebody arrived (Mary, Sue and Max being all the people under consideration), then the set of John's doxastic alternatives consists in the possible worlds in which either Mary, Sue or Max arrived.

    Hintikka's semantics of attitude reports raises the problem of closure under logical consequences. In particular, it licences two unwanted kinds of inference. The first is what one may call '*Conjunction with Arbitrary Logical Truths*', an inference such as from 'John believes that P' to 'John believes that P and Q', where Q is any arbitrary logical truth, as in (22a) (cf. Barwise Perry 1982). The second is what one may call '*Addition of Arbitrary Disjuncts*', the inference from 'John believes that P' to 'John believes that P or Q', where Q is any arbitrary proposition, as in (22b):

(22) a. <u>John thought that Mary left.</u>
      John thought that Mary left and the president of the United States arrived or did
      not arrive.
   b. <u>John thought that Mary left.</u>
      John thought that Mary left or the president of the United States arrived.

(22a) is licenced since *Mary left* and *Mary left and the president of the United States arrived or did not arrive* are true in exactly the same possible worlds. (22b) is licenced since *Mary left or the president of the United States* is true in every possible world in which *Mary left* is true.[15]

2.2.3.3. Partiality 1 and 2

At least part of the problem of closure under logical consequences can be overcome by replacing possible worlds by situations and identifying the content of intentional states or acts with sets of situations. This is the move that Situation Semantics makes (cf. Barwise/Perry 1982). As Muskens (1989a, b) has shown, it can also be implemented within a more traditional model-theoretic semantics, using partial models.

    Situations introduce partiality in two ways. First, they may contain only a restricted set of entities; second, they need not specify for every entity whether it falls or does not fall under a particular predicate. Truth value gaps (or, equivalently, the assignment of a third truth value #) may then arise from two sources: either from a singular term not having a referent in the relevant situation or from a predicate not being specified positively or negatively for a given entity.

    The required notion of partial model with situations, which I will henceforth use, is as follows:

(23) <u>Partial Situation Model</u>

    For an intentional state or act e, M(e) (the *partial situation model* dependent on e) is
    a quadruple <D, S, I+, I-> such that D is a set of entities, S a set of situations, and I+
    and I- functions mapping individual constants to functions from elements in S to
    elements in D (where I+(s)(c) = I-(s)(c)) and n-place predicates to function from
    elements in S to subsets of D^n (where for any predicate R and any $s \in S$, I+(s)(R) ∩
    I-(s)(R) = ∅).

I will often write 'D(e)' and 'S(e)' for the first two components D and S of such a partial model.

    Given this notion, the logical form of (11a) will now be spelled out as follows, where for a
sentence S, $[S]^{(e, s)} = [S]^{M(e)}(s)$:

(24) (∃e)(<e, [*John*]> ∈ [*believe*]* & (∀s)(s ∈ S(e) --> [*that some woman left*]$^{(e, s)}$ = 1))

Each situation $s \in S(e)$ in a model M(e) determines a partial model <D, I+(s), I-(s)> in the sense of
(18a) with the truth definition given in (18b).

    Given the account of belief reports in (24) and the truth definition in (18b), the unwanted
inferences of Conjunction with Arbitrary Logical Truths and Addition of Arbitrary Disjuncts are
now invalid. The inference (22a) is blocked if *the president of the United States arrived or did not
arrive* does not have a truth value in John's thought model (that is, either if *the president of the
United States* does not have a referent in John's thought model or it is not in the positive or negative
extension of *arrive*). The inference in (22b) is blocked just in case *the president of the United States
arrived* is undefined in some situation in the content of John's thought, since given (18), a
disjunction is true in a situation s just in case neither disjunct is #, and at least one disjunct is true.[16]
Note that in the same way, the invalid inference of Disjunction Distribution in (6), Section 2.1., is
blocked.

  One remaining task is to develop a compositional semantics of clauses as denoting event-situation
functions. In this paper, I will not do this for the subsentential level (though it is a not very difficult
technical task); rather I restrict myself to showing how clausal complementation can be interpreted
compositionally.

    For the purpose of a compositional treatment, it is best to conceive of the denotation of
expressions directly as functions from intentional states or acts to functions from situations to
'extensions' (individuals or relations among individuals in those situations). In the case of n-place
predicates, such 'extensions' will consist in pairs of positive and negative extensions. Thus, *leave* will
denote a function mapping an intentional state or act e and a situation s to a pair consisting of a set of
pairs of events e' of leaving and agents x' who leave ([*leave*]$^{+(e, s)}$(e', x')) and a set of pairs <e'', x''>

such that x is not a leaving by x ($[leave]$-(e, s)(e'', x'')). In the subsequent sections, I will generally simplify semantic representations by disregarding negative extensions when no negation is involved or by omitting event and situation argument places when they are not crucial.

Turning to attitude verbs, *believe* now denotes a function mapping a pair consisting of an intentional state or act e and a situation s to a three-place relation. This relation holds between a belief state e, an agent x and an event-situation function F (the 'proposition') just in case the corresponding two-place belief-relation holds between e and x, and F maps the belief state e and every situation s in the partial model of e to 1.[17] This condition on the belief relation is an instance of the following more general condition on verbs of acceptance:

(25) *Lexical Condition on Verbs of Acceptance*

For a (three-place) verb of acceptance V, an event e, an entity x, and an event-situation function F,

$<e, x, F> \in [V]$ iff $<e, x> \in [V]^*$ and for every $s \in S(e)$, $F(e, s) = 1$.

As we will see later, other kinds of propositional attitude verb involve different lexical conditions on how the event-situation function (which a clausal complement stands for) is related to the mental state or act argument.

By the Uniformity Condition, the denotation of any embedded clause is a function from events to a function from situations to truth values. There are many contexts, however, in which embedded clauses do not seem to involve an intentional state or act, as in the following examples:

(26) a. That John is at home means that Mary is not at home.
     b. That John is sick is true.
     c. That x is prime implies that x is a number.
     d. That x is prime contradicts the fact that x is even.

Such constructions pose a challenge to the event-based account of clauses, for one may not want to invoke implicit mental state or acts which the embedded clauses in (26) would be about. However, there is a rather simple technical way to account for such cases. In addition to mental states or acts in the domain of discourse, I will assume a null event e*, an event which is part of every mental state or act, but exists in a world or situation s even if there are no mental states or acts in s. Naturally, e* has as its content the empty information state, the set of all possible situations. Thus, a clause denotation applied to e* yields a function from all possible situations to truth values, depending on whether the clause is true, false, or undefined in those situations. The meaning of (26a) then can be formalized as in (27):

(27) λes[[*means*]$^{(e, s)}$](λs'[[*John is at home*]$^{(e*, s')}$], λs'[[*Mary is not at home*]$^{(e*, s')}$]>)]

((27) leaves the factive presupposition for both argument positions of *mean* unaccounted for, though can be subsumed under the general treatment of factivity to be give in Section 5.) It is a merely technical issue to construe a sentence meaning such as (27) compositionally, an issue which would lead away from the present concerns.

The null event e* is useful in another way, namely in order to account for when an independent sentence is true in certain counterfactual possible worlds or situations. Take the sentence S = *two plus two equals four* and suppose w is a possible world in which there are no mental states or acts. Then if the range of the function denoted by S consisted only of concrete mental states or acts, S could not be evaluated in w; but intuitively S is true in w. However, if the range of the function includes e*, which exists in all possible worlds, there will be no problem in evaluating S in w. A related case is that of a possible situation s which has never been considered by anyone. In this case, there will be no actual mental state or act e such that s ∈ S(e). Nonetheless, intuitively, S is true in s. If the domain of the function denoted by S consisted only of actual mental states or acts, S could not be evaluated in S; but if the domain also includes e*, a truth value evaluation is possible.

2.4. Independent sentences

So far we have only looked at embedded sentences, which were construed as predicates predicated of the intentional act or state that was the Davidsonian event argument of the attitude verb. Given the Uniformity Condition, independent sentences should have the same type of meaning; that is, they should denote functions from events to functions from situations to truth values, where the events are intentional states or acts. But which intentional act or state do the denotations of independent sentences apply to?

One answer to this question might be that they should apply to the speaker's belief state. But this cannot be right. For it would make it impossible for a speaker to make an assertion while lying.

For a better answer, one might take the notion of assertion proposed by Grice (1969) and modified by Schiffer (1972). According to their account, a speaker by asserting a sentence S wants the addressee to have an activated belief that S. On this account, a semantic operation very roughly of the following sort will evaluate declarative sentences on the basis of their propositional content, where 'addr(e)' refers to the addressee of e, 'goal(e, x, p)' means 'x's goal of doing e is to bring about that p', and 'act-bel(e, x)' means 'e is an activated belief of x':

(28) For an event-situation function F,

$$\text{assert(F)} = \lambda e[\text{goal}(e \text{ ag}(e), {}^{\wedge}(\exists e')(\text{act-bel}(e', \text{addr}(e)) \& (\forall s)(s \in S(e') \dashrightarrow F(e', s) = 1))]$$

According to (28), if a speaker sincerely asserts *it is raining*, then he or she wants the addressee to have an activated belief state with the content that it is raining. (28) may have its problems; but I will not discuss the adequacy of this account. (28) should only indicate how a treatment of declarative sentences within the event-predicational account may look like.

Expressive illocutionary acts are typically performed by uttering sentences like *the weather is so awful!*, where the speaker's purpose is only to express his own mental state, rather than making the addressee believe a particular proposition. Unlike assertions, sentences uttered with an expressive illocutionary force can be taken as predicates predicated of the speaker's mental state. So here the sentence can be construed simply as being a predicate of the mental state 'behind' the utterance (B(e), for e being the utterance). Thus, we have:

(29) For an event-situation function F,
$$\text{express(F)} = \lambda e[(\forall s)(s \in S(B(e)) \dashrightarrow F(B(e), s) = 1)]$$

According to (29), if a speaker sincerely utters *the weather is so awful*, then he or she is in a mental state with the content that the weather is so awful.

Directives, that is, the illocutionary act type performed by imperatives such a *leave the room!*, involve (like assertions) some desired act on the part of the addressee. This act has to be an event argument of the verb; that is, by uttering *leave the room!,* the speaker wants the addressee to perform an act that is a leaving of the room. Imperative sentences thus are interpreted by the following semantic operation:

(30) For a relation between events and individuals F,
$$\text{dir(F)} = \lambda e[\text{goal}(e, \text{ag}(e), {}^{\wedge}\exists e'(F(e', \text{addr}(e))))]$$

Questions, the illocutionary act type associated with interrogatives, can be construed as a special case of directive, as was suggested by Searle/Vanderveken (1985): with a question, the speaker expresses his or her desire that the addressee perform an assertion that is an answer to the question. For the sake of simplicity, this is formulated in (31) only for yes-no questions:

(31) For an event-situation function F,
$$\text{y-n-quest(F)} = \lambda e[\text{goal}(e, \text{ag}(e), {}^{\wedge}(\exists e'')(<e'', \text{ag}(e)> \in [\textit{believe}]^* \& ((\forall s)(s \in S(e'') \dashrightarrow$$
$$F(e'', s) = 1 \text{ v } (\forall s)(s \in S(e'') \dashrightarrow F(e'', s) = 1))]$$

According to (25), if a speaker utters *did John come?*, he or she wants his or her addressee to make an assertion with the content either that John came or that John did not come. Again, I will not go into the issue of whether this is really an appropriate semantic account of imperatives and interrogatives. The purpose of this section was only to indicate how illocutionary act types could be incoporated into the event-based account, and thus that the event-based account of embedded sentences can, in principle, be carried over to independent sentences.

3. Other types of mental state and act verbs

A central idea in the treatment of other attitude verbs that follows is that acceptance, in particular belief, plays the role of a primitive attitude on the basis of which other kinds of attitudes can, at least in part, be defined. In addition to belief, desire will also play some role. The relevant mental attitude verbs differ from verbs of acceptance to a significant extent just in the way the clausal complement will be evaluated with respect to the alternatives in the belief state (or some other state or act of acceptance). For example, they may involve existential, rather than universal, quantification over doxastic alternatives, and they may involve an evaluation of the clause as false, rather than true, in all or some of the alternatives in the associated content.

A general remark of caution has to be made at the outset of this section. The analyses of the verbs that I will give mainly serve just to account for their inferential behavior. They should be understood as approximations only. They may be very much simplified and incomplete. However, whatever conditions may be lacking in those analyses, they should not interfere with the other conditions responsible for the inferences that are to be accounted for. The enterprise of reducing natural language concepts to primitives may itself be considered questionable (since there are almost always counterexamples to particular analyses). But it should be emphasized that the motivation of the following derives from the premise that the inferenial behavior of verbs constitutes semantically relevant data which a semantic theory has to account for - it seems to govern purely linguistic phenomena such as the distribution of negative polarity items.

I will distinguish three major types of mental attitude verbs besides verbs of acceptance: negative verbs such as *doubt*, emotive verbs such as *want*, *be glad* and *hope*, and verbs of consideration such as *wonder*. I will also discuss complex mental state verbs like *be surprised*, and *remember*, which describe attitudes that are composed of simple subattitudes in one way or another.

3.1. Negative verbs

There are few 'simple' negative mental state or act verbs in English, that is, negative mental state or act verbs which involve not more than one attitude. By contrast, there seem to be many 'complex

attitude verbs' which involve negative subattitudes, as will be discussed later (cf. Section 3.4.). One 'simple' negative verb describing a mental state or act is *doubt*:

(32) John doubts that Mary left.

There are a number of proposals concerning the meaning of *doubt* that have been given implicitly or explicitly in the literature. Muskens (1989) takes *doubt that* P to mean 'believe that not P is possible'. Barwise and Perry (1982) take *doubt that* P to be ambiguous between 'not believe that P' and 'believe that not P'. On Asher's (1987) view, *doubt that* P describes an implicit belief that not P.

To doubt that P seems to be stronger than to lack a belief that P and to think its negation to be possible; *doubt* involves some ground or reason for holding the negation to actually be true. However, this reason may be too weak to lead to a belief in the negation in the strong sense. 'Doubt that P', perhaps, can best be paraphrased as 'weakly believe that not P', whereby a strong belief that P should imply a weak belief that P (for I also doubt something if I am convinced it is not true).

The formal analysis of *doubt* below does not take this paraphrase literally and, in some way, insert a negation symbol in the complement clause; rather, it gives a direct formulation of the relevant lexical condition on *doubt*:

(33) <u>Lexical condition on *doubt*</u>
    For an event e, an entity x, and an event-situation function F,
    <e, x, F> $\in$ [*doubt*] iff <e, x> $\in$ [(*weakly*) *believe*]* and for every s $\in$ S(e), F$^{(e, s)}$ = 0.

Doubt behaves differently from *believe* with respect to certain inference types. Unlike *believe*, it does not support Conjunction Distribution:

(34) # <u>John doubts that Mary arrived and Bill left.</u>
    John doubts that Mary arrived and John doubts that Bill left.

Suppose the premise of (34) is true. Then in a weak state of belief e on the part of John *Mary arrived and Bill left* is false. But this may be the case if only *Mary arrived* is false, but *Bill left* is true. Thus, for the same state e, it will not hold that [*doubt*](e, [*John*], [*that Bill left*]).

Furthermore, *doubt*, unlike *believe*, does support Disjunction Distribution:

(35) <u>John doubts that Mary arrived or Bill left.</u>
    John doubts that Mary arrived, or John doubts that Bill left.

This can be seen from the validity of the following two inferences, the second of which is trivial:

(36) a. John doubts that Mary arrived or Bill left.
        John doubts that Mary arrived, and John doubts that Bill left
    b. John doubts that Mary arrived, and John doubts that Bill left.
        John doubts that Mary arrived, or John doubts that Bill left.

That (36a) is valid can be seen as follows: suppose the premise in (36a) is true; then for the weak state of belief e of John, *that Mary arrived or Bill* left is false in M(e). But this means that both *that Mary arrived* is false in M(e) and *that Bill left* is false in M(e). Hence we have both [*doubt*](e, John, [*that Mary arrived*]) and [*doubt*](e, John, [*that Bill left*]).

   It also follows that *doubt* is downward entailing, but not upward entailing, unlike *believe*:

(37) John doubts that Mary is French or German.
    John doubts that Mary is French.
(38) # John doubts that Mary arrived.
        John doubts that anybody arrived.

   A different kind of negative mental state predicate is *be unaware*. Here the third value 'undefined' comes into play. *Be unaware that* P roughly means that P is undefined in every alternative that belongs to the content of the agent's belief state. There may, as usual, be additional conditions involved in the lexical meaning of *be unaware*; which will not be relevant to account for the inferential behavior of the verb. Very approximately, we have:

(39) Lexical condition on *be unaware*
    For an event e, an entity x, and an event-situation function F,
    $<e, x, F> \in$ [*be unaware*] iff $<e, x> \in$ [*believe*]* and for every $s \in S(e)$, F(e, s) = #.

   In this section, we have seen how negative verbs can be treated within the present approach to attitude reports by a change in the kind of truth value to be assigned to the complement clause in the situations that form the alternatives of some belief state. Moreover, we have seen that for negative mental state or act verbs verbs, we can actually take belief states as the event arguments, and thus reduce the attitudes expressed by the negative verbs to belief. As we will see below, there are other propositional attitudes that can, at least in part, be reduced to belief.

3.2. Intensional verbs taking interrogative complements

An interesting group of mental state verbs, which have not received much attention in the semantic literature, are verbs like *wonder, ask oneself*, *consider*, or *be interested in*. These verbs take 'intensional' interrogative complements:

(40) a. John wondered whether Mary arrived.

    b. John wondered who arrived.

(40a) neither implies that John believes that Mary left nor that he believes that Mary did not leave; rather, it implies that he, in some way, takes both possibilities under consideration. Similarly, (40b) implies that for every relevant person x, John believes neither that x left nor that x did not leave, but that he takes both possibilities regarding x under consideration (cf. Groenendijk/Stokhof 1982).

    Now given that the content of a belief state corresponds to a set of alternative situations (each one of which the agent takes to be a way (the relevant part of) reality could be), there is a straighforward way of formulating the relevant lexical conditions on *wonder*. Again, I take the event argument of *wonder* to be a belief state. *Wonder* then requires that the complement clause be evaluated with respect to such a belief state as follows: the complement clause must be assigned 'true' in some alternative of e and 'false' in some other alternative of e. Thus, both a positive evaluation and a negative evaluation of the complement clause are under consideration according to what the agent believes. (Again, this may be only a partial characterization of the meaning of *wonder*.)

    Note that here the use of partial logic is crucial. If a belief state were identified with a set of possible worlds, rather than a set of (partial) situations, such an analysis would give the wrong result. For then it would always hold that an agent wonders whether P, for any proposition P that the agent fails to believe and that is not a logical truth or falsehood. Such a proposition will be true in some, but not every, world compatible with what the agent believes, and, because possible worlds are complete, it will also be false in some such world. Thus, with possible worlds, the distinction between entertaining P and failing to entertain P cannot be drawn. But if a belief state is identified with a set of situations, then every such situation will carry only information the agent considers to be possibly true and no information that the agent does not consider at all.

    In order to formalize this account, I will restrict myself to *whether*-interrogative complements. I will take the denotation of a *whether*-clause to be identical to that of the corresponding *that*-clause. Thus, *whether Mary arrived* will denote the same event-situation function as *that Mary arrived*. Then for *wonder* when taking a *whether*-complement, we get approximately the following analysis:[18]

(41) <u>Lexical condition on *wonder*</u>

For an event e, an entity x, and an event-situation function F,

<e, x, F> ∈ [*wonder*] iff <e, x> [*believe*]* and for some s ∈ S(e), F(e, s) = 1, and some

s' ∈ S(e), F(e, s') = 0.

(41) also explains the particular inferential behavior that *wonder* exhibits. As was pointed out to me by David Kaplan, *wonder* is neither upward entailing, as seen in (42a), nor downward entailing, as seen in (42b) (where John knows that (and hence cannot wonder whether) Mary does not own a wood house). Moreover, *wonder* disallows Conjunction Distribution, as seen in (42c):

(42) a. # John wondered whether Mary owns a wood house.
　　　　　 John wondered whether Mary owns a house.
　　 b. # John wondered whether Mary owns a house.
　　　　　 John wondered whether Mary owns a wood house.
　　 c. # John wondered whether Mary was invited to the party and John was invited, too.
　　　　　 John wondered whether Mary was invited to the party, and he wondered whether
　　　　　 Bill was invited too.

Suppose that the premise of (42a) is true, that is, for John's belief state e and some situation s S(e), *Mary owns a wood house* is true in s, and for some situation s' S(e), *Mary owns a wood house* is false in s'. But this only means that *Mary owns a house* is true in s; nothing guarantees that *Mary owns a house* is false in any of the situations in S(e), and if this is not the case, the conclusion will be false. Suppose that the premise of (42b) is true; then for John's belief state e and some situation s S(e), *Mary owns a house* is true in s, and for some situation s' S(e), *Mary owns a house* is false in s'. In s', *Mary owns a wood house* will also be false (if not undefined). But this may also be the case for every other situation, in particular s; and in that case, the conclusion will be false. For the failure of Conjunction Distribution in (42c), suppose *Mary was invited to the party and John was invited* is true in a situation s S(e) and false in a situation s' S(e), and suppose *Mary was invited to the party* is false in s'. Then it may still be that *John was invited* is true in every situation in S(e), in which case the conclusion does not hold.

Not all verbs that take interrogative complements can be treated like *wonder*. Among those that have to be treated differently are speech act verbs such as *ask* and factive mental state verbs such as *know*. I will come to speechact verbs in Section 4.1. and to factive mental state verbs in Section 5.1.

3.3. Emotive verbs

Under emotive verbs, I subsume any verb that implies an emotional relation of the agent toward the

proposition. Emotive verbs make up a large class of verbs. They include purely emotive verbs such as *be happy*, *hate*, *want*, and *wish* as well as cognitive emotive ones such as *hope* and *fear*.

  Emotive verbs differ in their inferential behavior from verbs of acceptance in two respects. First, they are not upward entailing:

(43) a. # <u>John is glad that a student who took his class passed.</u>
   John is glad that a student passed.
  b. # <u>John wants Mary to die without pain.</u>
   John wants Mary to die.

Second, they do not allow for Conjunction Distribution:

(44) a. # <u>John hates that the sun is shining and he does not have the day off.</u>
   John hates that the sun is shining, and he hates that he does not have the day off.
  b. # <u>John wants to work till four and have the rest of the day off.</u>
   John wants to work till four, and he wants to have the rest of the day off.

Otherwise, emotive verbs pattern with verbs of acceptance by allowing for Conjunction Introduction (provided, of course, the premises involve the same mental state).

  A way of explaining the inferential behavior of emotive verbs comes from a recent proposal concerning their semantic structure first made for *want* by Stalnaker (1984) and generalized to verbs like *be glad* and *wish* by Heim (1993) (see also Asher 1987). According to this proposal, emotive verbs involve a comparison, roughly speaking, between the proposition and its negation. In Stalnaker's terms (1984: 86) 'wanting something is preferring it to certain alternatives, the relevant alternatives being those possibilities that the agent believes will be realized if he does not get what he wants.' According to this suggestion, *want* involves an indicative conditional: the belief state which *want* applies to does not specify that the complement clause holds or does not hold according to what the agent believes, rather *want* P means that any alternative in the content of the belief state in which P holds is preferred by the agent to one in which P is false.

  The account of *want* that I have sketched applies best to cases in which the content of the desire concerns the past or the present, as in (45):

(45) a. John wants Mary to have won the race.
  b. John wants Mary to be asleep (at this moment).

(45a) implies that John does not know whether Mary won the race or not, and (45b) implies that

John does not know whether Mary is asleep or not.

This implication of a lack of a definite belief concerning the truth of the content of desire seems to be absent, though, when the content relates to the *future*. Thus (46a) and (46b) can naturally be true at the same time:

(46) a. John wants Mary to win the race tomorrow.

b. John believes that Mary will win the race tomorrow.

I take the behavior of desire reports with future propositional content to be special case having to do with the particular semantics of future tense and hence can be neglected. (Presumably, the fact plays a role that English future is not really a tense, but rather acts as a modal, quantifying perhaps over several situations in a branching future.)

For analysing *want* with past and present propositional content, we can make good use of three-valued logic. One of its lexical conditions simply is that the complement clause be evaluated as undefined in every situation in the content of the belief state. Formally, this yields the following approximate condition on *want*, where $<_x$ is the relation 'being preferred by x to':

(47) <u>Lexical analysis on *want*</u>

For an event e, an entity x, and an event-situation function F,

$<e, x, F> \in$ [*want*](e, x, F) iff $<e, x> \in$ [*believe*](e, x), for some $s \in S(e)$, F(e, s) = #, and for every minimal extension s' of s such that F(e, s') = 1 and every minimal extension of s'' of s such that F(e, s'') = 0, s' $<_x$ s''.

Perhaps (47) captures only a consequence of the meaning of *want* when applied to a rational agent; but is suffices to explain the semantically relevant properties of *want*.

At first sight, it might seem as if (47) reduces desire to belief, a rather doubtful result. But this is not the case. Even though (47) makes explicit use only of an event that is a belief state, it also involves a relation of subjective preference $<_x$. This relation clearly involves the propositional attitude of desire and is not reducible to belief.

Heim (1992) suggests that the same analysis can be carried over to *be glad* and *wish*, as in (48a) and (48b):

(48) a. John is glad that Mary had won the race.

b. John wishes that Mary had won the rance.

The difference to *want* consists only in the evaluation of the complement clause in the belief

alternative. *Be glad* carries the presupposition that the complement clause be true in every alternative. The preference relation then holds between any alternative and a minimal revision of that alternative in which the complement is false (cf. Heim 1992):

(49) Lexical condition on *be glad*

For an event e, an entity x, and an event-situation function F,

<e, x, F> [*be glad*] iff <e, x> $\in$ [*believe*]*, for every s $\in$ S(e), F(e, s) = 1, and for every s' maximally similar to s such that F(e, s') = 0, s <$_x$ s'.

The complement clause of *wish* is counterfactual. That is, *wish* presupposes that the complement is false in every situation in the content of the belief state (cf. Heim 1992). This is captured by the following approximative analysis:

(50) Lexical condition on *wish*

For an event e, an entity x, and an event-situation function F,

<e, x, F> $\in$ [*wish*] iff <e, x> $\in$ [*believe*]*, for every s $\in$ S(e), F(e, s) = 0, and for every s' maximally similar to s such that F(e, s') = 1, s' <$_x$ s.

It is easy to see that these analyses of emotive verbs imply the failure of Upward Entailment. Moreover, they imply the failure of Conjunction Distribution. This basically follows from the fact that emotive verbs involve a negative evaluation of the complement clause. To see this for *want*, take a belief state e for which the following holds for an event-situation F: for any situation s, s $\in$ S(e), for all minimal extensions s' and s'' of s, (F & F')(e, s') = 1 and (F & F')(e, s'') = 0, and s' <$_x$ s'', and for all s,s' $\in$ S(e), F(e, s') = 1 and F(e, s'') = 0, then s''<$_x$ s'. e has a coherent model; but [*want*](e, x, F & F') holds and [*want*](e, x, F) does not hold.

There is a nice piece of empirical evidence for this treatment of emotive verbs (despite, perhaps, its lack of intuitive appeal). Both negative and emotive verbs involve, in some way or other, the assignment of the truth value 'false' to the complement clause: negative verbs involve a negative evaluation of the complement clause in all doxastic alternatives, whereas emotive verbs involve a negative evaluation of the complement clause with respect to a hypothetical situation which is compared to a situation verifying the complement clause. Now it is revealing that negative and emotive verbs are sometimes treated on a par, for example in the distribution of subjunctive in Spanish and some other Romance languages (cf. Kempchinsky 1986). Subjunctive in Spanish is licenced precisely with the classes of negative and emotive verbs:

(51) a. Juan niega / duda que Maria hable español.

'John denies / doubts that Mary speaks (subj.) Spanish.'

   b. Juan quiere / es feliz / espera que Maria hable español.

     'Juan wants ' is happy / hopes that Mary speaks (subj.) Spanish.'

   c. Juan cree / dice / sabe que Maria habla español.

     'Juan believes / says / knows that Mary speaks (ind.) Spanish.'

Thus, Spanish subjunctive appears to be required in an embedded clause just in case the embedding verb (in virtue of its lexical meaning) implies a negative evaluation of the clause. Thus, we have the following condition:

(52) <u>Condition on Spanish subjunctive</u>

   A verb V licences subjunctive in its complement iff for any e, x, F, $<e, x, F> \in [V]$ implies:

   for some situation $s \in S(e)$, $F(s) = 0$.

   Let me conclude with a general remark concerning the nature of the treatment of mental state or act verbs given in the last two sections. For the verbs under consideration, the event argument was always taken to be a belief state (though there could be differences as to whether it was a weak or a strong belief). The differences between verbs were traced only to differences in the conditions on the evaluation of the propositional complement relative to that belief state. Thus, for the attitudes considered, belief played the role of a primitive attitude, to which other attitudes could, at least in part, be reduced (with desire occasionally coming into play as well). However, this does not mean that belief and desire are taken to be the only primitive attitudes. I have not discussed verbs of intention, for example, and it is questionable whether intention is reducible to belief and desire (cf. Brand 1984).

3.4. Complex attitude verbs

So far, we have considered attitude verbs that involved a single intentional state or act that was characterized by the complement clause. Many attitude verbs, however, involve more than one intentional state or act. For example, *remember that* P involves a prior belief state that P as well as a current thought that P. *Be surprised that* P, as suggested by Asher (1987), involves a prior expectation that not P as well as a current realization that P. I will call an attitude verb which involves two or more intentional states or acts a '*complex attitude verb*'. In this section, I will discuss some of the ways in which complex attitude verbs can be analysed into several distinct subattitudes. I will not develop new analyses of complex attitude verbs, but rather show how particular proposals that have been made in the literature can be developed within the present terms. An important result

will be that the different subattitudes of a complex attitude verb may be responsible for different sets of semantic properties.

   Given Asher's (1987) proposal for *be surprised*, *be surprised* can approximatively be analysed as follows, where $<_t$ is the relation of temporal precedence:[19, 20]

(53) Lexical analysis of *be surprised*

   For an event e, an entity x, and an event-situation function F,

   $<$e, x, F$>\in$ [*be surprised*] iff $<$e, x$>\in$ [*believe*]*, for every s $\in$ S(e), F(e, s) = 1, and

   there is an event e', e' $<_t$ e, such that $<$e', x$>\in$ [*expect*] and for every s' $\in$ S(e'), F(e', s') = 0.

   As we will see, this analysis can account for the inferential behavior of *be surprised*. *Be surprised* is neither upward nor downward entailing, which is shown in (54) and (55), nor does it licence Conjunction or Disjunction Distribution, which is shown in (56) and (57):

(54) a. # John is surprised that Mary failed.
         John is surprised that Mary failed or was absent.
    b. # John is surprised that a good student failed.
         John is surprised that a student failed.
(55) a. # John is surprised that Mary failed or was absent.
         John is surprised that Mary failed.
    b. # John is surprised that a student failed.
         John is surprised that a French student failed.
(56) # John is surprised that Mary is at the party and her husband is not there.
     John is surprised that Mary is at the party, and he is surprised that her husband is
      not there.
(57) # John is surprised that Mary arrived or Bill arrived.
     John is surprised that Mary arrived, or he is surprised that Bill arrived.

The inferences in (55) are invalid beacause the complement clause in the premise may be true, but the complement clause in the conclusion false.

   This inferential behavior shows that *be surprised* patterns both with negative verbs (failure of Upward Entailment and of Conjunction Distribution) and with verbs of acceptance (failure of Downward Entailment and failure of Disjunction Distribution). This double behavior can be explained by the presence of the two subattitudes in the analysis of *be surprised*. Failure of Upward Entailment and Conjunction Distribution is due to the subattitude of negative prior expectation (evaluation of the complement clause as false in all alternative situations of the prior expectation);

failure of Downward Entailment and Disjunction Distribution is due to the subattitude of current realization (evaluation of the complement clause as true in all alternatives of the current state or act of acceptance).

A similar account applies to *be disappointed*. *Be disappoined that* P might approximately be analysed into a previous desire that Q, where Q is perceived as being incompatible with P, and a realization that P. As one can easily check, *be disappointed* exhibits the failure of the same inference as *want* on the one hand (failure of Conjunction Distribution and Upward Entailment) and of *believe* on the other hand (failure of Disjunction Distribution). This is expected if the analysis suggested above is correct.

Thus, the presence of more than one subattitude can explains why complex attitude verbs like *be surprised* and *be disappointed* exhibit a different inference pattern than other, simple attitude verbs.

The analysis of a complex attitude verb into subattitudes raises a general issue that should briefly be addressed, namely what is the status of the subattitudes in the overall meaning of the attitude verb? There are several ways in which a subattitude may figure in the meaning of a complex attitude verb. One way is that the subattitudes together provide a complex event argument (the mereological sum of the individual subattitudes). Alternatively, only one subattitude might provide the event argument, whereas the other subattitudes will only constitute a lexical implication. For example, in (46), the subattitude of prior expectation does not provide (part of) the event argument of *be surprised*; rather a lexical condition associated with *be surprised* requires the presence of this subattitude. The event argument (to which event predicates could have access in the sentence meaning) consists only of the subattitude of current realization.

The motivation for treating an attitude verb in this way, rather than taking the complex attitude to be the mereological sum of the subattitudes, comes from adverbial modification and tense. Adverbs and tense can modify only the intentional state or act that occupies the event argument position, not subattitudes whose presence is due only to a lexical implication. Tense and adverbial modifiers of *be surprised* affect only the current realization, not the prior negative expectation. Thus, future tense in (58a) modifies the attitude of realization, rather than the preceding negative expectation, and so *for a long time* in (58b); and, to take another example, in the case of *remember*, tense and adverbs affect only the current thought, not the prior belief, which is seen in (58c) and (58d):

(58) a. John will be surprised that Mary arrived.

    b. John for a long time was surprised that Mary left.

    c. John will remember that Mary left.

    d. John just remembered that Mary left.

Thus, *remember* should be analysed analogously to *be surprised*. One subattitude of a prior

(activated) belief constitutes a lexical implication; the other subattitude of a current activated belief provides the event argument of the verb (which means that it is the subattitude to which other event modifiers can have access in the sentence meaning).

There are also verbs where the subattitudes arguably form a complex event argument. For them, a treatment in terms of mereological sum formation would be adequate. Among such verbs are *convince* and *persuade*:

(59) a. John quickly convinced Mary that she should leave.
　　 b. John easily persuaded Mary that she should leave.

In at least one reading of (59a), *quickly* modifies the complex event consisting of John's attempts of persuasion together with Mary's aquisition of a new belief. (59b) has a reading in which *easily* characterizes the complex event of John's talking to Mary and Mary's adopting a new belief.

Thus, the lexical analysis of *convince* will roughly take the following form, where v is the operation of mereological sum formation:

(60) <u>Lexical condition on *convince*</u>
　　　For an event e, entities x and y, and an event-situation function F,
　　　$<e, x, y, F> \in [convince]$ iff there are events e' and e'' such that e = e' v e'', $<e', e''> \in$ [*cause*], $<e', x, y, F> \in$ [*talk to... about*], and $<e', y> \in$ [*believe*]* such for every $s \in S(e)$, $F(e'', s) = 1$.

Another parameter that plays a role in the analysis of complex attitude verbs is the distinction between asserted and presupposed subattitudes. The lexical meaning of a verb generally makes a choice as to whether a subattitude is asserted or presupposed. Those subattitudes that are asserted can be 'affected' by negation; those that are presupposed won't. In the case of *remember*, the prior belief is a presupposed subattitude, whereas the subattitude of current activated belief is part of what is asserted:

(61) John did not remember that Mary smoked.

Clearly, for a lexically presupposed subattitude, a treatment of the subattitude as a lexical implication as in (53) would be inadequate. A formal account of lexical presuppositions for attitude reports is not a trivial matter, but it is beyond the scope of this paper.

Clearly, if two subattitudes form a complex event argument, neither one can be presupposed. Therefore, negation can affect either subattitude in the case of *convince* and *persuade*:

(62) John did not convince / persuade Mary to leave.

(62) with *convince* can be true either if John did not try to convince Mary, or if he tried, but did not succeed, to make Mary believe that she should leave.

    Complex attitude verbs are numerous and present many challenges for lexical semantics. In this section, I have only touched upon some of the issues they raise.

4. Verbs of saying and expression

4.1. Speechact verbs

In Section 2.4., we have seen how the meaning of independent sentences can be treated as being dependent on an intentional state or act. Related to this issue is the semantics of speech act verbs, verbs which describe acts that can be performed by an utterance of an independent sentence. If the analysis of independent sentences along the lines of Section 2.4. is correct, then it seems natural to carry it over to speech act verbs. For the verb *assert,* we get the following complex condition as part of its lexical meaning:

(63) Lexical condition on *assert*
    For an event e, an entity x and an event-situation function F,
    <e, x, F> $\in$ [*assert*](e, x, F) iff x's goal with uttering e is: there is an e' such that
    <e', x> $\in$ [*believe*]* and for every s $\in$ S(e'), F$^{(e', s)}$ = 1.

    For the verb *ask*, which takes interrogative complements, we get (64) as an approximate analysis, which, like the lexical analysis of *wonder* (i.e., *ask oneself*) in Section 3.6., involves both a condition on the assignment of 'true' and the assignment of 'false' to the sentence in some belief alternative.

(64) Lexical condition on *ask*
    For an event e, an entity x and an event-situation function F,
    <e, x, F> $\in$ [*ask*] iff x's goal of uttering e: there is an e' such that <e', x, F> $\in$ [*assert*] or
    <e', x, ($\neg$ F)> $\in$ [*assert*].

    However, analyses of verbs of saying will not be sufficient yet. Verbs of saying have certain properties that distinguish them from mental state or act verbs, and these are not captured by conditions like (63) and (64). The properties in question are [1] the absence of a *de re* reading and

[2] the failure of, basically, any inferences.

Let me first point out two distinct senses of 'verb of saying'. Many speech act verbs have implicit and explicit uses. For example, (65a) may be understood in an explicit way in which the complements clauses resembles closely John's actual utterance, rather than reporting something that John's actual utterance may have only implied. By contrast, *say* in (65b) (because of simple present tense) can only be understood as implicit saying, as a disposition to convey a particular content:

(65) a. John said (literally) that Mary left.
    b. John says that Mary is a professor.

Verbs of explicit saying exhibit a property that distinguishes them from all mental state or act verbs as well as from verbs of implicit saying, namely they disallow most types of inferences - even to very obvious logical consequences. For example, the following inferences are invalid - provided that the verb in question is in fact understood as reporting explicit saying:

(66) a. # <u>John said that a tall woman left.</u>
      John said that a woman left.
   b. # <u>John said that Mary left the room.</u>
      John said that Mary moved.

The only inference types that seem to go through with verbs of explicit saying are Conjunction Introduction and Distribution, given appropriate circumstances:

(67) a. <u>John said that Mary arrived, and he said that Bill left.</u>
      John said that Mary arrived and Bill left.
   b. <u>John said that Mary arrived and Bill left.</u>
      John said that Mary arrived, and he said that Bill left.

The inference (67a) is possible just in case John's utterance that Mary arrived and his utterance that Bill left form a single complex utterance. The inference (67b) is allowed, since any utterance of the form 'Mary arrived and Bill left' consists of two subutterances of the form 'Mary arrived' and 'Bill left'.

The failure of inferences with verbs of saying is most obvious with verbs that describe a particular manner of speaking, for instance *whisper, shout, laugh, mumble*, or *mutter*:

(68) a. # <u>John laughed / shouted / whispered that John met a dangerous man.</u>

John laughed / shouted / whispered that John met somebody.

   b. # <u>John laughed / shouted / whispered that Mary left the room.</u>

John laughed / shouted / whispered that Mary moved.

The absense of any inferences from attitude reports with verbs of explicit saying may be related to another property of such verbs: verbs of explicit saying disallow a *de re*-reading of an NP in the complement clause. There seems to be no way in which *his father* in (69a) could have a *de re* reading yielding a noncontradictory content as in (69b); and similarly, (69c) seems strange when John's utterance actually was (69d) (see the criterion for and the treatment of *de re*-readings in the Appendix, Section 2):

(69) a. John (literally) said / laughed / shouted / whispered that his father was not his father.

   b. About his father, John laughed / shouted / whispered that he was not his father.

   c. John (literally) said / laughed / shouted / whispered that some woman stole his wallet.

   d. Mary stole my wallet.

I want to propose a common reason for why attitude reports with verbs of explicit saying resist any inferences to obvious consequences and disallow *de re* readings of NPs. The reason is that clausal complements of verbs of explicit saying function semantically in two ways. On the one hand, they provide a propositional content that characterizes the content of some state or act described by the verb; on the other hand, they provide the form which the reported utterance must have taken. Clearly, the described agent's utterance cannot be precisely of the form of the *that* clause. Clausal complements of verbs of explicit saying differ from direct direct quotation in that they allow for more differences, for example differences in the choice of pronouns. But there are limits to that, and that is because the *that*-clause should resemble as much as possible the utterance described. This condition also explains the absense of a *de re* reading. For an NP in a *de re* reading provides an expression that does not maximally resemble the expression the agent actually used.

One might now think that perhaps clausal complements of verbs of explicit saying only provide a form and no propositional content. But this is wrong. Verbs of explicit saying may impose conditions on the content of the complement clause and more importantly, they generally imply a particular illocutionary force. For example, *say, whisper*, and *shout* only describe assertions, not, for instance, questions, since they cannot take interrogative complements:

(70) # John said / laughed / shouted / whispered where Mary had been.

Moreover, verbs of explicit saying may convey a particular attitude toward the content of what is

uttered, for instance in the case of *laugh*. This means that the complement clause also has to provide an argument for the assertion relation, that is, a proposition.

For verbs of explicit saying the *that*-clause thus must provide two sorts of arguments: one being the clause as a form, the other one the content of the clause as an event-situation function. The first, sentential argument enters a certain relation to the verbal event argument which I will call 'REPHR'. For an event e and a sentence S, 'REPHR(e, S)' means that e is an utterance of a sentence maximally resembling S. The notion of maximal resemblence should tolerate differences between the clausal complement S and the actually utterance e. For example, S may be in a different language than the utterance e, S, being in subordinate position, may differ syntactically from the actually uttered sentence, and S may differ in grammatical features of pronouns (person) and tense from the sentence uttered with e. I will not try to give a precise account of the REPHR relation; perhaps it is most adequate to leave it as an inherently vague notion. The second, propositional argument provided by a clausal complement of a verb of explicit saying enters whatever speechact relation is associated with the meaning of the verb.

For *say*, for example, we get the following condition, where [*assert*] is the relation characterized in (71):

(71) Lexical condition on (explicit)*say*

For an event e, an entity x, a sentence S, and an event-situation function F,
$<e, x, <S, F>> \in$ [*say*] iff REPHR(e, S) and $<e, x, F> \in$ [*assert*].

Manner-of-speaking verbs exhibit another property which may be derived from the fact that the clause has to specify the form of the utterance. Unlike most other attitude verbs, they disallow extraction of wh-phrases from their complement clause (they are 'nonbridge verbs') (cf. Erteshik-Shir 1977, Stowell 1982):

(72) #? Who did you shout / whisper / laugh that Mary likes e?

It is tempting to relate the unacceptability of (72) to the absence of a *de re* reading, that is, derive it from the condition of maximal formal resemblance. Then the extraction from the complement of a manner of speaking verb is disallowed because the relation REPHR can hold only between an utterance and a complete sentence; it cannot hold between an utterance e and a sentence of the form *Mary likes* e. (For a sentence with a gap for a wh-phrase cannot maximally resemble an utterance whose content is the argument of the assertion-relation.)[21]

This treatment of verbs of explicit saying raises the question of what exactly is responsible for the presence of the rephrasal condition in the meaning of an attitude verb. Is it simply that verbs of

explicit saying describe events (utterances) that, like the complement, have a form and a meaning, or is it the linguistic nature of the utterance event (namely, that it can be the utterance of the complement)? To answer this question, one has to see whether attitude verbs that describe occurrent mental acts are subject to a similar condition (as opposed to attitude verbs that describe, let us say, dispositions)? It appears that such attitude verbs, e.g., *think*, do not behave like verbs of explicit saying: they allow for *de re* reference and for inferences to obvious consequences:

(73) a. John thought that his father was not his father.

    b. <u>John thought that Mary arrived.</u>
       John thought that somebody arrived.

However, there are some mental act verbs that show similarities to verbs of explicit saying, namely verbs like *deduce* and *prove*. These are verbs which describe a relation between an agent and a syntactic object, rather than a proposition, and hence may be sensitive to the form of the complement clause, not just its content. Such sensitivity in fact has been claimed to obtain (cf. Cresswell 1985, Richard 1990). As Cresswell and Richard note, the order of the conjuncts seems to matter in examples such as (74a) and (74b):

(74) a. John proved that A and B, as well as that B and A.

    b. From 'B and A' John deduced that A and B.

This indicates that *prove* and *deduce* may involve a condition similarly to REPHR, relating the form of the clause to the described mental act.

    With verbs of explicit saying (and perhaps verbs like *prove* and *deduce*), we have seen that clauses may characterize the Davidsonian event argument in yet another way, namely by specifying the form, not the content, of the described event. Thus, verbs of explicit saying present a case in which the event-predicational format for the evaluation of complement clause had to be exploited in two distinct ways. Here the complement clause specifies both the content of the intentional act and the form the intentional act displays.

    On this treatment of complements of verbs of explicit saying, use was made of a maximally fine-grained notion of proposition. Thus, the treatment fares with semantic accounts of attitude reports according which both the form and the content of the clause matters for determining the object of an attitude (cf. Richard 1990, Larson/Ludlow 1993 among others). However, it appears that such a maximally fine-grained notion of proposition is needed only for a limited class of attitude verbs, and to adopt such a treatment for all attitude verbs would blur the semantic differences among attitude verbs that we have seen.

5. Factivity

5.1. A new treatment of factivity

Attitude reports with factive verbs such as (75) seem to present a challenge to the event-based account of clausal complementation:

(75) John knows that Sue left.

Factive verbs presuppose the truth of their complement clause (Kiparsky/Kiparsky 1971). Thus, they appear to require reference to the actual world in addition to characterizing the content of some intentional state or act of an agent.

On one view of the truth presupposition with factive verbs, factive verbs presuppose the truth of the complement in the world in which the sentence has been uttered (cf. Barwise/Perry 1982). We will see, however, that such a view is not adequate. Moreover, we will see that the proper linguistic characterization of the (appropriately generalized) category of factive verbs appears to involve not the notion of truth, but rather reference to some other intentional state, a phenomenon which fit well in the event-based account of clauses. This, then will lead us to new and more adequate event-based account of factive verbs.

Concerning the factive presupposition, it appears that the presupposition of factive verbs is not a presupposition of the truth of the complement clause with respect to the actual world (in which the sentence is uttered), but rather a presupposition of the truth of the complement clause in the belief model of some agent (who, in the case of simple attitude reports, simply is the speaker). This can be seen from deeper embedded occurrences of factive verbs in an appropriate discourse context, for example in:

(76) John believes that Mary thought that Sue left and he believes that she knows that
      Sue left.

In (76), the presupposition of *know* does not consist in a committment to the truth of *Sue left* on the part of the speaker, but rather on the part of the decribed agent John.

In fact, the proper generalization concerning factive verbs appears to be as follows: the complement clause of the factive verb must be held true by the 'agent' that is next higher to the subject referent of the embedding attitude verb in the sentence. In the case of a simple factive attitude report, the 'next higher agent' will be the speaker; in the case of an embedded clause with

factive main verb, the 'next higher agent' will be the referent of the subject of the attitude verb embedding the clause. Thus, the next higher agent for *knows* in (75) is the speaker, whereas the next higher agent for *knows* in (76) is John, the referent of *he*. Crucially, it is impossible to skip an intermediate agent, as can be seen from examples such as (77a):

(77) a. John believes that Mary thinks that Max knows that Sue left.

   b. John believes that Sue left, and he believes that Mary thinks that Max believes
      that Sue left.

(77a) cannot possibly have a reading indicated in (77b).[22]

   Thus, it appears that complements of factive verbs differ from complements of nonfactive verbs precisely in that they specify not only the content of the attitude described by the factive verb, but in addition of an attitude of the 'next higher agent'. This condition on factive complements can be cast straightforwardly within the event-based account as follows. The complement clause of a factive verb is evaluated with respect to two distinct intentional states or acts: first, the event argument of the factive verb, and second, the mental state of the 'next higher agent'. In a first formalization, the second conjunct of (76) would be represented as:

(78) $(\exists e)(<e, [John]> \in [believe]^{*}$ & $(\forall s)(s \in S(e) \rightarrow [Sue\ left]^{(e,\ s)} = 1$ & $(\exists e')(<e, Mary> \in$
   $[know]$ & $(\forall s)(s \in S(e') \rightarrow [that\ Sue\ left]^{(e',\ s)} = 1)))$

Here *that Sue left* is predicated of both John's belief state and Mary's. The lexical meaning of *know* itself, [*know*], falls together with the meaning of *believe* with an additional justification condition, which is a crucial part of the meaning of *know*. Thus, [*know*] basically is the meaning of *be sure*, that is, it consists of some form of justified belief.[23]

   But how can a sentence meaning such as (78) be obtained compositionally? One way would be on the basic of syntactic copying of the complement clause to the next higher clause, as in:

(79) John believes [that Sue left] that Mary knows that Sue left.

Such a syntactic treatment, however, may be problematic, since it is not clear how it would account for the locality condition on factive verbs (i.e., the fact that the factive presupposition has to be satisfied with respect to the next higher attitude).

   Without going further into the issue, it appears that also a purely semantic treatment is possible, which I will chose. On this treatment, (78) is the result of a modified application of the semantic operation of argument satisfaction for factive verbs. The idea is that the interpretation of the

syntactic relation between a factive verb and its clausal complement does not simply consist in plugging up one argument position of the verb's denotation with the proposition denoted by the clause, but rather, in addition, in predicating the clause of the 'next higher' intentional state or act. A compositional treatment of this requires a distinction between two sorts of syntactic argumenthood relations (for the purpose of semantic interpretation): one that holds between a nonfactive verb and its clausal complement and one that holds between a factive verbs and its clausal argument. The two relations will be evaluated by different semantic operations. The operation that leads to the predication of the clause of the two distinct intentional states or acts can apply only to the denotation of a verb and the denotation of a clausal complement if the verb is factive. I will call this syntactic relation 'factive argumenthood':

(80) <u>The relation of factive argumenthood</u>
    For a verb V and a clause S,
    FACT-ARG(V, S) iff S is clausal complement of V and V is factive.

The semantic operation which is associated with the syntactic relation FACT-ARG, 'factive argument satisfaction' (fact-arg), can be defined as follows, where R is a function that may be denoted by a two-place factive verb:

(81) <u>Argument satisfaction for (three-place) factive verbs</u>
    For a three-place event-situation-dependent relation R, an event-situation function F,
    fact-arg(R, F) = $\lambda ese'x[F^{(e, s)} = 1$ & $<e', x, F> \in R^{(e, s)}]$

Applying (81) to the second conjunct of (77b) yields the following denotation for the higher embedded clause:

(82) [*knows that Sue left*] = $\lambda ese'x[[$*that Sue left*$]^{(e, s)} = 1$ & $<e', x, [$*that Sue left*$])> \in [$*know*$]^{(e, s)}]$

    (82) leaves open whether the factive verb itself describes an attitude of acceptance or not; that is, it does not specify how the proposition is to be evaluated with respect to the event argument of the factive verb. This is adequate since there are factive predicates that do not describe an attitude of acceptance, for example *be unaware*.
    There is one problem with (82), however. The problem is that the factive clause does not stand in the same semantic relation to the 'next higher' attitude as the propositional content of that attitude. To see this problem, consider the following examples:

(83) a. John knows that Sue left.

    b. Does John know that Sue left?

    c. Mary doubts that John knows that Sue left.

    d. Mary is glad that John knows that Sue left.

Given (82), (83a), when uttered by a speaker a, would mean that a wants his addressee to believe that Sue left and that John is sure about that. Similarly, by uttering (83b), a speaker would ask both whether Sue left and whether John is sure about that. However, what (83a) and (83b) imply is that the speaker takes it for granted that Sue left.

    (83c), given (82), would mean that Mary doubts that Sue left and that she doubts that John knows* that Sue left. (83d) would mean that Mary is glad that Sue left and she is glad that John is sure that Sue left. But what (83c) and (83d) imply is rather that Mary simply believes that Sue left.

    (83a) and (83b) simply show that factivity constitutes a presupposition, and the examples (83c) and (83d) show that factivity in a deeper embedded clause may involve only the belief of the 'next higher' agent, not his or her attitude described by the verb.

    The examples in (83) might suggest that a factive presupposition always consists in predication of the factive clause of the belief state of the next higher agent. However, things are more complicated when we look at examples with verbs of desire or saying such as:

(84) a. John wants Sue to leave, and he wants Mary to regret that Sue left.

    b. John wishes Sue would leave, and he wishes Mary would regret that Sue left.

    c. John said that Mary regrets that Sue left.

In (84a), *that Sue left* does not specify the content of John's belief; rather it specifies the content of his desire. In (84b), *that Sue left* need not specify the content of John's belief (John might be lying); if anything, *that Sue left* has to specify part of what John takes to be the 'common ground' (or what John takes to be his addressee's belief).

    These observations constitute what is known as the problem of presupposition projection in attitude contexts (cf. Karttunen 1973, Heim 1992). In this paper, I will not offer a satisfactory solution to this problem, but only introduce a device which might allow for an appropriate treatment. I will assume that a function B takes intentional states or acts and maps them to appropriate 'background states', usually the belief state on the basis of which the intentional state or act is defined. However, in the case of *want*, the background state will not be the actual belief state of the agent, but rather the belief state extended by the content of the desire; in the case of *wish*, it will be the belief state revised by the content of the counterfactual desire (cf. Heim 1992). (82) then has to be replaced by:

(85) <u>Argument satisfaction for (three)-place factive verbs (modification)</u>

For a three-place event-situation dependent relation R and an event-situation function F,

fact-arg(R, F) = λese'x[(∀s')(s' ∈ S(B(e)) --> F(B(e), s') = 1 & <e', x, F> ∈ R(e, s))]

This is not a sufficient account of presupposition projection in attitude reports, since it does not take the dynamics of presuppositions into account, i.e., the fact that presuppositions can be satisfied only when they have been properly introduced into the discourse (cf. also Section 3.5.).

There is another, more difficult problem that this treatment of factivity raises, and that is a problem with anaphoric binding. It arises with examples such as the following:

(86) a. Mary believes that *every man* knows that *his* wife loves him.

   b. Mary believes that *somebody* found out that *his* passport was missing.

If we apply the account of factive presuppositions to these examples, we get problematic results:

(87) a. (∃e)(<e, [*Mary*]> ∈ [*believe*]* & (∀s)(s ∈ S(B(e)) --> [*his wife loves him*](B(e), s) = 1 &

   (∀s)(s ∈ S(e) --> [*every man knows* that his wife loves him*](e, s) = 1)))

   b. (∃e)(<e, [*John*]> ∈ [*believe*]* & (∀s)(s ∈ S(B(e)) --> [*his passport was missing*](B(e), s)

   = 1 & (∀s)(s ∈ S(e) --> [*somebody found out that his passport was missing*](e, s) = 1)))

In (87a), *him* in the second conjunct cannot stand for a variable bound by *every man*. Similarly, in (87b), *his* in the second conjunct cannot stand for a variable bound by *somebody*.

One solution to this problem one might think of would be that *every man* and *somebody* are evaluated with scope outside of their clause. For (87a), we would then get something like:

(88) (∃e)(<e, [*Mary*]> ∈ [*believe*]* & (∀x)(∀s)(x ∈ [*man*](e, s) = 1 & s ∈ S(B(e)) -->

   [*his wife loves him*](B(e), s) = 1 & (∀s)(s ∈ S(e) --> [*x knows* that x's wife loves*

   him](e, s) = 1)))

However, this solution is problematic, since it is well-known that quantifiers in natural language generally do not take scope outside of their clause. Presumably, a technical solution to the problem may be found in a dynamic semantic treatment of presuppositions (cf. van der Sandt 1992). Though it still has to be seen how a dynamic semantic treatment can fit into the event-based account of clauses in general.

There is another issue that may seem problematic on the proposed account of factivity. This is the

first person use of *know*. On the present treatment, *know* only involves belief states (of possibly different agents). Now with a first person subject, this leads, it may appear, to an equivalence of (89a) and (89b), which is counterintuitive:24

(89) a. I believe that Mary left.

    b. I know that Mary left.

Both in (89a) and (89b), on the present account, *that Mary left* specifies the content of the speaker's belief state, and nothing else. However, there are other differences in the semantics of (89a) and (89b) that I have given. One difference is that *that Mary left* holding of the speaker's belief state is a presupposition in (89b), but not in (89a), where it is only an assertion. This difference, however, is presumably unessential and may be blurred by the fact that a clause generally has a sincerity condition associated with it. According to this condition, the speaker of (89a) believes that he believes that Mary left, and hence believes that Mary left. The more important difference lies in the justification condition, which is associated with *know*, but not with *believe*. Thus, (89b), but not (89a), asserts that the speaker is justified in his belief that Mary left. So the intuitive difference felt between (89a) and (89b) has simply to do with an additional semantic condition associated with *know*, and is independent of a presupposition of truth.

    The treatment of factivity that I have presented makes clear the status of the category of factive verbs. Factive verbs are not characterized by a particular property of their lexical meaning, but rather by their role in a sentence meaning. On the present account, this means that they induce a special relation of factive argumenthood to their complement clause; this relation is evaluated by a semantic operation of factive argument satisfaction, which differs from the ordinary operation of argument satisfaction in the described way.

5.3. Accommodating interrogative complements

Factive verbs generally do not only take *that*-clauses as complements, but also interrogative complements :

(90) a. John knows whether Mary arrived.

    b. John knows who arrived.

Interrogative complements with factive verbs receive a particular interpretation. (90a) roughly means that if Mary arrived, then John knows* that Mary arrived, and if Mary did not arrive, then John knows* that Mary did not arrive. Similarly, (90b) means that for any relevant person x, if x arrived,

then John knows* that x arrived, and if x did not arrive, then John knows* that x did not arrive.

There is a way of capturing this interpretation of interrogative complements with factive verbs within the present approach and in particular the present treatment of factivity. I will restrict myself to *whether*-interrogative complements and assume that interrogative complements with wh-phrases can be handled in a similar way. As in the case of intensional interrogative complements discussed in Section 3.2., I will assume that *whether*-interrogative complements denote the same event-situation function as the corresponding *that*-clause. Then (90a) can be evaluated as the following event-situation function:

(91) $\lambda es[(\exists e')(<e', \text{John}> \in [know^*](e, s)$ & $(\forall s')(\forall s'')(s' \in S(e')$ & $s'' \in S(e')$ -->
$[whether\ Mary\ came](e, s) = [whether\ Mary\ came](e', s')))]$

That is, whatever the truth value of *whether Mary came* is in any belief alternative of the speaker, it is identical to the truth value it has in any belief alternative of John.

The sentence meaning in (91) can be obtained by introducing a special argument satisfaction operation for interrogative complements, namely:

(92) <u>Argument satisfaction for extensional *whether*-interrogative complements</u>

    For w two-place event-situation dependent relation R and an event situation function F,

    ext-*whether*-interrog(R, F) = $\lambda esx[(\exists e')(<e', x> \in R(e, s)$ & $(\forall s')(\forall s'')(s' \in S(e)$ & $s'' \in S(e')$

    $\dashrightarrow F(e, s) = F(e', e'))))]$

As in the case of factive *that*-clauses, this semantic operation will be able to apply to a verb denotation and a clause denotation only if the clause stands in a special syntactic argumenthood relation to the verb, a relation which holds only between an extensional verb and a *whether*-interrogative complement:

(93) <u>Argumenthood relation with extensional *whether* interrogative complements</u>

    For a verb V and sentence S, EXT-*whether*-INTERROG(V, S) iff V is extensional

    (w.r.t. its object argument position) and S is a *whether* interrogative complement of

    V.

    This treatment of extensional interrogative complements was governed by a general strategy, which is familiar from the treatment of factivity: the denotation of the complement clause is kept as simple as possible (in fact, it does not differ from the corresponding *that*-clause); instead more complexity and differentiation is put into the syntactic relation between the verb and the complement clause and its semantic evaluation. This means that the semantic complexity now resides in the semantic contribution of the clause to the sentence meaning, rather than its denotation in isolation.

5.4. A reassessment of the category of factive verbs

On the treatment of factivity given in the last section, factivity is an intentional notion: factivity is construed not as involving a presupposition of the truth of the complement in the actual world, but rather as involving the specification of the content of some other intentional state or act besides the event argument of the factive verb, namely the 'background' state of the 'next higher agent'. In this section, I argue, based on observations by Cattell (1978), that the linguistically relevant notion of factivity has to be generalized in certain a way. The new notion, unlike the old one, *has* to be construed as an intentional notion. The broader class of verbs that this notion subsumes consist in any verbs whose clausal complement specifies both the content of some intentional state or act of the subject referent and in addition, the content of some intentional state or act of some other agent, whether explicitly mentioned or implied by what the sentence means.

    The linguistically relevant category of factive verb is characterized by a number of syntactic and semantic phenomena. These are peculiar not only to factive verbs in the familiar sense, but also to

the broader class of verbs that includes factive verbs.

The first characteristic of factive verbs is that they disallow adjunct extraction from their complement clause:

(94) a. What did John say / believe / know / regret / find out that Mary saw t?

b. Why did John say / believe / # know / # regret / # find out that Mary came t?

Cattell (1978) made an important observation about this test for factivity, noting that it captures a wider class of verbs than factive verbs, namely all verbs which are what Cattell calls '*response-stance verbs*'. 'Response-stance verbs' are verbs that are not 'volunteered-stance verbs'. The latter include *believe*, *say*, *assert*, *imagine*, and *suggest* and are characterized as verbs that 'involve the assignment to its subject of a claim about the truth of its complement such that the claim is not already common ground' (Cattell 1978, p. 71). Response-stance verbs consist of factive verbs in the familar sense as well as verbs like *doubt*, *deny*, *comment*, *mention*, *confirm*, and *agree*. The latter verbs are not factive, but belong to the appropriately extended class of verbs in that they describe an intentional state or act against the background of another intentional state or act with the same or a related content. For example, *confirm that* P means 'assert P, knowing P has been asserted before and is part of the common ground', and *agree that* P means 'believe or assert that P, knowing that P is being maintained by some other relevant agent'. As the following examples show, adjunct extraction is impossible also from the complement of these verbs:

(95) a. Who do you doubt / deny / comment / mention / confirm / agree that John killed t?

b. # Why do you doubt / deny / comment / mention / confirm / agree that John killed
Mary t?

I will not provide a new explanation for why adjunct extraction is impossible in these cases (see Szabolsci/Zwarts 1992 for a proposal). The point I want to make simply is that whatever the reason for the impossibility of adjunct extraction, factive verbs behave exactly the same as other response-stance verbs and thus involve the same relevant syntactic or semantic properties.

The event-based account of clauses provides a very natural way of treating factive verbs as a special case of response-stance verbs. Factive verbs require that the complement clause specify the content of both the event argument of the attitude verb and of the background mental state of the 'next higher agent'. Response-stance verbs, more generally, require that the complement clause specify the content of both the event argument of the embedding attitude verb and the mental state of some other agent.

Other peculiarities that at first sight appear to be characteristic of factive verbs also show up with

other response-stance verbs. For example, factive verbs, as well as other response-stance verbs, disallow a dependent interpretation of *same* or *different*, relating to a constituent outside the complement clause:

(96) a. Everybody believes / says / imagines that a different student was guilty.

    b. # Everybody knows / doubts / confirms / denies / agrees with me / that a different student was guilty.

Again, I will not provide an explanation for this phenomenon. The point was simply to show that it is not restricted to factive verbs, but is characteristic of all response-stance verbs.

    One important point that the parallelisms between factive verbs and other response-stance verbs show is that not only factive verbs lead to a distinctive contribution in a sentence meaning, but also other response-stance verbs. Both kinds of verbs share semantic and syntactic properties which cannot be due simply to a peculiarily in their lexical meaning. Hence response-stance verbs have to be 'decomposed' into distinct attitudes not only in the lexicon, but in the sentence meaning as well. Given the treatment of factivity in the preceding section, this means that like factive verbs, response-stance verbs in general involve a special argumenthood relation which will be evaluated by a special semantic operation that is involved in the composition of the sentence meaning. Perhaps one has to distinguish individual argument relations for individual response-stance verbs; or perhaps one can assume special argument relations for larger classes of response-stance verbs. In the former case, *confirm* would require a syntactic relation and associated semantic operation of roughly the following sort:

(97) a. The syntactic argument relation for *confirm*

      For a verb occurence V and a clause occurrence S,

      CONF-ARG(V, S) iff V is an occurrence of *confirm* and S is a clausal complement of V.

    b. The semantic operation for *confirm*

      For a three-place event-situation dependent relation and an event situation function F,

      conf-arg(R, F) = $\lambda e x[(\exists e')(\exists x)(e' <_t e$ & x' ≠ x & <e', x, F> ∈ [*assert*] &

                <e, x, F> ∈ $R(e'', s'')$)]

According to (97a), *confirm* requires that the clausal complement specify the content of a prior assertion of some agent other than the referent of the subject of *confirm*.

5.5. Syntactic factivity

The treatment of clausal complements of factive and other response-stance verbs that I have given may have another application, namely to a syntactic constructions which is associated with what appears to be a factive effect, a construction which appears to be independent of lexical factivity. This construction is object extraposition with 'expletive' *it* as in the following examples:

(98) a. John regrets it that Sue left.

    b. John knows it that Sue left.

    c. John finally believes it that Sue left.

Extraposition *it* cooccurs with factive verbs in (98a) and (98b). But in (98c), *it* cooccurs with a nonfactive verb.

    Crucially, in the latter context, extraposition still triggers what looks like a factive effect, or, better, it yields an effect that roughly corresponds to factivity in the generalized sense of the previous section. The semantic effect of *it* in (98c) appears to be that the proposition that Sue left has been previously believed by the speaker - or rather has been previously entertained by the speaker or some other relevant person in the context.

    Note that this means that object extraposition *it* with clausal complements is not semantically vacuous and hence cannot be expletive. A plausible analysis then is that object extraposition *it* is kataphoric to the clause in extraposed position, and as such will be evaluated in the ordinary way with respect to the event argument of the verb. The extraposed clause receives an evaluation of its own. It will be evaluated as specifying the content of an act or state of acceptance of some other agent relevant in the discourse context. If we take this act or state to be related to the utterance by a relation CR (for 'common ground'), we can formulate the content of the object extraposition construction as follows:[25]

(99) <u>The semantic operation associated with factive extraposition</u>

    For a three-place event-situation dependent relation R and an event-situation function F,

    $\text{EXTR}(R, F) = \lambda e s e'[<e', x, F> \in R^{(e, s)} \& (\forall s')(s' \in S(CR(e)) \rightarrow F(CR(e), s') = 1)]$

    We have seen how the event-based account of clauses handles a range of phenomena with attitude verbs. In the remaining section, I will address a more general issue which the event-predicational approach as such brings up.

6. Mental states and acts as semantic objects in other constructions

In the event-based account of attitude reports, intentional states or acts play a central role in that the function of a clause embedded under an attitude verb was to specify the content of the intentional states or act described by the attitude verb. This account raises the question whether there are other phenomena in natural language besides attitude reports that involve intentional states or acts and for which the view of clauses as characterizing intentional states or acts would hence have another application. In what follows, I will discuss a number of phenomena that arguably involve intentional states or acts as semantic objects.

There are two constructions for which it has previously been argued that they involve epistemic states: epistemic modals and (indicative) conditionals. In this section, I will also suggest, in somewhat speculative ways, that also certain generic sentences involve mental states as semantic objects. For all three cases, I will sketch formal semantic analyses which are straigthforward extensions of the event-based account of clausal complements of attitude verbs.

One proposal of epistemic modals as involving mental states as semantic objects has been made by Veltman (1985) (see also Landman 1989). On Veltman's account, epistemic modals operate on epistemic states or 'information states'. The function of *may* in (100a), on his view, is to indicate that the proposition that John is in the house holds in some extension of the current information state, and the function of *must* in (100b) that the proposition holds in some extension of every extension of that information state:

(100) a. John may be in the house.
     b. John must be in the house.

Veltman's account, however, leaves open what exactly such information states are. In order to apply the event-based account to conditionals, it is necessary to give an answer to this question. One possible answer is that the relevant information state is simply the belief state of the speaker. However, this is rather problematic. For then questions with epistemic modals such as *May / Must John be in kitchen?* would not make any sense. (The speaker certainly does not ask a question concerning his own belief state.) A more plausible alternative is that an information state is the state of information shared by both speaker and addressee (the 'common ground').

Let us say that this state is the background state B(e) of the utterance e. The meanings of (100a) and (100b) then can be formalized within the event-based account as in (101a) and (102a) respectively, with the meaning of *may* and *must* given in (101b) and (102b):

(101) a. $\lambda e[<B(e), ag(e), [$*John is in the house*$]> \in [$*may*$]]$
     b. <u>Lexical condition on epistemic *may*</u>
         For an event e and event-situation function F,

[*may*](e, F) iff for some extension M' of M(e), for every s ∈ S(M'), $F_{(M', s)} = 1$.

(102) a. λe[<B(e), ag(e), [*John is in the house*]> ∈ [*must*]]

b. Lexical condition on epistemic *must*

> For an event e, an entity x and an event-situation function F,
>
> <e, F> ∈ [*must*] iff for every extension M' of M(e), there is an extension M'' of M'
>
> such that for every s ∈ S(M''), F(M'', s) = 1.

Here, the denotations of expressions are treated in a somewhat different way than earlier: denotations now depend on a model M', rather than a mental state or act - since there may be no mental state or act supporting the extended model M'.

Indicative conditionals as in (103) have been analysed in the same spirit (cf. Veltman 1985; see also Gaerdenfors 1989), following the Ramsey test on conditionals given in (104):

(103) If John is in the house, Mary is in the house, too.

(104) Accept a sentence of the form 'If A, then C' in a belief state B iff the addition of A to
     B also requires accepting C.

Again, this account of indicative conditionals can straightforwardly be cast in present terms. (105) would be analysed as follows, where EXT is the relation of model extension:

(105) λe[(∀M')(EXT(M', M(B(e)) & (∀s)(s ∈ S(M') --> [*John is in the*
     house](M', s) = 1) --> (∀s)(s ∈ S(M') --> [*Mary is in the house*](M', s) = 1))]

A parallel analysis is more problematic for subjunctive conditionals as in (106a), though it has also been defended (cf. Gaerdenfors 1989). It would require an appropriate notion of belief state revision. Assuming that such an account were viable, (106a) would be analysed as in (106b):

(106) a. If John were in the house, Mary would be in the house too.
     b. λe[(∀M')(REV(M', M(B(e)) & (∀s)[*John were in the house*](M', s) = 1 -->
        (∀s)(s ∈ S(M') --> [*Mary would be in the house*](e, s) = 1))]

Without entering the issue of whether such an analysis is adequate or can be made adequate, it is clear that the event-based account of sentence meaning would allow for a straightforward formalization.

There is one other construction that I would like to suggest as a potential candidate for an epistemic semantic analysis, namely generic sentences of a certain kind, illustrated in (107) and (108):[26]

(107) a. An American business man wears a suit.

   b. A plant becomes yellow when it does not get enough water.

(108) a. One can always start from the beginning.

   b. PRO to live is PRO to work.

Generic sentences of the type in (107) and (108) arguably all, in some way, involve generic quantification over situations (cf. Moltmann 1992, Chap. 3, Sect. 5). (107a) quantifies over situations characterized by there being an American business man; (107b) quantifies over situations characterized by a plant that does not get enough water; (108a), presumably, quantifies over situations in which someone has made a mistake when trying to finish something; (108b) finally quantifies over 'situations of life'. Generic sentences like those in (107) and (108) usually consist of two parts: a restriction and a nuclear scope. In (107a), the restriction is *an American business man* and the nuclear scope the rest of the sentence; in (107b), the restriction consists of both *a plant* and *when it does not get enough water*, and the scope of *becomes yellow*.

My rather speculative suggestion is that generic sentences of this sort actually do not quantify over situations (in the world), but rather over human experiences. This actually corresponds to a tradition in philosophy (following Hume) which maintains that certain generic sentence, for instance dispositional sentences, do not express a generalization about the world, but rather a generalization about human experiences or a 'projection of an epistemic policy onto the world' (Stalnaker 1984). On such a view, (107a) would have a logical form as in (109), where Gn is a generic quantifier (ranging over potential human experiences):

(109) $\text{Gn}(e)((\forall s)(s \in S(e) \to ((\exists x)([\textit{American Business man}]^{(e,\,s)}(x) \to [\textit{wears a suit}]^{(e,s)}(x))$

(109) employs exactly the event-based terms that were introduced for the semantics of attitude reports. Note that the existential quantifier in (109) has to be understood as a dynamic existential quantifier which when occurring in the antecedent of an implication can bind a variable in the consequent (cf. Groenendijk/Stokhof 1992).

There are two sorts of linguistic indications that the type of generic sentence exemplified in (107) and (108) is, at least sometimes, treated as expressing a generalization about potential human experiences.

First, such generic sentences allow for certain occurrences of temporal adverbs ('adverbs of quantification') in which they count what Lewis (1972) calls 'cases', rather than times or events:

(110) a. An American always wears a suit.

   b. A white horse is always a surprise.

If generics of the sort in (107) and (108) actually quantify over human experiences, then the adverbs in (110a, b) do not require a special analysis, for instance in terms of unselective binding (cf. Lewis 1972); rather, they can still be considered event quantifiers - now ranging over human experiences.

The second linguistic indication for quantification over human experiences comes from the interpretation of logophoric pronouns in generic sentences. Logophoric pronouns are pronouns that refer to the intentional subject of the mental state or act or speech reported in an embedded clause or, in an independent sentence, the speaker. There are some logophoric constructions with reflexives in English, which were noted by Ross (1970) and are illustrated in (111) and (112):

(111) a. As for myself / Concerning myself, I would never watch TV.
    b. John said that as for himself, he would never read this book.
(112) a. Somebody different from myself is hard for me to understand.
    b. John said that somebody different from himself was hard for him to understand.

In (111a), *myself* refers to the speaker without being related to a syntactic antecedent. *Himself* in (111b) refers to John, the intentional subject of the reported speech, again, without being related to a syntactic antecedent. Similarly for *myself* and *himself* in (112a) and (112b).

Also implicit arguments of relational nouns such as *friend* behave logophorically, an observation also due to Ross (1970):

(113) a. A friend will be coming. (implies the speaker's friend)
    b. Mary whispered that a friend was in the truck. (implies Mary's friend)

And furthermore, the empty subject of (certain) infinitives, socalled 'PRO', arguably is a logophoric expression: it always refers to the intentional subject of the state or act the clause is predicated of:

(114) a. John wants PRO to solve the problem.
    b. John persuaded Mary PRO to leave.

Given the event-based account of attitude reports, a logophoric reflexive in English can be taken to always refer to the agent of the intentional state or act with respect to which the sentence is evaluated (ag(e), with e being this state or act).

Now the crucial observation is that in generic sentences of the sort of (107) and (108), the evaluation of logophoric expressions systematically shifts toward human experiencers:

(115) a. As for oneself, one should never choose the second best option.

     b. Somebody different from oneself is hard to understand.

(116) Friends are a great help in times of hardship. (Ross 1970)

(117) a. It is easy PRO to solve this problem.

     b. PRO to excel is not always to be PRO happy.

Oneself is a generic (logophoric) reflexive. *Oneself* (as well as *one*) exhibit a well-known restriction to human agents. Both (115a) and (115b) express generalizations over situations from the point of view of a human agent as the experiencer; and *oneself* (as well as *one*) refers to the human experiencer of such a situation. Similarly, the implicit argument of *friend* in (116) is now filled by human agents, the experiencers of the 'times of hardship'. Finally, PRO in (117a) and (117b), so-called 'arbitrary PRO', is restricted to human agents: it stands for the human experiencer of the experiences the sentence generalizes over. Note that the two occurrences of PRO in (117b) are coreferential. This falls out from the account that I am suggesting, since the two occurrences refer both to the (only) experiencer of any of the experiences in the range of the generic quantifier.[27]

    Thus, for generic sentences, it is possible to maintain the same meaning for logophoric expressions that they have in other context, namely as referring to whoever is the agent of the event the sentence is about.

    I will not further elaborate the suggestion that generic sentences of the relevant sort express generalizations over human experiences. Generic sentences of all sorts pose difficult problems for semantic theory, which are far beyond the subject matter of this paper. The point of this section was only to show that there is evidence that generic sentences may express generalizations over human experiences and thus that there is another case in natural language in which mental states or acts constitute semantic objects, and hence give independent support for the event-based account of clausal complements.

7. Summary and open issues

In this paper, I have given a general account of attitude reports, based on the view that clausal complements have the function of specifying the content of an intentional state or act. Within this approach, various mental state or act verbs have been accounted for, based on belief (and desire) as a primitive attitude, and verbs of saying by introducing an additional function for the complement clause, as specifying the form of an utterance. Moreover, it was argued that the event-based account of clauses has further applications besides attitude reports, namely to epistemic modals, conditionals and generics.

The account of attitude reports in this paper takes propositions to be unstructured objects and differs from many accounts which take propositions to be structured meanings. The main motivation for structured-meanings approaches is to block unwanted inferences from attitude reports (cf. Cresswell 1985, Soames 1988, Richard 1990, Larson / Ludlow 1993). On the present view, inferences are blocked not by systematically incorporating aspects of the syntactic structure into meanings, but rather by three other factors: first, the use of partial models, second, the assumption that referential NPs may have as their values partial objects (or pairs of objects and modes of presentations), and third (in the limited case of verbs of explicit saying) by an additional function of the clausal complement as specifying the form of the event. This conception of intensionality accounts for a number of semantic differences among attitude verbs, differences which do not seem to be adequately captured by approaches that uniformly assign maximally fine-grained denotations to embedded clauses.

The account of attitude reports given in this paper leaves many questions unanswered, both of the linguistic and the philosophical kind. Among the linguistic problems are the treatment of anaphoric reference and presuppositions in attitude reports, the treatment of other kinds of attitude verbs, in particular verbs of intention, and other kinds of clausal complements, in particular infinitival complements. Among the philosophical issues that the account raises are the nature of the semantic values that are assumed (such as conceived objects and 'modes of presentations', and the mental states and acts themselvees), some idealizations that had to be made, and the attempt itself of lexically analyzing natural langauge concepts into primitives. Such questions were left open, under the premise that the primary focus of a semantic theory of attitude reports is to account for the linguistic data that were given.

Appendix

1. The event-based account and dynamic semantics

I have given a semantic analysis of attitude reports whose purpose mainly was to explain differences in the inferential behavior that different attitude verbs display. However, there are other semantic phenomena which an analysis of the internal structure of attitudes should say something about. Among the most prominent ones are anaphora across different attitude contexts (of the same or of different agents) and presupposition projection. The first issue has been discussed extensively by Asher (1987) within Discourse Representation Theory, the second one by Heim (1992) (though only for a small number of attitude verbs).

The semantic account of attitude reports of this paper is static and as such does not provide a sufficient account of anaphora in attitude contexts. But still, it can provide a necessary condition for

when anaphora support is possible. Consider the following examples:

(1) a. # Mary doubts that *somebody* entered the room. She believes that *he* sat down.
    b. # Mary wants *somebody* to enter the room. She believes that *he* will sit down.
    c. Mary believes / knows / is surprised that *somebody* entered the room. She believes
       that *he* will sit down

Anaphora support in (1a) is impossible simply because *doubt* involves a negative evaluation of the clausal complement, which implies that there is nobody in John's belief model who entered the room. Anaphora support is impossible in (1b) because the first sentence presupposes that the complement clause is not already true in Mary's belief model. Anaphora support is possible in (1c) because *believe*, *know*, and *be surprised*, given the analyses given earlier, all imply that the complement clause is true in Mary's belief model.

   The present account is able to say whether there are appropriate entities in the model of a given attitude to act as the values of anaphora. But it does not say how anaphoric reference works. However, it should be able to incorporate an adequate treatment of anaphora and cross-attitudinal anaphoric reference. (It certainly can incorporate an E-type account of anaphora or a dynamic semantic account along the lines of Dynamic Predicate Logic (Groenendijk/Stokhof 1991).)

2. The *de re-de dicto* distinction

By the way the meaning of embedded clauses was formalized, every constituent of the clause was evaluated with respect to one and the same event argument on which the evaluation of the entire clause depends. Concerning the interpretation of definite and indefinite NPs, this means that only *de dicto* readings, not *de re* readings, have been taken into account. In the *de re* reading, an NP refers to an entity by means of a property which the described agent would himself not necessarily attribute to the entity, whereas this is the case with *de dicto* readings. Consider (1a) and (1b):

(1) a. John believes that the governor is drunk.
    b. John believes that some politician is drunk.

In a *de re* reading of *the governor* in (1a), John might hold the belief that the person who actually is the governor is drunk, without believing that that person is the governor; by contrast, in the *de dicto* reading of *the governor*, he must hold the latter belief. Similarly, in a *de re* reading of *some politician* in (1b), John may hold a belief about a particular person that he is drunk, without believing that that person is a politician, whereas in the *de dicto* reading, John must also hold the

latter belief:

(1a), according to the analyses that I have made use of so far, would be formalized as in (2):

(2) $(\exists e')([believe](e', \text{John}) \& (\forall s')(s' \in S(e') \rightarrow \lambda es[[is\ drunk]^{(e,\ s)}(\iota x[[governor]^{(e,\ s)}(x)))(e', s') = 1))$

(2) implies that John attributes to the entity he believes is drunk the property of being the governor; but this corresponds to the *de dicto* reading of *the governor*.

In what follows, I show how *de re* readings can be handled within the event-based account of attitude reports. The treatment I propose does not require a scope distinction or an ambiguity in the meaning of the attitude verb, as in most previous accounts. For commonly, the *de re-de dicto* distinction is treated as either a scope distinction (following Russell 1905) or a distinction between two different kinds of belief (following Quine 1956). Briefly put, the first approach is problematic since the *de re-de dicto* distinction, as has often been noted, does not exhibit typical properties of a scope distinction (cf. Cooper 1979); and the second approach is linguistically implausible in that it imposes an ambiguity on attitude verbs for which there is not much independent evidence.

The way I will treat the *de re-de dicto* distinction was suggested informally by Fauconnier (1985): the *de re-de dicto* distinction consists in a choice regarding which 'mental model' serves for the evaluation of the NP in question. So in (1a), *the governor* is in the *de dicto* interpretation evaluated with respect to John's belief model; whereas in the *de re* interpretation, it is evaluated with respect to the speaker's belief model. There is evidence for this view of the *de re-de dicto* distinction, which comes from the intermediate *de re* readings, noted by Kripke (1977):

(3) Jones doubts that Holmes believes that Smith's murderer is insane.

In (3), *Smith's murderer* may have an intermediate *de re* reading, a reading which is *de re* with respect to Jones's belief state, but not with respect to the speaker's belief state. On this reading, the speaker uttering (3) need not believe that there is anybody who is Smith's murderer, nor need Homes believe that there is such a person. Only Jones need to believe it; and concerning such a person, Jones doubts that Holmes believes that he is insane.

The task now is to make this account of the *de re-de dicto* distinction precise and to provide a compositional semantic analysis of *de re* attitude reports.

Intuitively, the idea for *de re* interpretations is as follows: constituents in an embedded clause need not all be interpreted with respect to the event argument of the embedding verb; for referential NPs, in particular, this is only optional. Referential NPs when interpreted *de re* are evaluated with respect to the belief state of the speaker (or some other agent's belief state, as we will see below),

rather than the mental state or act that is the event argument of the embedding attitude verb. Thus, *the governor* in (3) in the *de re* reading will be evaluated with respect to the speaker's belief model (the model of the utterance), rather than John's belief model.

But how can the evaluation of *the governor* have access to the speaker's belief model? Here a technical device can be used that originally was introduced for other purposes, namely double indexing (see Cresswell (1990) for the most extensive discussion). A constituent then will denote not a function from a single event to extensions, but rather a function from two distinct events and two situations to extensions. One event will be identified with the event argument of the embedding verb, whereas the other event argument will be 'stored' and only later in the process of compositional evaluation identified with the speaker's belief state. For *the governor* we will get the following two interpretations:

(4) For events e and e', and situations s and s',
    a. $[the\ governor]_{\text{de re}}(e, s)\ (e', s') = \iota x[x \in [governor](e', s')]$
    b. $[the\ governor]_{\text{de dicto}}(e, s)(e', s') = \iota x[x \in [governor](e, s)]$

Here e' corresponds to the speaker's belief state and s' to a doxastic alternative of the speaker. e corresponds to John's belief state and s to a doxastic alternative of John. In the *de re* reading, e' and s' play a vacuous role, whereas in the *de dicto* reading, e and s play a vacuous role. These vacuous argument positions are needed only in order to make the meanings for *de dicto* and *de re* interpreted NPs uniform, allowing other semantic operations to apply to them in a compositional way.

The additional two argument positions in the denotation of a definite NPs in (4a, b) require a corresponding modification of the notion of predication. Applying the denotation of a (one-place) predicate (an operation mapping an event and a situation to a set of individuals) to the denotation of a definite NP (a four-place operation) will now result in a four-place operation, mapping a quadruple consisting of an event e, a situation s, an event e', and a situation s' to a truth value. Thus, predication is to be conceived as an operation of the following sort (where G is the denotation of a definite NP as in (4) with either a *de re* or a *de dicto* reading):

(5) <u>Predication for *de re* and *de dicto* NP denotations</u>
    For a four-place operation G mapping an event-situation pair to an operation mapping
    an event-situation pair to an individual, and a two-place operation R mapping an event-
    situation pair to a set of individuals,
    $\text{pred}(G, R) = \lambda ese's'[<e'', G(e, s)(e', s'))]> \in R(e', s')]$

What happens with the third and fourth argument of a four-place event-situation function

resulting from the application of pred? There are two ways in which such a function can act as the third argument of an attitude verb like *believe*.

   In the first case, it yields the four-place event-situation function $\lambda e's'e''x[<e'', x, F(e', s')> \in [believe](e', s')]$. In this case, the definite NP in the complement clause will be evaluated with respect to the next higher intentional state or act. In the second case, it yields the six-place event-situation function $\lambda e's'e'''s'''e''x[<e'', x, F(e''', s''')> \in [believe](e', s')]$. In this case, the definite NP in the complement clause will be evaluated with respect to a yet higher intentional state or act.

   The two ways for a clause to act as a semantic argument of an attitude verb correspond to two semantic operations of propositional argument satisfaction. These operations will be able to interpret one and the same syntactic relation between verb and clausal complement:

(6) Propositional-argument satisfaction for clauses with *de re* and *de dicto* interpreted NPs
   For an operation F mapping an event-situation pair to an operation mapping an event-
   situation pair to a truth value, and an operation R mapping an event-situation pair to a
   three-place relation between events, individuals and event-situation functions,
   (i) prop-arg-1(R, F) = $\lambda e's'e''x[<e'', x, F(e', s')> \in R(e', s')]$
   (ii) prop-arg-2(R, F) = $\lambda e's'e'''s'''e''x[<e'', x, F(e''', s''')> \in R(e', s')]$

   What I have done so far is just a sketch of a treatment of the *de re-de dicto* distinction within the event-based account of attitude reports. On this treatment, the *de re-de dicto* distinction is considered a purely semantic ambiguity; that is, it is due to two distinct semantic interpretations of one and the same syntactic structure. This seems right; for in general nothing in the syntactic structure tells us whether an NP has to be interpreted *de re* or *de dicto*.

   This analysis of the *de re-de dicto* distinction could easily be extended to any referential or quantified NP. In fact, NPs other than definite or indefinite ones seem to allow for a *de re* interpretation as well, for instance universally quantified NPs such as *every student* as in (7):

(7) John believes that every student is guilty.

(7) can have an interpretation in which John believes about every x who happens to be a student that x is guilty. Saarinen (1979) notes even more readings: one in which only the quantifier, but not the restriction, is interpreted *de re*; and one in which only the restriction, but not the quantifier, is interpreted *de re*. On the first reading, (7) means that for every x in the set X of students, John believes that x is a student and guilty, without necessarily believing that X makes up the totality of students. On the second reading, (7) means that for the set X of students, John believes that every x in X is guilty, without necessarily believing that x is a student. It is rather obvious how these

intermediate readings of quantified NPs could be obtained technically within the event-based account.

The treatment of the *de re-de dicto* distinction that I have proposed could in principle apply not only to referential NPs, but also to other constituents in a sentence. The question then arises whether there are other kinds of expressions besides NPs (and, given the readings of (7), N's and determiners in isolation) that allow for *de re* interpretations. For predicates and clauses, the answer appears to be negative. Consider the following examples:

(8) a. John believes that Mary is smoking.

   b. John believes that Mary is playing a game.

(8a) could not possibly mean that John believes that Mary did an action e which the speaker knows to be smoking, but not John (who actually believes that e is a playing of a game). Similarly, (8b) could not possibly mean that John believes that Mary did an action e so that the speaker knows that e is Mary's departure and John believes e is Mary's arrival.

Thus, the interpretation of constituents with double indexing along the lines of (5) and (6) is limited. It then has to be seen how those limits can be explained. The present account certainly would allow any constituent to be interpreted both *de re* and *de dicto*.28

The treatment of *de re* readings of NPs by means of double indexing leads us to a related technical semantic issue, namely the treatment of indexicals such as *I*:

(9) John believes that I have arrived.

True indexicals such as *I* are always interpreted with respect to the utterance event, never with respect to the intentional state or act that is the Davidsonian event argument of the embedding verb. Therefore, true indexicals would require a treatment with double indexing as well. But they would be subject to the additional condition that the second event index be stored all the way up in the compositional interpretation of the sentence. Technically, one can distinguish the second event index of true indexicals from the additional index of *de re* NPs simply by assigning the former a different argument place in the denotation of the indexical, let's say the last argument place in the three-place event-situation function that is the denotation of *I*. The denotation of *I* then can be described as:

(10) For events e and e', and a situation s,

   $[I](e, s, e') =$ the only a such that a is the agent of e'.

The third argument place is meant to be identified with the mental state or act with respect to which

the entire sentence is evaluated at the end stage of the compositional interpretation of the sentence.

I will leave the issues of *de re*-interpreted NPs and indexicals with these remarks. This appendix was intended only to give some indications as to how phenomena of *de re* reference and indexicality can be handled technically within the event-based account of attitude reports.

3. *De se* reference

In this section, I want to briefly point out another application of the event-based account of attitude reports, namely to *de se* reference.

De se interpretation, discussed by Castañeda (1966, 1967, 1968) and Perry (1979), is a reading of a personal pronoun in attitude contexts in which the pronoun cannot be substituted by any coreferential description. One of Castañeda's examples involves an amnesiac who has lost his memory of his wartime experiences. Reading a biography about a war hero he fails to recognize that he himself is the war hero. In this case, (1a) with a *de se* pronoun is true, but (1b) with a *de re* reading of *he* false:

(1) a. The amnesiac does not believe that he (himself) is a hero.
   b. The amnesiac believes that he is a hero.

Previous approaches generally take a pronoun that allows for a *de se* and a *de re* interpretation to be ambiguous (cf. Lewis 1979, Cresswell 1985, Chierchia 1989). Without going into a discussion of those proposals, let me present a way of treating the *de re-de se* distinction as a matter of semantic indeterminacy, rather than a matter of ambiguity. The account I propose rests on the assumption that NPs in embedded contexts may refer to 'partial entities' and that models for propositional attitudes depend on concrete mental states or acts.

On my account, *he* in (1a) and *he* in (1b) refer to two distinct partial entities in the amnesiac's belief model. *He* in (40a) refers to an entity specified by whatever the amnesiac associates with the person he read about; by contrast, *he* in (1b) refers to the entity specified only as the agent or intentional subject of the belief state on which the model depends. Crucially, only the notion of a belief-state-dependent model makes such a property available in an appropriate way. The belief state itself need not be in this model; but it is possible to use a function AGENT in an event-dependent model M(e) which when applied to e and a situation s in S(e), it will map an entity to 1 just in case x is the intentional subject of e. This then yields the following construal of *de se* reference:

(2) *De se* reference of a pronoun
   A pronoun refers to an entity x in a model M(e) *de se* iff for all $s \in S(e)$, $[AGENT]^{(e, s)}(x) = 1$.

There are also expressions that seem to obligatorily refer *de se*. Among those is the *he himself-* construction in (1a). Moreover, the empty subject of infinitives as in (3) appears to refer obligatorily *de se* (cf. Higginbotham 1992):

(3) The amnesiac remembers PRO to have been a hero.

Those expressions always refer to the agent of whatever the relevant event for the evaluation of the clause is. Thus, we have:

(4) [*he himself*]M(e) = [PRO]M(e) = the x such that [AGENT]$^{(e, s]}(x) = 1$.

With this I conclude the discussion of further possible applications of the event-based account of attitude reports that I have proposed in this paper.

Acknowledgments

Notes

[1] A special case of the Uniformity Condition is what Barwise/Perry (1983), following Davidson (1969), call 'Semantic Innocence'. By 'Semantic Innocence' Davidson meant the intuition that independent and embedded sentences (in particular, those embedded under an attitude verb) should have the same meaning.
    There seem to be exceptions to the Uniformity Condition. For example, it is generally assumed that predicative and referential NPs have different denotations. The Uniformity Conditions, thus, should be modified so that a particular syntactic function (determined by the syntactic context in which the expression occurs) may be responsible for different meanings of occurrences of the same expression.

[2] There are linguistic indicators for the degree of committment of a described attitude, namely degree words like *very (much)*:

(1) a. John is very sure that Mary arrived.

    b. John believes very much that it will be raining.

    Furthermore, there are linguistic indicators for the presence of a condition concerning the source or justification of the acceptance, namely the applicability of the *as far as*-construction, which distinguishes verbs with a justification condition from those which lack such a condition:

(2) As far as I can see / I heard / I was told / I know / # I believe / # I assume /

    # I suppose / # I imagine , Mary has arrived.

3 These inference patterns roughly correspond to those that Bonevac (1984) uses. However, Bonevac does not provide explicit data, and I sometimes disagree with the results he reports.

4 See, for example, Richard (1990) for the view that it is not part of the subject matter of semantics.

5 It has to be mentioned, though, that Ladusaw's (1979) account is not undisputed and is not the only account; see in particular Landman/Kadmon (1994).

6 *John believes that* S, *and he believes that* S' is equivalent to *John believes that* S *and that* S' (but not to *John believes that S and S'*). Hence, the same inferences are valid for sentences of the form 'a V *that* S' and *that* S" as for those of the form 'a V *that* S and a V *that* S". Of course, also sentences of the form 'a V *that* S *or* a V *that* S' and of the form 'a V *that* S *or that* S" are equivalent.

7 For potential problems with Conjunction Introduction for states of acceptance, see also Stalnaker (1984, Chap. 3).

8 This has in fact been suggested by Stalnaker (1984). For potential problems with this view, however, see Richard (1990).

9 For the general issue of whether it makes sense to say that a clause specifies the form of a mental state, see Richard (1990).

10 The event-predicational format also is a way to understand Discourse Representation Structures as the objects of attitudes within Discourse Representation Theory, as suggested by Kamp (1990).

11 There is one potential problem with the relativization of inferences to a particular mental state or act. It may be that two event arguments of the verb believe, let us say e and e', have a 'sum' that is a complex belief state e" composed of e and e' (e" = e v e'). And there may be good evidence that sum formation is possible for event arguments of verbs in the same way as for plural nouns. But then why could the inferences not be licensed with respect to such a complex belief state. Let us assume that e is John's belief that P and e' is John's belief that ¬P. Then also e v e' is a belief state of John that P and also a belief state of John that ¬P. But then why is not e v e' a belief state of John that P and ¬P? Intuitively this is wrong. What seems right is only that e v e' is a belief state of John that P and that ¬P (e v e' arguably is the belief argument for *John believes that P and that ¬P*). The reason is that e v e' is not a belief state with a single content. It is a belief state which supports two distinct 'mental models' simultanously. So the condition should be imposed that in order for the inferences to hold,

the premises should involve belief states with a single content.

12 Landman (1987) takes the first approach to semantic values of NPs in attitude contexts, locating the source of opacity in certain kinds of partial objects that serve as the semantic values of NPs. These partial objects are intentional objects, so-called 'pegs'. Different pegs may be approximations of the same actual object, and the same actual object may correspond to the same peg.

13 As has been pointed out by Schiffer in various places (Schiffer 1987, 1990, 1994), there are serious problems with the modes-of-presentation view of the semantic values of terms in belief sentences. However, this is a general problem affecting many accounts of attitude reports and is relatively independent of the specific purpose of this paper. This paper certainly does not try to solve or even get around this problem.

14 Examples of contradictory contents with *assume*, *suppose*, and *conclude* are:

(1) a. Assume / Suppose that x is prime and not prime, then you can conclude anything.
    b. John concluded from his (wrong) premises that there was a number that was both
       prime and not prime.

Note that these verbs (which are also verbs of acceptance) impose no condition whatsoever on the coherence of the propositional content of their complement with respect to other beliefs of the agent.
    I take *believe* not to allow for contradictory contents. Certainly, an agent may believe that P and, at the same time, believe that Q, where P and Q are incompatible. But here, arguably, two distinct belief states are involved. For in this case, it seems not true that the agent believes that P and Q, but rather only that the agent believes that P and that Q (see also Fn. 3).
    In order to model impossible contents logical systems have been developed with 'impossible' worlds and a fourth truth value 'both true and false' (cf. Rescher/Brandom (1979) and also Blamey (1986)).

15 This problem arises in basically the same way in an account in which *believe* denotes a relation between agents and sets of possible worlds (the propositions expressed by the complement clause) (cf. Soames 1987). Given that John believes that P is true and Q is a logical consequence of P, it follows that John believes that P and Q (since P and P *and* Q correspond to the same sets of possible worlds). Given the applicability of a general rule of Conjunction Distribution to belief reports, it furthermore follows that John believes that Q.

16 The 'relevance condition' on the added disjunct, however, may actually not be sufficient to rule out unwanted inferences. Even if John thought about whether Bill left, the following inference seems strange - at least in unprejudiced speakers' intuition:

(1) # <u>John thought that Mary arrived.</u>
      John thought that Mary arrived or Bill left.

The strangeness of the inference in (1) becomes even more prominent when (1) is contrasted with the following perfectly valid inference:

(2) <u>John thought that Mary arrived.</u>
    John thought that somebody arrived.

So there is an even stronger condition governing the attribution of a belief in a disjunction. This condition seems to be a global condition to the effect that each disjunct of a disjunction must be true in some, but not in every, alternative. It remains to be seen how such a condition could be handled formally within a compositional semantics.

17 Modelling the content of attitudes in terms of partial models raises the general problem of implicit belief. There may be infinitely many beliefs that one may attribute to an agent, but only finitely many can be represented explicitly in the agent's concrete mental state, that is, the belief state that may be the Davidsonian event argument of *believe*. For example, an agent may believe that all natural numbers have a certain property *P*, but the agent cannot have an explicit conception of each number. But still for any given natural number *n*, one can correctly attribute the belief to the agent that *n* is *P*.
    Within the partial-models approach, such implicit beliefs come in as follows: even though the concrete mental state or act that is the event argument of *believe* may itself only represent explicit beliefs of the agent, the partial model it is associated with will 'generate' the 'relevant logical consequences' of the explicit beliefs, that is, it will support relevant implicit beliefs.
    Admittedly though, this picture may be oversimplified as an account of implicit belief. It is not at all clear that the notion of partial model will capture all the implicit beliefs of an agent. For example, it will have trouble with beliefs about concrete entities the agent has never heard of, let's say, the person first born in 1750? Even about that person, one might attribute an implicit belief to the agent that that person is male or female. In any case, the issue of implicit belief raises further issues for the approach that I am taking. See Field (1978), Richard (1990), and Crimmins (1992) for discussions of the issue of implicit belief.

18 Apparently, *wonder whether Mary is German*, on this account, is equivalent to *believe that Mary is German or is not German*, which intuitively does not seem to hold. The difference between *believe* and *wonder* consists in that *believe* allows for complements that describe implicit beliefs of the agent, which is not possible with *wonder*. Thus, even if an agent did not explicitly consider the possibiliy of Mary's being German, one may still attribute to him or her the implicit belief that Mary is German or is not German, though he won't be wondering whether Mary is German. In present terms, this means that the event argument of *wonder* is a belief state only in the narrow sense of explicit belief, not in the literal sense of the object language expression *believe*.

19 This may be only a partial characterization of the meaning of such verbs; in addition, *be surprised* also characterizes the emotional state resulting from an expectation not met. This can be seen from modification by the adverb *very*:

(1) John is now very surprised that Mary left.

In (1), *very* modifies not the prior expectation, but John's current emotional state. Clearly, there is a correlation between the strength of the prior expectation and the strength of the resulting emotional state. But there is other evidence that *very* in (1) does not modify the prior expectation, but rather the emotional state accompanying the current realization. For this is the same subattitude that *now*

modifies in (1), and different adverbs in a sentence modifying different subattitudes should be impossible.

20 There is a conflict with negation and presupposition that arises from this formalization of the lexical meaning of *be surprised*. Negation affects only the prior negative expectation, whereas tense affects only the current expectation:

(1) a. John is not surprised that Mary left.
    b. Now, John is surprised that Mary left.

(1a) implies that John realizes that Mary left, but that he lacked a prior expectation to the contrary. *Now* and present tense in (1b) both modify John's current realization that Mary left.
    This presumably means that *be surprised* does not really refer to the entire state of the prior negative expectation, but rather to the transition from that expectation to the subsequent realization.

21 Manner-of-speaking verbs also exhibit other syntactic peculiarities. In particular, they disallow deletion of *that*, as in (1a), and they do not require the presence of a complement, which is seen in (1b):

(1) a. John whispered / laughed / shouted *(that) Mary is here.
    b. John whispered / laughed / shouted.

Stowell (1982) therefore argued that the complement clause of manner-of-speaking verbs is an adjunct, rather than a complement. But then if *that*-clauses refer to propositions, as in traditional semantic accounts, it is difficult to make sense of a *that*-clause being a syntactic adjunct semantically. The event-predicational format, at first sight, seems to provide a straightforward way of interpreting adjunct *that*-clauses since here *that*-clauses with verbs of acceptance are treated basically as predicates of the event argument of the verb. They have the same status as adverbs like *slowly* or *tomorrow* in Davidson's (1967) proposal, and adverbs typically are adjuncts to the verb.
    A problem with this application of the event-predicational format, however, is that in the particular case of manner-of-speaking verbs, the complement involves a more complex condition than simple predication. In addition to characterizing the content of the event, the complement also characterizes the form of the event (cf. Section 4).

22 In this respect, factivity differs from *de re* reference, which allows skipping intermediate intentional contexts:

(1) John believes that Mary thinks that Max believes that the woman in the corner is
    not a woman.

(1) can have a reading in which Mary does not think that Max is mistaken, but only John does.
    The difference between factivity and *de re* reference corresponds to a more general distinction among presupposition triggers noted by Zeevat (1992). Lexical presuppositions (such as sortal correctness conditions) differ from what Zeevat calls 'resolution presuppositions' (such as referential presuppositions) in contexts embedded under attitude verbs (in particular *believe*). Lexical presuppositions have to be satisfied with respect to the belief state of the bearer of the attitude,

whereas resolution presupposition may skip this belief state and be satisfied somewhere 'higher up' in the semantic structure of the sentence. For example, the lexical presupposition of *repeat*, a prior occurrence of the relevant event, must be part of what John believes in (1a). In contrast, the resolution presupposition of the *when*-clause in (1b), namely the fact that Bill left, need not be part of what John believes:

(2) a. John believes that Mary repeated the mistake.
    b. John believes that Mary arrived when Bill left.

Examples of presupposition triggers that may skip the immediate attitude context were noted also by Fauconnier (1985).

    Factive presuppositions are clearly lexical presuppositions; though, of course, they need not be satisfied by the belief state of the agent of the embedding attitude verb. Rather they have to be satisfied by the belief state of the next higher agent.

23 Thus, this analysis takes knowledge to be justified belief shared by some other agent. For a detailed account of the justification condition on knowledge, see, for instance, Goldman (1986).

24 Thanks to Jim Lambek for bringing this issue to my attention. In these examples, *know* and *believe* actually might not describe the speaker's mental state, but rather be used parenthetically in the sense of Urmson (1952).

25 A construction related to factive extraposition is the obligatory extraposition of a conditional clausal complement in (1a) and (1b):

(1) a. John would know it if Sue had left.
    b. John would believe it if Sue had left.

Here it is even more obvious that the extraposed clause has its own semantic function, independently of extraposition *it* (which stands for the same propositional content, but specifies the content of the event argument of the verb). In (1a), the extraposed clause expresses the antecedent of a conditional whose consequence is expressed by the rest of the sentence. Thus, the denotation of (1a) is roughly as follows:

(2) $\lambda es[(\forall s')(s' \in S(CR(e)) --> [$ *Sue had left*$]^{(e, s')} = 1) --> (\exists e')([know^*]^{(e, s)}(e', [John])$ &
    $(\forall s'')(s'' \in [it]^{(e', s'')} = 1)))]$

26 These generics have been distinguished from other kinds of generic sentences by Krifka (1987) (who calls them 'I-generic').

27 Coreference (among other things) causes problems for a view on which arbitrary PRO stands for a universal quantifier (cf. Epstein 1984).

28 A possible candidate for a *de re* interpretation might be the double-access reading of tense (cf. Enç 1989), as in:

(1) John thought that Mary is pregnant.

For (1) to be true, Mary's being pregnant must overlap with the utterance time, as well as with John's state of thought. However, unlike in the case of *de re*-readings of NPs, for the double access reading, it is not sufficient that tense be evaluated with respect to some higher intentional state or act; it must at the same time be evaluated with respect to the event argument of the embedding verb.

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