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Kinds of Opacity and Their Representations*

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Abstract

Examinations of referential opacity have almost invariably focused on propositional attitudes, and even more specifically, on belief sentences. This focus has obscured the fact that there are a number of other kinds of sentences in which the logic-linguistic phenomenon of referential opacity occurs. This paper distinguishes two main kinds of referential opacity and offers distinct representations of their logical forms.

1 Referential Opacity

The *context* in which an occurrence of a referring expression (name, description, etc.) r in a sentence S occurs is *extensional* if the occurrence of r passes both of the following two tests (cf. Chisholm [2]).

1.1 The Substitutivity of Co-Extensives

An occurrence of r in S passes the test of the Substitutivity of Co-Extensives if and only if the result of replacing the occurrence r by any referring expression that refers (extensionally) to the same thing as r does not change the truth value of S .

For example, consider

- (1) The Morning Star is blue.

Given that

- (2) The Morning Star is the Evening Star,

the expression *the Morning Star* can replace *the Evening Star* in (3) to yield

- (3) The Evening Star is blue.

*I want to thank William J. Rapaport and Stuart C. Shapiro for their comments on earlier versions of this work.

Since (3) must have the same truth value as (1), the occurrence of *the Morning Star* in (1) passes the test. On the other hand, the occurrence of *the Morning Star* in

(4) John believes that the Morning Star is blue,
does not, since

(5) John believes that the Evening Star is blue,
need not have the same truth value as (4).

1.2 Existential Generalization

The occurrence of the referring expression *r* in the sentence *S* passes the test of Existential Generalization if and only if the result of existentially generalizing over the position occupied by *r* in *S* follows from *S*.

For example, the occurrence of *Mary* in

(6) John knows Mary,
passes the test, because

(7) There is someone, *x*, such that John knows *x*,
follows from (6). On the other hand, the occurrence of *Santa* in

(8) John seeks Santa,
fails the test, because

(9) There is someone, *x*, such that John seeks *x*,
does not follow from (8).

An *intensional context* is one that is not extensional. An intensional context is often also called an *opaque context*, and an extensional context, a *transparent context*. In the examples, *the Morning Star* in (1) and *Mary* in (6) occur in extensional or transparent contexts, whereas *the Morning Star* in (4) and *Santa* in (8) occur in intensional or opaque contexts.

2 Examples of Opaque Contexts

In addition to the propositional attitudes, which express an agent's attitude towards some proposition or another, such as

(10) John believes that the Morning Star is blue,
there is a number of other kinds of referentially opaque sentences; some are given below.
There are intensional, transitive verbs, which express an agent's mental state as regards some object or another, such as

(11) John loves Mary.

Though John may love Mary, he may hate Lucy, even though unbeknown to him they are one and the same. There are logical modalities, such as

(12) Necessarily, nine is greater than seven.

Though

(13) The number of the planets is (identical with) nine,

it does not follow that

(14) Necessarily, the number of the planets is greater than seven.

And, though they are not generally so regarded, there are the attributive adverbs, those like *quickly* in

(15) John swam the river quickly.

This treatment of attributive adverbs as generating opacity is new. As will be seen, it rests on the general theory of action proposed by the philosopher Donald Davidson [6], though he himself holds that such adverbs must be excluded from his theory.

According to Davidson, a verb of action refers to an event, an act. In (15) then, John performed a certain act, a swimming of the river. As far as *swimmings* of the river go, his swimming of it was quick. If the time it took John to swim the river is compared to the times it has taken others to *swim* the river, John's time was among the fastest. John's act of swimming the river may, however, also be described as a *crossing* of the river. Thus, we may add the identity statement

(16) John's swimming of the river is a crossing of the river.

But though his swimming is a crossing, it does not follow that

(17) John crossed the river quickly.

On the contrary, it is very likely that he *crossed* the river slowly. If the time it took John to cross the river is compared to the times it has taken others to cross the river, which will perhaps include such modes of crossing as rowing, swinging (on a rope), and driving (on a bridge), John's time would no doubt be among the *slowest*.

Finally, some sentences are simply best interpreted as intensional; I term them *intensional sentences*. Consider the sentences

(18) The Morning Star is blue.

(19) The Evening Star is red.

(20) The Morning Star is the Evening Star.

Both (18) and (19) are usually understood in just one way. They are, however, ambiguous. The two interpretations can be illustrated by supposing that

(21) Nothing is both red and blue.

On the *extensional* interpretation, it follows from (18) – (20) that

(22) The Morning Star is red.

On the *intensional* interpretation, (18) – (21) are therefore inconsistent; the one thing is said to be blue and red. On the *intensional* interpretation, however, there is no contradiction at all. In this case, *the Morning Star* and *the Evening Star* refer to *intensional* objects, and the properties of one do no longer flow to the other. The *intensional* interpretation may perhaps be clearer in the case of

(23) The Morning Star is seen in the morning.

(24) The Evening Star is not seen in the morning.

These sentences are not inconsistent if *the Morning Star* and *the Evening Star* are understood as referring to *intensional* objects.

There are alternatives to handling the *intensional* interpretation in terms of *intensional* objects. Instead of saying that there are two *intensional* objects, one of which has the property of *being blue* and the other the property of *being red*, one might say that there is just one *extensional* object, which has the two complex properties of *seeming blue if viewed in the morning* and of *seeming red if viewed in the evening*. In a system such as SNePS in which *intensional* objects are already accepted, however, there is little advantage, and no point, in trying to do without them.

3 Two Kinds of Opacity

I distinguish two different general kinds of referential opacity. The two groups are distinguished according to whether or not sentences are understood as referring to *intensional* entities. An *extensional* object is merely one which CASSIE — that is, the SNePS system — holds to be governed by an *extensional* logic, and an *intensional* object is one which she holds to be governed by an *intensional* logic¹.

Another way of distinguishing the two groups is in terms of whether the inference failures associated with the opacity are permanent and unchanging, or whether they are just a matter of some agent's ignorance. For example, consider

(25) John believes that the Morning Star is blue.

(26) The Morning Star is the Evening Star.

¹In SNePS, most base nodes can thus be treated as representing *extensional* objects. This view is not the standard SNePS one.

(27) John believes that the Evening Star is blue.

Certainly, (27) does not follow from (25) and (26). But if John were not ignorant of (26), the inference would go through². On the other hand, consider

(28) John swam the river quickly.

(29) John's swimming of the river is (the same act as) his crossing of the river.

(30) John crossed the river quickly.

Again, (30) does not follow from (28) and (29). But this time, there is nothing which any agent, John or CASSIE or anyone, is ignorant of, but which, were he to know it, the inference would go through. In the first case the inference succeeds or fails depending on whether certain additional information is represented in the network, and so needs to be switched on or off accordingly. In the second case, however, the inference permanently fails. This important difference is sufficient to warrant separate logical forms.

The propositional attitudes and the *intensional* transitive verbs fall into the first kind, whereas the attributive adverbs and the *intensional* sentences fall into the second. The logical modalities are a mixed bag. Work is currently in progress towards the development of a theory of naive logical modalities. Such a theory aims to capture the naive and crude grasp that speakers possess of modal notions without the full force of an apparatus as powerful as possible world semantics. The attribution of rich semantic notions such as possible worlds to speakers is questionable, so there is good reason to do without them.

My aim is to provide representations of the *logical form* (cf. Davidson [6], Woods [15] and Moore [10]), of each of these two quite different kinds of referential opacity. It is *not* my aim to provide a complete or detailed *semantic analysis* of the various notions we will be dealing with. I do not, for example, aim to provide a semantic analysis of the propositional attitude *know* in terms of belief and so on (cf. Rapaport, Shapiro and Wiebe [12]) or of the adverb *quickly* in terms of comparisons between the times elapsed for those things said to be quick and those that are not (cf. Cresswell [5]). Though ultimately such details need to be represented, my aim is the more modest one of representing their logical form, the notion of which is now explicated.

To *analyse* an expression is to explain it in terms of, or reduce it to, other concepts of which one presumably has a better grasp. To give the *logical form* of an expression is to depict its inner logical structure, if, indeed, there is any. In giving the logical form, we want to capture enough of the structure to exhibit certain entailments. Here is an example to illustrate the difference.

(31) A is greater than B.

(32) B is less than A.

Obviously, (31) and (32) entail one another. In view of

²Or rather, if we attribute to John the normal inference abilities then we want him to be able to draw the inference.

- (33) For any numbers X and Y, X is greater than Y if and only if Y is less than X,

a theory might eliminate one relation in favour of the other. It might therefore represent *less than* in terms of *greater than* (or *visa versa*).

But though the meanings of these relations are connected by (33), the *structure* of neither is included in that of the other. (32) does not really mean (31); nor does (31) really mean (32). There is, after all, no way to decide which of the two predicates is the *real* primitive and which is the parasite. But more importantly, the representation of (32) via (31) would obscure the crucial difference between³

- (34) John believes that if A is greater than B then B is less than A.
 (35) John believes that if A is greater than B then A is greater than B.

A better strategy is therefore to represent both *greater than* and *less than* as simple, irreducible, primitive relations, and to provide, separately and independently, a representation of how they are related; viz., of (33). The relations are thus represented as having the same logical form. Though (31) and (32) entail one another, they do so in virtue of (33) and *not in virtue of their logical form*.

4 Opacity of the First Kind

The two examples of this kind of opacity to be considered are the propositional attitudes and the intensional, transitive verbs.

4.1 Rapaport's Representation of Beliefs

In contrast to Wyatt [16], I follow Rapaport [11] and understand the distinction between *de re* beliefs and *de dicto* beliefs in terms of to whom a belief sentence attributes a knowledge of the individuating terms it contains. Thus, in the *de re* sense,

- (36) John believes that the Morning Star is blue,

is understood so that John believes that something which CASSIE believes is named *the Morning Star* is blue, whereas in the *de dicto* sense, it is understood so that John believes that something which *John* believes is named *the Morning Star* is blue. In terms of the canonical forms offered by Rapaport [11], the *de re* sense of (36) is expressed by

- (37) Of the Morning Star, John believes that it is blue,

whereas the *de dicto* sense is expressed by

- (38) John believes that Morning Star is blue.

³This is a form of the *Imputation Problem* discussed by Barnden [1]. A similar difference is noticed by Frege [7].

But though I agree with the way Rapaport draws the distinction between *de re* and *de dicto*, I do not agree with his representations. His representation of

- (39) The Morning Star is blue,

and the *de re* sense of (36) (i.e., of (37)) is given in Figure 1. His representation of (39) and the *de dicto* of (36) (i.e., of (38)) is given in Figure 2. In addition to some difficulties mentioned

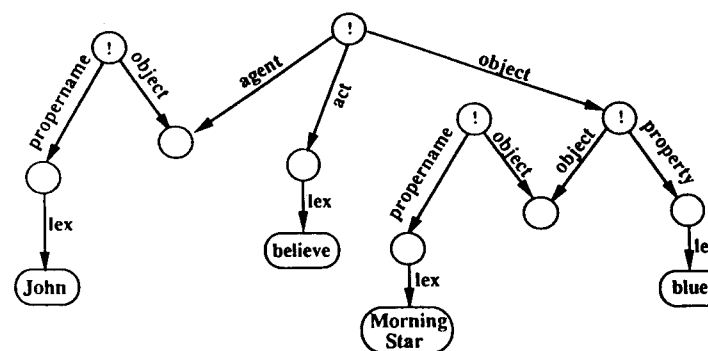


Figure 1: Rapaport's Representations of (37) and (39).

in Wyatt [16], there are the following two, somewhat interconnected, difficulties with Rapaport's representation of beliefs.

4.1.1 First Difficulty

According to Rapaport's theory, the Morning Star in (38) is different from the Morning Star in (39). The idea is that in the *de dicto* sense, (38) is about some entity that the *agent* (John) conceives of, and so requires a new base node to it distinguish it from CASSIE's concept of the Morning Star⁴, referred to in (39). I have previously suggested (Wyatt [16]) that this view lacks plausibility since it follows that (38) and (39) are *not* about the one thing, the Morning Star, but about two quite different things which merely "happen" to have the same name.

Moreover, Rapaport's view can be interpreted in two ways, both of which lead to more serious problems. It may be interpreted as either

⁴Rapaport allows that it might be discovered that the two Morning Stars are co-extensive, in which case they are linked using the EQUIV/EQUIV case frame.

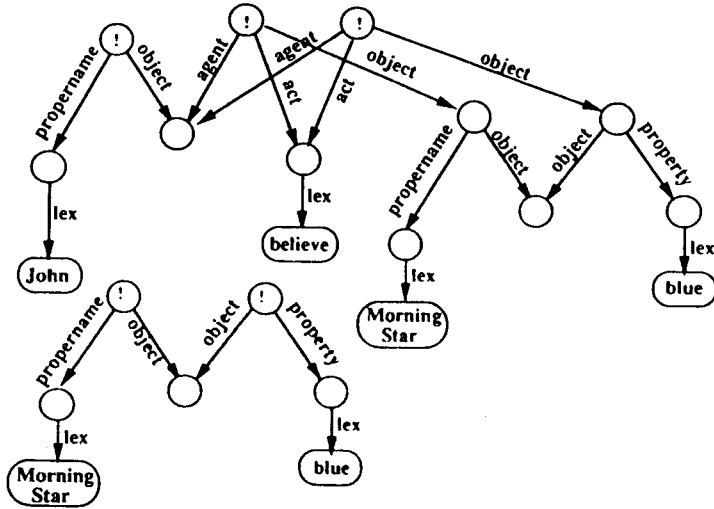


Figure 2: Rapaport's Representations of (38) and (39)

- (A) Every *de dicto* sentence introduces a new base node.
- (B) Only the first *de dicto* sentence (containing a given referring expression) introduces a new base node.

Interpretation A can be rejected on the ground that from the two sentences,

(40) John believes that the Morning Star is blue,

and

(41) John believes that the Morning Star is the Evening Star,

it would no longer follow that

(42) John believes that the Evening Star is blue,

since it would not be the same Morning Star in each case.

Interpretation B leads to a more subtle problem. It will not always be possible to tell whether a given piece of network was produced via a *de dicto* sentence or via a *de re* sentence, and hence not always possible to tell whether a new node should be introduced or not. Compare the sets of sentences, S_1 and S_2

- (S_1) The Morning Star is blue.
Of the Morning Star, John believes that it is blue.
Of the Morning Star, John believes that it is named *the Morning Star*.
- (S_2) John believes that the Morning Star is blue.
(John's) Morning Star is blue and is named *the Morning Star*.

The two sets generate the same network (on Rapaport's theory), which given in Figure 3.

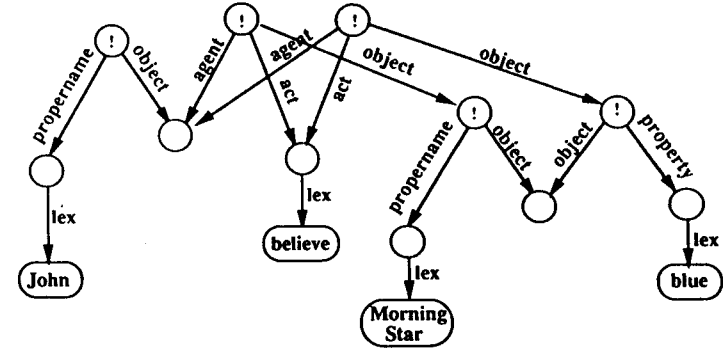


Figure 3: Representation of S_1 and/or S_2 .

If, assuming interpretation B, CASSIE is told

(43) The Morning Star is blue,

new network would be added if she had been told the sentences in S_2 , but not if she had been told those in S_1 . But there is no way to tell merely from the network which set of sentences generated it and so no way to tell whether or not a new base node need be created.

In place of Rapaport's theory then, a *de dicto* sentence will, by default at least, introduce a new base node only if the referring expression is completely new for CASSIE, only if she has never heard that name before. If CASSIE is already acquainted with a name, then she needs specific *evidence* that some new occurrence of that name does *not* refer to the same thing as do the earlier occurrences. It is that evidence which then allows her to distinguish between the two nodes bearing the same name. But without such evidence, she would in general be unable to tell them apart; and so without such evidence, there should be just one base node.

4.1.2 Second Difficulty

This difficulty with Rapaport's representations of beliefs emerges when two distinct matters are considered together; viz.,

- (A) How the EQUIV/EQUIV case frame is used in general.
- (B) The fact that Rapaport's theory treats a *de dicto* belief as consisting more or less of two beliefs that are held separately and independently, instead of as a single belief of two separate propositions.

Each matter is considered in turn before the second difficulty itself is examined.

The first matter, A, concerns Rapaport's representation, shown in Figure 4, of

- (44) The Morning Star is blue.
- (45) John believes that the Evening Star is blue,

and, to secure the identity of the "two" Morning Stars,

- (46) John's Evening Star is the Morning Star.

What is the relation between nodes m2 and m4? On the one hand, one might hold, in virtue of the equivalence of b1 and b2, that m2 and m4 represent the very same proposition. If m4 were asserted, there would be no new sentence that CASSIE could utter; in virtue of m2, she already believes that b2 is blue. Indeed, m4 should, on pain of inconsistency, actually be asserted. As far as CASSIE's beliefs are concerned, b1 and b2 may as well be merged to a single node (cf. Madia and Shapiro [8]). On the other hand, one might hold that m2 and m4 represent quite different propositions. After all, m2 is about b1, whereas m4 is about b2, which is supposed to represent a quite different thing. What needs to be decided is whether an *extensional* occurrence of *the Morning Star* refers to b1, or to b2, or indiscriminately to either. This question will be returned to shortly.

The second matter, B, concerns the fact that Rapaport represents propositions jointly believed, as being separately and independently believed. In particular, the *de dicto* belief

- (47) John believes that the Morning Star is blue,

is represented as two separate beliefs; viz., as

- (48) Of the Morning Star, John believes that it is blue, and of the Morning Star, John believes that it is named *the Morning Star*,

instead of as

- (49) Of the Morning Star, John believes both that it is named *the Morning Star* and that it is blue.

Putting A and B together allows the second of our two main difficulties to be stated.

Consider Rapaport's representations of

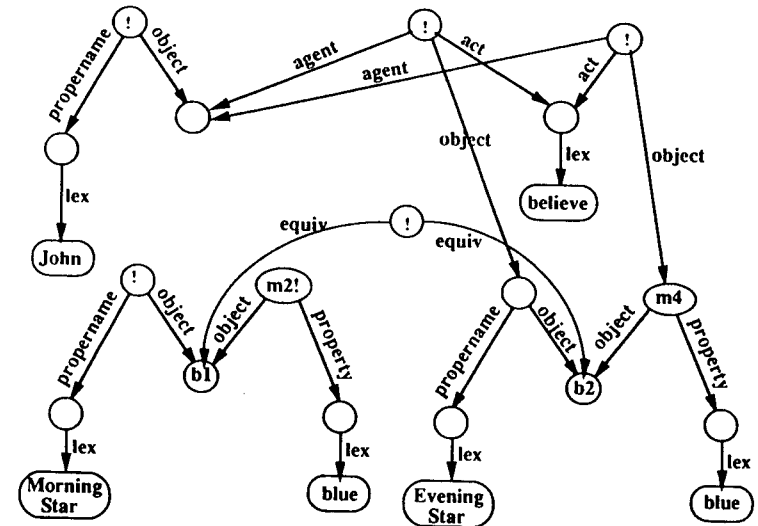


Figure 4: Rapaport's Representation of (44) - (46).

- (50) The Morning Star is blue.
- (51) John believes that the Evening Star is blue.
- (52) John's Evening Star is the Morning Star.
- (53) Of the Morning Star, John believes that it is bright.

Figure 5 shows Rapaport's representations of (50) - (52) together with two alternative representations of (53), which are shown by the dotted lines.

The difficulty is now straightforward. Alternative 2, but not alternative 1, licenses CASSIE to report

- (54) John believes that the Evening Star is bright,

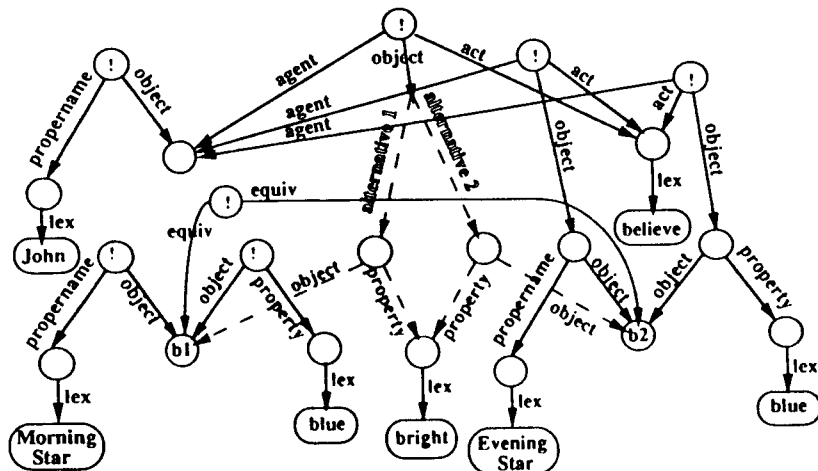


Figure 5: Rapaport's Representation of (50) - (53).

even though (54) does follow from the sentences given. Rapaport's theory therefore *requires* that an extensional occurrence of *the Morning Star*, as in (53), refer to b1, rather than to b2. In other words, it must favour alternative 1 over alternative 2 as the representation of (53). But what reason could be given for doing so?

One possible reason might be that an extensional occurrence of a name, such as *the Morning Star* in (53), refers to the base node connected to the name via the arc (lex- proper-name- object).

This must be rejected, for in that case, if instead of (53), we considered the extensionally equivalent proposition

(55) Of the *Evening Star*, John believes that it is bright,

then the representation would now be as per alternative 2, and the invalid inference to (54) would now be licensed after all.

A second possible reason might be that *the Morning Star* in (53) refers to the thing that CASSIE, not John, holds to be named *the Morning Star*. But, b1 and b2 are *equally* the thing that CASSIE holds to be so named. There is no general way for the network to remember that b1 was created to represent one of CASSIE's concepts, but b2 was created to represent (one of CASSIE's concepts

of) one of John's concepts.

4.2 A Revised Representation of Propositional Attitudes

There are three intermingled sources of the difficulties for Rapaport's theory: the introduction of a new base node in representing belief sentences in the *de dicto* sense; the seductive effect of having base nodes which are "extensionally equivalent" but which, because they are not merged into a single node, tempt one into thinking that an extensional occurrence of a term can refer to one but not the other; and the representation of beliefs the agent holds jointly as if he held them singly.

To solve these difficulties, the following ideas are adopted

- (I) A sentence in the *de dicto* sense will not automatically introduce a new base node. A new base node will be introduced only if CASSIE has specific evidence that the object the *de dicto* sentence is about is one she was not previously acquainted with.
- (II) Multiple beliefs expressed by a single sentence, as in the case of a sentence in the *de dicto* sense, will be represented so as to include the fact that the beliefs are jointly or simultaneously held.

The following methodological principle is also adopted

- (III) No representation should make essential use of the EQUIV/EQUIV case frame. It should make no difference whether nodes linked by the EQUIV/EQUIV case frame are merged into a single node or not. This remains true even when there are opaque contexts at issue. But, to avoid the seductive effect above, merging is highly recommended⁵.

The new representation of the *de re* sentence

(56) Of the *Morning Star*, John believes that it is blue,

is given in Figure 6, and of the *de dicto* sentence

(57) John believes that the *Morning Star* is blue,

in Figure 7. This figure shows how the two beliefs contained in (57) are jointly or simultaneously held: m3 represents the fact that the propositions m1 and m2 jointly held. By locating the TYPE of an act *below* the point at which acts, or sub-acts, are joined, propositional attitudes other than belief can be similarly represented while maintaining the fact that the propositions are jointly held (cf. [11]). Figure 8 shows the representation of

(58) John fears that the *Morning Star* is blue.

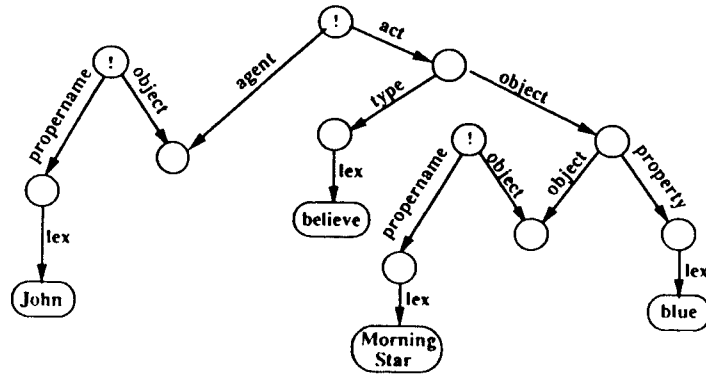


Figure 6: New Representation of (56).

Figure 9 shows the representation of the sentences that caused the problem for Rapaport's theory; viz., (50) - (53). The figure is presented assuming that after (52), the base nodes representing the Morning Star and the Evening Star have been merged, as recommended by III. In order for CASSIE to be able to infer (54), she would have to jointly hold $m1$ and $m5$, which she clearly does not. Inference is controlled by, to put it roughly, transitivity of "jointly held". For CASSIE to be able to infer from (51) that

(59) John believes that the Morning Star is blue,

it is enough that she know

(60) John believes that the Morning Star is the Evening Star.

Figure 10 shows the representations of (51) and (60), from which (59) follows by transitivity of "jointly held". To put it roughly: $m10$ represents John's belief that $m1$ and $m2$, and $m11$ represents John's belief that $m2$ and $m3$, from which we permit the inference to John's belief that $m1$ and $m3$.

4.3 An Extension of the Theory

The above approach is easily extended to apply to things other than ordinary objects, such as concepts and properties. The *de re* and *de dicto* senses of a sentence thus become merely the

⁵The use of the EQUIV/EQUIV case frame is thus merely an issue of whether network should or should not be simplified by merging, and this is at best a minor representation issue.

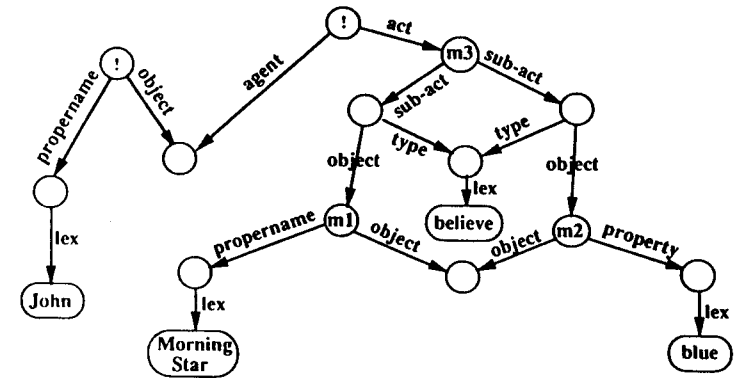


Figure 7: New Representation of (57).

extremes of a range of cases. Suppose that *XX-er* is an adjective meaning that someone has *XX* chromosomes, and so is extensionally equivalent to *female*. Below is a range of cases, which the extended theory can handle.

(61) Henry VIII believes that Lady Jane is female,

where Henry is acquainted with *Lady Jane* and *female*,

(62) Henry VIII believes that the fourteenth queen before Elizabeth II is female,

where he is acquainted with only *female*, and

(63) Henry VIII believes that the fourteenth queen before Elizabeth II is an *XX-er*,

where he is not acquainted with either term.

4.4 Intensional Transitive Verbs

It is also easy to extend the approach to the intensional, transitive verbs so that both senses of:

(64) John loves Mary.

can be represented; viz.,

(65) Of Mary, John loves her,

(66) Of Mary, John *both* loves her and believes that she is named *Mary*.

The representations parallel those of the propositional attitudes.

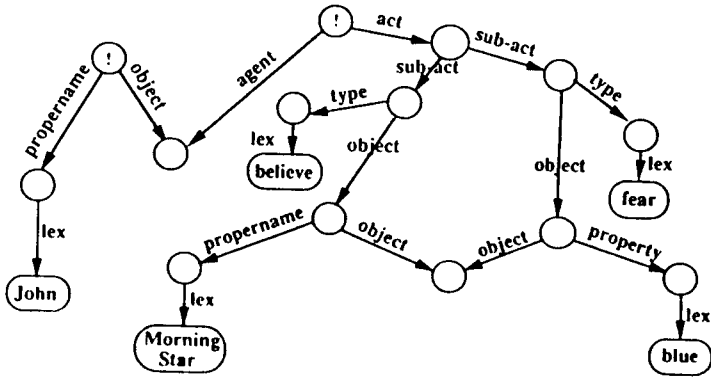


Figure 8. Representation of (58).

5 Opacity of the Second Kind

The logic of the attributive adverbs and the intensional sentences really is quite different from that of the propositional attitudes and the intensional, transitive verbs. Given that:

(67) John swam the river quickly,

and that

(68) John's swimming of the river is identical with John's crossing of the river.

there simply is no other sentence, S, which, together with (1) and (2), would allow CASSIE to infer⁶

(69) John crossed the river quickly.

Because of this difference, quite different representations are provided. The central idea is to represent attributive adverbs using intensional entities, entities which CASSIE holds are governed by non-extensional logic. Thus, though

(70) John swam the river quickly,

and

(71) John crossed the river slowly,

there will be nothing that is both quick and slow.

⁶Except, of course, such S as would *alone* entail (69).

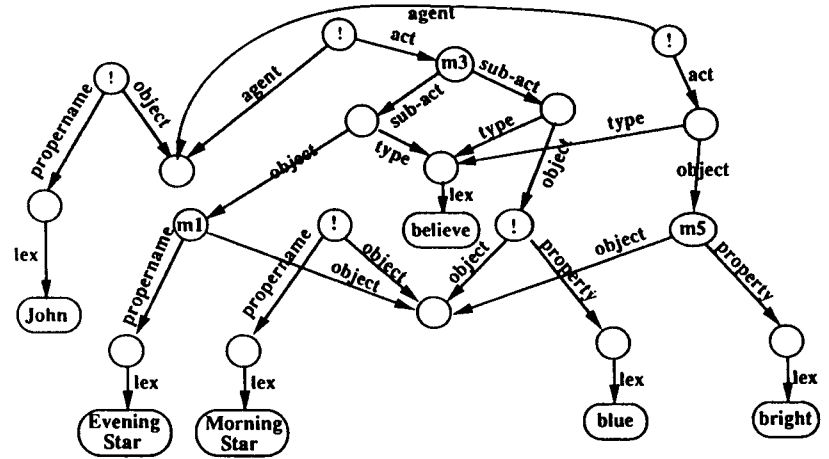


Figure 9: New Representation of (50) - (53).

5.1 Aspects

The intensional objects to be used in our representations are called *aspects*, which are reminiscent of Frege's *senses* [7]. Given a description, d, the Fregean sense associated with it is the *meaning* of d. The aspect associated with d, however, is the result of conceiving of the thing d refers to as, or *qua*, a thing to which the description d applies. Aspects are *objects*, albeit intensional, abstract objects. The general form of an aspect is:

aspect := *object*, *qua* *description true of the object*

In Wyatt [16] this intuitive notion of "qua" is replaced formally using Church's λ -abstraction [3].

5.2 Attributive Adverbs

There has been a considerable amount of work done on the nature of adverbial modification. By and large, there have been two main approaches. The first derives from Davidson's work on the logical form of action sentences [6] and treats adverbial phrases as representing properties of *events*. The second and more common approach treats adverbial as making complex predicates out of a simple ones. According to this approach, the adverb *quickly* in

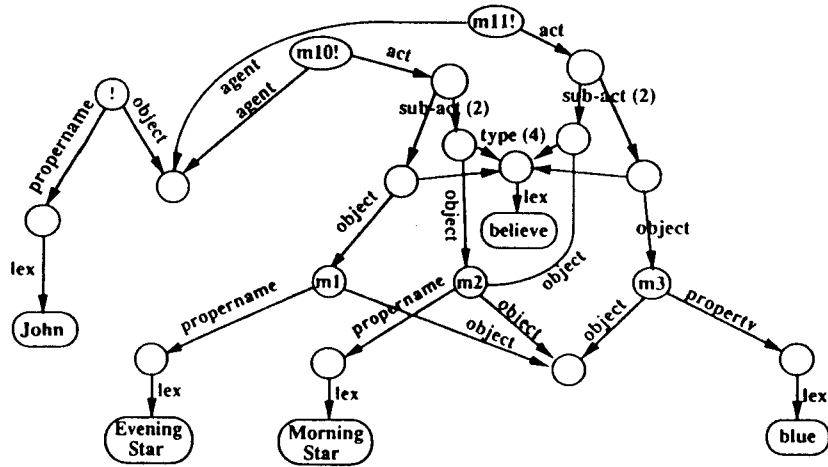


Figure 10: Representation of (51) and (60), from which (59) follows.

(72) John runs quickly

operates on the predicate *runs(x)* to form the *complex* predicate (*quickly(runs)*)(*x*) which is then predicated of John. This approach is favoured by Clark [4], Parsons [13], Montague [9], Thomason and Stalnaker [14], and Cresswell [5]. In this paper, the first approach is followed because the second, though able to accommodate the attribute adverbs, is not able to accommodate the intensional sentences, which, part of my claim is, have the same logical form as the attributive adverbs.

5.2.1 Davidson's Theory of Action

Davidson is concerned with the logical form of action sentences, and in particular, with adverbial modification. He explicitly excludes "intentional" adverbs such as *deliberately*, because they impute intentions to the agent, and "attributive" adverbs such as *quickly*, because of the very inference failures diagnosed above as stemming of opacity. Thus, he considers only sentences in which the action is modified by adverbial phrases, as in

(73) John swam the river near the rapids.

Davidson holds that (73) entails *as a matter of logical form*

(74) John swam the river.

His aim is to capture enough of the internal structure of (73) to reveal such entailments. According to Davidson, verbs of action contain an extra place which refers to the *event* that the verb is then said to be about. Thus, (73) has the logical form

(75) There is an event *e* such that *e* is a swimming, *e* was done by Jones, *e* was done to a river, and *e* was done near the rapids.

In this form, the entailments to the more simple sentences are straightforward. The representation of (73) is in Figure 11. The fact that (73) entails (74) is evident from the fact that the representation of (73) includes that of (74).

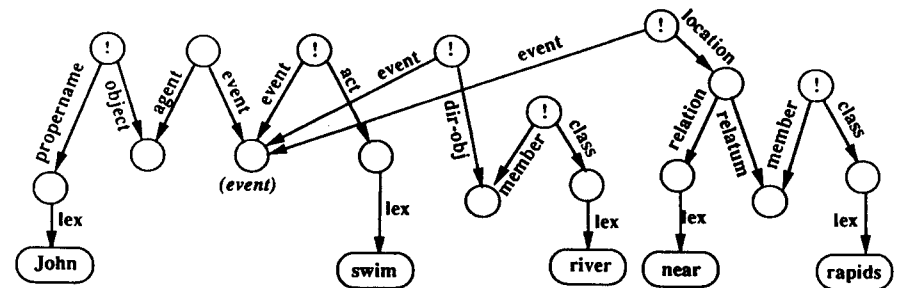


Figure 11: Representation of (73).

5.2.2 The Representation of Adverbs

The sentence containing an attributive adverb

(76) John swam the river quickly,

is understood as having the logical form

(77) There is someone *b*₁ named *John*, there is an action *b*₂ that is a swimming, and there is an object *b*₃ that is a member of the class of rivers, such that *b*₁ is the agent of *b*₂, and *b*₂ has *b*₃ as its direct object, and there is an aspect *a*₁ — *b*₂, qua *m*₁ — which is quick.

Assuming that John's swimming of the river is the *same* event as his crossing of the river, and that

(78) John crossed the river slowly,

the representations of (76) and (78) are as in Figure 12. No inferences from the properties of an aspect to properties of the object the aspect is an aspect of, are permitted. Thus, nothing is said to be both quick and slow, since a1 (i.e., b2, qua being a swimming) is a different aspect from a2 (i.e., b2, qua being a crossing). (Details are in Wyatt [16].)

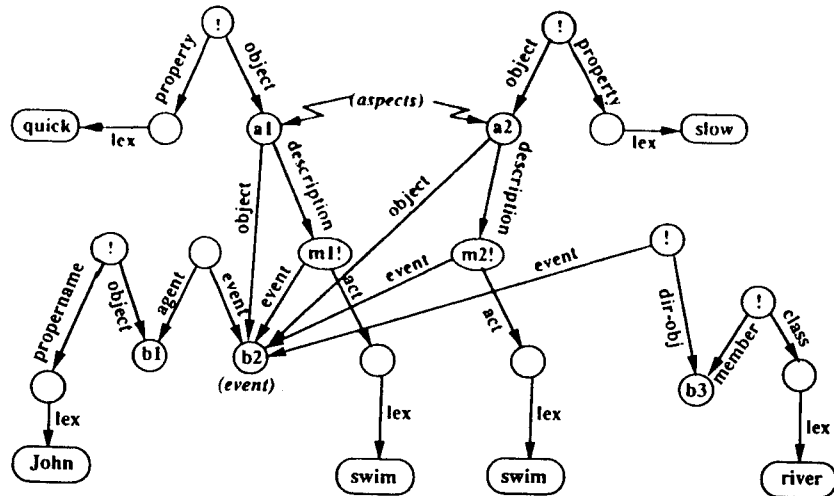


Figure 12: Representation of (76) and (78).

5.3 Intensional Sentences

Finally, intensional sentences are represented in terms of aspects, too. Consider again

(79) The Morning Star is blue,

understood as an *intensional* sentence; that is, so that it is *not* inconsistent with

(80) The Evening Star is red,

(81) The Morning Star is the Evening Star,

and

(82) Nothing is both blue and red.

In this intensional sense, (79) is understood as having the logical form

(83) The Morning Star, qua thing named "Morning Star", is blue,

and is represented in Figure 13.

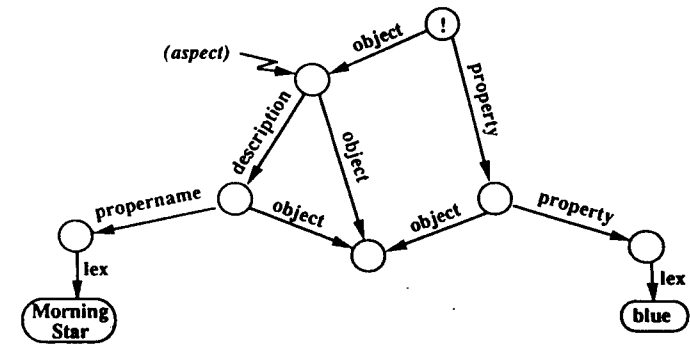


Figure 13: Representation of (79).

6 Conclusion

An examination of various opaque sentences reveals that their logic is far from uniform. The central difference discussed turned on whether or not the inferences that fail because of the opacity can succeed if further information is available. The propositional attitudes and the intensional, transitive verbs are of the first kind. The attributive adverbs and the intensional sentences are of the second kind. The logical form of the two kinds were given distinct representations.

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