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QUANTIFIED MODAL LOGIC, REFERENCE AND ESSENTIALISM

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0. Introduction

Since the publication of Quine's *Reference and Modality* it is widely assumed, by proponents and adversaries of quantified modal logic alike, that there is a close link between quantified modal logic and essentialism. So, for instance, Føllesdal, a proponent, argues that if one wants to quantify into modal contexts without having modal distinctions collapse, then these contexts have to be referentially transparent and extensionally opaque. He also points out that *essentialism* is just this combination of referential transparency and extensional opacity:

> 'Whatever is true of an object is true of it regardless of how it is referred to (referential transparency), and among the predicates true of an object, some are necessarily true of it, others only accidentally (extensional opacity)'.
> (D. Føllesdal: *Quine on Modality*, 184)

Although Quine rejects both quantified modal logic and essentialism, he subscribes to Føllesdal's interpretation (cf. Quine's reply to Føllesdal in *Words and Objections*, 336). Henceforth we will use Føllesdal's definition of essentialism as it is characterized by referential transparency and extensional opacity. (See section 1.)

According to Quine, in order to be able to quantify into modal contexts, these contexts should be referentially transparent: $\exists x[\Box(x>7)]$ holds because $\Box(9>7)$ is true; but 9 = the number of planets; so, $\Box$ (the number of planets > 7) should hold. The latter statement is not true if necessity is necessity de dicto, but it is true if by necessity we mean necessity de re. This is dealt with in detail in section 2.

In the literature it is hold that quantified modal logic involves that the referring terms are rigid designators. Because the arguments rest on de dicto considerations, we say in section 3 that this view of quantified modal logic involves essentialism de dicto. We also argue that this view is on bad terms with essentialism (de re), according to which whatever is true of an object is true of it regardless of how it is referred to. Next we claim in section 3 that —contrary to what is generally hold in the literature— quantified modal logic does *not* presuppose that the referring terms are rigid designators. From an essentialist point of view, there can be no difference (metaphysically) between (i) Hesperus is Phosphorus, and (ii) The Evening Star is the Morning Star. However, proponents of quantified modal logic claim that (ii) is not (metaphysically) necessary, while (i) is.

1. Identity and Substitutivity

Leibniz' Law says that two terms refer to the same thing if one may be substituted for the other with preservation of truth. In contemporary treatments of identity this law is presented as follows:

$$(1) \models a = b \supset (\ldots a \ldots \sim \ldots b \ldots)$$

where $\ldots a \ldots$ is a context containing occurrences of the name a, and $\ldots b \ldots$ is the same context except that one or more occurrences of a have been replaced by b: if $a = b$, then what holds for a also holds for b and vice versa.
In the propositional calculus we have a similar principle, the Replacement theorem:

$$(2) \models A \sim B \supset (\ldots A \ldots \sim \ldots B \ldots)$$

where A and B stand for propositions.
And the analogue of the Replacement theorem for the predicate calculus is principle

$$(3) \models P(a) \sim Q(a) \supset (\ldots P(a) \ldots \sim \ldots Q(a) \ldots)$$

where P and Q stand for predicates (with one argument).
These three principles which express successively referential transparency (1) and extensional transparency ((2) and (3); in the case of sentences: truth-functionality) hold for extensional logic.

As pointed out by Quine and others, transferring principles (2) or (3) from classical propositional or predicate logic respectively to modal logic would erase the distinction between truth and necessary truth. The arguments are simple. Remember that $\models E$ if and only if for any world w, $w \models E$; where $w \models E$ stands for "E is true in w".

Suppose (2) also held for intensional contexts. Then, in particular, $\models A \sim B \supset (\Box A \sim \Box B)$. Taking the expression $a = a$ for A, it follows that $\models B \supset \Box B$, since both $a = a$ and $\Box(a = a)$ hold in any world w. Because we also have the converse, $\models \Box B \supset B$, it follows that $\models B \sim \Box B$. Suppose (3) also held for intensional contexts. Let w be any world and suppose $w \models B$. Taking $P(a) := a = a$ and $Q(a) := a = a \& B$, we then have $w \models P(a) \sim Q(a)$ and hence, by principle (3), $w \models \Box(a = a) \sim \Box(a = a \& B)$. Since $\Box(a = a \& B)$ is equivalent to $\Box(a = a) \& \Box B$, it follows that $w \models \Box B$. So, we have shown that from principle (3) it follows that $\models B \supset \Box B$ and therefore $\models B \sim \Box B$.

Consequently, principles (2) and (3) should *not* hold for modal contexts. In other words, modal contexts should be *extensionally opaque*; that is, —formulated negatively— general terms and sentences with the same extension (truth value in the case of sentences) must in general not be interchangeable with preservation of truth. Such interchangeability would amount to a collapse of modal distinctions. Formulated positively, extensional opacity means that some properties belong to things necessarily and other properties, identifying the same object, belong to things only accidentally. For instance, "being equal to itself" is a necessary property of the object referred to by 9, while "being equal to the number of planets" is an accidental property of the same object.

2. *Referential Transparency*

Before discussing the notion of referential transparency it seems useful to state the characteristics of the positions which play a role in our discussion.

The three aforementioned principles hold for extensional logic. In other words, *extensional logic* is characterized by

1) referential transparency (Leibniz' Law, principle (1)), and
2) extensional transparency (truth-functionality in the case of sentences).

Modal logic is extensionally opaque. If we accept Føllesdal's definition, we must acknowledge the validity of principle (1) for modal logic as well. Accordingly, the following principles are assumed to hold for *modal logic*:

1) referential transparency, and

2) extensional opacity (non-truthfunctionality in the case of sentences).

Finally, *essentialism*, according to Quine,

> 'is the doctrine that some of the attributes of a thing (quite independently of the language in which the thing is referred to, if at all) may be essential to the thing, and others accidental'. (WP 175-176)

This, we think, corresponds quite closely with Føllesdal's definition.

At first sight it seems very easy to assess where the three positions differ and where they agree. All three of them are supposedly characterized by referential transparency. Modal logic and essentialism agree in their extensional opacity —this seems undisputed— and both differ in this respect from extensional logic.

Although Quine subscribes to Føllesdal's description of quantified modal logic and essentialism, he is not an adherent of either of them. On the contrary. Because of Quine's enormous influence in these matters, we will first review his arguments against admitting principle (1) in modal contexts; after that we will discuss at what price, according to Quine, one could defend quantified modal logic.

Principle (1) expresses referential transparency. Given a true identity statement, this principle says that one of its two terms may be substituted for the other in any statement *salva veritate*. Although it is easy to find examples to the contrary, the basis of this principle seems solid. As Quine puts it:

> 'Failure of substitutivity reveals merely that the occurrence to be supplanted is not *purely referential*, that is, that the statement depends not only on the object but on the form of the name. For it is clear that whatever can be affirmed about the object remains true when we refer to the object by any other name.' (LPV 140)

This makes one wonder at the outset what could be the force of Quine's argument against proponents of necessary properties, of necessity as something inhering in things themselves. Quine argues that modal (necessity) contexts are afflicted by failure of substitutivity, i.e., by referential opacity. Whatever may be the force of this argument, here —in the text just quoted— Quine argues the more important point, to wit, that what is true of an object is true of it regardless of how it is referred to. And for both essentialists and modal logicians this certainly will encompass necessary properties.

In order to see why modal contexts are afflicted by referential opacity, let us consider the following true statements.

(i) The number of planets = 9.
(ii) 9 is necessarily greater than 7.

Substituting 'the number of planets' for '9' in (ii) results in the false statement

(iii) The number of planets is necessarily greater than 7.

Given the truth of (i) and (ii) and remembering Quine's point that whatever is true of an object remains true of it when we refer to it by another name, one wonders perhaps why (iii) is false. To make Quine's stand clear, two points should be considered. Firstly, Quine takes 'necessarily' here to mean the same as 'analytic'. Thus, (iii) is equivalent to

(iv) 'The number of planets is greater than 7' is analytic.

Presupposing an intuitive understanding of 'analytic', it seems clear that (iv) is false. Secondly, terms like 'analytic', 'analyticity', 'necessary' and 'necessity' are dependent on our way of referring to objects; only relative to specifying an object can we distinguish its essential and accidental traits, but not absolutely, not as attaching to the object itself. This point is repeatedly emphasized by Quine (Cf. LPV 148, 149, 151, 155). Following tradition we could say: necessity is only *de dicto*, not *de re* (does not attach to things themselves).

In responding to Quine's criticism of modal logic, some philosophers have taken recourse to a purified universe, limiting their ontology to *intensional* objects by restricting the values of their variables. That is to say, all objects nameable by names which fail the test of interchangeability in modal contexts are rejected; the only objects remaining are such that any two conditions uniquely determining those objects are analytically equivalent.

This solution proved to be mistaken (Cf. LPV 152 f, WO 197 f). More important, however, is the fact that both Quine's argument and the proposed remedy against it turn heavily on the notion of analyticity or necessity de dicto (Cf. LPV 155). The question then is whether Quine's argument poses a real threat to the proponents of quantified modal logic. Clearly, it does not. One can agree with Quine's argument *without* giving up one's adherence to quantified modal logic. There is no reason why an adherent of quantified modal logic or essentialism could not acknowledge analyticity and agree that 'necessary' sometimes just means 'analytic' and that principle (1) does not hold generally for sentences ruled by 'is analytic' (Cf. iv) above). On the other hand, a proponent of quantified modal logic or essentialism must deny that (iii) could *only* mean what we expressed by (iv) and nothing else. As Quine himself has put it in later work (Cf. TT 114-115; PT 73): (iii) is *false de dicto* (that is, if we suppose (iii) to be equivalent to (iv)), but *true de re* (i.e., if we mean by (iii) that it belongs to the essence of 9, the object referred to by 'the number of planets', to be greater than 7).

Quine's argument that necessity contexts are afflicted by referential opacity obtains only if we take necessity as necessity *de dicto*. It follows, so it seems at least, that if we conceive of necessity as necessity *de re*, as attaching to things themselves, we will not be troubled by referential opacity. Thus, from a purely formal point of view, there seem to be no restrictions on quantified modal logic. However, the price, according to Quine, we have to pay for accepting quantified modal logic is to commit ourselves to 'the metaphysical jungle of Aristotelian essentialism'. (Cf. WP 176).

As we saw before, both quantified modal logic and essentialism are positively characterized by referential transparency, as is extensional logic. Nonetheless, we shall argue in the next section that quantified modal logic and essentialism should be distinguished precisely in respect of this supposed referential transparency.

3. Quantified modal logic, reference, and essentialism

We have mentioned before attempts to meet Quine's criticism of modal logic by limiting the ontology to *intensional* objects; the only objects remaining then, we saw, are such that any two conditions uniquely determining those objects are analytically equivalent. We will not consider these attempts —if only to avoid discussions concerning analyticity— and focus our attention on more recent attempts to defend quantified modal logic.

Consider the following formula: $\forall x \forall y[x = y \supset \Box(x = y)]$ which is a consequence of Leibniz' Law (1).

According to Quine's exposition of quantified modal logic (cf TT 116 f), the only terms allowed to replace the variables in this formula are Kripke's rigid designators or Føllesdal's genuine names. (For our purposes both can be equated.) That is to say, terms which in all possible worlds refer to the same object they refer to in the actual world. The same point is defended by Føllesdal (cf. 1986, p. 102). Føllesdal even wants to limit *all* the terms we usually consider to be referring to genuine names (rigid designators). He proposes this as a Kantian regulative idea (ibidem, p. 111).

If such a restriction is imposed on our referring terms in necessity contexts, it is easy to see what *referential transparency* comes down to in quantified modal logic. If any terms (to wit, rigid designators) are co-referential, they may be substituted for each other in all contexts salva veritate. To the objects designated by those terms (i.e., rigid designators), quantified modal logic attributes some properties as *necessary* properties, others only as accidental ones (extensional opacity). In this sense quantified modal logic implies *essentialism*. For reasons which will become clear later on, we will speak here of *de dicto* essentialism.

Extensional logic is also characterized by referential transparency but, unlike quantified modal logic, it does not impose restrictions on its referring terms. On the contrary, any co-referential terms whatsoever are substitutable for each other salva veritate. Although it is defensible, in a sense, to say that both quantified modal logic and extensional logic are characterized by referential transparency, it is clear that *extensional* logic rests on a broader concept of referring or, alternatively, accepts more expressions as *referring* expressions than quantified modal logic (as it appears in the literature) wants to accept. In a word, extensional logic does not limit its referring expressions to rigid designators; any co-referential terms meet the requirement of referential transparency.

The question now is whether it is possible to defend another kind of essentialism which combines the extensional opacity (as characteristic of quantified modal logic) with the broad conception of referential transparency which is prevalent in *extensional* logic. We will denominate the kind of essentialism proposed here as essentialism *de re*. We will argue that the distinction between necessary and contingent truths, as defended by quantified modal logic, turns on considerations which are *external* to the necessity advocated by essentialism de re.

Consider again the examples given by Quine.

(i) The number of planets is necessarily greater than 7.
(ii) 9 is necessarily greater than 7.

As we saw before, (i) is *false de dicto*, but *true de re*; (ii) is true de dicto as well as de re.

We now want to determine whether this de re —de dicto distinction also makes sense with regard to some other well-known examples. Kripke, for instance, argues that there is a fundamental difference between

(iii) Hesperus is Phosphorus, and
(iv) The Evening Star is the Morning Star.

(iii) would be metaphysically necessary because 'Hesperus' as well as 'Phosphorus' are supposed to be *rigid* designators. On the other hand, (iv) would be only contingently true because 'the Evening Star' and 'The Morning Star' are considered to be *accidental* designators.

Let us state the following premisses which are generally acknowledged, at least by modal logicians.

1. (Self-)identity is a necessary property.
2. 'Hesperus', 'Phosphorus', 'the Evening Star', and 'the Morning Star' all refer to the same object, the planet Venus.
3. 'Hesperus' and 'Phosphorus' are rigid designators.
4. 'The Evening Star' and 'the Morning Star' are accidental designators.

Given these premisses we could read (iv) above as follows:
The object, variously referred to by 'the Evening Star' and 'the Morning Star', i.e., the planet Venus, is necessarily identical with itself.

Here we have a clear *de re* reading of (iv), moulded upon the example of the de re reading of (i) above. More importantly, it is evident that in this *de re* sense, (iv), just like (i), should be considered as true. This means that, in this *de re* sense, (iv) is a *necessary* truth. Assuming the truth of the premisses, one cannot deny (iv) on penalty of contradiction.

A de re reading of (iii) leads, of course, to the same result. So we see that both (iii) and (iv), on a *de re* reading, should be considered as *necessary* truths. This follows from premisses 1. and 2., and from these *alone*.

This de re reading of (iii) and (iv) comes down to a kind of essentialism which combines the referential transparency that is prevalent in *extensional* logic (cf. premiss 2) with extensional opacity. (The latter, of course, only if we assume —not unreasonably— that not *all* the properties a thing has are necessary.) Earlier we characterized this kind of essentialism as essentialism *de re*.

Before turning to a *de dicto* reading of (iii) and (iv) it is useful to have a closer look at the premisses stated above. Only premiss 1 is of a metaphysical nature and has to do with necessity *de re*. (According to Kripke —cf. NN 108, for instance— 1 would hold even if we had no referential apparatus at all.) The others are factual (2) or concern (the peculiarity of) our referential apparatus (3 and 4). As we saw, our de re reading of (iii) and (iv) —according to which both are necessary truths— rested on only premisses 1 and 2. This makes it clear from the outset that any alleged difference between (iii) and (iv) should be founded on considerations which are independent of these two premisses (in particular, the first one).

Let's now turn to a *de dicto* reading of (iii) and (iv). The point we just made is corroborated by the way Kripke in particular tries to establish the supposed difference between (iii) and (iv). Kripke classifies (iv) as a *contingent* truth and (iii) as a *necessary* one, on the grounds that the referring terms of (iv) are accidental designators and those of (iii) rigid ones. It is clear that this supposed difference between (iii) and (iv) rests on premisses 3 and 4 which concern our referential apparatus. The difference between (iii) and (iv) is accounted for by means of the distinction between rigid and accidental designators; this distinction, in turn, reflects the different ways we refer to objects. As the difference between (iii) and (iv) arises from our referential apparatus, our different ways of referring to objects, it should be characterized as *de dicto*. The referring terms of (iii) then, being rigid designators, could not have designated, in any possible world, an object different from the one they designate in the actual world. That is why we may characterize (iii) as a *de dicto* necessary truth. On the other hand, the referring terms of (iv) might have referred, in another possible world, to something different. So (iv), unlike (iii), cannot be classified as a *de dicto* necessary truth, but should be considered as a contingent one as the negation of (iv) might have been true.

But what has all of this to do with *de re* or metaphysical necessity (or contingency)? We just remarked that the negation of (iv) might have been true. But, whatever way one prefers to interpret the negation of (iv), there is one thing no such interpretation could come down to: the *denial* of our *de re* reading of (iv). That would involve a straightforward contradiction. So, although (iv) is, in a sense, contingent (i.e., de dicto), and the arguments of modal logicians aim at establishing its *metaphysical* contingency, these arguments, based as they are on de dicto considerations (premisses 3 and 4), *are not* and *cannot be* detrimental to the metaphysical (de re) status of (iv) as a *necessary* truth.

Because the arguments of modal logicians in regard to (iii) and (iv) rest on de dicto considerations, we have characterized the essentialism involved by quantified modal logic as *de dicto* essentialism. (Alternatively we could have called it essentialism de re mixed up with some de dicto elements. However, we will not quarrel over words).

It is easy to see why there can be no choice between essentialism de re and essentialism de dicto. One more look at our premisses (1 - 4) makes this clear. Our de re reading of (iii) and (iv) —based on premisses 1 and 2 - involved essentialism de re. This essentialism de re (premiss 1) is necessarily presupposed by quantified modal logic, although in its classification of truths —exemplified here by (iii) and (iv)— quantified modal logic does not do justice to this point. The converse, however, does not hold. Essentialism de re is independent of quantified modal logic (as it appears in the literature), as is shown by the former's independence of the premisses 3 and 4, which are of crucial importance to quantified modal logic. Quantified modal logic can be viewed as a combination of essentialism de re and some fundamental assumptions concerning our referential apparatus. This combination comes to the fore most clearly in the way modal logicians distinguish between necessary and contingent truths. With the help of (iii) and (iv), we have shown that quantified modal logic (as it appears in the literature) acknowledges as (metaphysically) *necessary* truths only those which are necessary de re as well as de dicto (that is to say, with the exclusion of truths like (iv) which are only necessary de re).

By making a distinction 'de re - de dicto' in regard to the examples (iii) and (iv) we have tried to make it clear that essentialism (de re) and quantified modal logic (as conceived by Quine, Føllesdal, Kripke and others) cannot be identified. On the contrary. Metaphysical or de re essentialism is quite independent of quantified modal logic; this latter, on the other hand, presupposes essentialism de re and is dependent on it. The essentialism that is implied by quantified modal logic —earlier we called it de dicto essentialism— is, we saw, a mixture of essentialism de re and de dicto elements, inherent in our referential apparatus. This mixture becomes prominent in the way quantified modal logic distinguishes between necessary and contingent truths, by using the distinction between rigid and accidental designators. It must be clear from the above that —from a de re essentialist point of view— quantified modal logic gives a distorted picture of the metaphysical facts because it excludes those truths as necessary ones which are only de re necessary.

Next, we will consider how essentialism de re and quantified modal logic fare with respect to the modal version of Leibniz' law (1):

$(1^*) \models a = b \supset \Box(a = b)$.

1) An essentialist (de re) would read (1 *) as a statement about *objects*, saying that if two objects are identical, they are necessarily identical. (cf. Kripke NN 107-108).
2) Although a modal logician cannot deny the essentialist interpretation of (1*), he *adds* something to it, to wit, the following condition: '*a*' and '*b*' are *rigid designators*. This addition is *not* necessary. First, there is the trivial point that any term can be said to be equal to itself in a necessity context. Substitute '*a*' for '*b*'. Then surely $a = a$ and $\Box(a = a)$, also when '*a*' is not a rigid designator. So, as we saw before, when we take necessity as necessity *de re* (in the sense of premiss 1), there is no need to impose restrictions on our referring terms.
3) To add weight to our point that '*a*' and '*b*' need not be rigid designators, we will now consider a third reading of (1*), at odds with both our first and our second one: if '*a*' and '*b*' are co-referential, they are co-referential in all possible worlds; the *object* they refer to, however, need not be the *same* in all possible worlds. To make things vivid, imagine both '*a*' and '*b*' in the actual world to refer to, say, Quine, and in another one to Kripke.

Far-fetched as this interpretation may be, its most significant point is that it *excludes* the possibility of '*a*' and '*b*' being rigid designators; these latter refer in all possible worlds to the *same object* they refer to in the actual world. As we said, this third reading is also at variance with our first *de re* reading; in the latter it is the same object, in all possible worlds in which it exists, that is at stake, whether we refer to it or not. The importance of this third reading, however, is that it adds weight to our contention that the scope of (1*) is not limited to rigid designators.

The following observation is due to Stephen Read and is acknowledged gratefully. Let x and y refer to the same object o in this world and suppose z is a rigid designator for o. Then $w \models x = z$; so, according to (1*) x and z refer to the same object o in every world w'. Using a similar argument with y instead of x then yields that x and y refer to the same object o in any world w' and hence would be rigid designators after all. However, this argument —interesting as it is— presupposses that any object o has a name which is a rigid designator. We believe this is not the case.

So, we have two objections against the view that quantified modal logic presupposes that the referring terms are rigid designators:

1. The requirement that the referring expressions should be rigid designators is on bad terms with the first feature of essentialism: whatever is true of an object is true of it regardless of how it is referred to.
2. Although (1*) certainly holds for rigid designators, (1*) does *not* imply that the referring expressions should be rigid designators. It only says that if x and y refer to the same object o in this world w, then they refer to the same object o' in every world w', where o' may be different from o.

Finally, we remark that the ambiguity of, for example, □ (the number of planets > 7), which can be read both de dicto and de re, can be avoided by using the expression "the number of planets in this world w_o". "The number of planets" can be seen as a function that assigns a name to every possible world w.

Conclusion: Quantified modal logic (as it appears in the literature) and essentialism (de re) *should* be distinguished. On the other hand, we can stick to Quine's and Føllesdal's definition of essentialism on the proviso that we take referential transparency in the sense that is prevalent in *extensional* logic. Quantified modal logic corresponds with a de dicto essentialism in which the referential transparency has a bearing on rigid designators. In de re essentialism the referential transparency has a bearing on arbitrary designators. Contrary to what is generally hold in the literature, quantified modal logic does *not* presuppose that the referring terms are rigid designators.

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