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ORIGINAL RESEARCH

On the translation from quantified modal logic to Counterpart Theory

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Abstract
Lewis (1968) claims that his language of Counterpart Theory (CT) interprets modal discourse and he adverts to a translation scheme from the language of Quantified Modal Logic (QML) to CT. However, everybody now agrees that his original translation scheme does not always work, since it does not always preserve the 'intuitive' meaning of the translated QML-formulas. Lewis discusses this problem with regard to the Necessitist Thesis, and I will extend his discourse to the analysis of the Converse Barcan Formula.

Everyone also agrees that there are CT-formulas that can express the QML-content that gets lost through the translation. The problem is how we arrive to them. In this paper, I propose new translation rules from QML to CT, based on a suggestion by Kaplan. However, I will claim that we cannot have 'the' translation scheme from QML to CT. The reason being that *de re* modal language is ambiguous. Accordingly, there are different sorts of QML, depending on how we resolve such ambiguity. Therefore, depending on what sort of QML we intend to translate into CT, we need to use the corresponding translation scheme. This suggests that all the translation problems might just disappear if we do what Lewis did not: begin with a fully worked out QML that tells us how to understand *de re* modal discourse.

Keywords David Lewis · Counterpart theory · Quantified modal logic · Necessitist Thesis · Converse Barcan Formula

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1 Introduction

Lewis (1968) claims that his language of Counterpart Theory (CT) interprets modal discourse and he adverts to a translation scheme from the language of Quantified Modal Logic (QML) to CT in order to support his claim. Everybody now agrees that his original translation scheme does not always preserve the 'intuitive' meaning of the translated sentences, since it translates contentious metaphysical theses of QML into first-order logical truths. There is much discussion about this problem with regard to the Necessitist Thesis. I will extend this discourse to the analysis of the Converse Barcan Formula.

Everyone also agrees that there are CT-sentences that can do the work, namely, that can express the QML-content that gets lost through the translation. The problem is how we arrive to them. Many authors attempt to provide new translation schemes from QML to CT (see, for instance, Forbes 1982, 1990; Ramachandran, 1989). Others argue that no new translation scheme is needed, because, as Lewis claims, we do not always need to pass through QML: when Lewis's scheme does not work, we can simply translate the natural language directly into CT, with no need for any structural principles to employ in order to arrive to our candidate CT-formulas (Hunter & Seager, 1980). In this paper, I propose a mixture between these two strategies. I will provide new translation rules from QML to CT, based on a suggestion by Kaplan, so that we have structural principles to apply in order to get the CT-formulas that correctly translate the QML language, if it gets lost through Lewis's original translation scheme. However, I will claim that we cannot have 'the' translation scheme from QML to CT. I will argue that this is the consequence of the fact that there are different ways to resolve the ambiguity of *de re* modal discourse into the language of QML, to which correspond different translation schemes from QML to CT. My aim is to suggest that all the translation problems might just disappear if we begin with a fully worked out QML that tells us how to understand *de re* modal claims.

2 The change of the intuitive meaning

The translation rules from QML to CT, offered by Lewis's original translation scheme, which are relevant to this paper, are the following (where 'ϕx' is an open sentence and '$(\phi x)^w$' means 'ϕx is true in the world w', the monadic predicate 'W' stands for 'to be a world', and the binary predicates 'I' and 'C' stand respectively for 'to be in a possible world' and 'to be a counterpart of') (Lewis, 1968):

TRa: $(\forall x \phi x)^w$ is $\forall x\ (Ixw \rightarrow \phi^w x)$.[1]
TRb: $(\exists x \phi x)^w$ is $\exists x\ (Ixw \wedge \phi^w x)$.
TRc: $(\Box \phi x)^w$ is $\forall y\ \forall z\ ((Wy \wedge Izy \wedge Czx) \rightarrow \phi^y z)$.
TRd: $(\Diamond \phi x)^w$ is $\exists y\ \exists z\ (Wy \wedge Izy \wedge Czx \wedge \phi^y z)$.

[1] '$\phi^w x$' is a convenient notational variant for '$(\phi x)^w$'.

In the next Sections, I will show that some important modal formulas change their intuitive meanings in the process of their translations from one language to the other. I will not offer a detailed analysis of the notion of 'intuitive meaning' of a formula. However, as I interpret this notion, the intuitive meaning of a formula is given both in terms of the content expressed by the sentence which that formula intends to represent, and in terms of the inferences that can be drawn from its truth and its falsity.

2.1 The Necessitist Thesis

Lewis (1968) showed awareness of the problem of the change of intuitive meaning with regard to the QML-formula NE:

NE: $\forall x \Box \exists y\ (x=y)$,

which informally claims that every actual thing necessarily exists. NE is a formula relevant to the necessitism/contingentism debate, recently brought to the fore of philosophical discussion by Timothy Williamson in 'Modal Logic as Metaphysics' (2013). Indeed, necessitists take NE to be valid, while contingentists deny it.[2] The reason is that the validity of NE in QML implies that every actual thing exists in each and every world, namely, it rules out contingent actual existence. Lewis claims: 'It may disturb us that the translation of $\forall x \Box \exists y\ (x=y)$ (everything actual necessarily exists) comes out true even if something actual lacks a counterpart in some world' (1968: 119). Indeed, NE is formalized in CT by the formula NE*:

NE*: $\forall x\ (Ix@ \rightarrow \forall y\ \forall x_1\ ((Wy \wedge Ix_1y \wedge Cx_1x) \rightarrow \exists x_2\ (Ix_2y \wedge x_2=x_1)))$.

(where '@' stands for 'to be the actual world'). Lewis's approximation to validity for a formula is that its translation into CT turns out to be a theorem of CT (1968).[3] In order to determine whether or not NE* is a theorem of CT, let us say that if there is a description of the pluriverse that is consistent with the axioms of CT and in which NE* fails, then NE* is not a theorem of CT.

NE* turns out to be a theorem of CT, and it is pretty obvious why it is so.[4] NE* is true if and only if (hereafter, iff) for every actual thing, all its counterparts are such that, in their worlds they are something. Therefore, all that the truth of NE* requires is simply that, *if* an entity is a counterpart of an actual thing in some world *y*, then that entity is something in *y*. But of course, *if* there is a counterpart of an actual thing in *y*, then that counterpart is something in *y*. Therefore, NE* is a theorem of CT, since there is no description of the pluriverse in which NE* could fail.

[2] Two points need to be stressed. Firstly, the Necessitist Thesis, as it has been formulated by Williamson (2013), is a formula stronger than NE, namely NNE: $\Box\forall x \Box\exists y\ (y=x)$. However, whatever I will say about the translation of NE into CT holds for the translation of NNE as well. Secondly, for Williamson, in order to express necessitism, NNE should be read with unrestricted quantification. However, I will ignore this complication, which serves no purpose in this context.

[3] The logical kernel of CT is first-order logic with identity. No modal operator occurs in it and the axioms of CT determine how some primitive predicates, such as *I*, *W* and *C* I have introduced above, work. Inasmuch as validity only concerns the logical kernel, it is slightly misleading to qualify as validity the status of CT theorems. However, the CT-formula that I am discussing (NE*), as the reader can easily see, is logically valid.

[4] As anticipated, NE* is a logical truth of first-order logic, and all logical truths of first-order logic are theorems of CT.

I claim that what bothers Lewis is that the intuitive meaning of NE gets lost in its translation into CT. NE tells us that every actual thing necessarily exists, but its translation in CT, NE*, says that every actual thing is something in all the worlds in which it exists. Moreover, the theoremhood of NE*, as the reader can easily see, has nothing to do with whether or not actual individuals necessarily exist, which is to say, from the perspective of CT, that the truth of NE* has no bearing on the matter as to whether or not actual individuals have counterparts in all the worlds. Accordingly, since Lewis surely believed in contingent actual existence,[5] the theoremhood of NE* in CT does not rule out that some actual individuals exist contingently.

The problem is that the QML-formula NE has an existential import that gets lost through the translation into CT. Let us distinguish between the 'strong' and the 'weak' reading of the *de re* necessity. According to the strong reading, for an entity *a* to be necessarily *F*, *a* has to be *F* in all the worlds. The weak reading, instead, only asks *a* to be *F* in all the worlds *in which it exists*, so that it makes the *de re* necessity conditional upon the existence. Hence, when the box in NE is read as strong, saying that every actual thing necessarily exists is tantamount to say that every actual thing exists in every world. By contrast, the weak reading of the box delivers the trivial content that every actual thing exists in all the worlds in which it exists. It is because the box in NE is read as strong that NE has the existential import that makes it valuable in the necessitism/contingentism debate. By contrast, NE* expresses the weak reading of the *de re* necessity, and that is why it lacks the existential import.

2.2 The Converse Barcan Formula

Let us consider, now, another formula that is relevant to the necessitism/contingentism debate: the Converse Barcan Formula (CBF):

CBF: $\Box \forall x \, Fx \rightarrow \forall x \, \Box \, Fx$.

CBF informally claims that, if necessarily everything is *F*, then every actual thing is necessarily *F*. Necessitists usually take CBF to be valid, while contingentists take such formula to be invalid. Indeed, necessitists believe that the domain of what exists at a world does not change from one world to another,[6] and the validity of CBF in QML rules out that old individuals go missing in counterfactual situations. In fact, a counterexample to the validity of CBF would be given by a model in which the domains associated to the worlds are decreasing. Precisely, if it is possible for an actual entity *a* to disappear in a counterfactual situation, then the fact that necessarily everything is *F* (namely, the truth of the antecedent of CBF) does not guarantee the

[5] Lewis's notorious modal realism without overlap leads him to admit contingent (actual) existence. However, as we know, Lewis accepts that (actual) individuals exist according to different worlds, through their counterparts. But it is sufficient for the contingent existence of an (actual) individual that there should be some possible worlds in which it has no counterparts, and it is an evident feature of modal realism, via recombination (Lewis, 1986: 87–92), that it is so.

[6] Recall, indeed, that necessitists take NE and NNE to be valid. However, note that necessitists may be modalists, that is they may accept modality as a brute fact that cannot be explained. In that case, therefore, they would not confer any explanatory power to possible worlds semantics, which the thesis that all worlds have the same domains concerns. However, in this paper, by 'necessitists' I mean necessitists who are not modalists.

truth of the consequent of CBF: indeed, *a* would fail to be *F* in that world in which it does not exist. Note that what just said makes sense only if, for some entity to be necessarily *F*, that entity has to be *F* in all worlds, namely only if the *de re* necessity in the consequent of CBF is read as strong.

Let us see, now, Lewis's translation of CBF into CT:

CBF*: $\forall w\ \forall x\ (Ww \wedge Ixw \rightarrow Fx) \rightarrow \forall x\ (Ix@ \rightarrow \forall w\ \forall y\ ((Ww \wedge Iyw \wedge Cyx) \rightarrow Fy))$.

Informally, CBF* says that, if in all the worlds all the objects are *F*, then all the counterparts of every actual object are *F*. Lewis (1968) claims that the translation in CT of CBF, namely our CBF*, *is* a theorem of CT. And this is trivial. Indeed, the antecedent of CBF* quantifies over everything that exists in every world. If what exists in every world is *F*, then, clearly, all the counterparts of every actual object are *F*: if they exist, they are in some world, according to the postulate P3 of CT (Lewis, 1968), which is to say, they are in the range of variation of the quantification in the antecedent. Therefore, since there are no descriptions of the pluriverse in which CBF* might fail, CBF* is a theorem of CT.

Like NE (and NNE), CBF, in the process of its translation into the CT-formula CBF*, changes its intuitive meaning. First of all, note that CBF*, unlike CBF, reads the *de re* necessity in the consequent as weak. Indeed, what the consequent of CBF* says is that all the counterparts of every actual thing are *F* in the worlds in which they exist, which is to say that every actual thing is *F* in all the worlds in which it exists. Accordingly, while CBF claims that, if necessarily everything is *F*, then every actual thing is (strongly) necessarily *F*, CBF* comes to say that, if necessarily everything is *F*, then every actual thing is (weakly) necessarily *F*. Furthermore, the question whether CBF* is a theorem of CT has no bearing on the question whether domains vary from one world to another, which is to say that CBF* has no existential import. And since Lewis, as I said, believes in contingent existence and, hence, admits that the domains of worlds might decrease, the theoremhood of CBF* does not rule out that there are admissible (for the Lewisian) descriptions of the pluriverse in which individuals disappear in counterfactual possibilities.

The problem is that CBF*, unlike CBF, expresses the weak *de re* necessity in the consequent, and that is why the existential import gets lost through the translation from QML to CT.

3 The source of the loss of the intuitive meaning

The problem I am concerned with in this paper affects the translation of *de re* modal formulas from QML to CT. Whenever counterparts are involved, CT calls for a double quantification (one quantifier that varies over the worlds and the other over the counterparts). Let us focus on rule TRc of Lewis's translation scheme:

TRc: $(\Box\phi x)^w$ is $\forall y\ \forall z\ ((Wy \wedge Izy \wedge Czx) \rightarrow \phi^y z)$.

TRc combines two universal quantifiers. By doing so, it reflects the weak understanding of *de re* necessity: it has no existential import. Therefore, it is because we use TRc that the existential import of NE, CBF (and NNE) gets lost. Accordingly, it is the rule TRc which is the source of the loss of intuitive meaning.

Note that this is also the reason why the Barcan Formula (BF) (another formula that is relevant to the debate on necessitism) keeps its intuitive meaning through its translation into CT.

BF: $\forall x \Box Fx \rightarrow \Box \forall x Fx$.

BF, informally claims that, if every actual thing is necessarily *F*, then necessarily everything is *F*. Necessitists usually take BF to be valid, because the validity of BF in QML rules out that new individuals appear in counterfactual situations. The relevant point for the purpose of the translation of BF into CT is that, unlike what has been said for the *de re* necessity at stake in the consequent of CBF, the *de re* necessity involved in the antecedent of BF does not need to be read as strong. Indeed, let *a* and *b* be all the entities that there actually are, and suppose that *b* does not exist in some world. Suppose now that the antecedent of BF is true: *a* and *b* are necessarily *F*, by being *F* in all the worlds in which they exists. In this scenario, where we are reading the *de re* necessity in the antecedent as weak, we can still say that the truth of the antecedent of BF guarantees the truth of the consequent only if there are no new inhabitants that appear in counterfactual circumstances. This is why the translation scheme works well with BF: since the *de re* necessity involved in the antecedent of BF does not need to be read as strong, then TRc is adequate in this case.[7]

4 Kaplan's suggestion for the translation of the strong *de re* necessity

By employing TRc, Lewis has established that the *de re* necessity always calls for a double universal quantification. David Kaplan suggested rule TRc^K, in place of TRc (Kaplan's proposed translation clause is mentioned in Lewis 1968):

TRc^K: $(\Box\phi x)^w$ is $\forall y\ (Wy \rightarrow \exists z\ (Izy \wedge Czx \wedge \phi^y z))$.

TRc^K, unlike TRc, combines a universal quantifier for the worlds with an existential quantifier for the counterparts. By doing so, TRc^K can preserve, so to speak, the existential import through the translation from QML to CT. Indeed, TRc^K expresses the strong reading of the *de re* necessity: according to TRc^K, for an entity *a* to necessarily satisfy ϕ, *a* needs to have a counterpart in every world which satisfies ϕ.

However, note that TRc^K leaves open the possibility of some counterpart of *a* that does not satisfy ϕ, in some world in which *a* has more than one counterpart. Indeed, TRc^K only demands that in every world there exists a counterpart of *a* that satisfies ϕ. I find this unsatisfactory, because, intuitively, we want *all* the counterparts of *a*, everywhere, to satisfy ϕ, in order to say that *a* necessarily satisfies ϕ. Therefore, I propose to modify TRc^K with $TRc^{K'}$.

[7] The translation of BF into CT is given by BF*:BF*: $\forall x\ (Ix@ \rightarrow \forall w\ \forall y\ ((Ww \wedge Iyw \wedge Cyx) \rightarrow Fy)) \rightarrow \forall w\ \forall x\ ((Ww \wedge Ixw) \rightarrow Fx)$. As I said, the intended meaning of BF is maintained through its translation into BF* of CT. Indeed, BF* expresses the same content expressed by BF in QML: if every actual thing is such that all its counterparts are *F* in their worlds, then in every world everything is *F*. Moreover, BF* would be a theorem of CT under the same conditions at which BF would be valid in QML: iff descriptions of the pluriverse in which new individuals appear in counterfactual situations were not semantically admissible. And, since for Lewis there are semantically admissible descriptions of the pluriverse in which new inhabitants appear in counterfactual possibilities, BF* is not a theorem of CT (Lewis, 1968: 124).

$TRc^{K'}$: $(\Box\phi x)^w$ is $\forall y\ (Wy \rightarrow \exists z\ (Izy \wedge Czx \wedge \forall z_1\ ((Iz_1y \wedge Cz_1x) \rightarrow \phi^y z_1)))$.[8]

I claim that, by means of $TRc^{K'}$, we get all the translations from QML to CT we were looking for.

Let us start with NE, which is translated now by the CT-formula 1*:

1*: $\forall x\ (Ix@ \rightarrow \forall y\ (Wy \rightarrow \exists z\ (Izy \wedge Czx \wedge \forall z_1\ ((Iz_1y \wedge Cz_1x) \rightarrow \exists x_1\ (Ix_1y \wedge x_1 = z_1)))))$.

1* claims that every actual thing has a counterpart in every world, and for every counterpart of an actual thing there is something identical to it. The last part of 1* (from the universal quantifier that quantifies over every counterpart z_1 of x) is redundant. Therefore, 1* simply claims that every actual thing has a counterpart in every world. And recall that NE claims that every actual thing necessarily exists.

Let us consider now CBF:

CBF: $\Box\ \forall x\ Fx \rightarrow \forall x\ \Box\ Fx$.

By means of $TRc^{K'}$, we get CT-formula 2*:

2*: $\forall x\ \forall y\ (Wy \wedge Ixy \rightarrow Fx) \rightarrow \forall x\ (Ix@ \rightarrow \forall y\ (Wy \rightarrow \exists z\ (Izy \wedge Czx \wedge \forall z_1\ ((Iz_1y \wedge Cz_1x) \rightarrow Fz_1))))$.

Recall that CBF claims that, if necessarily everything is *F*, then every actual thing is (strongly) necessarily *F*. 2* intuitively expresses, in counterpart-theoretic terms, the same content expressed by CBF in QML: 2* claims that if everything in every world is *F*, then for every actual thing there is a counterpart in every world, and all the counterparts are *F*.

Therefore, formulas 1* and 2* intuitively express, in counterpart-theoretic terms, the same contents expressed respectively by NE and CBF in QML. Furthermore, 1* and 2* would be theorems of CT at the same conditions at which NE and CBF would be valid in QML: in the former case, iff contingent actual existence were ruled out and, in the latter case, iff descriptions of the pluriverse in which old inhabitants disappear in a counterfactual possibility were not semantically admissible. Accordingly, 1* and 2* express the same intuitive meanings as NE and CBF. And 1* and 2* are not theorems of CT, since they do not follow from the axioms of CT.[9]

5 A point about the CT-formula for CBF

Let us focus on formula 2*, which I said is the correct translation into CT of CBF, since it keeps the intuitive meaning of CBF unchanged. I claimed that, in order to get the correct translations into CT of QML-formulas with the strong *de re* necessity, we need to employ rule $TRc^{K'}$. However, a counterexample might come from what Lewis writes about the following QML-formula:

3: $\exists x\ \Box\ Fx \rightarrow \Box\ \exists x\ Fx$.

[8] Accordingly, for the sake of uniformity, TRc should be replaced by TRc':TRc': $(\Box\phi x)^w$ is $\forall y\ \forall z\ ((Wy \wedge Izy \wedge Czx) \rightarrow \exists z_1\ (Iz_1y \wedge Cz_1x \wedge \phi^y z_1))$. However, the addition to TRc of the existential quantification is redundant. So, in the rest of the paper, I will keep considering TRc. And the same can be said about TRd.

[9] As we know, in order to show that, we only need an admissible description of the pluriverse in which 1* and 2* fail. A description of the pluriverse in which the Lewisian principle of recombination (1986), which is not a theorem of CT, holds will do the job.

'The translation is not a theorem, but would have been under the rejected postulate that, for any two worlds, anything in one had some counterpart in the other' (Lewis, 1968: 124). Therefore, one might be tempted to think that the formula that should stand for CBF in CT is not 2*, but the translation into CT of 3, obtained by means of rules TRc, namely:

3*: $\exists x\, (Ix@ \wedge \forall w\, \forall y\, ((Ww \wedge Iyw \wedge Cyx) \rightarrow Fy)) \rightarrow \forall w\, (Ww \rightarrow \exists x\, (Ixw \wedge Fx))$.

3* informally says that, if some actual thing *a* is such that all of its counterparts are *F* in their worlds, then in every world there exists something that is *F*. As Lewis writes, 3* would be a theorem of CT at the same conditions at which CBF would be valid in QML (and 2* would be a theorem of CT): iff descriptions of the pluriverse in which old inhabitants disappear in a counterfactual possibility were not semantically admissible. And since we know, by now, that such descriptions are admissible for CT, 3* is not a theorem of CT.

Nonetheless, here are the reasons why 2*, rather than 3*, should stand for CBF in CT. The first evident thing that goes missing from CBF to 3* is the contents expressed by the sentences which these formulas mean to represent. While CBF, informally, says that, if necessarily everything is *F*, then every actual thing is (strongly) necessarily *F*, 3*, informally, claims that, if some actual thing is (weakly) necessarily *F*, then necessarily there exists something that is *F*. Hence, it is evident that these two formulas, at least intuitively speaking, say different things.

Furthermore, suppose that in the actual world there are only *a* and *b*, and that *a* exists in all worlds through its counterparts. Then, suppose that *a* is necessarily *F*, so that the antecedent of 3* is true. Now, the truth of the antecedent would guarantee the truth of the consequent even though *b* did not exist in some worlds: 3* would be true in a description in which an old inhabitant disappears in counterfactual situations. Therefore, while CBF and 3* are true at the same conditions (iff decreasing world-domains are not admissible), their falsity has different consequences: while the invalidity of CBF implies that CBF fails in all the decreasing models, from the fact that 3* is not a theorem we cannot infer that 3* fails in all the decreasing models. And the same holds for 3 of QML (3 and 3* share the same intuitive meaning):[10] that is why CBF, rather than 3, is relevant to the debate on necessitism. By contrast, from the non-theoremhood of our formula 2* we can infer that it fails in all the descriptions of the pluriverse with decreasing world-domains.

Therefore, it is true that 3* is a formula whose theoremhood in CT would have the same consequences as the validity of CBF in QML. However, not only CBF and 3* seem to say different things, but also different consequences can be drawn, when they are false, and, as I said in Sect. 2, I take these to be relevant factors to determine the intuitive meaning of a formula. Accordingly, it is 2*, rather than 3*, that expresses in CT the same intuitive meaning of CBF, and it is the rule $TRc^{K'}$ we need to apply in order to get it.

[10] We saw that, for the description with decreasing world-domains to work as a counterexample, CBF needs the strong *de re* necessity. By contrast, as the reader can see, 3 need not involve the strong *de re* necessity. Accordingly, Lewis's original translation scheme works fine with 3: the intuitive meaning is kept through its translation into CT-formula 3*.

6 The *de re* possibility

If we want to keep the inter-definability between necessity and possibility, as we surely do, we need to extend what was said about the *de re* necessity to the *de re* possibility. So, we need to admit a difference between a 'weak' and 'strong' reading also for the *de re* possibility. Such a distinction might sound more intuitive when applied to *de re* necessary sentences. Nonetheless, if it is plausible when applied to the *de re* necessity, then it should be acceptable when applied to the *de re* possibility too. The strong reading of the *de re* possibility is the common one, according to which, for an entity to be possibly *F*, there must be a world in which that entity exists and is *F*. Such a meaning is captured by Lewis's rule of translation TRd, which employs a double existential quantification:

TRd: $(\Diamond\phi x)^{w}$ is $\exists y\, \exists z\, (Wy \wedge Izy \wedge Czx \wedge \phi^{y}z)$.

By contrast, according to the weak reading of the *de re* possibility, some entity *a* is possibly *F* iff there is at least one world in which *a* is *F*, *if a* exists in that world. In order to capture this content, one should use a rule, which combines an existential quantifier for the worlds with a universal quantifier for the counterparts. And that is what the rule suggested by Kaplan (in Lewis 1968) does:

TRd^{K}: $(\Diamond\phi x)^{w}$ is $\exists y\, (Wy \wedge \forall z\, ((Izy \wedge Czx) \rightarrow \phi^{y}z))$.

However, I have modified Kaplan's rule TRc^{K}. Therefore, in order to keep the inter-definability between possibility and necessity, I might feel the need to modify TRd^{K} accordingly:

$TRd^{K'}$: $(\Diamond\phi x)^{w}$:$\exists y\, (Wy \wedge \forall z\, ((Izy \wedge Czx) \rightarrow \exists z'\, (Iz'y \wedge Cz'x \wedge \phi^{y}z')))$.

However, in this case the addition turns out to be redundant and TRd^{K} and $TRd^{K'}$ are equivalent (I will nonetheless focus on $TRd^{K'}$ in what follows).

The rule for translating the weak reading of *de re* possibility is very important, because Lewis (1968) rejects Kaplan's suggestion for alternative translation rules (TRc^{K} and TRd^{K}) precisely because of TRd^{K}. And what bothers Lewis with respect to TRd^{K} applies to my $TRd^{K'}$ as well. I will be back on this point in Sect. 8, since I need to address Lewis's concern, which also affects my proposal for new translation rules.

7 What about the translation scheme?

I believe that we do not need to decide between the two translation schemes, namely between Lewis's proposal (TRc and TRd) and Kaplan's proposal (in my modified version: $TRc^{K'}$ and $TRd^{K'}$). Rather, I believe that we need to clarify what sort of QML we intend to translate into CT. Indeed, as I am going to show, *de re* modal language is ambiguous, and there are different sorts of QML, depending on how we resolve such ambiguity. Therefore, depending on what sort of QML we pick, we would need one translation scheme instead of the other.

We know that Lewis assumes, as the starting point of the process of translation, a QML with world-relative quantifiers (for other ways of setting up a QML, see, for instance, the systems of Zalta & Linsky 1994, and Williamson 2013). However, any specific version of QML needs to take a stand on how to understand *de re* modal claims. In other words, as anticipated, we need to know how the QML we intend to translate into CT resolves the ambiguity of *de re* modal language. For instance, let us consider the following *de re* modal sentence:

4: Everything is necessarily material.

By 4, we might want to say either that every actual thing is material in all the worlds in which it exists, or that every actual thing is material in every world. We know, by now, that the first reading is the weak reading of the *de re* necessity, while the latter is the strong one. Now, the standard translation of 4 into the language of QML is given by formula 4':

4': $\forall x \Box Mx$.

However, without any explicit assumption about the kind of *de re* necessity we are employing in 4', 4' would come out as an ambiguous QML-formula, open to two different interpretations. But clarifying *de re* modal claims is the whole point of a QML. So, the advocates of a QML need to make up their minds whether they want to have a weak or a strong understanding of *de re* necessity. In other words, they need to decide whether the box in 4' stands for the strong or the weak reading. Of course, in order to keep the inter-definability between necessity and possibility, a strong reading of the *de re* necessity gives us a weak reading of the *de re* possibility, and vice versa.[11]

Accordingly, depending on what sort of QML we intend to translate into CT, we would need one translation scheme instead of the other. For instance, if the QML we intend to translate into CT is one which interprets the box in 4' as weak, then we apply Lewis's original translation scheme, with rule TRc, according to which 4' comes to say in CT that every actual thing is such that in all the worlds, if it has a counterpart, then that counterpart is *M*. If, instead, the QML reads the box in 4' as strong, then we need to apply rule $TRc^{K'}$, for which 4' comes to say in CT that every actual thing is such that in all the worlds it has at least one counterpart, and all its counterparts are *M*. Therefore, there is no need to choose, once and for all, between the two translation schemes: depending on which kind of QML we are referring to, we use the corresponding translation scheme.

My point is that it is not as if one translation scheme is wrong and the other is correct. For instance, take again QML-formula NE. When the box in it is read as weak, NE claims something trivial, which is not relevant to the necessitism/contingentism debate. Still, it claims something that someone might want to say. Therefore, we might want to translate into CT that content, and in order to do that, we need to apply rule TRc that delivers to us a formula (NE*), which has the same intuitive meaning as NE, read according to such a QML. Instead, if we want to say something relevant to the necessitism/contingentism debate, we should privilege the strong reading of the box in NE. Then, in order to get that content into CT, we need to use rule $TRc^{K'}$. Therefore, I believe that since there are two different, legitimate ways to interpret the *de re* necessity in modal discourse, to which correspond two different ways to specify a QML, we need two different translation schemes from QML to CT to apply accordingly.

[11] Exploring the relationships between the two different sorts of QML (for instance, if the contents of one are expressible in the other) lies beyond the scope of this paper.

Besides, to choose, once and for all, one translation scheme, instead of the other, would be inappropriate. Indeed, while a QML which interprets the box as strong is appropriate for expressing the interesting contents related to the necessitism debate of QML-formulas NE, CBF (and NNE), there are other cases in which we need a QML which reads the *de re* necessity as weak. For instance, we might want to talk about the properties that an entity has in all the worlds *in which it exists*, namely, about its *essential* properties. In this case, we need a QML that reads the *de re* necessity as weak and, accordingly, TRc is the right rule to apply for getting the correct CT-formulas.

Of course, everything that was said with respect to rules TRc and $TRc^{K'}$ must hold for TRd and $TRd^{K'}$ as well. So, for instance, if a QML that interprets the *de re* necessity as weak is appropriate for talking about essential properties (and, accordingly, we apply rule TRc, in order to get that content into CT), then that same sort of QML, which thus reads the *de re* possibility as strong, must be appropriate for talking about the *accidental* properties (and, accordingly, we apply rule TRd). And indeed this is the case. For instance, when we say that Plato is accidentally a philosopher, because he is possibly not a philosopher, we intend to claim that there is at least one world, in which Plato exists and is not a philosopher (strong *de re* possibility). The weak *de re* possibility would not work in this context. Indeed, let us take a world, *w*, where Plato does not exist. In *w*, the conditional 'if Plato exists, then he is not a philosopher' would be trivially true, because of the falsity of the antecedent, and it would make true that Plato is accidentally a philosopher. However, we want Plato to be accidentally a philosopher by virtue of worlds where he exists and does something other than philosophy.

Now, the fact that the strong reading is the correct interpretation of the *de re* possibility in some case is plain, since, as I said, we are used to such a reading. However, I can easily show that there are cases where the weak reading is the privileged interpretation of the *de re* possibility, and, accordingly, a QML which reads the diamond as weak (and correspondingly the box as strong) is the appropriate one. For instance, we saw that the strong reading of the *de re* necessity is the appropriate one when we want to talk about the *necessary* existence of something: if we say that something necessarily exists, we mean to say that it exists in all the worlds, rather that it exists in those worlds in which it exists. Correspondingly, the weak reading of the *de re* possibility is apt when we want to talk about the *contingent* existence. For instance, if we want to say that Plato contingently exists, namely that he possibly does not exist, the strong reading of the *de re* possibility would not work: we do not want to claim that there is some world in which Plato exists and does not exist, since there would be no such a world. We should rather say that there is some world where, *if* Plato exists, then he does not exist. Accordingly, if there is a world, *w*, where Plato does not exist, the conditional is true, and, hence, it makes true that Plato is possibly non-existent. Instead, in all the worlds in which Plato exists, the conditional is false. So, the contingent existence of Plato depends on the fact that there is some world in which he does not exist, exactly as it should be. Hence, in this case, we need a QML which reads the *de re* possibility as weak and, accordingly, we need to apply rule $TRd^{K'}$ in order to get that content into CT.

Therefore, I aim to suggest that all the translation problems might just disappear if we do what Lewis did not: begin with a fully worked out QML that tells us how to understand *de re* modal discourse.

8 Are Kaplan's rules acceptable?

What I am claiming in this paper is that, since there are different ways to resolve the ambiguity of *de re* modal language, there are different sorts of QML we can pick and, accordingly, we need different translation schemes from QML to CT, depending on what sort of QML we intend to translate: if we mean to translate a formula of a QML which reads the *de re* necessity as strong, then we need to apply the translation scheme suggested by Kaplan; if we intend to translate a formula of a QML which reads the *de re* necessity as weak, we need to apply the original translation scheme proposed by Lewis.

However, there is an important potential problem with this proposal. Lewis dismisses Kaplan's suggestion of alternative rules for the translation of modal operators, because they would make us jump out of 'the frying pain, into the fire' (Lewis, 1968: 119). Indeed, the replacement Kaplan suggests implies consequences, in Lewis's opinion, even worse than the loss of the intuitive meaning of NE. The problem has to do specifically with rule TRd^K, which we need to accept, if we adopt TRc^K. Let us consider formula 5:

5: $\exists x \lozenge (x \neq x)$.

which is the natural translation into QML of *de re* modal sentence 6:

6: something could be distinct from itself.

By employing TRd^K, in place of TRd, 5 would be translated into CT by 5*:

5*: $\exists x (Ix@ \wedge \exists y (Wy \wedge \forall z ((Izy \wedge Czx) \rightarrow z \neq z)))$.

And 5* is true, unless every actual thing has at least one counterpart in every world (Lewis, 1968). But this is, Lewis says, unacceptable.[12] Therefore, he discards Kaplan's suggestion for amending the translation scheme and, eventually, decides to stick with rules TRc and TRd and to reluctantly accept the unpleasant consequences, since the modifications Kaplan suggested lead to even worse consequences.[13]

As it should be clear by now, I do not intend to replace Lewis's rules with Kaplan's rules. Rather, I think that the two translation schemes are both valid: it is only a matter of what sort of QML we intend to translate into CT. Nonetheless, if Kaplan's translation scheme is inappropriate, this is a serious problem for my proposal.

However, I believe that once the distinction between a strong and a weak reading of the *de re* possibility is made clear, Lewis's concern about TRd^K (and my $TRd^{K'}$) disappears.

First of all, note that 5 is the negation of 7:

[12] While Lewis wants to deny the necessity of identity, he does not intend to deny the necessity of self-identity (Lewis, 1986, 263).

[13] As anticipated, the consequences Lewis discusses apply to my rule $TRd^{K'}$ as well. Indeed, by means of $TRd^{K'}$, we would translate 5 into the CT-formula 5*':5*': $\exists x (Ix@ \wedge \exists y (Wy \wedge \forall z ((Izy \wedge Czx) \rightarrow \exists z' (Iz'y \wedge Cz'x \wedge z' \neq z)))$,which, as the reader can easily see, incurs in the same problematic raised by 5*. In the following, for the sake of simplicity, I will only discuss 5*.

7: $\forall x \Box (x=x)$,

which is the natural translation into QML of *de re* modal sentence 8:

8: everything is necessarily self-identical.

Depending on what sort of QML 7 belongs to, and *a fortiori*, depending on how we have decided to read the *de re* necessity in 8, we need to read the diamond in 5 accordingly. Now, the usual way to interpret the *de re* necessity in 8 is the one provided by the weak reading: we want the property of self-identity to be necessarily had by absolutely everything, and not only by those things that necessarily exist. So, if we resolve the ambiguity of such a sentence and decide that the box in 7 stands for the weak *de re* necessity, 7 comes to say that every actual thing is self-identical in all the worlds in which it exists. In this way, also Plato, whose existence is supposedly contingent, is necessarily (essentially) self-identical. This means that, according to the very same QML, the reading of the diamond in 5 is the strong one (given into CT by rule TRd), according to which 5 comes out as false: there is no actual thing that exists in some world and is not identical to itself. Therefore, in a QML which reads the diamond in 5 in the most common way (namely, as strong), 5 comes out as false, as it is expected to do.

Nonetheless, I said that there is no correct and no wrong reading of the *de re* possibility in 6: both the weak and the strong reading are allowed, and, according to what reading we select, we get a certain QML. So, whenever we interpret the *de re* possibility in 6 as weak, through a QML that reads the diamond in 5 as weak, 5 is translated into CT by means of the problematic rule TRd^{K} (on my proposal, $TRd^{K'}$) proposed by Kaplan.

Now, the problem with the weak interpretation of the diamond in 5 arises when 5 comes out as true and, correspondingly, 7 as false, because we do not want to deny the necessity of self-identity. Well, the first thing to note, as Lewis already does, is that, if we do not allow for contingent existence, the weak reading of the diamond in 5 would make 5 false. Indeed, in this case, there would be nothing actual such that, if it exists in a world, it is distinct from itself. In fact, if every actual thing necessarily exists, then there is no world that would make the conditional true, by virtue of the falsity of the antecedent: in all the worlds, the conditional would be false. Therefore, in this case, 7 would be true, and the necessity of self-identity would be safe.

However, things are different if we allow for contingent existence, as Lewis does. Well, in such a case, as Lewis claims, 5 would come out as true. Strictly speaking, this means to deny the necessity of self-identity: as a matter of fact, 7 turns out to be false. Nonetheless, first, in this case only necessary existents are allowed to have necessary properties. Contingent things, since they do not exist in every world, can only have contingent properties. Hence, not only they are contingently self-identical, they are also, say, contingently *F*, for any *F* among their actual properties.

Secondly, and more importantly, Lewis arguably rejected TRd^{K}, because he had in mind the classical strong reading of the diamond. According to such a reading, the truth of 5 (and, hence, the falsity of 7) implies that there is an actual thing *a*, such that *a* exists in a world and, in that world, *a* is distinct from itself. And this would be unacceptable. But this is not what we need to buy: the truth of 5 (and, so, the falsity of 7) does not commit us to some actual thing which has, in some world in which it exists, the property of being distinct from itself. Rather, it only commits us to some actual *a* such that, *if a* exists in a world, then is distinct from itself. And this conditional can only be trivially true, namely it can only be true in those worlds in which *a* does not exist.

Therefore, first, the most common reading of the *de re* possibility in 6 is offered by a QML which interprets the diamond as strong, and, on such a reading, the QML-formula 5 is false and, thus, the necessity of self-identity is safe. Second, it is true that on a less common, but still acceptable reading of the *de re* possibility in 6, given by a QML that reads the diamond in 5 as weak, 5 *is* true (if we allow for contingent existence). However, the truth of 5 in this case does not imply the unacceptable consequences Lewis envisages. Therefore, I claim that once we accept the difference between a strong and a weak reading of the *de re* possibility, Lewis's concern about TRd^K (and my $TRd^{K'}$) should no longer worry us.

9 Conclusions

I agree that we need structural principles in order to arrive to the CT-formulas that correctly translate the QML-language that, sometimes, gets lost through Lewis's original translation scheme. However, *de re* modal language is ambiguous, and there are different ways to resolve such ambiguity into the language of QML. Therefore, I believe that all the translation problems might just disappear if we begin with a fully worked out QML that tells us how to understand *de re* modal discourse. Indeed, once we know what sort of QML we intend to translate into CT, we can use the corresponding translation scheme: while Lewis's original translation scheme is the appropriate scheme in order to translate a QML that reads the *de re* necessity as weak, Kaplan's rules (with my modifications) are the adequate rules to apply for translating a QML that interprets the *de re* necessity as strong.

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