METAPHYSICAL VIEWS ON QUANTIFIED MODAL LOGIC

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Abstract. This paper provides an overview of the metaphysical views treating the problem of merely possible objects. This overview maps different aspects of Quantified Modal Logic and the problem of merely possible objects. There are three elements discussed in the formal part of the paper: objectual quantification, rigid terms and the evaluation clauses for quantifiers. The philosophical part regards the following metaphysical views: actualism, possibilism, contingentism and necessitism. The provided mapping connects the formal aspects with the metaphysical views.

Keywords: *Quantified Modal Logic, merely possible objects, actualism, possibilism, contingentism, necessitism.*

Introduction

When engaging in modal talk, we often refer to various possible objects, such as a possible stick, a possible situation, the possible child of Wittgenstein. If the possible objects we refer to are not actual, then they are merely possible objects or possibilia. How are we to account for such objects? Are there any mere possible objects? In this paper, I discuss this metaphysical issue in relation to Quantified Modal Logic (QML), which was developed for the treatment of modality. I study the interaction between QML and the metaphysical issues one can raise with respect to such a tool.

This paper is structured as follows. In section 1, I briefly discuss the relation between metaphysics and QML, following Williamson's (2013) considerations regarding this relation.

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In section 2, I briefly present two semantic approaches to first-order modal logic[2], i.e the constant-domain approach and the varying domain approach, as exposed by Fitting and Mendelsohn (1998). A varying domain semantics is obtained by some formal constraints imposed on the model defined for a constant-domain approach.

In section 3, I focus, following Garson (2001), on three aspects that set the ground for asking whether QML is committed to mere possibilia: the objectual interpretation, the rigid terms assumption and the evaluation clauses for quantifiers[3]. Each of these aspects are discussed in relation to a metaphysical claim. For instance, Cresswell (1991, 274) states that the objectual interpretation together with possible-worlds already embed a commitment to mere possibilia. The rigidity of terms is important in the rejection of the controversial Barcan Formula (BF) and of the converse Barcan Formula (converse BF)[4]. Finally, the evaluation clauses for the quantifiers correspond to constant domain semantics or varying domain semantic approach to QML. I focus on the metaphysical problems of a varying-domain semantics and constant-domain semantics. The latter is approached by two formal constructions: constant-domain first-order modal models and locally constant-domain first-order modal models. The varying-domain approach was developed to meet the intuition that what objects exist at different possible worlds is a contingent matter: some objects from the actual world could have failed to exist and other objects could have come into existence. This

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2 The problem of possibilia can be discussed in relation with QML in general. However, for matters of simplicity I will reduce the discussion to a first-order modal logic and its semantics (FOML).

3 Garson (2001) presents the developments of QML beginning with objectual quantification and the assumption that terms are rigid. On this common ground he proceeds to present different approaches concerning the way a quantified modal model is defined. Quantification can be understood in other ways as well. For instance, it can be understood substitutionally or conceptually. However, in this paper I am concerned with the consequences of interpreting quantification objectually.

4 An instance of the BF '$(\exists x)\Diamond Px \rightarrow \Diamond(\exists x)Px$', and an instance of the converse BF is '$\Diamond(\exists x)Px \rightarrow (\exists x)\Diamond Px$'.

constraint can also be seen as device to avoid quantification over mere possibilia. However, it is often argued that it does embed a kind of commitment to mere possibilia[5]. The constant-domain approach, depending on how it is constructed, can have two metaphysical consequences: it can either admit quantification over mere possibilia, or, as Cresswell (1991) suggests, it can go against the intuition of the contingency of existence.

In the last section, I present Barcan's critique on Kripke's semantics. This critique is meant to show that varying-domain semantics, as proposed by Kripke (1971), is not immune to a commitment to mere possibilia. The critique makes the mappings between QML and the different metaphysical views more complicated since some actualist approaches are designed to meet this critique.

Before presenting the relevant aspects of the semantics for the first-order quantified modal logic, I would like to make explicit the relation between the formal developments and the metaphysical developments as presented in section 3. The formal aspects concern the two semantic proposals: the constant-domain and the varying-domain approach. The competing metaphysical views relating to the formal aspects will be the following: actualism, possibilism, necessitism and contingentism. Actualism should be seen as paired with possibilism within a debate, and necessitism should be seen as paired with contingentism within another debate (Williamson 2013). Thus, in this paper I discuss both the internal assumptions that lead to the metaphysical debates and the debates themselves. I also focus on how they should be paired with the formal results. I do not treat the formal aspects of QML as discerning between the metaphysical views, but as giving rise to the metaphysical debates.

5 This critique can be found for instance in Barcan (1993), Zalta and Linsky (1994), Williamson (1998) or Stalnaker (2012).

1. Semantics and metaphysics

Williamson (2013, 146-147) discusses the relation between metaphysics and logic in general and argues that logic should not be regarded to be neutral with respect to metaphysical problems. In this paper I work with Williamson's claims that quantified modal logic is not neutral and that metaphysics interferes in formal constructions such as the semantics for QML.

How do metaphysics and formal constructions interfere? Accepting additional types of entities such as mere possibilia into one's theory should be done only if necessary. The semantics of a formal construction treating modal notions may determine an expansion of ontology. In this way, the semantical approach imports a metaphysical problem. A semantical approach to modality in terms of possible worlds is often seen to allow for possibilia. To see when possibilia are admitted, I examine several developments of QML considered to appeal to mere possibilia and the various metaphysical views trying to explain these developments. I regard metaphysical views as metaphysical models which provide the resources to interpret the consequences of a formal construction, consequences which exceed the explaining resources the formal tool has. Metaphysical tools will guide the interpretation of metaphysical consequences of QML within such a model. I will search for the mappings between the metaphysical models and the formal approaches with respect to the semantics of QML.

2. A Presentation of the semantics of a first-order modal logic

Following Fitting and Mendelsohn (1998), I will present a constant domain and a varying domain semantics for first-order modal logic. However, I will make some changes in the language, specifically, in the list of symbols used[6].

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[6] For instance, the symbols used for possible worlds in Fitting and Mendelsohn's presentation are capital letters from the Greek alphabet: Γ,

First, I will present a constant domain semantics and then specify the changes needed for a varying-domain semantics, *i.e* changes of the evaluation clauses for quantifiers.

A frame[7] for a first-order modal logic is F=<W,R,D>, a triple consisting of: W, the set of possible worlds; R, the accessibility relation between worlds; D, a set of objects. A constant domain first-order modal model based on a frame F is a quadruple M=<W,R,D,Ï>, where Ï is a function mapping a set of n-tuples from D to the extension of a predicate P at a world w, Ï(w,P). To provide the evaluation clauses for the formulas, an assignment function υ is needed in order to map each free variable x to a set of n-tuples from D, υ(x). If υ(x) is part of the extension of a predicate P at w, then υ(x) ∈Ï(P,w)[8]. Given Fitting and Mendelsohn's (1998, p. 98) presentation of the constant-domain modal model, the evaluation clauses for quantified sentences are the following:

(E ∀) M,w $\Vdash_{\upsilon}$ (∀x)φ *iff for every x-alternative ω of υ such that M,w* $\Vdash_{\omega}$ *ϕ, where an x-alternative ω of υ agrees on the assignment of free variables in ϕ, except (possibly) x.*
(E ∃) M,w $\Vdash_{\upsilon}$ (∃x)φ *iff there is at least one x-alternative ω of υ such that M,w* $\Vdash_{\omega}$ *ϕ.*

A varying domain semantics is obtained by some adjustments on the definition of a frame and model. A varying domain frame F=<W,R,D> has it's elements defined in the same manner as a constant domain frame. However, the domain of the frame D(F) is defined as U{D(w)| w∈W}, that is the union of all

Δ, Ω etc. I will instead use letters as 'w', 'u', 'v' etc. for possible worlds, following Forbes (1994).

7 Fitting and Mendelsohn (1998) use the terminology of *constant domain augmented frame*, since the frame is an extension of a frame for propositional modal logic. F is constructed on the modal propositional frame F=<W,R> by the addition of D, the domain over which quantifiers range. A model M is a *constant domain first order model*, given the way an interpretation Ï is defined.

8 The evaluation clauses relevant for the discussion are the clauses for quantified sentence.

sets of objects existing at the different members of W. Thus, each w has an associated D(w), the domain of objects existing at w. A model M is a varying domain first-order modal model M=<W,R,D,Ï> where Ï maps elements from D(F) to the extension of a predicate P at a w. Thus, elements from the extension of a predicate at a world w need not be elements of D(w). However, some changes are made concerning the valuation of quantified sentences. The evaluation clauses for truth in a varying domain first order modal model M=<W,R,D,Ï> remain the same as in a constant domain first order model, except for the evaluation clauses for quantified sentences, given Fitting and Mendelsohn (1998, p. 104):

> (E $\forall$*) M,w $\Vdash_{\upsilon}$ ($\forall$x)φ *iff for every x-alternative ω of υ at w, such that M,w* $\Vdash_{\upsilon}$ *φ, where an x-alternative ω of υ is one that agrees on the assignment of free variables in* ϕ*, except (possibly) x.*
> (E $\exists$*) M,w $\Vdash_{\upsilon}$ ($\exists$x)φ *iff there is at least one x-alternative ω of υ at w, such that M,w* $\Vdash_{\upsilon}$ *φ.*

In a varying-domain semantics the assignment function for quantified formulas is restricted to D(w). Thus, formulas with free variables are evaluated relative to D(F) and quantified formulas, relative to D(w). Even though the feature of an unrestricted evaluation of formulas with free variables is kept in a varying-domain semantics, the introduction of a domain of the frame D(F) is needed in order to differentiate between D and D(F). In a constant domain model, D is regarded as a set of objects, whereas in a varying-domain semantics, as a function relativizing the set of existing objects to each possible world. Thus, in a varying-domain semantics D(F) does the job D does in a constant-domain semantics.

Depending on how we choose to evaluate quantified sentences, one can provide different metaphysical views. In the next section, I especially focus on the relation between the evaluation clauses for quantifiers, domains and the metaphysical approaches associated.

3. Quantifiers, rigid terms and domains

I will focus on the metaphysical discussion in relation to the semantics of QML. This relation concerns the problem of possibilia. Stalnaker (2012) addresses the problem of the interaction between metaphysics and semantics both as a general issue, and as an applied question regarding the problem of mere possibilia and quantifiers. The question is how to evaluate quantified formulas in a possible-worlds semantics with objectual interpretation of quantifiers, in order to overcome the problem of possibilia. After surveying the accounts developed in order to eliminate possibilia, Stalnaker presents his own account in which quantification should be restricted to what there really is, without appealing to problematic entities. I will address the same issue regarding the ontological commitment that emerges from the interpretation of quantifiers, but I will focus on both the metaphysical consequences of a constant-domain semantics and the metaphysical constraints imposed on a varying-domain semantics.

In Cresswell (1991) the interpretation of quantifiers is discussed in relation to the BF and the question is why should they be interpreted as restricted rather than unrestricted. Cresswell considers the best solution to be established on semantic grounds and not by metaphysical criteria. The reason is the following: if we use a semantics with possible worlds and domains as sets of objects, then we have already made a commitment to non-existents or mere possibilia. Since the commitment is already made, there is no need to choose our evaluation clauses for quantifiers by metaphysical criteria and we should rather make the decision on pragmatic grounds such as the simplicity and fruitfulness of the semantics. For instance, he considers the systems in which the BF is valid, to be basic for the systems without the BF. This is because one way to show the BF is valid rests on the unrestricted evaluation of quantifiers[9]. However, I would raise the following

[9] The other way to show the BF to be valid is to impose the condition that no possible world contains objects not in the actual world.

two questions: (i) are there other metaphysical aspects, except from committing to non-existents or possibilia, that should count in evaluating the two semantic approaches? (ii) are restricted evaluation clauses for quantifiers committing to non-existents in the same way as unrestricted evaluation clauses?

To answer these questions, I will present the problematic features of QML, focusing on the interpretation of quantifiers. Thus, the approach will proceed from semantics towards metaphysics. We start with the objectual interpretation of quantifiers and continue with rigid terms and the evaluation clauses for quantifiers. Since the discussion regarding constant-domain or varying-domain semantics takes the first two as common ground, I will start with the objectual interpretation and the rigid terms assumption. In this discussion, I will follow Stalnaker (2012) in following Carnap (1950) in making the distinction between external or substantive questions regarding metaphysical subjects and internal questions, those regarding the semantic aspects of the framework. I will concentrate on the substantive aspects and questions regarding the two semantic approaches.

3.1. Objectual interpretation

In the semantics presented, a frame F is a triple with the following elements, F=<W,R,D>, where D is the set of objects over which quantifiers range and we have no prior discrimination between actual and possible objects. However, a constant-domain first order modal model based on F, M=<W,R,D,Ï>, validates the BF and this formula can be shown to imply quantification over mere possibilia. In a varying-domain first order modal model M=<W,R,D,Ï>, D is taken to include both actual and merely possible objects. If we restrict the discussion to what D consists of, the objectual quantification seems problematic for both directions we choose: constant-domain or varying-domain semantics. In this sense, Cresswell (1991) considers the metaphysical commitment to merely possible objects to be unavoidable.

3.2. Rigid terms

The thesis of rigid terms is problematic for a constant domain semantics since counterexamples against the converse BF are based on this assumption. Consider the following instance of the converse BF: $(\exists x)\Diamond Px \rightarrow \Diamond(\exists x)Px$. In a varying-domain semantics with the assumption that terms are rigid, this formula is shown to fail. The antecedent '$(\exists x)\Diamond Px$' is shown to be true since there is an x such that Px is true at a possible world u, where wRu. 'Px' is true since the value assigned to x is in the extension of predicate P, but the object assigned to x need not belong to D(u). If object a, existing at w, is in the extension of P at u, then for 'Px' to be true, x must be assigned the same value in the two worlds of the model. Kripke (1971) explains the admission of truth values for sentences containing free variables relying on the thesis of rigid terms. Considering the sentence "x is bald" containing the free variable 'x', he argues that we can assign a truth value, even though x replaces an object which does not exist at the actual world. For instance, he argues that "Sherlock Holmes is bald" may still have a truth value, even though Sherlock Holmes does not exist at the actual world[10]. The same holds for "Socrates is a philosopher". The sentence has a truth value at a possible world where Socrates does not exist, since objects may belong to extensions of predicates at worlds at which they do not exist and we rigidly refer to "Socrates". If we go back to the converse BF, the antecedent is made true by Socrates who could have been a sophist, but the consequent is made false since there may be another possible world in which Socrates enters the extension of the predicate "sophist", but does not exist at that world.

10 In his later papers, Kripke reevaluates the thesis that Sherlock Holmes or Pegasus are merely possible objects and instead argues for the thesis that fictional objects are abstract objects tied to the fiction from which they originate. See Kripke (2011) 'Sherlock Holmes' is a rigid term, referring to Sherlock Holmes in every possible world, but this status of fictional object, prevents it from being actualized in other possible worlds.

3.3. Evaluation clauses for quantifiers.

Many first-order modal logics work with the assumptions that quantifiers are interpreted to range over a domain D of objects, either restrictedly or unrestrictedly, and that terms are rigid. What is considered problematic is the evaluation clauses we apply to quantifiers since this determines whether we work with a constant-domain semantics or a varying-domain semantics. The evaluation clauses making the quantifiers range unrestricted or restricted correspond to (E$\forall$) and (E$\exists$), for unrestricted range, and (E$\forall$*) and (E$\exists$*), for the restricted interpretation. Given the evaluation clauses, we can ask what ontological commitment each pair generates and whether there are any other metaphysical aspects we should consider when interpreting quantifiers.

3.3.1. The constant-domain approach

Beginning with a constant-domain approach to first-order modal logic, the pair (E$\forall$) and (E$\exists$) is based on the assignment function taking values from D. The truth of quantified sentences in a model M at a world w depends on the values taken from the whole domain D and worlds are thought of as having the same domain in the model. This semantic direction comes as a natural extension of the semantics for first-order logic, in which the evaluation of a formula is based on a single domain of objects, that the assignment function picks values from. Moreover, as Cresswell and other defenders of an unrestricted treatment of quantification state[11], in a constant domain approach to the semantics for first order modal logic, the classical rules for quantifiers, such as universal instantiation (UI) are preserved: $(\forall x)\varphi \supset \varphi[x/y]$, where every free occurrence of 'x' in ϕ is replaced by 'y'. What the rule states is that if something holds about every individual in a domain, then it also holds about a certain individual. Thus, if a universally quantified

[11] See Zalta and Linsky (1994), and Williamson (1998).

formula is true, then each of its instances are true as well. Preserving the classical rules for the quantifiers is one of the motivations for the constant-domain approach. However, the metaphysical consequences seem to impose restrictions leading to the varying-domain approach. In order to better approach the metaphysical consequences of a constant-domain approach, the following distinction should be considered, namely, the distinction between a constant domain first order modal model and a locally constant-domain modal model. Each direction determines different metaphysical interpretations.

Following Fitting and Mendelsohn's (1998) presentation of the semantics for first-order modal logic, if we impose certain conditions on the accessibility relation R in a model M, we get either the BF valid, or the converse BF. For the validity of the BF, the condition is that if wRv, then $D(v) \subseteq D(w)$. Thus, if v is accessible from w, then the domain of v does not exceed that of w. This feature of the semantics is called anti-monotonicity. The other condition, which could be imposed on the accessibility relation R in a model, is that of monotonicity. A model M is monotonic if given any pair of worlds $w \in W$ and $u \in W$, if wRv, then $D(w) \subseteq D(u)$. In a monotonic model, the converse BF is valid, even though the BF is not. A first-order modal model which is both monotonic and anti-monotonic, is defined to be a locally constant-domain first-order modal model. In such a model, both the BF and converse BF are valid. In a locally constant-domain first-order model, if wRv, then D(w)=D(v). In such a model, the BF and the converse BF are valid because all worlds contain the same elements in their associated domains, and not because we have the $(E\forall)$ and $(E\exists)$. Locally constant-domain first order modal models follow from the conditions of monotonicity and anti-monotonicity, which are conditions imposed on worlds with respect to their domains. Because a locally constant-domain model follows from combining the two conditions, the specifics of this semantics consists in the conditions imposed on the world domains, while a constant-domain semantics is defined by the evaluation clauses for the quantifiers. What substantive differences follow from the semantic differences between the two constant-domain approaches?

From a formal point of view, the common ground would be that the BF is valid on both approaches. This aspect is problematic for an actualist who would like to preserve the intuition that domains associated with worlds should vary. The difficulty comes from problematic objects the truth of the BF seems to be committed to, such as a possible talking donkey. However, Cresswell (1991) sees a very important substantive difference that follows from the two approaches, namely, that objects in a locally constant-domain first-order modal model are necessary existents. A formula such as '$\Box(\forall x)\Box(\exists y)(x=y)$' is valid because for every $w \in W$ and $u \in W$, if wRu, then D(w)=D(u) and thus, every object exists in every possible world. In a constant-domain first-order modal model, the substantive aspect that follows is weaker. In such a model, quantifiers are permitted to range over non-existents and a commitment to such objects is permitted. The BF is accepted as well and quantification over possible talking donkeys is legitimate. This interpretation rests on rejecting the actualist claim that there are only actual objects. Thus, there are two substantive views that follow from the kind of approach made with respect to our constant-domain first-order modal model: we either accept that everything is necessarily something, or even Williamson's (2013, 2) stronger claim that "necessarily, everything is necessarily something" or we quantify over non-existents. Here, "x is something" should be understood in a stronger sense, namely, to exclude "x is non-existent". One can go in either direction, namely, in the direction of quantifying over non-existents, or taking everything to be necessary.

If one wants to avoid quantification over non-existents, in the sense of making a distinction between what there is and what there could be, one can adopt Zalta, Linksy and Williamson's proposal that "necessarily, everything necessarily is something"[12]. In this way, the metaphysical consequence of a locally constant-domain approach is taken as a metaphysical interpretation of a constant-

[12] See Zalta and Linsky (1994) and Williamson (1998) or Williamson (2013).

domain approach. The domain D in a model M is interpreted as consisting of only existing objects. 'Existence' is reserved not only to what the actualist usually takes to exist[13]. Whether the quantifiers are permitted to take values from D and world domains are unspecified, or whether world domains are taken to be the same, we can have the same metaphysical interpretation over the locally constant-domain and the constant-domain approaches. Thus, the thesis that there are no non-existing objects, seen as a consequence of a locally constant-domain approach, can be taken as a metaphysical interpretation for the constant-domain approach.

The other metaphysical approach is quantification over non-existents. Besides the ordinary unproblematic objects, the quantifiers range over mere possibilia as well. If the constant-domain approach is used, one is not compelled in taking objects to be necessary existents. To be a necessary existent would mean to exist at all possible worlds. Since world domains are not relevant for evaluating quantified sentences, no such condition of necessary existence is imposed[14]. Can this constitute a metaphysical interpretation with respect to the locally constant-domain approach? Cresswell sees the locally constant-domain approach to be forcing a stronger metaphysical view than the constant-domain approach, which only needs quantification over non-existents. However, we can force a metaphysical interpretation over locally constant-domain model and consider world domains to contain non-existent objects as well. They contain such objects in the sense that quantifiers range over them. In this way, we maintain a symmetry with constant-domain models in the sense that being a value of a bound variable does not imply existence.

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13 However, there are disputes related to what it means for an objects to be actual. For instance, Zalta and Linsky (1994) take everything to be actual, even the mere possibilia. What I have in mind here is rather a definition coming from a Russellian tradition, as Barcan claims her view to be. In Barcan (1993) the controversial possibilia and the uncontroversial objects are distinguished by the criteria that the latter can be objects of reference, while possibilia cannot be.

14 See Cresswell (1991).

The other semantic approach, namely, the varying-domain approach manages to avoid both quantification over non-existent objects or mere possibilia, at least in the object language, and the assumption that "necessarily, everything is necessarily something". These consequences are avoided by the restrictions imposed on the definition of a first-order modal model.

3.3.2. The varying-domain approach

The varying-domain approach was proposed by Kripke (1971) in order to create a correspondence between the semantics and the intuition that world domains should vary. His motivation was that what objects exist at different possible worlds is a contingent matter. We can imagine all sorts of objects which do not exist at the real world[15], but which are nevertheless possible, thus being possible existents. This revision of the semantic approach allows us to model the intuition that even though a talking donkey is possible, it does not mean there is something at the real world which is possibly a talking donkey. Thus, we have a substantive issue which determines a decision in the evaluation of modalized sentences. The request to make a distinction between the set of elements each world has, determines a substantive distinction between the elements the set D has, namely actual and possible objects. This distinction is made explicit by Kripke (1971), by individualizing a single element from W as the actual world. However, the varying-domain semantic approach presented in this paper does not single out a special element from W as the actual world. If no actual world is singled out, the truth of a formula in a model M is evaluated at an arbitrary world and the possible objects are defined relative to the world of evaluation. However, both approaches (the one which singles out the actual

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[15] Using 'real world' instead of 'actual world', as Kripke(1993) does, is useful in making a distinction between what we intuitively call the real world and what we call the actual world of a modal model.

world and the one treating the worlds indiscriminately) can work with actualist assumptions. Even though in the semantics presented, following Fitting and Mendelsohn (1998), we do not have a world singled out as the actual world, the authors define the quantifiers in a varying domain first-order modal model to be actualist. The quantifiers are actualist since, given a formula '$(\exists x)\phi$', it is true in a model M at a world w, $M,w \Vdash_{\upsilon} (\exists x)\phi$, if the assignment function picks out values from D(w). Thus, a quantified formula, not in the range of a modal operator, is evaluated with respect to the objects existing at the world of evaluation. The elements of the set D(w) are defined by the authors as objects actually existing at w.

It seems that a varying-domain semantics works under two restrictions emerging from metaphysical considerations. The first one is that world domains should vary, since it is contingent what objects exist at a possible world. The second is that quantifiers should range only over existing objects from the world domain of a possible world. Thus, in a varying-domain semantics the substantive aspects impose conditions on the semantics.

Even though this semantic approach should meet some actualist conditions, as Cresswell states, its innocence with respect to possibilia is not complete. Varying-domain semantics is still considered to be committed to possibilia. This critique has been formulated by Barcan Marcus (1993) as well, and it has been restated in the recent literature[16]. Barcan's critique is that allowing domains to vary implies a commitment to possibilia. Thus, the fault does not lie in the evaluation clauses for the quantifiers, but in the condition that other worlds may contain objects different from those at the actual world. To admit that world domains vary is to allow the model to work with mere possibilia as objects of reference and to make them relevant in evaluating modalized sentences. Her second critique comes from the objectual

16 Zalta and Linsky (1994), Williamson (1998), Bennett (2005) and more recently Stalnaker (2012). Unlike Zalta, Linsky and Williamson, Stalnaker defends a varying-domain semantics.

quantification direction. Cresswell sees this as committing to quantification over non-existents and authors like Williamson (1998) and Zalta and Linsky (1994) develop the critique that quantification over non-existents or possibilia is unavoidable in the metalanguage.

4. Barcan against Kripke's semantics

Modal logic with an objectual interpretation of quantifiers and a possible worlds semantics faces the problem of possibilia. It is not clear whether Barcan takes only a variable domains interpretation of quantifiers to be committed to possibilia. What is clear is that she sees Kripke's admission of possibilia to be a consequence of such a variable domains interpretation. If we allow other possible worlds to contain objects which are not members of the actual world's domain, then possibilia have been admitted. Relying on Williamson (1998), I would interpret her claim in the following manner: accepting that other possible worlds have different domains of objects is to accept there is an object x such that x is a member of the domain of a possible world different from the actual one. Thus, if we take the domain of the actual world to be a proper subset of D, then the construction has some sort of commitment to possibilia. 'Admission of possibilia' is not a clear charge against the variable-domains interpretation. If we go back to Williamson, we can say that Kripke's proposal is committed to possibilia at the level of the metalanguage of the QML with variable domains. Another interpretation would be that admission of possibilia means employing such objects to explain different the use of modal idioms. Since it is not clear where this commitment to possibilia is produced, the interpretation is informal. If we look at what Barcan considers to be problematic about possibilia, we can better understand what 'admitting possibilia' means.

Barcan stands against Quine's (1961) critique with respect to modal logic. Modal logic implies a commitment to objects such as the possible fat man in the doorway, and Quine considers this issue as problematic. How do we distinguish between such possible objects? How do we distinguish between a possible fat man in the doorway and the possible bald man in the doorway? We have no criteria of identification for such a possible object. To distinguish between two objects is to provide criteria of identification. However, Barcan argues that such criteria can be provided. We can establish there is a set of properties such that only one object could satisfy it. However, Barcan (1993, p. 197) considers that by "a mere concatenation of properties" no object is obtained. One should see the problem the other way around. While Quine's critique is that we have no possible objects since we have no identity conditions, Barcan argues that there cannot be an identity relation where there is no object. Thus, possibilia cannot enter an identity relation or self-identity relation, because they do not exist. This would be Barcan's (1993, p. 200) sense of "no identity without entity". This argument is meant to show a deeper problem in employing possibilia. Admitting possibilia means taking such objects to be objects of reference. Barcan appeals to a description of actual objects in order to show that possibilia cannot be objects of reference. Her claim is that we can refer to actual objects because we have a naming device and they are components of truths about identity statements. Both aspects rely on ostension. This requires that objects which are named and stay in a self-identity relation are objects of acquaintance at one point. Thus, the distinction between actual objects and possibilia is that the former have been objects of acquaintance at one point. Thus, the main critique is that possibilia cannot be admitted since they cannot be objects of reference.

However, how are we to accommodate the intuition the varying domain semantics manages to capture, namely, that there could have been more things than there actually are? A constant-domain semantics with a quantification domain restricted to the objects of the actual world would not be able to capture this idea. If the domain of quantification is not restricted to the one from the actual world, then possibilia have been admitted as well. Here the sense of "admitting possibilia" can be extended from "taking possibilia as objects of reference" to "quantifying over possibilia". The constant domain approach seems to either be committed to possibilia, or to go against the contingency of existence. It seems that to account for the contingency of existence, we need possibilia. However, is there any innocent admission of possibilia and how are to define such an innocent commitment? Quantification over possibilia seems to be a stronger commitment, thus, the constant domain approach is less innocent than one in which such quantification is not required. The answer seems to lead us to a varying domain approach and see how damaging its admission of the problematic objects is.

How is reference to possibilia produced? In the semantics for quantified modal logic developed by Kripke (1971), a quantified sentence is evaluated relative to the actual world. An existentially quantified sentence, in which a property is predicated about an individual, is true if there is an individual at the actual world such that it belongs to the extension of the given predicate. The problems seem to appear when the quantifier is in the scope of the modal operator. Consider an existentially quantified sentence in the scope of a modal operator, in which a property is predicated about an object, which does not belong to the domain of the actual world. The sentence is true if there is a world such that the existentially quantified sentence is true. Since the sentence is existentially quantified, then at the given world there must be an individual such that it belongs to the extension of the predicate. "Possibly there could have been talking donkeys" is evaluated as true if there is a world in which the sentence "There are talking donkeys" is true. This is in turn true if there is at least one object at that world such that it is a donkey and it talks. Thus, this can be the first case in which admission of possibilia is produced. The second one is produced in the case of atomic sentences. The language of QML used by Kripke (1971) does not admit individual constants and variables are used instead. So in the case of atomic sentences such as 'Px', the formula is true if the individual x enters the extension of the predicate P, even though the object named by x does not exist at the world of evaluation. This is the sense of the

"Sherlock Holmes is bald"[17] example. We can take a sentence such as "x is bald" in which x can stay for any entity not in the domain of the actual world. Since such statement is given a truth value, then we have taken a mere possible object as an object of reference.

It seems that the critique of Zalta and Linsky (1994) and Williamson (1998) concerning the commitment to possibilia at the level of the metalanguage of QML is determined by the admission of mere possibilia as objects of reference. Admission of possible objects as objects of reference does not refer only to a commitment by means of quantifying over such objects, but it also refers to an appeal to such objects in order to offer the evaluation and truth conditions of sentences in modal contexts.

The critique Barcan provides against Kripke's semantics and the metaphysical consequences of this semantics are important for the development of different actualist approaches to QML that try to remove mere possibilia. These actualist approaches differ with respect to how quantification is understood and how the objects of quantification are treated. This leads to some varieties of actualism that make the mappings between the metaphysical views and the formal developments even more difficult.

5. Conclusion

I presented two semantic directions for first-order modal logic and the metaphysical problems associated with them. Both semantics work with the objectual quantification and the assumption that terms are rigid. The departure of varying-domain semantics from the constant-domain semantics is made with respect to the evaluation clauses for the quantifiers. Depending on the formal direction we choose, different metaphysical interpretations come into play.

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17 Recall that Kripke (2011) would exclude fictional entities from the spectrum of mere possibilia, since he argues there that fictional entities are abstract objects.

The discussion concerning the semantics for QML is shaped by metaphysical aspects. A central point concerning the metaphysics in QML is the problem of mere possibilia or quantification over non-existents. One direction is to accept quantification over non-existents and consider it a compromise that should be made since it seems unavoidable. The other direction is to impose conditions that would avoid quantification over such objects, at least with respect to how quantifiers are defined to work, namely as ranging only over existing objects at the world of evaluation. The former corresponds to a possibilist interpretation of quantifiers, while the latter corresponds to an actualist interpretation. However, there are other possible directions. For instance, rejecting any kind of commitment to mere possibilia or non-existents, as proposed by Williamson's (2013, 2) solution that "necessarily, everything is necessarily something". In this way, one can adopt a constant-domain semantics without quantification over non-existent. Another direction is to embed in the semantics the idea that world domains are different since it is contingent what individuals exist at different possible worlds.

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