

A TWO-DIMENSIONAL ACCOUNT OF EPISTEMIC MODALS

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PREVIEW

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ABSTRACT

Not everyone knows that water is H_2O . Suppose Alice is one of those people. Alice says, "For all I know, water might not be H_2O ." Intuitively it seems like Alice has spoken truly. That is, it seems like it is epistemically possible (for Alice) that water is not H_2O . However, conventional accounts of modality in linguistics and philosophy of language predict that any metaphysically impossible statement will also be epistemically impossible (for anyone). And there are plausible arguments, from Kripke and others, that purport to show that it is metaphysically impossible for water to be anything other than H_2O . So according to the standard accounts of modality, Alice has in fact said something false. This is highly counterintuitive and suggests that the standard accounts of modality need to be reworked. I offer a new account of modality that is capable of representing what I call EPIMs: epistemically possible metaphysical impossibilities. Sentences like "water might not be H_2O " and "Hesperus might not be Phosphorus" are examples of EPIMs, and others can be readily found (including many that do not rely on Kripkean considerations about metaphysical possibility). My new account explains the existence of EPIMs while retaining the versatility and explanatory power of the standard accounts.

INDEX WORDS: modality, epistemology, epistemic modality,
two-dimensionalism, semantics

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PREVIEW

CHAPTER 1

BACKGROUND

Epistemic modals are statements like “for all I know, it might be the case that p .” More precisely, epistemic modals are statements about what is possible or necessary given some body of knowledge. So “for all we know, it might be the case that p ” and “for all S knows, it might be the case that p ” are also epistemic modals, along with many other examples. Often, the explicit epistemic restriction (expressed by “for all I know”) is omitted, which means that statements like “it might be the case that p ” will often have at least two readings. On standard semantic treatments, modal statements like “it might be the case that p ” are said to be true if there is some (accessible) possible world at which p is the case. However, given certain widely accepted claims about the nature of metaphysical necessity, there are some epistemic modals that are true in some contexts even if they are not true at any possible world.¹

More precisely, epistemic modals seem to be statements about what is possible relative to some knowledge base. Often, this knowledge base consists in what is known by some agent (or group of agents). Given the semantic treatment sketched out above, it is reasonable to say that p is epistemically possible relative to a knowledge

¹Any mention of worlds or possible worlds is intended to refer to metaphysically possible worlds, unless I specify otherwise.

base iff p is, in some appropriate sense, consistent with that knowledge base. Similarly, p is epistemically necessary relative to a knowledge base iff $\neg p$ is inconsistent with the knowledge base.

Consider the statement “water might be XYZ,” where XYZ is some non-H₂O chemical compound. Kripkean considerations lead us to conclude that “water = H₂O” is (metaphysically) necessarily true. So any statement of the form “water might be XYZ” will turn out false. But on the epistemic interpretation, it seems like it should be true for those who are unaware of the chemical composition of water. So the challenge, then, is to find an account of epistemic modality that allows for claims which are metaphysically necessarily false to nonetheless be epistemically possible. Call claims like this EPMI.² I will outline an account of epistemic modality that allows for EPMI using the two-dimensional semantic framework.

In this chapter I aim to lay out the background material required for this project. First, I will set up the problem by showing how necessity of identity, which is often taken to be a consequence of semantic externalism (à la Kripke and Putnam), conflicts with most accounts of epistemic possibility. Second, I will discuss the “standard” account of modality adopted by many philosophers and linguists. Third, I will lay out some of the historical background of the two-dimensional framework and show why it might seem like a promising approach to address the problem of EPMI. Finally, I will briefly discuss some alternatives to the standard account of modality and show why they do not fare any better than the standard account in dealing with

²Abbreviating the phrase “epistemically possible metaphysical impossibilities.”

EPMIs. This, in turn, will prompt a deeper investigation of two-dimensionalism in later chapters.

1.1 THE SEMANTICS OF NAMES AND NATURAL KIND TERMS: KRIPKE AND PUTNAM

In this section I will summarize the main claims of Saul Kripke and Hilary Putnam, advanced primarily in [17] and [26] regarding the semantics of names and natural kind terms and draw out an important consequence of the view.

1.1.1 SEMANTIC EXTERNALISM

Semantic externalism is, as Putnam memorably put it, the claim that “meanings just ain’t in the head.” [26] Put another way, semantic externalism is the claim that the semantic content of (at least some) terms are determined solely by factors external to the speaker and not by the speaker’s psychological state or by any collective psychological property of the speaker’s linguistic community.³ For Kripke and Putnam, these external factors are causal and historical. Kripke focuses on names and natural kind terms. He argues that the semantic content of these terms is fixed by the causal-historical chain leading from the speaker to the referent. Here is Kripke’s rough statement of the view (which accords well with Putnam’s version):⁴

³Since the meaning of a term is at least partially conventional, and these conventions are external to any particular speaker, there is a sense in which more-or-less everyone is an externalist. We might call this *minimal externalism*. The thesis which Kripke and Putnam put forward is stronger than minimal externalism and far more controversial.

⁴I will not detail the arguments advanced in favor of semantic externalism. The main reason for this is that I aim to present an account of epistemic possibility that is consistent with semantic externalism, and as such will not challenge the central claims of the position. For my purposes, then, the arguments can be assumed to stand. Note, though, that while

An initial 'baptism' takes place. Here the object may be named by ostension, or the reference of the name may be fixed by a description. When the name is 'passed from link to link' the receiver of the name must, I think, intend when he learns it to use it with the same reference as the man from whom he heard it.

On this view, then, there is an initial "baptism," wherein some speaker assigns some object (or a sample, in the case of natural kinds) a name, either via ostension or via definite description. For instance, one might take up a sample of a yellow metal and say, "Let this metal be called 'gold.'" This baptism serves to fix the reference of the name or natural kind term and does nothing else (even if the baptism involves a description). This gives the term its semantic content; when the baptizer uses the term, its semantic content just is its reference, as determined by the initial baptism. When others use the term, its semantic content is still just its reference, in virtue of their having the appropriate sort of historical connection to the baptism.

Putnam's version of semantic externalism is similar to Kripke's in the relevant respects. He presents the famous "Twin Earth" thought experiment. Here is one version:

Twin Earth is a world very much like Earth, except that it contains no H₂O. Wherever one would find H₂O on Earth, on Twin Earth one instead finds XYZ, a different liquid which is indistinguishable from water. Twin Earth's residents use the word 'water' to refer to XYZ. Now, consider a

I do not aim to refute semantic externalism, I am not committed to its being true. As I explain in §3, the problem I address arises whether or not semantic externalism is true.

resident of Earth, who does not know that water is H_2O , and his counterpart on Twin Earth, who does not know that the stuff he calls 'water' is XYZ. We might imagine that they are both in the same psychological state with regard to the word 'water.' But the Earthling's utterances are about H_2O , whereas the Twin-Earthling's utterances are about XYZ. So their utterances of 'water' have different referents. This, in turn, means that the word 'water' in English means something different from the word 'water' in Twin-English. And this difference is not due to any internal psychological state or property of the speakers of English and Twin-English; rather, it is due to the external facts abouts their respective worlds.

Putnam and Kripke have much in common. There are a few differences between their positions, though; Putnam, for instance, is primarily concerned with natural kind terms. My focus will be on Kripke's version of externalism. In places where Putnam's view is relevantly different from Kripke's, I will handle Putnam's version of externalism separately.

1.1.2 KRIPKE'S ANTI-DESCRIPTIVISM

One important feature of Kripke's view is his repudiation of descriptivism. Descriptivism, at its simplest, is the claim that the semantic content of a name (and perhaps other terms, such as natural kind terms) is given by a description which speakers associate with the name. Kripke rejects descriptivism on the grounds that it gets the modal properties of names wrong. For example, suppose that the semantic content of the name "Saul Kripke" is 'the author of *Naming and Necessity*.' If this

were the case, it would be necessarily true that Kripke is the author of *Naming and Necessity*. But surely this isn't necessary; that is, it seems like we want to say that Kripke might not have written *Naming and Necessity*.

This criticism of descriptivism holds even if we adopt a version of descriptivism in which there need not be any particular description associated with any given name. For example, John Searle holds that the semantic content of names is given by a cluster or family of descriptions. On this view, the subject of the name need not satisfy any single description from the family of descriptions, but it must satisfy some (perhaps many or most) of them. But this view is also susceptible to Kripke's criticism. If the semantic content of "Saul Kripke" is "the man who wrote *Naming and Necessity* **or** the man who invented semantic externalism **or** ...," then it is necessarily true that Kripke is the man who wrote *Naming and Necessity* **or** the man who invented semantic externalism **or** But presumably it is contingent whether or not Kripke satisfies any of the descriptions given at all. The upshot of this attack (and other related attacks), for Kripke, is that descriptivism must be false. Kripke does not offer a developed theory to replace descriptivism, but he sketches out the account given in §1.1 as a starting point.

1.1.3 NECESSITY OF IDENTITY

Kripke claims that one significant consequence of his position on the semantics of names and natural kind terms is the necessity of identity. Consider Cary Grant, born Archibald Leach. "Cary Grant" and "Archibald Leach" both name the same person. Proper names are rigid designators, and "Cary Grant" and "Archibald Leach" are both proper names. This means that "Cary Grant" designates the same thing in

each possible world, as does "Archibald Leach." Since these names designate the same object in this world, and since they designate the same object in every other world as they do in this one, Kripke argues that they must designate the same object in every possible world. Hence Cary Grant is necessarily Archibald Leach. This means that there are no worlds in which Cary Grant is a different person than Archibald Leach. Thus the statement that Cary Grant is Archibald Leach is necessarily true.

The same goes for natural kinds. If water is H_2O , then it is necessarily true that water is H_2O . There are no worlds in which water is XYZ. Of course, there might be worlds like Twin Earth—worlds in which some non-water substance is called "water." Similarly, there might be a world in which "Cary Grant" names a famous actor and "Archibald Leach" names a different person altogether. But these worlds are not worlds in which water is XYZ or in which Cary Grant is Archibald Leach.

Kripke states the thesis clearly:

We use 'Hesperus' as the name of a certain body and 'Phosphorus' as the name of a certain body. We use them as names of those bodies in all possible worlds. If, in fact, they are the *same* body, then in any other possible world we have to use them as a name of that object. An so in any other possible world it will be true that Hesperus is Phosphorus.

The thesis of necessity of identity helps motivate the problem described below in §3. However, before we can see the problem we must first discuss the standard account of epistemic modality.

1.2 EPISTEMIC MODALITY

In this section I will sketch out Angelika Kratzer's account of epistemic modals from [13] Kratzer's account has some features which are shared by most extant accounts of epistemic modals and is relatively straightforward, which makes it useful as a case study.⁵ I will also discuss some of the roles played by epistemic modals in our language and psychology.

1.2.1 KRATZER ON EPISTEMIC MODALS

Kratzer begins with a fairly standard possible worlds semantics for modals, but adds the notion of a relational modal "must in view of." The relational modal appears in statements like "In view of what is known, water must be H₂O." "What is known" in this statement functions as a "modal restriction," in that it serves to restrict the space of possibility—in this case, to those worlds consistent with what is known. The statement "In view of what is known, water must be H₂O" is true iff water is H₂O in all worlds consistent with what is known.

The worlds that fall under the modal restriction comprise the "modal base," in Kratzer's terminology. For instance, if we are operating in view of what is known, then the modal base consists in those worlds consistent with what is known.

One salient feature of Kratzer's analysis that is shared by most other accounts of epistemic modality is that it treats epistemic necessity as a restricted sort of

⁵In particular, Kratzer's account is equivalent to Lewis's account of epistemic modals, as discussed in [20].

metaphysical necessity. For example, there is an ongoing dispute regarding contextualist accounts of epistemic modality (advocated by, among others, Andy Egan, John Hawthorne, and Brian Weatherson). The dispute here is over cases in which two (or more) parties in a conversation have different knowledge bases. For instance, consider a case in which we have a speaker, Alice, who has not been outside in some time. The speaker claims that it might be raining. Bob, her audience, just came in from outside and knows that it is not raining. It is consistent with Alice's knowledge that it is raining outside, but not with Bob's knowledge. From Bob's point of view, the following inconsistent claims all seem plausible: first, that it is not true that it might be raining; second, that when Alice says it might be raining, she says something true iff it is consistent with what she knows that it is raining; and third, that it is consistent with what Alice knows that it is raining. Cases like this one are problematic, and the dispute is over how to explain these plausible but inconsistent claims.

The dispute over contextualist accounts of epistemic modality is significant, and I will return to cases like the one discussed above in chapter 5. For the moment, though, the important thing to note is that the various parties in this debate treat epistemic modality in terms of possible worlds and implicitly accept something like Kratzer's account, at least insofar as they are committed to treating epistemic necessity as a restricted sort of metaphysical necessity. But as we will see in the next section, this causes a problem if we take seriously the necessity of identity.

Another significant feature of Kratzer's work is that it is generally taken to demonstrate that the various sorts of modals in natural languages have a common "semantic

core." That is, Kratzer shows that any treatment of modals which does not explain their common semantic properties is suspect. This, in turn, suggests that any account of epistemic modals we develop should be part of an account of modals in general.

1.2.2 USES FOR EPISTEMIC MODALS

I have already noted that statements like "it might be the case that p " will often have at least two readings—one epistemic and one metaphysical. But I have not said anything about how we tell which reading is most appropriate in a given context. One might wonder, then, whether or not the epistemic reading is particularly common. Consider the following claim:

Epistemic modals are, in fact, not used very frequently. Suppose Alice says "water might not be H_2O ." Suppose also that Alice does not know that water is H_2O . If we give this statement the epistemic reading, then what was said is true. But we're inclined to say that Alice has uttered something false, which would indicate that we generally take utterances like Alice's to be expressing a claim about metaphysical modality. This suggests that ordinary, unembedded modal claims, ought generally to be given the metaphysical reading.⁶

This claim purportedly shows that epistemic modals may not be particularly common in everyday conversation. However, this does not actually follow. We can explain our inclination to say that Alice has said something false even if we give her utterance the epistemic reading. Perhaps when we hear Alice say "water might not be H_2O ," we evaluate it not in terms of what she knows, but instead in terms

⁶This claim was made to me by Nate Olsen in a personal communication.

of what we know. Since we know that water is H_2O , we judge the statement “water might not be H_2O ” to be false. Furthermore, it seems unlikely that non-philosophers are normally concerned with metaphysical possibility, as we can navigate the world outside the philosophy classroom fairly effectively while ignoring those possibilities that are merely metaphysically possible.⁷ This suggests that an epistemic reading of statements like “water might not be H_2O ,” when uttered in non-philosophical contexts, is more plausible.

Epistemic modals also have other roles in language. For instance, epistemic modals play an important role in explaining why people say things like “water is not H_2O .” Suppose Alice said “water is not H_2O .” If we were asked why Alice said what she said, a natural explanation would go something like this: she said water is not H_2O because she believes water is not H_2O ; on the assumption that she has consistent beliefs, this will entail that “water is not H_2O ” is epistemically possible for Alice.

In general, epistemic modals are often introduced to provide third-person explanations for why a speaker produced a certain utterance or acted in a certain way. Even if they do not appear frequently in other contexts, they are still widespread and important enough to warrant our attention.⁸

⁷I have another reason to suspect that non-philosophers are not normally concerned with metaphysical possibility, but it is anecdotal. In my experience, students need to be introduced to the concept of metaphysical possibility and (in many cases) need to be shown why it’s relevant to philosophical investigations.

⁸I want to stress that I make no claims about the frequency of epistemic modals as compared to other sorts of modals. My point is simply that epistemic modals have an important role to play in our linguistic conduct, and that our semantic theories should therefore take them seriously.

1.3 THE PROBLEM

As we have seen, one consequence of Kripkean semantic externalism is that there are more metaphysical impossibilities than we might have expected. If Kripke is right, it turns out that statements like “water is H_2O ” are metaphysically necessary. This, in turn, means that there are no possible worlds in which water is not H_2O . But this causes a problem for epistemic modals. If we adopt an account like Kratzer’s, then we are committed to saying that anything which is epistemically possible is metaphysically possible (that is, that there are no EP MIs).

The problem which arises here is fairly clear: if epistemic possibility is a restricted sort of metaphysical possibility, then anything which is metaphysically impossible will be epistemically impossible as well, relative to any knowledge base. Similarly, anything which is metaphysically necessary will be epistemically necessary, again relative to any knowledge base. When we consider this in light of Kripke’s necessity of identity thesis, we see that this means that statements like “water might not be H_2O ” are inevitably false on the epistemic reading. Similarly, statements like “water is H_2O ” invariably turn out to be epistemically necessary. Neither of these results seem appropriate. Not everyone knows that water is H_2O , and for some of those who don’t it should be epistemically possible that water not be H_2O .

The problem also arises with names. On the Kripkean picture, Cary Grant is (necessarily) Archibald Leach, but some people don’t know this; it should be epistemically possible that Cary Grant and Archibald Leach are different people for them. But on the going accounts of epistemic possibility, this is not the case, since there

are no worlds in which Cary Grant is one person and Archibald Leach another. So if Cary Grant's birth name is unknown, the expression "Cary Grant is not Archibald Leach" is an EPMI.

Note that this problem arises even if Kripke and Putnam are wrong and identity is contingent. In general, there are likely to be sentences which are either necessary or impossible and whose truth value is independent of our knowledge. Let us call such sentences unknown non-contingent sentences. Some statements of metaphysical necessity and possibility might be unknown non-contingent sentences. To borrow an example from Quine, consider the sentence "it is metaphysically possible for something without extension to be colored." If we do not know the truth of this sentence, then it is an unknown non-contingent sentence (assuming the truth of the principles of the modal logic S5). If it's false, it's an EPMI. One interesting class of statements here are claims about necessity of constitution, of the sort put forward in [11]. Johnston argues (*contra* Kripke) that statements like "water is H₂O" are not identity statements but rather claims about the constitution of water. Nonetheless, on Johnston's view there are no worlds in which water is constituted by something other than H₂O. Some sentences of mathematics might also be unknown non-contingent sentences. Consider Goldbach's conjecture: "Every even integer greater than two can be written as the sum of two primes." The truth value of Goldbach's conjecture is unknown, but if it is true it is presumably necessary (and if it is false it is presumably impossible). Goldbach's conjecture, then, is an unknown non-contingent sentence.

Note that epistemic necessity cannot easily be identified with knowledge.⁹ While the truth value of Goldbach's conjecture is not known, it might be a consequence of what is known. Epistemic necessity (at least on my account) is closed under consequence, and so if Goldbach's conjecture is a consequence of what is known, then it is epistemically necessary. As a result, even though Goldbach's conjecture is an unknown non-contingent sentence, it might turn out that Goldbach's conjecture is nonetheless epistemically necessary; its negation, then, would not be an EPMI.¹⁰ However, even if knowledge does not precisely map on to epistemic necessity, it does not follow that epistemic necessity is not an interesting and important object of study. It seems plausible, for instance, that anything which is epistemically necessary is either known or a consequence of what is known, and knowledge and epistemic necessity might coincide for certain kinds of ideal reasoners.

Sentences regarding *de re* necessary properties of objects can also be unknown non-contingent sentences, if we don't know whether or not the object in question has the property under consideration. For example, suppose that Alice, a painter, is about to display her newest work. No one but Alice has seen the work, which is named "Figure 1." It is known, though, that Figure 1 depicts a plane figure—in fact, it either depicts a square or a circle. We do not know whether Figure 1 is a square or a circle. If Figure 1 is a square, it is necessarily four-sided.¹¹ And so "Figure 1 is four-sided" is an unknown non-contingent sentence. Suppose there is

⁹This claim will be defended in §2.2.3 of chapter 2.

¹⁰For more discussion, see §2.2.3 and 2.2.5 of chapter 2.

¹¹This claim must be understood as a *de re* modal claim. That is, to claim that Figure 1 is necessarily four-sided is to claim that that very object could not have had three sides. Alice could have created a different painting, and that painting could have been called Figure 1, but it would not have been the very same object.

at least one unknown non-contingent sentence. If that sentence is true, then it is metaphysically necessary but it might well be epistemically contingent. If it is false, then it is metaphysically impossible but it might well be epistemically contingent. In either case, the problem I have outlined in this section for most extant accounts of epistemic modality arises.

A few different solutions to this problem are immediately apparent. First, we might reject necessity of identity. This would require us to present a new account of semantic content which accounts for the data supporting necessity of identity but does not commit us to it. More importantly, rejecting necessity of identity would not adequately address the problem; as I have shown, the problem is likely to arise whether or not necessity of identity is true. As a result, I will not pursue this line of inquiry. There are at least two further options. We might reject the possible worlds analysis of epistemic possibility. We might alternatively introduce epistemically possible worlds as the counterparts of the metaphysically possible worlds in the possible worlds analysis of metaphysical possibility. Both these approaches have issues which might make them seem implausible, at least on the surface. For instance, rejecting the possible worlds analysis would require us to reject an explanatory framework which has proven very powerful in dealing with other sorts of modality. It would also be both inelegant and semantically suspect to use a possible worlds analysis of metaphysical modality and some entirely different framework for epistemic modality. These sorts of considerations are unlikely to be decisive, but nevertheless I will not be pursuing these alternative approaches because there are advantages to working with the materials we have at hand (so to speak). If it is possible to solve the problem of EPIMs using only metaphysically possible worlds, then we don't need to introduce

epistemically possible worlds or jettison the possible worlds framework, and so the question becomes moot.

So here is the task: create an account of epistemic modals which respects necessity of identity and uses the same framework for epistemic and metaphysical modality. Ideally, this can be done with tools we already know and accept, namely, possible worlds (but see §5, below, for more discussion of alternatives to possible worlds). I aim to meet this challenge using the two-dimensional semantic framework.

1.4 THE TWO-DIMENSIONAL FRAMEWORK

In this section I will present a brief historical overview of the two-dimensional semantic framework. I have two goals in doing this: first, to make clear what the framework is, and second, to motivate the claim that the framework will provide a useful means of solving the problem described in the previous section.

1.4.1 TWO NOTIONS OF NECESSITY

I will use [3] as representative here. In this paper Martin Davies lays out a proposal for a formal account that characterizes the relations between several notions of necessity and between necessity and a prioricity, building on [4]. Davies's account is worth investigating for my project insofar as it helps motivate the use of a two-dimensional framework for an account of epistemic modality and because it forms

a very significant part of the background for my own account.¹² It is important to note, though, that I am not endorsing Davies's specific claims.

Davies begins with a quantified modal language that includes the familiar quantifiers and modal operators (\forall , \exists , \Box , and \Diamond). However, some natural-language expressions (often involving the word "actually") are difficult to formulate in this language. Consider Davies's example: the expression "It is possible that everything that is actually red should have been shiny." This expression is true if there is a world which contains all the things which are red in the actual world and in which those things are shiny. We cannot render this as

$$\Diamond(\forall x)(x \text{ is red} \rightarrow x \text{ is shiny})$$

since this is true if there is a world in which every red thing is shiny, whether or not those objects are red in the actual world. Similarly, we cannot render "It is possible that everything that is actually red should have been shiny" as

$$(\forall x)(x \text{ is red} \rightarrow \Diamond(x \text{ is shiny}))$$

because this holds if for each actual red thing there is a world in which that object is shiny. We are looking for a single world in which all of the actually-red objects are shiny, not several worlds, in order to capture the meaning of the initial expression.

¹²Davies's position is, of course, of great interest and importance in its own right, and there is much that could be said about it. I do not mean to suggest that Davies's account is significant only because it informs my own work. The point of my discussion of Davies is not to provide a thorough analysis of his account, since the success or failure of his account is irrelevant to the success or failure of my account. Rather, the point is to see why two-dimensional accounts in general might be seen as promising with respect to epistemic modality.

Davies's suggestion is to introduce the "actually" operator, symbolized **A**. Each model has a special privileged world, which we will call w^* . Davies suggests that this privileged world is to be understood as the actual world. Intuitively, sentences of the form **A**s are true iff s is true at w^* (but see below for a clarification). According to Davies, this lets us render "It is possible that everything that is actually red should have been shiny" as

$$\diamond(\forall x)(\mathbf{A}(x \text{ is red}) \rightarrow x \text{ is shiny})$$

This sentence is true if there is a world w such that every object in w that is red in the actual world is shiny in w . Any world which contains all the things which are actually red and in which those things are shiny will meet this description and hence make the expression "It is possible that everything that is actually red should have been shiny" true.

It should be noted that this translation does not accurately capture the truth conditions for the most natural readings of the English expression that we started with. In particular, Davies's translation is true if there is a world that contains shiny versions of some proper subset of the actual red things and lacks the other actual red things altogether. This suggests that Davies's proposal may not accurately capture the truth conditions of sentences involving the English word "actually." A more plausible representation could be obtained if we were to supplement Davies's actuality operator with an "actuality quantifier" (**A** x). Sentences of the form (**A** x) ϕx are true iff ϕx is true of all objects x in the privileged world w^* . We could then render "It is possible that everything that is actually red should have been shiny" as

$$\diamond(\mathbf{A}x)(\mathbf{A}(x \text{ is red}) \rightarrow x \text{ is shiny})$$