

Disposition Impossible

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Introduction

A lot of our ordinary theorizing about the world is suffused with disposition talk, broadly construed. We classify things as fragile, explosive, poisonous, and so on. We talk freely of the capacities and abilities of things and people, and indeed we talk explicitly about dispositions (particularly of people) in everyday discourse. We will describe someone as having a friendly disposition, being well-disposed towards someone else, being disposed to violent behaviour under certain circumstances, and so on. Theorizing in the sciences is also full of talk of dispositions, tendencies, propensities, and other phenomena that seem to be dispositional, or at least cousins of dispositional phenomena. Metals are *malleable* or *ductile* to different degrees, ecosystems are sometimes *fragile*, economies are sometimes *prone to* asset bubbles. If we were forbidden overnight to use any dispositional vocabulary, we would find it very difficult to do material science, ecology, or macroeconomics, to take just three examples, in anything like the way we ordinarily do.

In both science and ordinary life we have some idea of what it takes to have a disposition, and while this is far from being a worked-out philosophical account, one thing that is clear is that having a disposition has something importantly to do with *manifesting* that disposition under certain circumstances. That is not to say that in order to have a disposition something must actually manifest that disposition. There are certainly unmanifested dispositions: some fragile vases are never dropped, and hence never get the chance to manifest their disposition to break when dropped. So far, so uncontroversial.

Our purpose in this paper is to explore a further question. Given that dispositions need not be manifested, need it even be possible for them to manifest? Can something be disposed a certain way despite the fact that it not only *does not* but *cannot* ever manifest that disposition? There are two ways for a disposition to be unmanifestable in the sense we are interested in.¹ Firstly, it could be that the

¹ There is probably another sense of “manifestable” which comes to something like “disposed to

circumstances under which an object is disposed to act a certain way are impossible circumstances (so the object could never get a chance to manifest its disposition). Secondly, it could be that the thing the object is disposed to do is itself impossible. We thus take as our target in this paper claims of the form “X is disposed to Φ in circumstances C”, where C is impossible, or Φ -ing is impossible (at least for X), or both. We want to argue that some such claims are true, and *non-trivially* so. When we say that their truth is non-trivial, we mean that *not all* sentences attributing unmanifestable dispositions are true just in virtue of being such.

We thus face two groups of opponents. The first say that there are no unmanifestable dispositions. We take Martin and Heil to be assuming a view of this kind, at least with respect to dispositions to Φ where Φ -ing is impossible, when they say that ‘just as an agent cannot do the impossible, he cannot be disposed to do the impossible either.’ (Martin and Heil 1998, p. 297) To our knowledge, there has been no sustained defense of this view, although it is espoused in passing, both in print and (frequently) in conversation by philosophers interested in dispositions.

The second group of opponents are trivialists, who say that every object has every unmanifestable disposition. We take (something in the vicinity of) trivialism with respect to dispositions to Φ in impossible circumstances C to be a consequence of David Lewis’s conditional account of dispositions, when that account is taken together with Lewis’s semantics for counterfactual conditionals. This consequence is not something that Lewis himself draws attention to. We shall discuss this further in §5 below; there are a few subtleties to be taken into account.

The plan for the remainder of this paper is as follows. We shall begin with a brief discussion of the kinds of modality we are interested in examining (§2), and shall then distinguish three questions about unmanifestability which we think are related but not the same (§3). We shall then discuss some connections between disposition

manifest”. Presumably everything with a disposition is *disposed* to manifest that disposition. We are interested, rather, in whether it is *possible* to manifest certain dispositions.

³ There are also “is disposed to” constructions of other sorts: “Rex is disposed to bark at cats” mentions cats rather than circumstances. We will not address any questions about whether this sort of claim is to be analysed in our preferred “X is disposed to Φ in C” way.

ascriptions and conditionals (§4). Dispositions and conditionals are connected in interesting (if unstraightforward) ways, and we shall suggest that the debate as to whether we should be trivialists about unmanifestable dispositions bears certain important similarities to the debate about whether we should think that conditionals with impossible antecedents are trivially true.

In §5 we turn to cases. We aim here to establish that various unmanifestable disposition claims are true, while others are false (hence trivialism is a mistake). We also aim to demonstrate that unmanifestable dispositions are important for a number of realms of inquiry, especially psychology, but also physics, philosophy, and other areas. This, we hope, will both help persuade the reader of the non-trivial truth of the relevant claims, and avert suspicion that the issue is a ‘don’t care’.

Finally, in §6, we discuss some interesting choice points that arise once one admits the non-trivial truth of some unmanifestable disposition claims. Many interesting questions arise about when they obtain and how they relate to less exotic dispositions and non-dispositional matters. We cannot attempt to settle all of these questions in this concluding section; we merely aim to indicate areas of possible further enquiry.

1. The Modality

There are various things that could be meant by ‘unmanifestable’, depending on how the modality therein is understood. We shall focus primarily on the following:

- (a) Dispositions that cannot, as a matter of logical necessity, be manifested.
- (b) Dispositions that cannot, as a matter of metaphysical necessity, be manifested.
- (c) Dispositions that cannot, as a matter of nomic necessity, be manifested.

A proposition p is logically necessary, in the sense we shall employ in this paper, just in case the only way for p to be false is for some truth of logic to fail. It is controversial how metaphysical necessity should be characterized, but we shall suppose that more things are metaphysically necessary than are logically necessary, so that purely mathematical claims, or claims about the essences of things, are candidates to be metaphysically necessary even if they are not self-contradictory and

otherwise do not violate any logical principles. A proposition p is nomically necessary in our sense just in case the only possible way for p to be false is for some law of nature to fail.

We shall be looking at apparent examples of dispositions that are unmanifestable in all three of these senses during the course of §5. There may also be interesting and important ‘unmanifestable’ dispositions associated with other, more restricted modalities. Certain dispositions may be (now) unmanifestable if one takes the past to be necessary, and other dispositions may outrun the bounds of feasibility or practical possibility. However, we expect there to be much less resistance to the claim that there are (non-trivially) unmanifestable dispositions in these restricted senses. For example, we seem to be able to meaningfully debate which of Tony Blair or Nicholas Sarkozy is disposed to do a worse job of being US president, (in the circumstances where he becomes US president), even though the US constitution makes it impossible, in one good sense, for either to in fact become president of the USA.

It is (a)-(c) that we expect to generate most controversy, and these therefore are our focus in this paper.

Some philosophers would want to collapse the distinction between one or more of our (a)-(c). Some hold that all nomic necessities are metaphysical necessities, and some hold that all metaphysical necessities are logical necessities. Some even maintain that there is only one proposition that is logically or metaphysically necessary. While we will talk as if the three kinds of necessity are distinct, we think the main thrust of this paper would be unaffected if it turned out that there were not three grades of necessity here, but only two, or even one. Those inclined to see these three grades as making distinctions without a difference are invited to read us as providing three kinds of examples of unmanifestable dispositions, rather than examples that answer to different modal criteria.

2. Three Closely Related Constructions

There are three subtly different kinds of linguistic constructions that are regularly

used for discussing dispositional matters, and they raise different issues. The first of these kinds employs the phrase “is disposed to” to make dispositional claims. Our official targets in the bulk of this paper are claims employing this phrase: claims of the form “X is disposed to Φ in C”, where ‘X’ refers to an object, ‘ Φ ’ is a verb or verb phrase, and ‘C’ is a specification of circumstances. Sometimes in the literature a time co-ordinate t is added to this scheme. There may be some reasons to include a time co-ordinate separately rather than (say) build times into C or Φ , but we will suppress it as a separate index in the discussion that is to follow.

It is an interesting question how this “X is disposed to Φ in C” construction is related to other “is disposed to” constructions. There are the constructions that leave off any explicit specification of C: “he is disposed to overreact”, “it is disposed to decay rapidly”, and so on. We will presume that some circumstance, or range of circumstances, is tacitly supplied by context in these cases.

Other constructions, like “X is disposed to Φ when V”, or “X is disposed to Φ if V”, are often used to amount to the same thing as our main construction. A dog’s toy is disposed to squeak when squeezed; a vase is disposed to break if dropped. As far as we can tell, these amount to roughly the same as the claims that the toy is disposed to squeak in circumstances in which it is squeezed, and the vase is disposed to break in circumstances when it is dropped. The “is disposed to ... when ...” and “is disposed to ... if ...” constructions are also available when the final place is filled by something more sentence-like. For example: “Tim is disposed to get excited if the circus comes to town”. Note that this use of “if” is different from the use of “if”, more familiar to most philosophers, where it is used as a sentential connective to produce a conditional sentence. “Tim is disposed to get excited if the circus comes to town” is not best formalized as “The circus comes to town \rightarrow Tim is disposed to get excited”. That conditional may well be true as well, of course, but the disposition attributed to Tim in our example is one that he has in the actual world, not just in circumstances where the circus does come to town: already, right here, he is so disposed. (The function that “if” has here is similar to the sort of “temporary restriction” function that “if” plays in other contexts: see Lewis 1975 for a discussion of this use of “if”.)³ Again, we shall be assuming that these constructions are safely assimilated to “X is disposed to Φ in

C” constructions. “Tim is disposed to get excited if the circus comes to town” is roughly the same as “Tim is disposed to get excited in circumstances where the circus comes to town”.

The second general kind of construction to which we want to draw attention in this section is one that explicitly mentions dispositions: “X has a disposition to Φ in C”. For a number of purposes, using this way of talking or using “X is disposed to Φ in C” talk will not make any difference, except perhaps for those who are wary of admitting the existence of dispositions despite being happy to use the “disposed to Φ ” talk. But talking about dispositions, rather than what things are disposed to do, raises significant new questions. Once we have talk about dispositions, we can ask questions about their identity conditions: does it ever turn out that the disposition to Φ in C is identical to the disposition to ψ in D, where Φ and ψ are different and/or C and D are different? There is some temptation to think so: my disposition to have a cup of tea in the circumstances where [it is morning and I have not yet had one, and the stock market is slightly up] is plausibly the same as my disposition to have a cup of tea in the circumstances where [it is morning and I have not yet had one, and the stock market is slightly down], since my tea-drinking habits are insensitive to the stock market. On the other hand, there is also some temptation to think the two specifications specify distinct dispositions: it seems to make sense to *compare* my disposition to drink tea in the first circumstance with my disposition to drink tea in the second, in a way that suggests these are very similar, but distinct, dispositions.

One plausible thing to say is that there are both fine-grained dispositions, distinguished finely enough to have distinct dispositions whenever the specifying circumstances are distinct, and *also* coarser dispositions, which are identical across a range of closely related circumstances and responses. (I may have one disposition to get bored watching soap operas, that satisfies a number of specifications of circumstances of soap-watching and boredom-exhibiting responses.) We need not take a stand on this sort of issue about dispositions in this paper however, except in §6, where it will turn out to have an interesting bearing on the issue of unmanifestable dispositions.

The third kind of construction we want to mention involves claims of the form “There is a disposition to Φ in C”. Claims of this form follow from claims of the form “X has a disposition to Φ in C”, we presume. But one possible point of controversy is whether there can exist a disposition to Φ in C even if nothing has it: whether there are uninstantiated dispositions. (Not just unmanifested dispositions, which are dispositions that are had but not activated, but uninstantiated dispositions, that are not even *had* by anything.) If uninstantiated dispositions exist, and we had an adequate grasp of the extent of these dispositions, appeal to these uninstantiated dispositions would be another avenue to try to establish that there are some unmanifestable dispositions, even if we were forced to concede that nothing actually *has* an unmanifestable disposition (and hence that all unmanifestable disposition claims made using the first two kinds of construction discussed in this section are false). While the issue of uninstantiated dispositions may repay some attention on another occasion, we will say no more about it in this paper, since our goal is to argue that some things are actually disposed to Φ in C, for either impossible Φ or impossible C.

3. Dispositions and Conditionals

Our use of the language of dispositions is closely linked to our use of conditional language, particularly “subjunctive” or “counterfactual” conditionals. When I am prepared to say that a given sample of salt is soluble, I am often also prepared to say that if the sample were placed in water, it would dissolve. When I think that Jones would get angry if taunted, I am often prepared to claim that Jones is disposed to get angry when taunted (especially if the state in virtue of which it’s true that Jones would get angry if taunted is a relatively stable, ongoing state).

Despite there apparently being a close connection between true disposition claims and true conditional claims, it is difficult to pin down exactly what that connection is. The

“simple conditional analysis” of dispositions is wrong. The simple conditional analysis⁵ holds that claims of the form “X is disposed at time t to Φ in C” are to be analysed as claims of the form “if X were to be in C at t , X would Φ ”. Sometimes dispositions can be masked (so that they are there but do not activate in C), or finked (so that they would go away were C to obtain).⁶ A properly packed fragile vase does not break if struck. A regime that instantly executes anyone with leukaemia makes it that case that nobody would be killed by the disease if they contracted it, but it does not stop leukaemia from being disposed to kill its host.

More sophisticated analyses of dispositions in terms of conditionals have been offered, most famously by David Lewis (1997, p. 149) who proposes the following:

Something x is disposed at time t to give response r to stimulus s if and only if, for some intrinsic property B that x has at t , for some time t' after t , if x were to undergo stimulus s at time t and retain property B until t' , s and x 's having of B would jointly be an x -complete cause of x 's giving response r .

This analysis fails as well. (One of us has indicated why he thinks so in Nolan 2005, pp. 104-5 and 232-33, and the other gives some of the reasons why she thinks so in Jenkins MS.) Indeed, we are confident that dispositions will not be able to be analysed entirely in terms of conditionals, though several more rounds of proposal-and-counterexample may be needed before everyone else agrees.

One fallback from offering an analysis of dispositions in terms of conditionals is to claim that there are conceptual entailments from disposition statements to conditional

⁵ The phrase ‘simple conditional analysis’ is used by in Lewis 1997, although he uses it for a slightly differently-worded thesis. He talks about something’s being disposed to give response r to stimulus s , rather than being disposed to Φ in C. There could be important differences between these phrasings. Perhaps most significantly: (1) the word ‘stimulus’ suggests a causal relationship to the relevant response, whereas circumstances need not be causally related to any Φ -ing that occurs in them; and (2) circumstances could be ongoing states, whereas the word ‘stimulus’ suggests something more event-like. We won’t dwell on these differences here, however, but simply import Lewis’s phrase ‘simple conditional analysis’ to describe a thesis couched in the more neutral vocabulary that we prefer.

The lure of the simple conditional analysis is (or at least once was) considerable. Lewis claims that “[a]ll of us used to think... that statements about how a thing is disposed to respond to stimuli can be analysed straightforwardly in terms of counterfactual conditionals” (p. 133). Whether or not everyone once thought that way, Ryle (1949, p. 43) and Quine (1960, §46) thought that something in the vicinity was correct, for at least some dispositions.

⁶ A classic presentation of the argument that dispositions and conditionals come apart is given in Martin 1994.

statements, without claiming that this analyses either. Mumford 1996 argues for such a view. However, the conditionals which Mumford thinks are entailed are of the form ‘If X is/were to be in C then provided no α -conditions obtain, X Φ s/would Φ ’, where α -conditions are ‘*conditions that prevent the manifestation of a disposition though the disposition itself remains*’ (p. 90). In other words, the entailed conditionals are of the form ‘If X is/were to be in C then, provided no conditions obtain(ed) that prevent(ed) the manifestation of X’s disposition to Φ in C, X Φ s/would Φ ’.

We don’t think that even such conditionals as these are entailed by disposition-ascriptions. In some cases X is disposed to Φ in C, yet if X were to be in C then it would lose its disposition to Φ in C, and would hence fail to Φ , even though no α -conditions obtained. Indeed, we think (*contra* Mumford) Martin’s reverse-cycle electro-fink case (Martin 1994) is like this.

So it is difficult even to state interesting entailments from dispositional statements to conditional statements. Capturing interesting and true entailments from conditional statements to disposition statements is not likely to be easy either, especially since conditionals connecting two states of affairs can be true because of factors that don’t seem relevant to the existence of the corresponding dispositions. For example, it can happen that X lacks the disposition to Φ in C but would acquire that disposition should X ever be in C. In which case, X would Φ were X in C, and yet X is not disposed to Φ in C. Martin’s original electro-fink case (Martin 1994) is of this kind.

Even if neither analyses nor entailments (whether from dispositions to conditionals or *vice versa*) are forthcoming, we can still maintain that there is in general some kind of rough connection between claims of the form “X is disposed to Φ in C” and “if X were to be in C it would Φ ”. So it may be illuminating, when thinking about unmanifestable dispositions, to think about the corresponding conditionals. Are there many cases where “if X were to be in C it would Φ ” are true when it is impossible for X to be in C?

It is worth pointing out here that both the simple conditional analysis and Lewis’s more sophisticated version will, in conjunction with trivialism about counterpossible

counterfactuals, deliver trivialism about some (though not necessarily all) classes of unmanifestable dispositions. By ‘trivialism about counterpossible conditionals’ we mean the view associated with Lewis and Stalnaker (Stalnaker 1968, Lewis 1973, pp. 24-6) that any counterfactual conditional with a metaphysically impossible antecedent is trivially or vacuously true.⁷

The simple conditional analysis of dispositions says that X is disposed at time t to Φ in C iff were X to be in C at t , it would Φ . Supposing it is impossible for X to be in C at t , the antecedent of the relevant counterfactual becomes impossible, and hence, according to the trivialist about counterpossibles, the counterfactual is rendered trivially true. Thus, by the simple conditional analysis, the unmanifestable-disposition claim is rendered trivially true.

Lewis’s sophisticated conditional account involves a different counterfactual: “If x were to undergo stimulus s at time t and retain property B until t’, s and x’s having of B would jointly be an x-complete cause of x’s giving response r”. But again, this counterfactual will have an impossible antecedent in cases where it is impossible for x to undergo stimulus s at time t and retain property B until t’. By the lights of the trivialist about counterpossibles, therefore, the conditional will be trivially true, and hence, assuming that stimulus/response talk can be cashed out using circumstances/ Φ -ing talk (see fn. ** above), some unmanifestable-disposition claims will come out trivially true.

A Lewis-style account only renders dispositional claims trivially true when C (or: the stimulus condition) is metaphysically or logically impossible. Lewis claims that propositions that are merely nomically impossible are true at *some* possible worlds, and not every counterfactual with a nomically impossible antecedent is to receive the same truth value. However, there are also theories of dispositions that render them automatically true even when C is only nomically impossible.

⁷ “Counterpossible conditionals” normally picks out a broader class of conditionals, so that e.g. indicative conditionals with impossible antecedents are counterpossibles too. At least one of us (DN) is happy with non-trivial counterpossible indicative conditionals as well, but indicative conditionals are less relevant to the discussion about disposition ascriptions.

One of them is offered in Armstrong 1996. Armstrong (1996, p. 17) offers the following account of what it is for a glass to have an (unmanifested) disposition of brittleness. His proposal is not explicitly conditional, but it uses terminology that is certainly closely related to conditional terminology:

Given the state of the glass, including its microstructure, plus what is contrary to fact – that the glass is suitably struck – then, given the laws of nature are as they are, it follows that the glass shatters.

The sense of ‘follows’ that Armstrong has in mind here is then cashed out using what he calls ‘the convenient, if metaphysically misleading, terminology of possible worlds’:

... in all worlds that have the same laws of nature as our world, and where the boundary-conditions are the same as our world, including the microstructure of the glass, but with the addition to the boundary conditions of a suitable striking of the glass, then in all these worlds [sic] the glass is caused to shatter. This is what it *is* for the glass to be brittle ...

His account thus, in effect, appeals to a certain kind of strict conditional.

What will happen to this kind of characterization when the ‘addition to the boundary conditions’ is some impossible circumstance *C*? Well, if *C* is metaphysically impossible, and if (as is presumably the case) Armstrong’s possible worlds are meant to be the metaphysically possible worlds, then we will get vacuous satisfaction of Armstrong’s condition. There will be *no* *C*-worlds which meet all the other requirements, for there will be no *C*-worlds at all. The universal claim (‘in all worlds ...’) is therefore vacuously true. Hence it follows from Armstrong’s proposal that, for any metaphysically impossible circumstances *C* and any Φ whatsoever, everything is disposed to Φ in *C*. Assuming that logical impossibilities are also metaphysical impossibilities, the same goes for any logically impossible *C*.

Furthermore, even if *C* is merely nomically impossible, the fact that it is ‘all worlds that have the same laws of nature as our world’ that are relevant will give the same trivializing result. There will be no possible worlds which have the same laws of nature as our world and at which *C* is true, for a nomic impossibility is something

which does not occur at any possible world with our laws. So Armstrong's proposal entails that if C is impossible in any of the three ways we are considering, the corresponding dispositional claim will automatically be true.

We should note that the accounts discussed in this section do not make *all* kinds of unmanifestable disposition trivially true. Dispositions involving an impossible Φ but a possible C are not trivialized by the considerations we've discussed. But it is interesting that partial trivialization of unmanifestable dispositions is a consequence of such influential views about what it is to possess a disposition.

We would also like to stress that it is an option to *reject* trivialism about counterpossible conditionals. One of us makes a case for doing so in Nolan 1997. Once one accepts that some counterpossible conditionals are true and some are false, a conditional analysis of dispositions cannot force one into trivialism about any kind of unmanifestable dispositions in the ways discussed in this section. Furthermore, once one is happy with non-trivial counterpossibles, the connection with conditionals suggests that there may well be unmanifestable dispositions as well, for example when the counterpossible conditionals are stably true, are true because of the features of the object that centrally features in the conditionals, or whatever other conditions are typical symptoms that a true conditional is associated with a true disposition claim.

4. Discussion of Cases

In this section we will be looking at a number of situations where we think claims of the form "X is disposed to Φ in C " are true, although at least one of Φ and C is either logically, metaphysically, or nomically impossible. We shall also describe various situations where we think such claims are false, in an attempt to resist the trivialist claim that they are always true.

5.1 Unmanifestable Dispositions of Agents

Jane is disposed to be surprised when there is a detectable round square object in front of her. This is a fact about her psychology, and it is due (in part at least) to the fact that she's interested in round squares but very confident that none exist. But Jane is

not disposed to be surprised when there's an *undetectable* round square object in front of her. It is false to claim that she has that disposition.

Moreover, there are ways of finding out these facts about Jane. You can check whether she believes in round square objects, whether she believes they're even possible, what kinds of things surprise her, and so on. You can learn that she does not think they are possible, that she is surprised upon detecting things she previously thought were impossible, and that she is not surprised by things that she cannot detect. So the disposition claims of the preceding paragraph are not epistemically inaccessible. If there is something objectionable about them, it is not that.

We take it that it is metaphysically impossible for there to be a round square object. Therefore, if everything we have said so far in this section is true, then there are some true claims of the form 'X is disposed to Φ in C' where C is metaphysically impossible, and there are some false claims of this kind. This would be enough to establish that some such claims are non-trivially true in the sense we are interested in.

Jane is also disposed to be surprised if some things detectably travel faster than the speed of light, but not if some things undetectably travel faster than the speed of light. If that's so, the same kind of point can be made about her being disposed to Φ in C where C is nomically impossible. Similarly for logically impossible C, if she is disposed to be surprised if she stumbles on an observable contradiction, but not by undetectable true contradictions.

Here's a case that involves a mathematically impossible Φ and a mathematically impossible C. (Depending on what you think about mathematical truth, these might be taken to be logical or metaphysical impossibilities.) Suppose Heidi is the best mathematician of her age, and X is some complex, mathematical conjecture, of the kind with which Heidi is most competent, whose truth-value is as yet unknown to Heidi and her community but which is in fact false. We can then say with some plausibility that Heidi is disposed to produce a proof of conjecture X on the condition that there is one. But Heidi, we may suppose, is *not* disposed to produce a proof of some other unproved conjecture Y from an area of mathematics with which Heidi is

unfamiliar with and in which she has a marked aversion to working. (Suppose Y is in fact also false.) It would be false to say that Heidi is disposed to produce a proof of Y on condition that there is one.

Here's another kind of case, involving a nomically impossible Φ and a nomically impossible C. Suppose it is nomically impossible to build a bridge of design A. The tensile strength of steel, say, just will not allow it, even though the design demands that steel be used. Nevertheless, it may be that the mayor in charge of directing the bridge-building program in her city is disposed to be pleased by a bridge of design A, because of its striking aesthetics, its potential to attract visitors to the city, its low cost, and so on. On the other hand, the mayor may well *not* be disposed to be pleased by a bridge of nomically impossible design B, which looks like an upside-down elephant and would cost more than the total council budget for the next twelve years. Indeed, she may be disposed to sack any engineer who builds a bridge of design B.

Although they sound right to us, the claims of this section about what agents are and are not disposed to do, feel and think could of course be disputed. It might be argued, for example, that we are confusing dispositions with counterfactuals. All that is true, one could maintain, is that *were* there to be a round square in front of me I *would* be surprised, while it is not the case that I would be surprised were there to be an undetectable round square in front of me.

We do not think we are thus confused. We know that there is a difference between conditionals and dispositionals: we discussed it in §4. And the dispositional claims sound right to us even when we are taking care to remember that difference. The response urges us to replace our talk of dispositions to Φ in impossible circumstances with counterfactuals. But counterfactuals are not an adequate substitute for what we wanted to say when we made those dispositional claims.

For example, it might not be the case that if Jane *were* to encounter a round square object Jane *would* be surprised. Perhaps the closest world where Jane encounters one is a world where Jane lack the disposition to be surprised; perhaps it is a world in which Jane has grown up with round square objects and am entirely comfortable with

them. Dispositions – or the lack of them – can be masked, finked, and so on (see §5 above), and it is well-known that all of this makes counterfactual claims sometimes poor substitutes for disposition-talk.

Consider Heidi again. Let's say that conjecture X is something she's been working on all her life, and she really hopes it turns out to be a theorem. Nevertheless, unbeknownst to Heidi, if X *were* to be a theorem it would be proved by her arch-rival Angela days before the completion of Heidi's own proof. In this case, we want to say that Heidi is disposed to be pleased if X turns out to be a theorem, even though, *were* X to be a theorem she *would not* be pleased – she would be livid at Angela's having scooped her.⁸

Let's now consider a different kind of opponent to the one who proposes to replace talk of unmanifestable dispositions with counterpossible conditional talk. This kind of opponent says that non-trivial unmanifestable dispositions are theoretically undesirable (perhaps because he already has some theory of dispositions that rules them out), and that we do not *need* to postulate them. Even if our claims about what Heidi and the mayor are and are not disposed to do have some intuitive pull, these intuitions should be resisted.

In response to this challenge, let us discuss benefits gained from postulating non-trivial unmanifestable dispositions of the kind discussed in this section other than the intuitive plausibility of the claims that we have presented. Some facts about what is possible are not known to us, and yet we often need to make predictions about what people will think, feel or do, explain their behavior, and decide how to interact with them in ignorance of these facts.

Before conjecture X has been proved or disproved, we do not know whether or not it is possible for it to be proved. But we may still need to know whether Heidi is disposed to prove it on condition that there is a proof. We may need to know, for example, who should be working on this project. Suppose Heidi's colleague Hilda is also an excellent mathematician but is not well-versed in the area of conjecture X.

⁸ We assume here the non-triviality of counterpossible conditionals, as described in §4 above.

Knowing that Heidi is, and Hilda is not, disposed to produce a proof of X on the condition that there is a proof gives us a basis for assigning tasks: clearly, we don't want Hilda working on X if that's the case.

In this section we have been discussing unmanifestable dispositions of agents, as we think these are some of the clearest cases of unmanifestable dispositions. Moreover, they seem to us important. In general, we care about how people are disposed. Our understanding of others as agents, and folk psychology in general, rely heavily on information about people's dispositions. We use this information to predict and explain people's other mental states and behaviour.

This seems to us to be true of the kind of unmanifestable dispositions we've discussed in this section, just as it is of manifestable ones. Knowing that S is disposed to Φ in C can help us predict S's behaviour, explain some of S's emotional states, and so on, whether or not Φ and C are possible. It can help us in these ways even if we do not know whether or not C and Φ are possible. (And we should expect there to be many such situations, as we will often be better at knowing each others' dispositions than knowing the relevant modal facts.) Indeed, knowing that S is disposed to Φ in C can be useful to us on occasion even if we know that one or both of Φ and C is *impossible*.

Knowing that Heidi is disposed to prove conjecture X on condition that there is a proof helps us explain why Heidi is working on conjecture X (and, indeed, why her head of department approves of her doing so). It helps ground our predictions that Heidi will put many hours into working on X, that she will do a good job investigating whether X has a proof, that she will be frustrated should X turn out to be false, and that she will be elated should X turn out to be true. These predictions concerning Heidi can be made in the absence of knowledge as to whether or not X is possible. (Indeed, even if we did know that X was impossible to prove, say because we were mathematical geniuses gossiping about our colleagues, knowing about Heidi's disposition would still help in predicting her behaviour and emotional responses.) Being able to predict people's behaviour and emotional responses under conditions of uncertainty is something we all, as folk psychologists, often have an interest in doing,

regardless of which modal facts we know.

Again, consider that in the bridge-design case we discussed on pp. *** above, it is useful for those designing the bridge to know about the mayor's dispositions to be pleased by a bridge of nomically impossible design A and to sack anyone who builds a bridge of nomically impossible design B. This information can be useful even if they already know that designs A and B are nomically impossible. For the knowledge enables them to make predictions about how the mayor will respond, emotionally and behaviourally, not only to bridges of design A and B, but also to other saliently similar bridges. Armed with this information, they can avoid wasting their time working on B and similar designs, and to concentrate on designing something similar to A (but – hopefully – nomically possible).

5.2 Unmanifestable Dispositions Without Agents

If we have shown that non-trivial unmanifestable dispositions are important for folk psychology, we will have done enough to make our point about their significance. But it might be suspected that if unmanifestable dispositions *only* played a useful role in such psychological explanations, then perhaps some other psychological resources could be used to play the same role: appeals directly to beliefs and desires with contents that could not be true, for example. So it would buttress our case if postulating unmanifestable dispositions played a useful role outside our theories of agents – and it is in any case interesting to see whether there appear to be any non-trivial unmanifestable dispositions of things that do not think or represent.

There is a relatively strong case to be made for non-trivial dispositions of objects to behave certain ways in circumstances ruled out by our laws of nature. Were the speed of light 3×10^{10} m/s in vacuum, rather than the actual 3×10^8 m/s, photons would travel at 3×10^{10} m/s: and, very plausibly, photons are disposed to have a speed of 3×10^{10} in the circumstances where they are in vacuum and the speed of light is 3×10^{10} m/s. Cars, on the other hand, are disposed to have a much slower speed in circumstances in which the speed of light is 3×10^{10} m/s; cars are *not* disposed to have a speed of 3×10^{10} m/s in the circumstances where the speed of light is 3×10^{10} m/s.

Or consider the dispositions of two bricks, each acted upon only by each other's gravitational forces, that are one metre apart. They are disposed to accelerate towards each other at a given rate. They are disposed to accelerate towards each other at a lesser rate in circumstances in which the gravitational constant is the same but gravity operates at a level proportional to the inverse cube of the distance rather than the inverse square of the distance. They are *not* disposed in such circumstances to accelerate towards each other at the same rate that they are disposed to accelerate towards each other when governed by our law of gravity.

One use for postulating counter-nomic dispositions (and lacks of dispositions) is predictive: when we have equipment that is set up to be sensitive to the value of a physical constant, for example, we can use our knowledge of the dispositions the object has and lacks, including some counter-nomic dispositions, in order to determine what those physical constants are. Take, for example, the justly famous Millikan oil drop experiment. Tiny oil droplets with static electric charges were sprayed into an electric field between two plates: the masses of the oil droplets were known, and by varying the electric field it could be determined that the charges on the droplets were integer multiples of a particular charge. This minimum charge that Millikan measured was the charge of one electron.⁹ Millikan thus demonstrated the "atomic theory of charge" was correct – larger charges were a matter of the presence of absence of numbers of objects with the same charge, and could not vary continuously.

When Millikan and others used the Millikan apparatus to determine the size of an electron charge, they did not know what that value was: but they did know a lot about the dispositions of the drops and the measuring apparatus. The oil drops were being pulled down by gravity, of course, and by varying the electric field different drops could be brought into equilibrium, the force of gravity downwards being exactly offset by the field strength pulling the droplets upwards. If the charge on the oil

⁹ Millikan's reported result is slightly different to the true value of an electron charge: and Millikan may have slightly "massaged" his reported result. These details do not matter for present purposes. Millikan also repeated the experiment many times, with later versions being ever more sensitive and carefully constructed: but it will do no harm if we generalise about his oil-drop experiments as a whole in the text.

droplets only came in fixed multiples of a minimum value, drops at a certain distance from the charge plates could only be brought into this equilibrium at particular field strengths (which field strength depending, of course, on the charge on the droplet). On the other hand, this pattern would not have been observed had the charges on the droplets appeared in quantities that varied continuously - the amount of electric attraction necessary to counterbalance the gravitational effect on the droplets would have been able to take all sorts of values.

The set-up was disposed to do different things depending on whether charge came in minimum “atoms” of charge, or rather varied continuously in the droplets. Furthermore, it was disposed to respond in one way if the minimum unit was approximately 1.6×10^{-19} coulombs, as it in fact was; and another way if the minimum unit was approximately 1.9×10^{-19} coulombs, for example.¹⁰ In the later circumstances, the machine would have brought the oil drops into fixed positions at quite different ranges of field-strengths. On the other hand, there were many dispositions that the Millikan apparatus lacked: it lacked the disposition for the oil drops to dance wildly in circumstances in which the charge of an electron was 1.9×10^{-19} coulombs in magnitude, for example.

Furthermore, the apparatus would not have been useful for Millikan’s purposes if he did not know about the disposition of the machine to react in different ways depending on whether the charges came in discrete multiples of a minimum or not, and depending on whether that minimum was around 1.6×10^{-19} coulombs or around 1.9×10^{-19} coulombs. So it seems to us that the Millikan apparatus had dispositions to react not just to nomicallly possible circumstances (such as charge, in the experimental circumstances, coming in multiples of the electron charge of approximately 1.6×10^{-19} coulombs), but also to nomicallly impossible circumstances (charge being continuous, electrons having 1.9×10^{-19} coulombs of charge): and taking note of these dispositions enables us to explain the workings of the apparatus necessary for the discovery of the charge of the electron.

Almost any example of a nomic necessity might be challenged, and there will,

¹⁰ In fact, the Millikan apparatus was sensitive to differences in charge much smaller than these two.

perhaps, be those who think that charge coming in discrete quantities, and the electron having roughly 1.6×10^{-19} coulombs of charge, are in fact nomically contingent. If the charge of the electron is contingent and depends, for example, on the way various symmetries were broken in the first microsecond of the universe, then perhaps the discovery of the charge of the electron is not an example of the discovery of a nomic necessity after all. Even if that is so, the lesson of the Millikan experiment remains intact, we think. We do not have to wait for further revelations about the ultimate physical story to tell whether our description of the Millikan apparatus is plausible: even on the assumption that electron charge is a matter of nomic law, it seemed correct to describe the apparatus as having dispositions to react differently to different electron-charge values. Once scientists have discovered how to experimentally detect the true laws of nature, the strategy we employed with Millikan's experiment will be able to be redeployed to describe those experiments: experimental apparatus sensitive to values set by the laws of nature are disposed to give different readings depending on different values of the parameters. And knowledge of these dispositions, including the dispositions to behave in nomically impossible situations, can be important in the process of investigating laws of nature by empirical means.

We think opponents of nomically unmanifestable dispositions will have more substantial concerns than quibbling about which laws of nature govern electrons. We suspect they will rather want to deny that Millikan oil drop apparatuses have the dispositions we attribute to them, and deny that information about such dispositions is relevant to Millikan's ability to determine the value of an electron's charge, and to our ability to explain what Millikan did.

Some might argue that there aren't really dispositions of the kind we are discussing, merely true counternomic conditionals of the form "If the minimum unit was approximately 1.9×10^{-19} coulombs, the Millikan apparatus would behave in such-and-such a way". But as we mentioned in §4 in connection with agents' dispositions, counterfactual talk is quite clearly an inadequate substitute for disposition talk in general, and the point is no less true in the cases we've been considering here. All sorts of factors could be interfering with the apparatus in such a way that its dispositions to behave in particular ways under particular counternomic conditions would not manifest because of that interference. And conversely, there can be various

reasons why such counterfactuals come out true although it would be false to attribute the corresponding disposition. So we doubt that this could be the basis of a satisfactory general account of this kind of case.

A second kind of case where attributing nomically unmanifestable dispositions seems to be worthwhile is in the case of scientific idealisations. In scientific practice, ideal gases or rigid rods or populations of animals with perfectly exponential growth curves are often appealed to in order to predict or explain the behaviour of actual objects, since it is often easier to make an idealisation and then add in some complications, or even to use an idealisation and ignore the complications as relatively insignificant, than it is to employ what information we have about actual systems. So understanding how a skidding car is disposed to behave on a frictionless surface can be a useful first step in understanding how skidding cars are disposed to behave on black ice or on oil slicks. How predator numbers are disposed to change when the predators are supposed to be feeding on idealised prey species is useful information when we want to predict or manipulate predator numbers in a habitat inhabited by real prey species which do not reproduce as smoothly. Of course, many of these idealisations describe scenarios that are nomically impossible, at best: the laws of nature do not seem to allow for entirely frictionless solid surfaces, nor entirely ideal gasses, nor species which have reproduction rates that allow their numbers to vary continuously over time, as opposed to jumping up or down in integer amounts when members of the species die or are born. (It may even be *metaphysically* impossible for a rabbit population to increase by 0.1 of a rabbit in a given period of time: but this does little harm to the idealisation.)

We expect our readers already believe that using idealisations is important for science. But someone who agreed with us about that might still object that talk of dispositions in idealised circumstances (including nomically impossible idealised circumstances) is not to be taken literally. Why suppose the car is disposed to skid in a certain way on a frictionless surface, rather than think that the car has a certain disposition only *according to an idealisation*? Idealisations represent many things that are false about the actual world (the existence of frictionless surfaces with cars on them, for example). Why not think they also misrepresent the dispositions of ordinary objects placed in ideal circumstances?

We do not doubt that a theory of scientific idealisations could be developed which did not require unmanifestable dispositions. But such a theory would lack the straightforward story available to the believer in unmanifestable dispositions about *why* the idealisation should say one thing rather than another about what the car does in the idealised conditions: the actual disposition of the car to behave in the relevant circumstances. It also seems more natural to us to suppose the car has a disposition to skid in a certain way when there is no friction that lies at the end of a continuum of dispositions it has to skid in cases of undergoing less and less friction: whereas the alternative proposal will presumably be committed to the dispositions the car has in nomically possible cases where there is *very* little friction, but tell an entirely different story about the endpoint of that spectrum where it experiences no friction at all.

Scientific idealisations do not provide a knock-down argument for the existence of unmanifestable dispositions. They do, however, provide a set of cases where it would be very useful to employ information about unmanifestable dispositions once such dispositions are admitted: employing information about idealised predator-prey relationships, or ideal gases, or ideal models of economies often is *better* for inquiry than the difficult and sometimes intractable task of employing literally true non-idealised models of phenomena. We think the most natural way to understand reasoning about dispositions in highly idealised circumstances is to often take such dispositions literally. But even those who prefer some instrumentalist or fictionalist treatment of such talk about dispositions should recognize that there are advantages to engaging in reasoning which is *apparently* about unmanifestable dispositions.

As well as nomically unmanifestable dispositions, we also think there are non-trivial non-agent-involving dispositions to respond to metaphysical impossibilities, for example mathematical impossibilities. Alan Baker (2005, §2) discusses (for reasons having to do with mathematical explanation rather than dispositions) a kind of cicada, known as the ‘periodical’ cicada. This cicada has an unusual life cycle, lasting 13 years in some areas and 17 years in others. The mature cicadas live a few weeks and reproduce. The new generation of immature cicadas then live underground for 13 or 17 years (depending on the area), before emerging to mate themselves and restart the cycle. The emergence of mature cicadas is synchronized, so that all the cicadas

within a particular area emerge at roughly the same time. The reason for the particular duration of the life cycles of these insects is that 13 and 17 are prime numbers, which helps to reduce coincidences between the cicadas' life cycle and those of predators who also appear at regular, smaller, intervals. Presumably the cicadas evolve these prime-number life cycles in response to pressure from predators with shorter life-cycles, and so are disposed to settle upon lifecycles are some sufficiently large prime number of years.

Consider the cicadas on a 13-year cycle. They were disposed, in the event of 12 rather than 13 being prime, to develop an immature stage of 12 rather than 13 years' duration. Similarly, the cicadas on a 17-year cycle were disposed, in the event of 16 rather than 17 being prime, to develop an immature stage of 16 rather than 17 years' duration. But it is mathematically (and hence, we assume, metaphysically) impossible for 12 or 16 to be prime.

In this case not much practical good would be done by focusing on the disposition of some cicadas to develop a life-cycle of 12 years in the circumstances where 12 is prime. But we suspect this is because it is obvious to us which numbers under 20 are prime, and so obvious to us that such cicadas have never found themselves in that situation. But imagine biologists for whom basic number theory was far more difficult, and who have appreciated that the cicadas would evolve to have a life-cycle of a number of years equal to a largish prime, but to whom it is not at all obvious whether 12 is prime or not nor whether 13 is prime or not. *They* might usefully use this information, for instance, to lead them to calculate whether 12 is indeed prime, to predict whether they should expect to find periodic cicadas with a life-cycle of 12 years. (Or, for that matter, to use the search for periodic cicadas to help get evidence about which numbers between 10 and 20 are prime, if they are especially terrible at mathematics.)

We might be in the situation of our hypothetical biologists with regard to other phenomena: where it is known that there is a close link between the phenomena and some mathematical structure, but our mathematical resources are too puny to make it obvious how the phenomena will act in the presence of the (hard to discover) mathematical facts. In such situations, relying on information about a system's

dispositions to be different given different mathematical scenarios may be of genuine use to inquirers. Some cases of using computers to do mathematics might be like this: we know that the computer is disposed to behave *this* way if the answer is A, and *that* way if the answer is B. Still, the fact that even the simple unmanifestable dispositions of the cicadas *could* be useful for inquirers, admittedly unlike us, in an intelligible way, points the way to thinking that counter-mathematical dispositions are in principle useful to postulate.

5.3 A Challenge

A certain kind of challenge might be raised in response to any or all of the putative examples of unmanifestable dispositions that we have described. Do we really have to say that the things in question *have* the disposition, or can we get away with saying they *would* have the disposition under certain circumstances? Take our cicadas, for example. We said that they actually were disposed, in the event of 12 rather than 13 being prime, to develop an immature stage of 12 rather than 13 years' duration. Couldn't we have said merely that *had 12 rather than 13 been prime*, they *would* have been disposed (under some/most circumstances) to develop an immature stage of 12 rather than 13 years' duration? Wouldn't that have been enough to accommodate whatever intuitions lay behind our saying what we did?

Let's start by being clear that we certainly are not at all confused about the difference between X's being disposed to Φ in C and X's being such that were C the case X would be disposed to Φ (under certain circumstances). When we say that the claims about things actually having unmanifestable dispositions sounded plausible to us, we say that in full awareness of the non-conditional nature of those attributions. We hope that our readers will share our verdicts whilst similarly aware.

In the light of that, we do *not* think that enough is done to accommodate our intuitions about the cases by substituting the claims we actually made with conditional ones in the manner suggested. The unconditional claims sound good to us. If we had independent reasons for thinking that there are no unmanifestable dispositions, maybe the conditional substitutes would be worth considering as a way to salvage something of the underlying intuitions without doing (what we consider to be) full justice to

them. We do not know of any good independent reasons, but for those who think they have such reasons, we recommend this as the strategy to pursue to explain the plausibility of objects having unmanifestable dispositions.

6. Choice Points for Theories of Unmanifestable Dispositions

Our central task was to make the case for the truth of some claims of the form “X is disposed to Φ in C”, where either it was impossible for X to Φ , or the circumstances C were impossible. That task is now largely complete, though we will offer some more sugar for this pill below on pp. XX-YY. The theory of unmanifestable dispositions does not end with their discovery, however. Once unmanifestable dispositions are posited, a host of questions arise about their extent, what principles they obey, and how the theory of unmanifestable dispositions relates to theories of related topics like modality, laws of nature, causation, chance, and so on. In the next two sections we address two philosophically important questions about unmanifestable dispositions.

6.1 *The Strangeness of Impossible Manifestations Condition*

Suppose we allow that it is a non-trivial matter whether a given thing has, for some Φ , the disposition to Φ in C, where C is impossible. Suppose also we allow that there are cases of impossible Φ s where objects have the disposition to Φ in C. A further question arises: are there any cases where “X is disposed to Φ in C”, where Φ is impossible but C is *possible*? That is, does anything have the disposition to do something *impossible*, given a *possible* trigger? Are there even any *possible* cases of something having such a disposition?

This issue is related to an issue that comes up in the theory of non-trivial counterpossible conditionals. The strongest case for needing to consider impossible situations when evaluating conditionals comes from conditionals with impossible antecedents: if intuitionistic logic were correct, would excluded middle still be a theorem? But perhaps, sometimes, conditionals with antecedents that are themselves possible may need to require consideration of impossible situations as well.

In a closest-world semantics for conditionals, in the style of Lewis-Stalnaker semantics for conditionals but extended to employ impossible worlds as well, the natural way to consider whether possible antecedents may take us to impossible situations is to consider what Nolan 1997, pp. 550-66 dubbed the “Strangeness of Impossibility Condition”, or SIC. For our purposes, we present a simplified form of the SIC:

(SIC) For any impossible world i , and for any possible worlds w and v , w is closer to v than i is.

Add this to a semantics for conditionals according to which $A \rightarrow B$ is true at w just in case there is a world where A obtains and B obtains that is closer to w than any world where A obtains but B does not obtain, and the closest world where a possible antecedent is true will itself be a possible world. So, for the most part, if the SIC holds, when the antecedent is possible we need only concern ourselves with what could possibly happen were the antecedent true.

However, if the SIC fails, then there can be circumstances where the closest world where some *possible* antecedent is true is itself an impossible world, in which case there can be true conditionals with possible antecedents but impossible consequents. One of us (Nolan) thinks that the SIC does suffer from counterexamples, though he was a little more hesitant to claim this in 1997 than he is now. For example:

If Graham Priest was correct after all, then there would be true contradictions.

(Graham Priest in fact endorses true contradictions - see Priest 1987. And we, at least, take it to be logically impossible for there to be true contradictions. But we believe there are possible worlds where Priest is correct - there are possible worlds where he rejects true contradictions, after all!)

If intuitionistic logic came to be thought a much more satisfactory basis for mathematics by the experts, and if intuitionistic investigations led to break-throughs in many areas of inquiry, and if important technological advances were made by the best minds in the field, which they would not have come to if they had been stuck in the rut of nonintuitionistic logic, then

intuitionistic logic would turn out to be correct after all. (Nolan 1997 p 551).

(Nolan takes it that intuitionistic logic is an incorrect theory of logic, and that it is logically impossible that it is so. Still, he is not a complete dogmatist about logic. There are contexts in which the above conditional can sound false, a result of confusion what we have reason to think is the case with what is the case. But there seem to him to be other contexts in which the above conditional appropriately expresses his non-dogmatism about intuitionistic logic.)

Another case that violates the SIC has been offered by David Vander Laan (Vander Laan 2004). He describes this case:

[A] student, working on a computer program which carries out proofs in a formal system, knows that the system's Gödel sentence is of special significance, and so includes a command to print 'I have proved my Gödel sentence!' if ever such a proof is found. The instructor points out that the command is superfluous: "The Gödel sentence says, in effect, 'This sentence cannot be proved in this system', so your programme isn't going to come up with a proof of it. The system would have proved something it couldn't if it executed the print command." (Vander Laan 2004 p 271)

The instructor's last claim sounds correct, but it has a possible antecedent and an impossible consequent: it is possible for the machine to execute a certain print command, but impossible for it to prove something it cannot prove.¹¹ The instructor's sentence uttered in different contexts may not express something true (there are contexts where we would want to say in response "No, if it had executed the print command it would have malfunctioned"), but since we take it counterfactuals are context dependent we do not think this is a very good reason for judging what the instructor said, in the context envisaged, as being incorrect. Counterfactuals with possible antecedents but impossible consequents are not always false.

Suppose Nolan is (now) right that the SIC fails, and that there are conditionals with possible antecedents and impossible consequents that are nevertheless true. You

¹¹ Consider the reading where what would happen is that both "it proves G" and "it cannot prove G" is true. The reading on which it cannot in fact prove G, but would if things were otherwise, is more debatable, since machines configured differently can perfectly well prove the Gödel sentence associated with the machine's actual programme.

might think that this opens the door for counter-examples to a “Strangeness of Impossible Manifestation Conditions” principle:

(SIM1) Where Φ is impossible, X is disposed to Φ in C only when C is impossible.

or alternatively

(SIM2) When X is disposed to Φ in C, and C is possible, then X Φ ing is possible.

(This mimics the claim that when $A \rightarrow C$ and A is possible, so is C, which is another way to capture the sort of thing that Nolan’s SIC guarantees.)

The logic of conditionals does not rule out conditionals of the form “Were it the case that C, X would Φ ”, where C is possible but it is impossible for X to Φ . We might expect that there would be cases, then, where X would Φ in C, even when C is possible but Φ is not. (Conditionals need not entail dispositional claims, but they are closely connected.)

Of course, establishing theoretical space for a denial of SIM is not yet much of an argument for rejecting SIM. But we think some examples are plausible. If Nolan lives up to his methodological principles, perhaps he is *disposed* to realise that intuitionistic logic is correct if it comes to be thought a much more satisfactory basis for mathematics by the experts, leads to break-throughs in many areas of inquiry, and important technological advances are made by the best minds in the field, which they would not have come to if they had been stuck in the rut of nonintuitionistic logic. He would then be disposed to do something impossible (assuming that “realise” is factive)¹², in a possible situation.

¹² If you doubt that “S realises that p” entails p, perhaps something like the claim that Nolan is disposed to *judge truly* that intuitionistic logic is correct in circumstances such-and-such will do to make the Φ impossible.

Or consider this simplified variant of Vander Laan’s case. I purchase a shiny new automated argument-evaluator for propositional logic. It is in good working order, and is designed so that when some premises and a conclusion that follows validly from them are typed on a piece of paper and fed into it, a green light on the top of the machine goes on, and it then prints out a semantic-tree proof of the validity of the argument. (If premises and a conclusion that does not follow from them are fed in, a red light goes on, and if anything else is fed in, it is supposed to beep and spit it out again.)

Suppose one of my students leaves the following argument with me to feed into the machine:

P1. $p \supset q$

P2. q

C. p

It seems like I could say at the next class “if I had fed in your argument and the green light had gone on, we would have had a genuine proof of affirming the consequent”.¹³ Indeed, I could also claim that we would have got a printout of a valid semantic-tree proof if that proof had been fed into the machine. These conditionals violate the SIC in the same way that Vander Laan’s conditional does—it is possible to feed in the proof and for the light to go on, but not possible for there to be a propositional logic proof of affirming the consequent.

It also sounds okay to our ears to go on and make the allied dispositional claim: the machine is disposed to print out a semantic-tree proof of affirming the consequent in the circumstances of that argument being fed into the machine and the green light going on. If that disposition claim is indeed true, then we have a counterexample to SIM.

We need not take a stand on SIM in this paper, and if disposition attributions turn out to be context dependent in something like the way conditional claims are, perhaps there are contexts that permit violations of SIM and others that do not, so perhaps the story about whether or not SIM holds is complicated in that way. We are inclined to

¹³ Affirming the consequent for the material conditional, anyway.

think that SIM is not uniformly true, but further investigation of this topic would be worthwhile: if SIM is true, it calls for an explanation, especially if the corresponding principle for conditionals is false. On the other hand, if SIM is false, it would be good to have an explanation of that, and it would be good to establish if any interesting restriction of SIM is still defensible.

6.2 Does every disposition have to have a possible manifestation?

As we explained in §3 above, there are subtle differences between phrases of the form “X is disposed to Φ in C” and phrases which talk *about dispositions*, such as “X has a disposition to Φ in C” or “There is a disposition to Φ in C”. Suppose you believe in unmanifestable dispositions, not just in the sense that you believe there are some true claims of the first form are true despite the impossibility of Φ and/or C, but you are also convinced that *there are* dispositions – properties, perhaps – which can be described as dispositions to Φ and C where Φ and/or C is impossible. Maybe you even believe that certain things have these dispositions.

It may look as if you are thereby committed to believing in dispositions that have no possible manifestation. But in fact this is not straightforward. For all we have said so far, it might be that the disposition to be surprised upon encountering a round square object is *identical* to the disposition to be surprised upon encountering something you previously thought did not exist. This disposition clearly does have possible manifestations; you could manifest it upon encountering a golden mountain, for example.

We do not propose to offer an opinion here on the question of how to count dispositions. There are ‘sparse’ options, on which we possess (relatively) few dispositions but two quite different-sounding disposition-ascriptions can ascribe the same one. And there are ‘abundant’ options, on which the disposition which makes true “X is disposed to be surprised upon encountering a round square” is different from that which makes true “X is disposed to be surprised upon encountering a golden mountain” (and, perhaps, from that which makes true “X is disposed to be surprised upon encountering things she did not previously believe in).

Our point is simply that believing claims of our target form does not immediately commit one to believing in dispositions which have no possible manifestation. Sparse conceptions are available which could prevent that consequence. This, we hope, might be of some comfort to those who feel metaphysically (or otherwise) unsettled by the idea of anything's being disposed to do the impossible. If being so disposed need amount to no more nor less than possession of a disposition to do something which is clearly *possible*, maybe it's not so bad.¹⁴

7. Conclusion

Apart from the intrinsic interest of investigating unmanifestable dispositions and their role in theorising, we think non-trivial unmanifestable dispositions, if admitted, will show that some otherwise tempting approaches to analysing talk about dispositions will have to be re-thought. We have already discussed how some proposals about dispositions, such as Lewis 1997 and Armstrong 1996, are mistaken if there are non-trivial unmanifestable dispositions (of the right sort). But we think the general lesson extends well beyond these.

One general strategy for analysing dispositional constructions is to take them to be some sort of *modal* construction, invoking nomological possibility and necessity perhaps, or perhaps even metaphysical possibility and necessity, especially if it is thought that dispositions somehow reflect the essences of the properties involved. However, if we are right that objects have some unmanifestable dispositions and lack others, such modal tools with plausible be too blunt to do the work required. Suppose, for example, that we are right that Heidi is disposed to produce a proof of false mathematical conjecture X on the condition that there is one, but is not disposed to produce a proof of false mathematical conjecture Y on condition that there is one (see **XX** above). As regards what Heidi *can* and *must* do, in both nomic and metaphysical senses, there is nothing to distinguish Heidi's relationship to conjecture X from her relationship to conjecture Y. She can't prove either, under any circumstances; she must fail to do so. Yet her dispositions towards the two conjectures are different. So it looks as if those who would attempt a modal analysis

¹⁴ Other identifications may also help relieve the anxiety, at least for some. For example, there is the option of identifying a disposition to do the impossible with some (possible or actual) categorical basis.

of dispositions at least have their work cut out to explain how, despite this difficulty, they can account for the difference (or, of course, to explain why we should be prepared to reject the claim that some unmanifestable disposition claims are true and others are false).

Another way of trying to analyse talk of dispositions would be to appeal directly to laws of nature. (For example, it could be suggested – though we do not think it is plausible – that X is disposed to Φ in C iff it is a law of nature that things of X's kind Φ in C.) But if, as we suggest, there are some true attributions of nomically unmanifestable dispositions and some false such attributions, it is very difficult to see how wielding laws of nature in an analysis would enable one to distinguish between the true and the false such attributions. The laws seem to pronounce the same way about any nomically impossible Φ or C: according to the laws, they just cannot happen. So it may be difficult to use the laws of nature to discriminate which unmanifestable disposition claims are true and which are false.

Finally, some may still hold out hope for a conditional analysis of disposition talk, or at least some interesting entailments between disposition claims and corresponding conditionals. Such people would be well advised to adopt theories of the conditional that do not make counterpossible conditionals trivial, if the truth of disposition claims and the truth of the related conditionals are to covary in any significant way in the case of unmanifestable dispositions. This is especially so if they accept dispositions to Φ in metaphysically or logically impossible circumstances C.

It is worth noting in passing that those who do not hope to reduce dispositions to anything else but are happy to take them as primitive need have no particular problem with accepting unmanifestable dispositions. As for those attempting to find conditions which falls short of an analysis of 'X is disposed to Φ in C' (e.g. merely necessary conditions, or merely sufficient conditions), the morals to be drawn from our discussion will vary from case to case. But in general it would be wise to proceed with an eye to the issues we have raised. For example, the view that it is merely *sufficient* for X to be disposed to Φ in C that X would Φ were it in C is enough, in the presence of trivialism about counterpossibles, to commit one to trivialism about

unmanifestable dispositions.

There are unmanifestable dispositions, and this is no mere isolated philosophical factoid. Relying on our grasp of them seems to be an important part of prediction and explanation in psychological matters and also matters not involving agents; they raise new and interesting philosophical issues; and they appear to have general ramifications for questions about how to understand dispositions. It might be impossible for such dispositions to manifest, but they do a lot of other things for us.¹⁵

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