

## Extending Modal Vision

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I offer a new technique for extending our knowledge of what is *possible*. The surest way to know that something is possible is to know that it is *actually* so. Yet it is notoriously more difficult to tell whether a state of affairs that has never obtained could obtain. To help us deal with such cases, I offer “continuity” principles that can extend our modal vision beyond the clear cases. These principles, if true, imply that certain “neighbors” of possible states of affairs are probably also possible. I then showcase some intriguing applications of these extension principles: I show how the principles can help us with ancient questions about the foundations of reality and with recent questions about parts and wholes.

## Extending Modal Vision

### 1. Introduction

Many deep and difficult questions in philosophy seem to bottom out in questions about *possibilities*. Consider a few examples. In answer to the question, “are we fundamentally physical beings?” some philosophers answer “no” on the grounds that body swapping is possible—since a thing that *is* its body cannot *not* be its body. Others answer “yes” on the grounds that our physical effects in the world would be *impossible* for non-physical beings.

Or consider one of the deepest questions anyone can ask: why is there anything at all? Some philosophers have answered, “because there *couldn't* have been nothing.” Others deny that answer; they think there *could* be a world absent of all things. Or: if there must be abstract objects, like numbers and so on, there is still the view that there can be a world without *concrete* things. The question of why there are any (concrete) things turns in part, then, on whether there could be an absent of all (concrete) things. Some say there can be; others say not. Who is right? How can we know?

Or consider this grand question: does God exist? There are famous ways to reduce this question to questions about possibilities. For example, is it *possible* for a perfectly loving, all powerful being to permit all the bad states of affairs we find in the actual world? If not, then the classical perfect being doesn't exist. Or consider this question: is it *possible* for there to be a perfect being that would enjoy perfection in all possible worlds? If so, then we may deduce that such a being exists in the actual world, assuming modal system **S5**. Philosophers debate these possibilities. Who is right? How can we know?

One more example: is epistemic justification *possible* without awareness? If so, then certain forms of *internalism*—according to which one's beliefs are justified by how well they fit with what one is, or has been, aware of—is false. Externalists say it is possible, while internalists deny that. Who is right? How can we know?

Premises about what is possible or impossible are commonplace in every field of philosophical inquiry. It would thus be enormously valuable to have a way to *test* whether a given situation is genuinely possible or impossible. There are Chalmers's conceivability-based tests, and they may be quite helpful in certain contexts. Yet, the purely "a priori" tests often seem to reduce to controversial intuitions. I don't mean to suggest that intuitions are unreliable. My point, rather, is just that their dialectical powers in many contexts are limited.

Is there another tool that can aid our modal assessments? One tool that is both powerful and often neglected is the tool of *inference* from other, more evident premises about what is possible. This tool enables us to extend our modal vision without requiring that we see *directly* into the possibility or impossibility of the situations under investigation.

In this chapter, I will wield the tool of inference in new ways. I will consider two categories of inference: deductive and inductive. Both are useful to the project of extending modal vision, but the latter is the least explored. Although I shall have a few things to say about deductive inference, my primary goal is to develop a procedure for inductively inferring that certain situations are (likely) possible. My discussion will unfold as follows. First, I'll clarify what I mean by 'possible' by giving standard modal axioms as an implicit definition. Next, I will motivate a defeasible principle of "modal continuity," which allows us to inductively infer that certain situations are possible. I'll then identify a restricted more reliable versions of the principle. In the remaining sections, I will showcase significant applications of continuity-based reasoning.

## **2. The Logic of Possibility**

I am interested in *metaphysical* possibilities. What does it mean to say that something is metaphysically possible? Here is what I mean:

‘ $x$  is metaphysically possible’ =<sub>def</sub> ‘it is not true that it is necessary that  $x$  is not true’.

This definition exchanges the term ‘possible’ for the term ‘necessary’. So what does it mean to say that something is *necessary*?

I take “necessity” to denote what *must actually be* in the strongest sense, independently of what anyone thinks. I grasp the concept first and foremost via examples: it is necessary that red is a color; it is necessary that no prime number is a prime minister; it is necessary that a cube has more volume than any of its proper parts; it is necessary that justice is a virtue; and so on. These necessary truths need not be *strictly* logically necessary (deducible from canonical logical rules). Also, necessary truths need not be *epistemically* necessary (i.e., rationally inescapable): for example, it might turn out to be necessary that matter is infinitely divisible, but I’m not rationally required to think this. The “necessity” I have in mind concerns the way things in reality must be. Anything whose denial is not necessary is *possible*.

I believe we can gain a more exact grasp of the concept of necessity by considering its logical properties. I understand ‘it is necessary that’ as a modal operator ‘ $\Box$ ’ that obeys the following axiom schemas of **S5** modal logic:<sup>1</sup>

- M**:  $\Box p \rightarrow p$
- K**:  $\Box(p \rightarrow q) \rightarrow (\Box p \rightarrow \Box q)$
- 4**:  $\Box p \rightarrow \Box \Box p$
- 5**:  $\Diamond p \rightarrow \Box \Diamond p$

For the sake of presentation, I will assume that the things that are necessary or impossible are situations (equivalently: states of affairs). So, axiom **M** says that if a situation *must*

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<sup>1</sup> I do not include **N** (the necessitation rule) because it, together with standard logic, implies that the theorem,  $\exists x(x=x)$ , is necessary, and thus that there must be something. I wish to avoid building into the *meaning* of ‘necessity’ anything that strictly implies the controversial metaphysical hypothesis that there must be something. Moreover, the axioms I give seem to me to sufficiently characterize an important conception of metaphysical necessity.

obtain, then it does obtain. From this axiom, we may deduce that whatever actually obtains *possibly* obtains.<sup>2</sup> **M** thus shows a relationship between actuality and modality. Axiom **K** shows a relationship between modality and logical consequence: a logical consequence of a necessary situation is itself a necessary situation. Finally, axioms **4** and **5** tell us that modality is itself necessary. So, for example, if a situation is metaphysically necessary, then it is necessary that it is necessary. And if a situation is possible (that is, *consistent* with whatever is necessary), then it is necessary that it is possible. These axioms record the idea that absolute, metaphysical necessity is rooted in the basic, unalterable nature of reality. That is to say, modal truths are *bedrock* principles of reality: they cannot be otherwise.

Although philosophers may debate the axioms, I intend to use them here to convey one important *interpretation* of “metaphysical necessity”. The axioms limit the scope of “possible” situations to those for which the accessibility relation is symmetric and transitive. There are, of course, less restrictive uses of the term “possible”: for example, it may be *strictly* logically possible for there to exist co-located objects even if that turns out to be metaphysically impossible. But my goal is to improve our modal vision of what is possible in this more restrictive sense. That goal is more challenging to reach, and for that very reason, reaching it will be more significant and rewarding.

### **3. From *this* is Possible to *that* is Possible**

We may infer certain possibilities from others. For example, someone might not see clearly whether the following situation is possible:

- (1) There is an object that has exactly 12 edges and 8 faces.

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<sup>2</sup> The deduction goes as follows. Suppose *p* does *not* possibly obtain. We defined ‘possible’ as ‘not necessarily not’. So it follows that it is *necessary* that *p* doesn’t obtain (applying double negation). So, by **M**, *p* doesn’t actually obtain. The contrapositive is this: if *p* actually obtains, then *p* possibly obtains.

Even still, one might find it immediately plausible that any *regular polyhedra* could be a shape of an object. In that case, one will find it plausible that for any regular polyhedra H, it is possible that:

(2) There is an object with shape H

Now with a little geometric reasoning, we can demonstrate that any object that has exactly 12 edges and 8 faces is a regular polyhedra. Thus, someone who accepts the possibility of (2) for any regular polyhedra may then *infer* that there could be an object that has exactly 12 edges and 8 faces. In this case, one comes to see that (1) is possible by *first* seeing that (2) is possible for any regular polyhedra.

The above example uses a deductive inference from one possibility claim to another. Deductive inference is useful in cases where (i) a given possibility claim is deducible from another, and (ii) the deduced claim was less evidently possible than the other. In such cases, one may move from the clearer case to the less clear case. I should emphasize that the clearer case need not seem much clearer than the less clear case. It could be that one case *subtly* seems possible, whereas the other seems to a *slightly less* subtle degree to be possible. Even then, someone who sees that the possibility of the second case logically follows from the possibility of the first gains a reason to become slightly more confident that the second case is also possible. This person enjoys an epistemic gain, even if subtle.

Let us turn now to cases where it may be reasonable to infer *non-deductively* that p is possible from the possibility of q. I will focus on the “continuity” cases that I identified in my article, “Continuity as a Guide to Possibility.”<sup>3</sup> These are cases where modal claims are *intrinsically similar* to each other. My goal is to find principles of modal continuity that

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<sup>3</sup> Much of the discussion to follow is adapted from that article.

can aid our modal vision via non-deductive inference. I don't claim to offer the only helpful procedure for non-deductive modal inferences. Rather, I offer one way to supplement our modal reasoning techniques.

I will begin by describing a few scenarios to illustrate what I mean by "modal continuity." Consider, first, a scenario in which multiple objects are co-located. Is that scenario possible? Suppose it is. Then, says Aristotle, we may infer other possibilities: "[If] there were two bodies in the same place, it would also be true that any number of bodies could be together; for it is impossible to draw a line of division beyond which the statement would become untrue" (Physics: 4.6). Notice that Aristotle isn't claiming here that there actually *could* be two bodies in the same place. The claim, rather, is that if there could be, then other possibilities *follow*: for example, there could be three bodies in the same place, and there could be four, and five, and any number of bodies in the same place. The thought is that a difference in number of co-located bodies doesn't seem to make a difference to whether the resulting co-location is possible. Even if you don't think co-location is actually possible, you may appreciate the intuition that if co-location were possible, then any number of things could be co-located. We might say such co-location scenarios are "modally continuous." For future reference, I will call a scenario involving co-located objects COLOCATED.

Consider another case. Suppose there is an array of evenly spaced vases. As it happens, each vase is superseded by another that is precisely 2 units taller than the previous one: their heights in arbitrary units are  $2u$ ,  $4u$ ,  $6u$ ,  $8u$ , and  $10u$ . Call this scenario 'SIZE'. Here is a question: if SIZE is possible, is it also (broadly logically) possible for there to be a vase that is  $3u$  tall? It would seem so. After all, if SIZE is possible, then there can be  $2u$  and  $4u$  tall vases. So, it seems there could also be a vase whose size is between those values.

Although we have never seen such a vase, it seems such a vase could exist. The alternative idea that there could be vases of a variety of heights but none that is three units tall is very odd—counterintuitive, epistemically undesirable, repugnant to the mind.

What accounts for our judgments concerning SIZE and COLOCATED? To start, notice that in both cases we assume that a difference in number doesn't make a difference with respect to possibility. With respect to SIZE, we assume that a vase of any arbitrary number of units tall is possible. Regarding COLOCATED, we assume that any number of things can be co-located if two things can be.

Perhaps the simplest principle that accounts for the above results is as follows:

Continuity: normally, if a proposition  $p$  differs from a proposition  $q$  by a mere quantity, then  $p$  is possibly true iff  $q$  is possibly true.

According to Continuity, a difference in mere quantity doesn't normally make a difference with respect to possibility. Let us say that propositions differ by a mere quantity iff they are expressible by sentences that only differ with respect to at least one quantitative term. So, for example, <there are two co-located objects> differs in mere quantity from <there are three co-located objects> because they are expressible by sentences that only differ with respect to the quantitative terms 'two' and 'three'. The proposal, then, is that quantitative differences don't generally suffice for modal differences. We expect modal continuity, other things being equal.

Continuity accounts for our intuitions about many apparent cases of modal continuity. So, for example, it accounts for our intuitions about SIZE: a difference with respect to vase size doesn't seem to make a difference with respect to the possibility of there being a vase of the given size. And it accounts for COLOCATED: a difference in the number of co-located objects doesn't seem to make a difference with respect to the possibility of there being the given number of co-located objects. Consider several other

cases: first, if extended simples are possible, then an extended simple of any size would seem to be (broadly logically) possible; second, there is no upper-bound on how many concrete objects could jointly exist; third, there is no lower-bound on how big a spherical object could be (assuming the possibility of a different cosmos, perhaps one having different laws, with more or less materials); fourth, if qualitatively colorful objects are possible, then there could be a colorful object of any complexity; and so on. Each of these cases exhibits modal continuity.

I offer a couple disclaimers. First, I do not claim that Continuity is a basic principle of reasoning. I leave it open whether Continuity may fall out of more basic epistemological principles. For example, one might think that Continuity is implied by a general principle of induction: we infer that this A is possible because these other As are possible. Or one might think that Continuity falls out of a principle of indifference: we infer that X is possible because it doesn't differ from Y in any evidently relevant respects, and Y is possible. Or one might think there is some other, more basic epistemic principle that implies Continuity. I leave the matter open. Our basis for proposing Continuity is just that it accounts for many apparent cases of modal continuity. There may also be other ways to motivate the principle.

Second disclaimer: I do not claim that there are no exceptions to Continuity. In fact, I think there are many exceptions, and I will discuss a few in the next section. What I claim, rather, is that Continuity is a good rule of thumb: it provides prima facie evidence for modal continuity in arbitrarily given cases (hence the 'normally' operator). I suggest that Continuity can give one a reason to think that certain situations are possible. For instance, suppose one has no reason whatsoever to affirm or deny that a certain claim X is possibly true. One then notices that X differs from a certain claim Y by a mere degree. Furthermore, one happens to be reasonably sure that Y is possibly true. I suggest that in this case, one

now has a reason to think that X is also possibly true. The reason may not be an “all things considered” reason. So, caution is called for. Even still, one has made an epistemic gain: one has found a way to extend one’s modal intuitions via a principle of modal continuity.

I will now develop a more precise statement of the general continuity principle. We may define ‘modal continuity’ in terms of a *modally unified class* of “quantitative” properties. We may characterize such a class as an ordered class of properties that are related to one another by certain asymmetric and transitive relations. For example, being k-sided stands in an asymmetric and transitive relation R—such as, more-sidedness—to being k+1-sided, for any k, where k is a positive integer. Here, then, is a more precise definition:

- (D<sub>1</sub>) ‘C is a unified class of degreed properties’ = ‘There exists a transitive and asymmetric relation R, such that for all x and all y, (i) if x is in C and y is in C, then either x bears R to y or y bears R to x, and (ii) x is a finite distance from y.’

We may now define ‘modal gap’ as follows:

- (D<sub>2</sub>) ‘G is a modal gap in C’ = ‘C is a unified class of degreed properties, such that (i) at least one member of C is exemplifiable, and (ii) G is a finite proper subclass of C, such that no member of G is exemplifiable.’

To illustrate, consider the class of properties of the form *being n meters tall*. Suppose every member of that class can be exemplified (individually) except for one: *being 4,512 meters tall*. Then the class of height properties has a modal gap. The class has a modal gap because *being 4,512 meters tall* cannot be instantiated, whereas every other tallness property can be.

With the above definitions in hand, we are now ready give a more precise statement of the general modal continuity principle:

- Continuity: normally, if C is a unified class of degreed properties, then C has no modal gaps.

Continuity accounts for our intuitions about SIZE and COLOCATED. Regarding SIZE, we said that vases can come in any size. Suppose that isn’t true. Then the class of vase-size

properties has a modal gap: some vase-size properties are exemplifiable (possibly instantiated) but not all. Continuity suggests otherwise. So, Continuity undergirds our sense that a difference in size doesn't seem to make a difference with respect to the possibility of there being a vase of the given size. Similarly, Continuity suggests that there is no modal gap in the class of co-location properties: if being 2 co-located objects can be exemplified, then so can being 3 co-located objects. These are the right results.

#### 4. Sharpening the Modal Tool

The general principle, Continuity, permits plenty of exceptions. I'll cite three. First, there are logically inconsistent properties in a unified class of degreed properties. Take, for example, the class whose sole members include *being a 3-sided polygon* and *being a 2-sided polygon*. This class may seem to be a unified class, for it may seem that *being a 3-sided polygon* bears an asymmetric and transitive relation—*more sided than*—to *being a 2-sided polygon*. Yet the class clearly has a modal gap: *being a 3-sided polygon* is exemplifiable, whereas *being a 2-sided polygon* is not even logically consistent.

Second, modal gaps result from limits applied to individuals. For example, I am limited in how big I can be: I presumably couldn't expand to the size of a galaxy. My size-limitation marks a break in modal continuity with respect to possible sizes of me. The modal break doesn't arise from rules of logic. Rather, it seems to arise from my essential nature. So, limitations in the natures of individuals cause modal breaks.

Third, modal gaps result from the necessity of necessities. For example, it is necessary that there is exactly 1 even prime number (if it is necessary that there are any numbers). It follows that it is impossible that there is instead exactly 2 even prime numbers. But that leads to a modal gap in the following unified class of properties: {*being in a world with exactly 1 even prime, being in a world with exactly 2 even primes*}. In general, the

number of necessary things (of whatever sort) cannot be increased or decreased. Thus, it seems safer to restrict the principle of modal continuity to classes of properties that imply nothing about the specific number of necessary things. (For this reason, “subtraction” arguments for the possibility of “nothing” are more plausible when restricted to showing the possibility of there being zero *contingent* things.)

In light of the above examples, I propose the following restricted continuity principle:

R-Continuity: normally, if  $C$  is a unified class of degreed properties, where each member of  $C$  is (i) strictly logically possible, (ii) generic, and (iii) not a property that implies a specific number of necessary things, then  $C$  has no modal gaps.

Condition (i) restricts the scope to properties that are logically consistent. That rules out mathematically incoherent properties, assuming the axioms of mathematics are understood as implicit definitions of the non-logical mathematical terms. Condition (ii) restricts the scope to properties whose exemplification isn’t essentially unique to a particular individual. Condition (iii) allows us to avoid dealing with properties that imply that exactly  $n$  necessary things exist, for some  $n$ .

I recommend R-Continuity for two reasons. First, like Continuity, it accounts for many cases of modal continuity, including SIDED and COLOCATED. Second, unlike Continuity, it avoids the sorts of counterexamples we considered above. It is thus more reliable than the general statement that no unified class of degreed properties whatsoever has a gap. I take it that the general statement is reliable, to an extent, because it provides defeasible evidence for arbitrary cases. But R-Continuity is an additional, more secure principle of modal continuity.

To be clear, I don’t claim that there are no exceptions to R-Continuity. The principle is designed to help us make *non-deductive* modal inferences. It is thus defeasible. The

notable advantage of R-Continuity over Continuity is that exceptions to R-Continuity are (apparently) fewer and further between. The restricted principle is, I suggest, a more reliable guide.

Restricted and unrestricted principles have their trade-offs. The unrestricted principle is the most widely applicable modal continuity principle, since it applies to all categories of modal claims. Restricted principles are sharper and more reliable. Yet they are less applicable. There are many ways to restrict, and thus sharpen the tool of modal continuity. I leave open for further research the project of identifying other modal continuity principles that may be useful for particular domains of inquiry.

At this point, one might wonder how the restricted and unrestricted principles are related to the nature of modality. What is it about necessity, for example, that gives rise to any defeasible principles of modal continuity? And what explains the breaks in modal continuity? R-Continuity includes what may appear to be ad hoc restrictions to Continuity—restrictions that ostensibly having nothing at all to do with modality. So, if the restricted principle is indeed more reliable, what accounts for that? What makes the restricted principles any “closer” to tracking the modal facts than the unrestricted principles? Answers to these questions would bring a deeper understanding of the source of the reliability of modal continuity principles—and may thus inspire greater confidence in the principles themselves.

These important questions aren't easy to answer, but I have a few proposals to offer for further consideration. First, perhaps modal continuity holds because (i) possibility differs from impossibility in a basic, categorical way, and (ii) basic categorical differences don't easily turn on mere differences in degree. Plausibly, differences in degree tend to be too slight to account for the deep difference in a basic category. And plausibly, the

difference between possibility and impossibility is deep and categorical: there are no intermediates, like less impossible or more possible. (Of course, people sometimes use expressions like “that’s barely possible,” but they’re plausibly talking about degree of difficulty, not degree of modality.) So, perhaps modal continuity tends to hold because a difference in degree would normally be too slight to account for a difference with respect to the basic categories of possibility and necessity. In short, perhaps category inspires continuity, other things being equal.

#### **4. Why is There Anything?**

In this section, I will showcase an application of R-Continuity. More specifically, I will show how R-Continuity may be used to support a crucial premise in an argument for the reality of a necessary causal foundation.

The argument I have in mind begins with the observation that some events appear to be caused by others. For example, some leaves fall off a tree, and something appeared to cause that to happen. What accounts for this observation?

The simplest principle of cause and effect is perhaps the most general: *everything* has a cause. Unfortunately, that principle is immediately problematic if it quantifies over *pluralities*. For take the plurality of *all things*. Any causes of them would be *among* them, which seems absurdly circular. (Note: the problem here isn’t with there being a cause of *each* thing; the problem is with there being a cause of *all* of them together.)

Those who wish to avoid causal circularity, then, will prefer a restricted principle. Which one? There are many candidates. Perhaps the most famous candidate is one that restricts the scope to *contingent* states or events—those that *might not* have obtained. We may state the principle as follows:

(C<sub>1</sub>) Every contingent state of affairs has a cause.

Yet this principle, too, faces problems. Perhaps the most famous is the Rowe-Ross-van Inwagen objection, which is basically that there can't be a cause of a *maximal* contingent state of affairs, since any external cause would be non-contingent (*necessary*) and could thus only produce *necessary* effects. The objection isn't decisive. Rather than get entangled in the thorns of the controversy over (C<sub>1</sub>), however, we may restrict the principle as follows:

(C<sub>2</sub>) Every contingent *state of existence* has a cause, where a state of existence is a state of affairs of there being certain concrete things.

This principle accounts for a wide range of cases, and it doesn't suffer from clear counter-examples.<sup>4</sup>

I am assuming here that it makes sense to talk about causes of states of existence.

To be more precise, though, I offer the following definition:

(D<sub>3</sub>) '*x* causes state of existence *s*' = 'there is a *y*, such that (i) *x* causes *y*, (ii) necessarily, if *y* exists, then *s* obtains, and (iii) possibly, *x* exists prior to (or without) the obtaining of *s*.'

The last condition accounts for the idea that causes may exist prior to—and so without—their effects. To illustrate: a factory counts as a cause of there being i-phones if it causes there to be a particular i-phone, and it *can* exist without there being i-phones. (Note that there could be many factories, each of which is *a* cause of there being i-phones.)

With (C<sub>2</sub>) in hand, we may now construct an argument for the reality of a necessary causal foundation of contingent reality. Here is the argument I have in mind:

(P<sub>1</sub>) There is a cause of *there being contingent causers*, where a *causer* is anything that can cause something.

(P<sub>2</sub>) Contingent causers can't be the sole causes of *there being contingent causers*.

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<sup>4</sup> What about so-called virtual particles? Don't they come into being without a cause? I answer that they come into being (apparently) without a *sufficient* cause. The causal principles I shall work with do not assume that causes must be sufficient for their effects. Eric's smoking may count as a cause of his lung cancer even if it was *possible* for other factors to have prevented his smoking from having that effect.

(C) Therefore, there is a non-contingent causer.

Consider each premise. The first premise, (P<sub>1</sub>), follows from (C<sub>2</sub>) only if the state of affairs of *there being contingent causers* is a contingent state of existence. Is it? I will return to that question soon.

The second premise says that contingent causers can't be the sole causes of *there being contingent causers*. Why believe that? The reason is that no contingent causers could exist prior to (without) the obtaining of the very state of affairs of which they are supposed to be the cause. Thus, given (D<sub>3</sub>), it follows that no contingent causers could be the cause of there being contingent causers in the first place.

From the two premises, a grand conclusion follows: there is a necessarily existent causer. I should emphasize that I make no assumptions about the nature of necessary things. A necessary causer may be composed entirely of material things. Or it may be something more ethereal. Questions about the nature of a necessary foundation are wide open.

There is a way to improve the argument. The weakest link in my argument is obviously the first premise—that there is a cause of *there being contingent causers*. But notice that the second premise says that there *can't* be contingent causers of *there being contingent causers*. As a result, we can reach the same conclusion using a more modest causal premise:

(P<sub>1b</sub>) There *can* be a cause of *there being contingent causers*.

This premise is consistent with there being *no* cause of our contingent universe. So even those who think our universe sprang into being uncaused could accept (P<sub>1b</sub>).

Interestingly, we can use (P<sub>1b</sub>) and (P<sub>2</sub>) to demonstrate that there is a necessarily existing thing that can be the cause of there being contingent causers. For from (P<sub>1b</sub>) and (P<sub>2</sub>), it follows that there *can* be a necessarily existent causer. And from that, together with

the modal axioms presented in section 2, it follows that there is a necessarily existent causer.<sup>5</sup>

This “improved” argument for a necessary causer crucially hinges upon (P<sub>1b</sub>). I will now show how we may support that premise using a principle of modal continuity. To begin, consider the following properties:

$p_1$  = being a cause of there being exactly 1 contingent causers.

$p_2$  = being a cause of there being exactly 2 contingent causers.

$p_3$  = being a cause of there being exactly 3 contingent causers.

R-Continuity predicts that if  $p_3$  is exemplifiable, then so is  $p_2$  and  $p_1$ . That is because these properties form a unified class of degressed properties, where each property is (i) logically consistent, (ii) generic, and (iii) not a property that implies a specific number of necessary things.

Is  $p_3$  exemplifiable? It is if the follow scenario is possible. There are exactly 2 contingent causers, and they together cause a third contingent causer. In that case, the 2 contingent causers thereby cause there to be exactly 3 contingent causers—and so  $p_3$  is exemplified.

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<sup>5</sup> Here is one way to show the inference:

Let 'N' abbreviate '∃x (N(x))', where 'N(x)' reads '□ (∃!(x) & ◇ (∃y (x causes y)))'.

1. Assume  $\diamond N$ .
2. Then:  $\diamond \square N$ . ( $\square(N \rightarrow \square N)$ , by axioms **4** & **5**)
3. Now suppose (for the sake of argument) that  $\diamond \sim N$ .
4. Then:  $\square \diamond \sim N$ . (by axiom **5**)
5. Then:  $\sim \diamond \sim \diamond \sim N$ . (by substituting ' $\sim \diamond \sim$ ' for ' $\square$ ')
6. Then:  $\sim \diamond \sim \square \sim N$ . (by substituting ' $\sim \square \sim$ ' for the second ' $\diamond$ ')
7. Then:  $\sim \diamond \square N$ . (because ' $\sim \sim X$ ' is equivalent to ' $X$ ')
8. But (7) contradicts (2).
9. So: (3) is not true. ((3)  $\rightarrow$  (7))
10. So:  $\sim \diamond \sim N$ .
11. So:  $\square N$ . (by substituting ' $\square$ ' for ' $\sim \diamond \sim$ ')
12. So: N. ( $\square X \rightarrow X$ , by axiom **M**)
- 13: So: if  $\diamond N$ , then N.

Alternatively, we could argue for the exemplifiability of  $p_3$  using R-Continuity. Let  $n$  be the number of contingent causers in the actual world. Possibly, one or more of the  $n$  causers can cause another contingent causer (perhaps by combining together in certain ways). In this scenario, there is thus a cause of there being exactly  $n+1$  contingent causers. So it is possible for there to be a cause of there being exactly  $n+1$  contingent causers. Now we may run the modal continuity principle through the numbers until we get to the case where there is a cause of there being exactly 3 contingent causers.<sup>6</sup> In this way, we find a continuity-based reason to think that  $p_3$  is exemplifiable.

We may now complete the “continuity-based” argument for a necessary causer. By R-Continuity, we infer that  $p_1$  is exemplifiable—since it is “modal continuous” with  $p_3$ . In other words, there can be something that causes there to be exactly 1 contingent concrete thing. We’ve already seen that no contingent concrete thing could cause there to be exactly 1 contingent concrete thing, as that would be circular. Therefore, there can be a necessary causer. Therefore, from our modal axioms,<sup>7</sup> *there is* a necessary causer—at least one.

Of course, R-Continuity is a defeasible principle. Thus, if someone has reasons to think there is no necessary causer, those reasons could in principle defeat the modal inference in the argument for a necessary causer. I don’t anticipate that my argument will resolve the debate over whether there is, or could be, a necessary causal foundation. Nevertheless, we have made significant progress toward advancing that debate. We found a new “modal” reason in support of a substantial metaphysical hypothesis about the causal foundation of reality.

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<sup>6</sup> I am assuming that the number of contingent causers is possibly finite. We could alternatively express the argument in terms of the number of partitions of contingent causers, since even in worlds with infinitely many causers, there is presumably a way to partition them into a finite number of partitions.

<sup>7</sup> I show this inference in note 5.

## 5. What is the Source of All?

In this section, I will show how to use continuity-based reasoning to build upon the conclusion of the argument given in the previous section. The conclusion, recall, was there is a necessary causer—something that exists of necessity and that can be the cause of there being contingent causers. Suppose that conclusion is true. Can we figure out anything further about the nature of the necessary causal foundation? I believe we can, with the tool of modal continuity. I will show how to use a modal continuity principle to infer that the necessary causal foundation has *unlimited* causal powers.

To begin, let ‘N’ refer to the *entire* necessary causal foundation, whether it consists of one necessary causer or many of them. I am not assuming that there is a single *thing* composed of all necessary causers. ‘N’ may refer to many things jointly. Merely for ease of presentation, however, I shall talk of ‘N’ in singular terms.

How much causal power does N have in total? N has at least *some* causal power, if the argument of the previous section is sound. We may measure causal power in terms of the amount of mass-energy a thing can produce. The estimated mass-energy of the entire visible universe is about  $10^{70}$  joules. So, if N can produce the mass-energy of our universe, then we may say that it has at least  $10^{70}$  units of causal power. Accordingly, N’s causal power is no less than the *most* amount of mass-energy it can produce. How much is that?

Suppose there is an upper limit  $m$ , such that N cannot produce more than  $m$  joules of mass-energy. So, for example, say that N can produce at most  $10^{71} + 21$  joules. In that case, the following two propositions are both true:

E<sub>1</sub>. A necessary foundation *can* cause  $10^{71} + 21$  joules of mass-energy.

E<sub>2</sub>. A necessary foundation *cannot* cause  $10^{71} + 21$  joules of mass-energy.

These propositions mark a *break* in modal continuity.

This break is unexpected, however. Why must there be an upper-bound with respect to how much mass-energy is *metaphysically possible*? Why couldn't there be, for example, a cause of  $10^{1171}$  joules of mass-energy? It is not easy to see what reason there could be for positing a modal break.

Suppose we lack a reason to expect an upper limit. Then by a principle of modal continuity (either Continuity or R-Continuity), we have an undefeated reason to think that there would be no such upper bound. Thus, we may suppose, instead, that if there can be a cause of  $m$  joules of energy, then there can be a cause of  $m+1$  joules of energy, for any  $m$ . If that's right, then we have a reason to infer that there is no upper limit to the amount of energy that  $N$  can produce. In other words, we have a reason to infer that there is no upper limit to  $N$ 's causal power, where  $N$ 's causal power is measured in terms of what  $N$  can produce.

I should emphasize that I make no assumptions about how  $N$ 's causal power is distributed within  $N$ . For all that I have said,  $N$  may have infinitely many parts, *each* of which is limited in causal power. The conclusion so far is just that  $N$  *in total* has unlimited causal power.

There is a corollary. Modal continuity gives us a reason to think that every conceivable degree of causal power alike *can* be instantiated. Suppose there is a *greatest conceivable* degree of causal power—*omnipotence* suitably defined. Then modal continuity gives us a reason to think a greatest conceivable degree of causal power can be instantiated. What could instantiate such a power? Clearly, if anything can,  $N$  can, since  $N$  is a source of all possible causal powers. Moreover, unless there is some reason to think that  $N$ 's

unlimited degree of causal power is *non*-maximal, then modal continuity gives us an undefeated reason to think that N has the greatest conceivable causal power.

There is another corollary. N's causal power is *essential* to N. This follows from our measure of "causal power" in terms of what N *can* produce. I am thinking of "can" in the sense of metaphysical possibility. So, if N can produce X, then *necessarily*, N can produce X—assuming modal axiom 5. (There may be other important senses in which N's causal power "could" vary.)

The argument isn't unassailable. As I see it, the most promising way to block the above reasoning would be to show why there is a break in modal continuity: for example, one may find some reason to think there is an upper limit to the amount of causal power it could take for a necessary causal foundation to produce contingent causers. My suggestion here is just that continuity-based reasoning opens up new ways to make headway on old debates.

## 6. What Composes What?

We may also apply our modal tool to inquiries that have emerged relatively recently in the history of philosophy. One such inquiry is about composition. Philosophers ask: under what conditions do things compose something? Answers fall into three categories: (i) things compose under *no* conditions (nihilism), (ii) things compose under *any* conditions (universalism), and things compose under *certain* conditions (restricted composition). I will make use of a modal continuity principle to provide a novel reason against option (iii).<sup>8</sup>

My strategy will be to give an argument based upon modal continuity for the

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<sup>8</sup> This section is adapted from my article, "Continuity as a Guide to Possibility."

conclusion that *either* there exists something that is composed of a tower and a distant nose—a *tower-nose*, or nothing composes anything. If the argument goes through for tower-noses, then the same reasoning should go through *mutatis mutandis* for any collection of (material) objects.<sup>9</sup>

I begin with which I call ‘the Modal Composition Argument’:

- P1. Possibly, there is a composite object  $O$  having proper parts  $p_1$  and  $p_2$ .
- P2. The proposition that  $p_1$  and  $p_2$  jointly compose something is different by a mere degree from the proposition that a tower and a nose jointly compose something.
- P3. Therefore, possibly, there is a tower-nose. (P1, P2, M<sub>4</sub>)
- P4. There is a tower and there is a nose.
- P5. If (i) there is a tower, (ii) there is a nose, and (iii) possibly, there is a tower-nose, then there is a tower-nose.
- P6. Therefore, there is a tower-nose.

Let us review the premises. Premise P1 asserts that composition is possible. I assume it to be true for the sake of argument because my goal is to show that *if* composition is possible, then composition is unrestricted. The conclusion I’m after, then, is that either composition is unrestricted, or nothing composes anything.

Consider, next, P2:  $\langle p_1$  and  $p_2$  jointly compose something  $\rangle$  is different by a mere degree from  $\langle$  a tower and a nose jointly compose something  $\rangle$ . Why think this? The reason is that the difference between a tower or a nose, on the one hand, and any other material object on the other, is plausibly specifiable in terms of a quantitative (degreed) difference in geometry, various spatial relations and dispositional properties. So, for example, suppose  $p_1$  is a frog’s leg. Now consider the following representation of a (sorites) series that goes from the frog’s leg to a particular tower:

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<sup>9</sup> I shall limit the argument’s scope to material (spatially situated) objects.



The geometries are radically over-simplified, but the point of the illustration isn't affected by the lack of specificity. The point is that the differences between a frog's leg and a tower are ultimately determined by differences in various degreed properties, such as degreed differences in geometry, spatial orientation, and dispositional, relational or functional properties. These difference-making properties form a unified class of degreed properties, where each member differs from another by a certain specifiable degree. Suppose that is right. Then <there is something composed of a tower and a nose> differs by degree from <there is something composed of  $p_1$  and  $p_2$ >. <sup>10</sup>

The next step is P3: possibly, there is a tower-nose. This step follows from the previous premises together with a principle of modal continuity. It is worth emphasizing that the relevant class of difference-making properties is both coherent and non-haecceitous. Hence, the inference in question is supported not only by a general, defeasible continuity principle, but also by the more robust, restricted principle (M<sub>4</sub>). It appears, then, that we have a “modal continuity” reason to accept the inference.

Let us now move one to P4: there is a tower and there is a nose. For example, there is my nose, and there is the Eiffel tower. I will assume this premise is true for the sake of argument. If you doubt the premise (perhaps because you don't believe in artifacts or

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<sup>10</sup> I am not suggesting that P2 premise is undeniable or completely uncontroversial. See, for example, [Merricks 2005] for dissent. Nevertheless, advocates of restricted composition commonly assume a premise like this, and so it is useful to see how it may be used in an argument against restricted composition. Note also that the premise is especially plausible on the standard “bottom-up” materialist picture according to which all properties of material objects are ultimately determined by the lower-level properties and relations instantiated by basic units of matter.

arbitrary undetached parts), then run the argument in terms of a pair of objects you think do exist. Nothing in the argument turns on the details of *which* material objects exist.

P5 is the final premise: *if* (i) there is a tower, (ii) there is a nose, and (iii) possibly, there is a tower-nose, *then* there is a tower-nose. You might think this is the premise to deny. But I believe there is a good reason to think P5 is true. The reason is based upon the possibility of a world *indiscernible* to ours in which there is a tower-nose. To see what I have in mind, suppose (i) there is a tower *T*, (ii) there is a nose *N*, and (iii) possibly, there is a tower-nose. The first thing to notice is that a principle of modal continuity implies the possibility of a tower-nose of *any* size and shape. Differences in size and shape are differences in degree, and so by R-Continuity, these differences (plausibly) don't make a modal difference. I suggest, then, if R-Continuity is true, then it is possible for there to be a tower-nose that is qualitatively indistinguishable from what would be the fusion of *T* and *N*. Moreover, by the same reasoning, there is a possible world with a tower-nose that is qualitatively indiscernible from ours: for again, no difference in arrangement of matter amounts to more than a mere difference in degree. Modal continuity implies, therefore, that there is a possible world that is qualitatively *just like ours* in which perfect duplicates of *T* and *N* compose something. But if *duplicates* of *T* and *N* compose something in a duplicate world, then it seems that *T* and *N* should themselves compose something in *our* world.

The above reasoning implicitly makes use of the following principle:

(C) Worlds that are intrinsic duplicates are compositional duplicates.

The thought here is that if you fix the facts about the existence and arrangement of the basic ingredients of a world, then you thereby fix the world's compositional facts. Put differently, if two worlds *differ* with respect to what objects compose what, then they

differ in some other, non-compositional respect.

The principle enjoys a ring of plausibility. Consider that without the principle, there cannot be any deeper *explanation* of why composition occurs when it does. Compositional facts would be inexplicable. Moreover, if (C) is false, then it seems it would be possible, in principle, for objects to “flicker in and out” of existence without *anything* changing position. So, Peter van Inwagen may be presently correct: there are no tables or chairs. But a second later, Hud Hudson may become right: there are tables, chairs and tower-noses—regardless of whether anything changed position or orientation! Such a “flicker” scenario doesn’t seem like it should be genuinely metaphysical possible. It is more plausible, I think, that non-compositional facts fix compositional ones. I suspect that many advocates of restricted composition will agree.<sup>11</sup>

The conclusion follows from the premises: there is a tower-nose. And if there is a tower-nose, then by the same reasoning, there is a fusion of any arbitrary collection of objects. Therefore, we have here a new, “modal continuity” argument for unrestricted composition from the assumption that composition is possible.

I don’t claim that the argument is decisive. Like any argument in philosophy, there is room for rational disagreement. Even still, principles of modal continuity *help*. Someone may find the premises of the Modal Constitution Argument quite plausible. I do. And since the *validity* of the argument crucially hinges on a principle of modal continuity, it seems the notion of modal continuity can play a valuable role in contemporary mereological inquires.

## 7. Conclusion

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<sup>11</sup> Ned Markosian, a defender of restricted composition, will agree. He accepts that the spatial profile of a world suffices for its compositional profile. See Markosian forthcoming: 6–7.

I have offered a new tool for modal reasoning. We have seen that the tool can help us make progress on a range of philosophical questions. I would like to close this chapter by briefly highlighting five additional questions with which the tool may assist.

First, can persons swap bodies? Modal continuity suggests so. For if a person can exchange one atom at a given instant, that person can exchange two, and three, and four, and all of them together. So, continuity-reasoning suggests that people *can* exchange entire bodies of any size. Of course, the principle is defeasible: someone could reply that there is independent reason to think human persons are their bodies. But *without* the independent reason, one may expect modal continuity.

Second, is there a limit to how much human persons can know? Modal continuity suggests not. Given any finite number of facts that are known, modal continuity implies that it is possible that someone knows more facts than that. Once again, one may have independent reasons to think there are limits. But without such reasons, one may expect modal continuity.

Third, is it permissible to push an innocent man onto train tracks to save five lives? Modal continuity suggests so—*if* it is permissible to push the innocent man onto the train tracks to save five *billion* lives. For if one *can* be permitted to kill someone to save  $n$  lives, then modal continuity implies that one can be permitted to kill someone to save  $n-1$  lives, for  $n > 1$ . Once again, one may have independent reasons to think there are exceptions. But without such reasons, one may expect modal continuity.

Fourth, is there ontological vagueness? Modal continuity suggests not. Suppose, for example, it is ontologically vague whether a man with (say) 61 hairs is bald. Then by modal continuity, it is ontologically vague whether a man with *any* number of hairs is bald. But that's absurd. So, it isn't ontologically vague whether a man with 61—or any

other number of—hairs is bald. What's true for baldness is true for every other category where ontological vagueness may be thought to creep in. Again, one may have independent reasons to think there are exceptions. But without such reasons, one may expect modal continuity.

Fifth, if consciousness is emergent, does it emerge of necessity from certain arrangements of wholly unconscious matter? Modal continuity suggests not. Arrangements differ from each other by mere degrees and quantities (such as size, mass, etc.), and thus modal continuity implies that these differences in degree don't make the categorical difference between whether emergent consciousness *must* emerge. Again, one may have independent reasons to think there are exceptions. But without such reasons, one may expect modal continuity.

We see, therefore, that the tool of modal continuity has a wide range of applications. Its power is limited, of course. In each of the applications, it is open whether someone will have reasons to think there are exceptions to its particular application. But then again, the power of every reasoning tool is limited. Even in the case of *deductive* reasoning, one may have reasons to question the premises from which a conclusion is deduced. So, despite the limitations, having a new reasoning tool increases our reasoning powers, and having a new tool for modal reasoning extends our modal vision.