Counterpossibles

Alexander W. Kocurek* Forthcoming in *Philosophy Compass*

Abstract. A *counterpossible* is a counterfactual with an impossible antecedent. Counterpossibles present a puzzle for standard theories of counterfactuals, which predict that all counterpossibles are semantically vacuous. Moreover, counterpossibles play an important role in many debates within metaphysics and epistemology, including debates over grounding, causation, modality, mathematics, science, and even God. In this article, we will explore various positions on counterpossibles as well as their potential philosophical consequences.

1 Introduction

Counterfactuals with impossible antecedents are called **counterpossibles**. Here are some examples of counterpossibles whose antecedents are impossible in different senses:

(1) **Metaphysical:** If water were hydrogen peroxide, life would not exist.

(2) **Logical:** If the Liar were both true and not true, paraconsistent logic would be correct.

(3) **Mathematical:** If Hobbes had squared the circle, he would have ended world hunger.

(4) **Conceptual:** If colorless green ideas had existed, they would have slept furiously.

It is standard to call a counterpossible whose antecedent is Xically impossible a "counter$X$ical"; e.g., (1) is a countermetaphysical, (2) is a counterlogical, (3) is a countermathematical, and (4) is a counterconceptual.

Counterpossibles present a puzzle for theorists working on counterfactuals. On the one hand, counterpossibles generally seem nontrivial and informative. They certainly do not all seem *equivalent* to each other. This can be seen by the fact that they seem to vary in truth value: intuitively, (1) and (2) seem true, (3) seems false, and as for (4), who knows? Of course, our intuitions could be mistaken about particular cases, but it seems plausible that counterpossibles are not all necessarily equivalent.

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On the other hand, the standard semantic accounts of counterfactuals predict just that—in fact, they predict all counterpossibles are *trivially* true. This is because they all analyze counterfactuals as (perhaps restricted) universal quantifiers over possible worlds: a counterfactual is true iff at all the [closest/relevant/most similar. . .] possible worlds where the antecedent is true, the consequent is true. But for counterpossibles, there *are no* possible worlds where the antecedent is true. So vacuously, anything is true at "all" of the [closest/relevant/most similar. . .] possible worlds where the antecedent is true. This is a general feature of universal quantifiers; e.g., if there are no zebras in my office, then vacuously, "all" of the zebras in my office are wearing pants. Thus, as Lewis (1973a, p. 24) famously puts it, "Confronted by an antecedent that is not really an entertainable supposition, one may react by saying, with a shrug: If that were so, anything you like would be true!"

So our intuitions about counterpossibles conflict with the standard accounts of counterfactuals. Something must give. . . but what? Are counterpossibles all vacuously true, despite initial appearances? Or are they genuine counterexamples to the standard accounts? More generally, are all counterpossibles necessarily equivalent (e.g., all true, all false, all semantically defective. . .), or can they differ semantically?

In what follows, we will explore different views on counterpossibles (§2) as well as some of the reasons philosophers have given in defense of these views (§3). As we'll see, counterpossibles have important consequences outside of semantics—e.g., for metaphysics, science, mathematics, and religion (§4). In closing, I'll raise some further questions that remain for the study of counterpossibles (§5).

There are two related kinds of conditionals that I set aside in what follows. First, I set aside **counterlegals** (or **counternomics**), which have "physically impossible" antecedents (e.g., "If something had traveled faster than light,. . . "). Typically, counterfactuals are only considered counterpossibles when their antecedent is *at least* metaphysically impossible. And while there are parallels between them, counterlegals do not raise the same kinds of semantic vacuity puzzles as counterpossibles. Second, I set aside indicatives with impossible antecedents. These raise similar puzzles as counterpossibles and are also philosophically interesting.[1] But there tends to be less controversy over them since it is generally thought that nontrivial indicatives only need *epistemically* possible antecedents.[2]

[1] See Nolan 2016 for an application to Curry's paradox.

[2] See Bennett 2003, pp. 54–57. Possible exceptions include "reductio" indicatives (cf. the

2 Views on Counterpossibles

Let's start by charting the landscape. There are two main camps in the debate over counterpossibles. According to **vacuism**, all counterpossibles are vacuously (i.e., necessarily) true, despite appearances to the contrary.

> **Vacuism**
> If A is impossible, then for any B, if A were the case, B would be the case.
>
> $$\neg \Diamond A \Rightarrow A \mathrel{\Box\!\!\rightarrow} B$$

Vacuists maintain that counterpossibles are semantically vacuous and explain the appearance of their nontriviality by appealing to pragmatics.[3] According to **nonvacuism**, some counterpossibles are true while others false. Nonvacuists maintain that counterpossibles are semantically nonvacuous and accommodate their nonvacuity by revising the standard semantic accounts of counterfactuals.[4]

There are other positions available. For example, one might think counterpossibles are all vacuously false. Or one might think the vacuism-nonvacuism dichotomy is in some way too coarse. In this section, I lay out some of the most prominent versions of vacuism (§2.1), nonvacuism (§2.2), and various intermediate positions that have been proposed (§2.3).

2.1 Vacuism

Vacuists say that things are not as they seem: though counterpossibles *seem* nontrivial, they are, *in fact*, all vacuously true. But why do they seem

discussion of reductio counterfactuals in §3.1) as well as indicatives encoding purported necessary or a priori entailments. See also Dorst 2019, p. 1234.

[3] Popper (1959) is an early defender of vacuism in the literature, though the view is predominantly associated with Lewis (1973a). Other vacuists include: Stalnaker (1968, 1996); Kratzer (1979); Bennett (2003); Emery and Hill (2017); Williamson (2007, 2017). Lycan (2001) holds that counterpossibles are vacuous when the antecedent is *known* to be impossible. Since the debate over counterpossibles is be between philosophers who (allegedly) know the antecedents in question are impossible, it seems appropriate to classify Lycan as a vacuist for current purposes. There was also discussion of a view like vacuism (but for indicatives) in thirteenth-century Arabic logic (El-Rouayheb, 2009).

[4] Downing (1959) and Goddard and Routley (1973) are early nonvacuists (though Downing was primarily concerned with counterlegals). Other nonvacuists include: Cohen (1987, 1990); Zagzebski (1990); Mares (1997); Nolan (1997); Merricks (2001); Goodman (2004); Vander Laan (2004); Kim and Maslen (2006); Krakauer (2012); Brogaard and Salerno (2013); Kment (2014); Bernstein (2016); Berto et al. (2018); Jenny (2018); Tan (2019).

nontrivial in the first place? Vacuists generally think that pragmatics can explain the appearance of nontriviality.

Gricean Account. Emery and Hill (2017, pp. 138–139) explain the felt nontriviality of counterpossibles as a Gricean implicature (Grice, 1975).[5] Speakers often assert trivially true sentences to communicate nontrivial information. Example: your friend is worried about losing their upcoming race. In an attempt to console them, you say, "Look. . . ":

(5) If you lose, you lose.

Taken literally, (5) is a tautology; but obviously, you mean to say more than that. The Gricean explanation is that speakers (perhaps implicitly) exploit the "maxim of quantity", which advises speakers to "be informative". Having heard you assert (5), your friend (perhaps implicitly) realizes that (5), taken literally, is trivial and thus charitably searches for a nearby nontrivial substitute (e.g., "Losing isn't be a big deal"). Emery and Hill argue that a similar story applies to counterpossibles.

One problem for this account is that implicatures arising from the maxim of quantity tend to go away when the sentence in question is embedded in a downward-entailing environment like negation or 'doubts' (Gazdar, 1979; Horn, 1989; Chierchia, 2004). Thus, the following generally sound terrible:

(6) a. It's not the case that if you lose, you lose.
 b. I doubt that if you lose, you lose.

By contrast, counterpossibles under such environments sound fine:

(7) a. It's not the case that if Hobbes had squared the circle, he would have ended world hunger.
 b. I doubt that if Hobbes had squared the circle, he would have ended world hunger.

Moreover, such an account is incomplete without specific details concerning what the implicature is and how it is generated (for further criticism, see Sendłak 2019).

[5]Technically, Emery and Hill (2017) only present a Gricean account for "philosophically sophisticated" speakers, who know the antecedent in question is impossible. While they think "philosophically unsophisticated" speakers also exploit pragmatic mechanisms to communicate nontrivial information with counterpossibles, they decline to provide a specific mechanism to explain this.

Heuristics Account. Williamson (2007, p. 173) compares counterpossibles with vacuous quantification. At first, (8) sounds false.

(8) Every golden mountain is a valley.

According to classical logic, however, (8) is true since there are no golden mountains. The reason (8) sounds false is that we normally treat sentences of the form "Every F is G" and "Every F is not G" as incompatible. Since we judge (9) as obviously true, we treat (8) as false.

(9) Every golden mountain is a mountain (and so not a valley).

This heuristic generally works, but it leads us astray when there are no Fs.

Similarly, Williamson (2017, p. 218) says we rely on the following heuristic when evaluating counterfactuals:[6]

> **HCC**
> Given that B and C are inconsistent, treat $A \mathrel{\Box\!\!\rightarrow} B$ and $A \mathrel{\Box\!\!\rightarrow} C$ as inconsistent.

On the standard accounts, HCC is reliable when A is possible, but it leads us astray when A is impossible—for in that case, $A \mathrel{\Box\!\!\rightarrow} B$ and $A \mathrel{\Box\!\!\rightarrow} C$ are both vacuously true. We naïvely judge (3) to be false because (10) is obviously true. So we apply HCC and conclude (3) is false, even though HCC is unreliable in this context.

(10) If Hobbes had squared the circle, he would not have ended world hunger.

Berto et al. (2018, p. 707) argue that this strategy incorrectly predicts that the following pair of counterlogicals should sound inconsistent:

(11) a. If it were raining and not raining, it would be raining.
b. If it were raining and not raining, it would not be raining.

However, Williamson is clear that "we are not completely helpless victims of our heuristics" (p. 222). He claims that in (11), HCC is overridden by our better senses. This makes it difficult to see what could constitute a counterexample to the account (which may itself be a criticism).

Even if the heuristics account is correct, it still does not explain why many philosophers judge some counterpossibles to be false, even when they're aware of the impossibility of the antecedent and are not inclined to

[6] I could not find out what "HCC" stands for.

judge universally quantified claims with empty domains as false. Moreover, this account needs to be furnished with an explanation of how we use counterpossibles to nontrivially communicate. Perhaps one could fruitfully combine the heuristics account and the Gricean account here, but the details remain to be worked out.

2.2 Nonvacuism

Nonvacuists take our intuitions about counterpossibles at face value: counterpossibles seem nontrivial because, in fact, they are! Since the standard accounts predict otherwise, the standard accounts must go. But what replaces them?

Typically, nonvacuists employ the following strategy: take your favorite semantics for counterfactuals and just sprinkle in some *impossible* worlds.[7] For example, on Lewis's (1973a) semantics, a counterfactual is true iff at all the "closest" (or most similar) *possible* worlds where the antecedent is true, the consequent is true.[8] A nonvacuist can take this account and just drop the "possible" qualifier: at all the closest *worlds* (possible or otherwise) where the antecedent is true, the consequent is true.[9]

Nowadays, few metaphysicians are worried about impossible worlds as entities. Lewis (1986, p. 7) rejected them, since he thought other worlds are as real as our own, so accepting impossible worlds into his ontology would require him to admit that something impossible obtains *in reality*. But most metaphysicians treat worlds as abstract or ersatz entities, e.g., maximally specific propositions or sets of sentences in some world-making language. So conceived, impossible worlds are no more metaphysically problematic than possible worlds (Nolan, 1997, 2013).[10]

One challenge for the impossible worlds approach is to clarify the notion

[7]For alternative approaches, see Fine 2012; Schaffer 2016; Weiss 2017; Priest 2018; Wilson 2018; Leitgeb 2019. The impossible worlds approach is closely related to relevant logic (Anderson and Belnap, 1975; Routley, 1989, 2019; Mares, 1997, 2004, 2020; Dunn and Restall, 2002) and connexive logic (Wansing, 2020), which also have nonvacuist motivations. However, as Nolan (1997) observes, one does not need to revise classical logic to utilize impossible worlds for this purpose.

[8]For ease of exposition, I'm simplifying Lewis's account by setting aside worries about the Limit Assumption. Interestingly, Lewis (1973b, pp. 430–431) considers adding "impossible limit-worlds" to his account in order to preserve the Limit Assumption, but ultimately rejects the proposal. See Vander Laan 2004, pp. 272–274 for related discussion.

[9]For more on how to implement this idea formally, see Brogaard and Salerno 2013; Berto et al. 2018; Kocurek and Jerzak 2021.

[10]At any rate, impossible worlds are useful beyond counterpossibles. See Berto and Jago 2018, 2019; Berto and Nolan 2021 for discussion.

of "closeness" or "similarity" for impossible worlds: when is one impossible world closer to the actual world than another? Of course, it's unclear how to gauge similarity even amongst possible worlds, but to many, it's more mysterious for impossible worlds. Arguably, context-sensitivity plays some role in addressing this concern (Nolan, 1997; Vander Laan, 2004), but there have been several attempts to articulate more specific and systematic similarity metrics with varying success (Krakauer, 2012; Brogaard and Salerno, 2013; Kment, 2014; Baras, 2019).

Here's a related question: could an impossible world be *closer* than some possible world? Nolan (1997, p. 555) discusses the following constraint on closeness that answers in the negative:

> **Strangeness of Impossibility**
> No impossible world is as close to the actual world as any possible world.

In the impossible worlds framework, this corresponds to the following principle (French et al., 2020):[11]

$$\Diamond A, \Box B \Rightarrow A \mathrel{\Box\!\!\rightarrow} B$$

Some nonvacuists endorse this constraint (Mares, 1997; Krakauer, 2012; Jago, 2014; Kment, 2014).[12] Others reject it (Nolan, 1997, 2017; Vander Laan, 2004; Bernstein, 2016; Clarke-Doane, 2017). Here's a potential counterexample:

(12) If Lewis were right about the metaphysics of possible worlds, modal realism would be false.

The consequent of (12) is (let's assume) necessarily true. Furthermore, the antecedent is technically possible: Lewis *could* have believed modal realism is false. Yet there's some temptation to say (12) is false, at least on one natural reading: when we evaluate it, we're holding fixed what Lewis's views actually were, even though doing so takes us to an impossible world. If this is correct, then Strangeness of Impossibility fails.[13]

[11] By "correspond", I mean frame correspondence: an impossible worlds *frame* validates $\Diamond A, \Box B \Rightarrow A \mathrel{\Box\!\!\rightarrow} B$ iff it satisfies Strangeness of Impossibility. (This is the same sense in which, e.g., the T axiom ($\Box A \rightarrow A$) corresponds to reflexivity in standard modal logic.) Also, while French et al. (2020) ignore logically impossible worlds in their models, the correspondence result holds even if one includes them.

[12] Berto et al. (2018) seem to express sympathy towards Strangeness of Impossibility, but do not explicitly endorse it.

[13] In conversation, several people have raised the concern that there's some sort of equiv-

2.3 Intermediate Views

The labels "vacuism" and "nonvacuism" misleadingly suggest these are the only two options. On the contrary, there are views that do not fall neatly on either side of this divide. Here, I mention three such views: one that says counterpossibles are vacuously false, and two that say vacuism and nonvacuism are correct for different "readings" of counterfactuals.

Absurdism. According to vacuism, all counterpossibles are vacuously *true*. By contrast, according to what we might call **absurdism**, most or all counterpossibles are absurd, i.e., vacuously *false*.[14] (I say "most or all" because absurdists may want to make an exception for counterfactuals of the form $A \mathrel{\Box\!\!\rightarrow} A$, which even nonvacuists tend to think are trivially true.)

Though absurdism directly conflicts with vacuism, there's a sense in which the two views are interchangeable (Lewis, 1973a, p. 25). Given a vacuist conditional $\mathrel{\Box\!\!\rightarrow}$, we can define an absurdist conditional $\mathrel{\Box\!\!\Rightarrow}$ and vice versa (setting aside the $A = C$ case).

$$A \mathrel{\Box\!\!\Rightarrow} C \quad \Leftrightarrow \quad \Diamond A \wedge (A \mathrel{\Box\!\!\rightarrow} C)$$
$$A \mathrel{\Box\!\!\rightarrow} C \quad \Leftrightarrow \quad \Diamond A \rightarrow (A \mathrel{\Box\!\!\Rightarrow} C).$$

Still, there may be reasons to prefer absurdism to vacuism. For one, there's some temptation to think anything *could* happen if the impossible had obtained (Cohen, 1990, p. 125).[15] As further motivation, Hájek (ms, 2020a,b)

ocation between "de re" and "de dicto" readings of (12) (as in "if Lewis's *actual* views were such that they were right. . . " vs. "if Lewis had the right view (whatever it were). . . "). On the former, (12) has an impossible antecedent; on the latter, (12) seems true. Vander Laan (2004, p. 271) gives an example that seems to avoid this worry. A graduate student writes a program that searches for proofs of a contradiction in Peano Arithmetic and is instructed to print "Contradiction!" upon finding one. In this context, the following seems false:

(i) If this computer program were to print "Contradiction!", Peano Arithmetic would be consistent.

Yet the antecedent is possible, since the computer could go haywire. We presumably hold fixed the fact that it won't go haywire when evaluating (i). Moreover, "this computer program" clearly refers to the actual lines of code the graduate student wrote. See Nolan 2017, p. 29 for another example.

[14] I have not found anyone who has endorsed (what I'm calling) absurdism in the literature. Lowe (1995, p. 49) has a view that comes close, though he explicitly rejects absurdism. According to Lowe, $A \mathrel{\Box\!\!\rightarrow} B$ is equivalent to $\Box(A \rightarrow B) \wedge (\Diamond A \vee \Box B)$, i.e., counterfactuals are strict conditionals plus the addition of a kind of "nonvacuity" clause. So on Lowe's view, counterpossibles are true only when their consequents are necessary; otherwise, they're false. This means Lowe rejects $A \mathrel{\Box\!\!\rightarrow} A$ for counterpossibles.

[15] For this to support absurdism, however, we need to assume Duality (see §3.2).

has recently defended **counterfactual skepticism**, according to which most ordinary counterfactuals are false. Though Hájek is officially neutral on whether counterpossibles are an exception, counterfactual skeptics might be tempted to extend their view to counterpossibles as well.[16]

Epistemic Nonvacuism. It is well known that counterfactuals give rise to so-called "epistemic" readings (Edgington, 2008). Example: a detective has narrowed the suspects down to Jones and Smith. She has both brought in for questioning, and determines Jones must be the culprit, as Smith was in a different country at the time of the crime. When asked why she had both Jones and Smith brought in, she says:

(13) If it hadn't been Jones, it would have been Smith.

In this context, (13) seems true—it's exactly why the detective brought Smith in for questioning! But there's also a way of hearing (13) on which it's false: if it hadn't been Jones, Smith still would have been in a different country, and so couldn't have been the culprit. Put differently: (13) is true on its **epistemic** reading, whereas it's false on its **circumstantial** reading. The former concerns what follows from the detective's evidence, whereas the latter instead concerns (among other things) the causal facts (Khoo, 2015).

Vetter (2016a) argues that while counterpossibles are nontrivial on their epistemic reading, they are vacuous on their circumstantial reading. We might call this **epistemic nonvacuism**. She postulates that the principle of the substitution of identicals can distinguish these readings: expressions that violate the substitution of identicals are interpreted epistemically (Vetter, 2016b, p. 2698). But many of the apparently nontrivial counterpossibles seem to violate this principle (more on this in §3.1). Thus, when we intuit a counterpossible as false, we are interpreting it epistemically (for critical discussion, see Locke 2019; Kocurek 2020; Dohrn 2021).

Counterconventional Nonvacuism. It seems tautologous to say that we always evaluate truth at a scenario using the linguistic conventions we *actually* adopt (Kripke, 1971, 1980). However, there are cases where counterfactuals seem to *shift* the conventions used to evaluate truth at a scenario (Einheuser, 2006; Kocurek et al., 2020). Example: in 2006, astronomers redefined the

[16]It's interesting to observe that at least one of his arguments (the argument from the indeterminacy of antecedents) seems to carry over to counterpossibles. This suggests that Hájek's brand of counterfactual skepticism would naturally lend itself to absurdism, even if he is not forced to accept this view.

word 'planet' so that Pluto no longer counted as a planet. They did this because many other objects in the solar system had physical properties similar to Pluto and they wanted to avoid a proliferation in the number of planets. (Many were upset by this decision.) Now, consider:

(14) If Pluto were a planet, dozens of other objects would also be planets.

In this context, (14) seems true—it's exactly why the astronomers felt the need to invent a new definition! But there's also a way of hearing (14) on which it's false: Pluto is so small and far away that if its physical traits were changed just enough to qualify it as a planet (according to the *actual* definition), it would still have no effect on these other objects. Put differently: (14) is true on its **counterconventional** reading, whereas it's false on its **countersubstratum** reading. The former involves shifting the conventional interpretation of an expression (e.g., 'planet'), whereas the latter holds fixed our conventions and shifts only worldly facts ("the substratum").

Kocurek and Jerzak (2021) argue that counter(meta)logicals are vacuous on their countersubstratum reading. For example, assuming classical logic is correct, (15) is a counter(meta)logical. And at first, it seems false since intuitionistic logic rejects the law of excluded middle.

(15) If intuitionistic logic were correct, the continuum hypothesis would be either true or not true.

But if we hold fixed what *we actually* mean by logical words like 'not' and 'or' in the consequent, then (15) is true (assuming we actually endorse classical logic): in the counterfactual scenario where intuitionistic logic is correct, it's still the case that according to our actual (classical) interpretation of 'not' and 'or', either the continuum hypothesis is true or it's not. By contrast, even holding fixed our conventions, (16) is still false:

(16) If intuitionistic logic were correct, the sentence "The continuum hypothesis is either true or not true" would be true.

This suggests the nonvacuous reading of (15) requires shifting the conventions governing logical vocabulary away from those we actually adopt. Later, Kocurek and Jerzak consider extending this view to other counterpossibles, including countermetaphysicals (cf. Locke 2019; Muñoz 2020). We might call such a view **counterconventional nonvacuism**.

Note: this is not the view that counterpossibles are "metalinguistic" in the sense that they're *about* language. For example, the view distinguishes between (15) and (16) above. Rather, the view is that nonvacuous counterpossibles involve shifting the conventions used to interpret language.[17] In this sense, counterpossibles are no more "about" language than quantificational claims are "about" variable assignments.[18]

3 Arguments

Let's now turn to some arguments for and against these various positions. Even though vacuism has been considered the "orthodox" position for quite some time, it is *prima facie* counterintuitive, whereas nonvacuism arguably has claim to being the more "intuitive" position. For this reason, most arguments presented in the literature are directed *against* nonvacuism (§3.1). Still, nonvacuists have given some positive arguments in favor of their view besides simply appealing to linguistic intuition (§3.2).

3.1 Arguments for Vacuism

Strict Entailment. The following principle is initially plausible.

> **Strict Entailment**
> If A necessarily entails B, then if A were the case, B would be the case.
>
> $$\Box(A \rightarrow B) \Rightarrow A \mathrel{\Box\!\!\rightarrow} B$$

For example, (17) seems valid:[19]

(17) a. Necessarily, if cats are purple, they are colored.
b. Therefore, if cats were purple, they would be colored.

But Strict Entailment entails Vacuism, since A necessarily entails everything if A is impossible (Lewis, 1973a; Zagzebski, 1990).[20]

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[17] This is why the argument in Brogaard and Salerno 2013, pp. 644–645 does not apply to this view. See Jenny 2018, p. 541 for a similar point.

[18] Compare this with distinction between counterfactuals being representation-sensitive vs. about representations on page 14.

[19] Here, I am assuming we can analyze (17a) using the material conditional $\rightarrow$. While it is highly controversial whether the English indicative can be faithfully analyzed as the material conditional in general, it seems reasonable in the case of necessitated conditionals like (17a). Thanks to an anonymous reviewer for raising this issue.

[20] In fact, Vacuism also entails Strict Entailment modulo an additional assumption:

Counterfactual Reductio
$\Diamond A, (A \wedge \neg B) \mathrel{\Box\!\!\rightarrow} \bot \Rightarrow A \mathrel{\Box\!\!\rightarrow} B$.

Nonvacuists tend to say two things in response. First, counterpossibles seem to directly undermine the intuitions supporting Strict Entailment. For example, (18) strikes many as specious:

(18) a. Necessarily, Hobbes did not square the circle.
b. Therefore, if Hobbes had squared the circle, he would have ended world hunger.

Second, our intuitions about Strict Entailment can be vindicated if all the standard principles of counterfactual reasoning hold for counterfactuals with *possible* antecedents. This could explain why (17) sounds fine, whereas (18) does not (Berto et al., 2018).

These responses are reasonable but not decisive. First, if we reformulate (18) more directly as an instance of Strict Entailment, as in (19), it sounds less bad (at least to me). So perhaps (18) sounds odd only because people find it counterintuitive that impossibilities necessarily entail everything, not because Strict Entailment fails.[21]

(19) a. Necessarily, if Hobbes squared the circle, he ended world hunger.
b. Therefore, if Hobbes had squared the circle, he would have ended world hunger.

Second, some nonvacuists reject Strict Entailment even when the antecedent is possible. In particular, notice that Strangeness of Impossibility follows from Strict Entailment, even when the latter is restricted to possible an-

Proof: Suppose $\Box(A \to B)$ is true, i.e., $\neg\Diamond(A \wedge \neg B)$ is true. Either $\Diamond A$ is true or $\neg\Diamond A$ is true. If $\Diamond A$ is true, then since $\neg\Diamond(A \wedge \neg B)$ is true, $(A \wedge \neg B) \Box\!\!\rightarrow \bot$ is true by Vacuism. Hence, $A \Box\!\!\rightarrow B$ follows by Counterfactual Reductio. If $\neg\Diamond A$ is true, then $A \Box\!\!\rightarrow B$ follows directly from Vacuism. QED. As far as I am aware, Counterfactual Reductio has not been discussed in the literature, though it seems like a principle many nonvacuists would be sympathetic to (especially if they endorse Strangeness of Impossibility).

It is also worth noting that Strict Entailment follows from two further principles:

Identity
$\Rightarrow A \Box\!\!\rightarrow A$

Closure
$\Box(B \to C), A \Box\!\!\rightarrow B \Rightarrow A \Box\!\!\rightarrow C$

[21] Nonvacuists could also explain this by appealing to context-sensitivity: by mentioning world hunger in (19a), one changes what worlds are relevantly similar to the actual world. Thus, in normal contexts, (19b) is false, but in asserting (19a), one changes the contextual parameters for assessing the truth of the counterfactual in such a way so as to guarantee (19b) is true. This could be an alternative explanation for why Strict Entailment seems like a good principle in most cases.

tecedents. Thus, those who reject Strangeness of Impossibility will say Strict Entailment can fail even for counterfactuals with possible antecedents.

No Counterfactual Logic. Nolan (1997, p. 554) has argued that nonvacuism challenges the validity of most, if not all, nontrivial principles of counterfactual reasoning (cf. Cohen 1990, p. 131).[22] For example, you might think that the following principle of counterfactual reasoning is solid:

> **Separation**
> If B and C would be the case were A the case, then B would be the case were A the case, and C would be the case were A the case.
>
> $$A \mathrel{\Box\!\!\rightarrow} (B \wedge C) \Rightarrow (A \mathrel{\Box\!\!\rightarrow} B) \wedge (A \mathrel{\Box\!\!\rightarrow} C)$$

But here's a potential counterexample:

(20) a. If every instance of conjunction elimination had failed, both Priya and Quinn would be sad.
b. Therefore, if every instance of conjunction elimination had failed, Priya would be sad.

If we accept (20a), then it seems we shouldn't accept (20b), as this would employ the very principle whose failure is being supposed. Examples like this can be generated for nearly any principle of counterfactual reasoning that isn't an instance of a noncounterfactual validity.

Some nonvacuists embrace this consequence (Cohen, 1990; Nolan, 1997). Others try to resist it. A common feature of examples like (20) is that they involve counter(meta)logicals. This suggests nonvacuists can avoid this result by maintaining counter(meta)logicals are vacuously true, even if countermetaphysicals are generally nonvacuous (Goodman, 2004; Kment, 2014). Alternatively, one may impose constraints on closeness to generate a nontrivial logic for counterfactuals (Berto et al., 2018). Finally, epistemic and counterconventional nonvacuists could, in theory, maintain a nontrivial logic for counterfactuals on some readings while rejecting a nontrivial logic on others (Kocurek and Jerzak, 2021).

[22] One major exception Nolan considers is Identity (see footnote 20). However, he suggests the following might be a counterexample to Identity (p. 555):

(i) If nothing were true, nothing would be true.

In addition, his logic of counterpossibles validates modus ponens since he imposes weak centering (pp. 564–565).

Substitution of Identicals. Williamson (2007, pp. 174–175) observes that nonvacuists reject (21), which is an instance of the substitution of identicals.

(21) a. If Hesperus weren't Phosphorus, Hesperus would still be Hesperus.
b. Hesperus is Phosphorus.
c. Therefore, if Hesperus weren't Phosphorus, Hesperus would still be Phosphorus.

Yet the substitution of identicals generally seems plausible for counterfactuals. For instance, the following inference seems valid:

(22) a. If the rocket had continued on its course, it would have hit Hesperus.
b. Hesperus is Phosphorus.
c. Therefore, if the rocket had continued on its course, it would have hit Phosphorus.

Williamson defends the validity of the substitution of identicals for counterfactuals: "it matters not that different names are used, because the counterfactuals are not about such representational features" (cf. Vetter 2016a, p. 2698). Yet, he argues, nonvacuism must deny this.

Nonvacuists tend to agree they must reject the substitution of identicals. One response to (22) is to say that the substitution of identicals is valid when one adds the premise that the antecedents of the relevant counterfactuals are possible (Brogaard and Salerno, 2013; Berto et al., 2018).[23] Another is to say that the substitution of identicals is valid when the antecedents counterfactually imply the identity claim (Kocurek, 2020). Thus, the premise needed to make (22) valid is not "It is possible the rocket continued on its course" but rather "If the rocket had continued on its course, Hesperus would still be Phosphorus".

The claim that nonvacuism implies counterfactuals are "about representational features" is misleading at best. Distinguish between a sentence *being about representations* and *being sensitive to representations*. The former concerns the subject matter of a sentence. The latter concerns how the truth conditions of a sentence are determined. Nonvacuists are only committed

[23] Williamson (2017, pp. 210–211) objects that this sort of view is ad hoc: "counterfactuals behave in radically different ways depending on the modal status of their antecedent: transparently, like a non-epistemic operator, if it is possible, opaquely, like an epistemic operator, if it is impossible. That suggests an implausibly hybrid semantics. A more uniform treatment is much to be preferred." A nonvacuist could deny their semantics is "implausibly hybrid". Kocurek (2020) argues that the nonvacuist should adopt a uniform treatment in which all counterfactuals are opaque regardless of the antecedent's status.

to counterfactuals being *sensitive* to representations: counterfactuals may receive different truth conditions upon substituting one expression with a necessarily equivalent expression. They are not committed to counterfactuals being *about* representations in any interesting sense (Kocurek 2020, pp. 623–624; cf. Berto and Jago 2019, pp. 278–279). For example, (21a) and (21c) are not about names: they're about celestial bodies. That's compatible with them receiving different truth conditions despite differing only in which of some coreferring names occur in the consequent.[24]

Thinking It Through. Our intuitions about counterpossibles start to break down once we think them through (Williamson, 2007, p. 172). Imagine I just finished taking a quiz. I wrote "11" as the answer to "$5 + 7 = ?$". In this context, (23) sounds false.

(23) If $5 + 7$ were 13, I would have given the right answer.

But Williamson observes: "If $5 + 7$ were 13 then $5 + 6$ would be 12, and so (by another eleven steps) 0 would be 1, so if the number of right answers I gave were 0, the number of right answers I gave would be 1." Thus, we reason our way to the truth of (23) after all.

Nonvacuists tend to deny that counterpossibles are closed under such reasoning: if $5+7$ were 13, the laws of arithmetic would have been different. So we can't assume standard arithmetic applies under such countermathematical suppositions. (This doesn't mean we can never appeal to such reasoning under these suppositions; it just means we can't always.)

Furthermore, it's hard to see how to apply Williamson's argument to countermetaphysicals such as (1). There's no straightforward way of reasoning from "Water is hydrogen peroxide" to any arbitrary conclusion since it is not a priori impossible. (We can't just apply explosion to the antecedent, since this makes use of Strict Entailment, which nonvacuists reject.)

Reductio Counterfactuals. Here is a related concern. Mathematicians often use countermathematicals when reasoning by reductio. For example, here's a proof that there's no largest prime number:

(24) If p were the largest prime number, then $p! + 1$ would be composite (since $p! + 1$ is larger than p) and $p! + 1$ would be prime (since $n! + 1$ is prime for any n). Contradiction.

[24]Compare this with grounding claims, which are also taken to be sensitive to representations without being about representations (Raven, 2015, p. 327).

One rarely (if ever) *needs* to use counterpossibles to articulate such reasoning; one could just as well use the material conditional. But one is generally *permitted* to articulate reductio reasoning using counterfactuals.

Williamson (2017, p. 214) argues that nonvacuists have trouble predicting that such reductio counterfactuals are *true*. In response to the "thinking it through" objection, nonvacuists say that one cannot apply ordinary mathematical reasoning under countermathematical suppositions such as in (23). Yet this is precisely what one must be able to do to render (24) true.

Nonvacuists may counter that vacuists have trouble predicting that such reductio counterfactuals are *nontrivial*. In mathematical proofs, one tries to rely as little as possible on pragmatics and to instead communicate what one means directly and literally. According to vacuists, however, reductio counterfactuals are literally vacuous. So how could they be useful in communicating nontrivial steps in a proof?

In the end, each side has a reasonable but incomplete account of reductio counterfactuals (cf. Kim and Maslen 2006, p. 101). Nonvacuists argue that in the context of mathematical proofs, speakers hold fixed mathematical facts, and so can apply mathematical reasoning within countermathematical suppositions (Berto et al., 2018, p. 704). The challenge is then to provide independent evidence for such context-dependence and explain why it's hard to hear reductio counterfactuals as false even outside these contexts (Williamson, 2017, p. 214). Vacuists argue that even though reductio counterfactuals are trivially true, there are nontrivial constraints on when such conditionals are assertible, even in mathematical proofs (Lewis 1973a, pp. 24–25; Wierenga 1998, pp. 95–98; Williamson 2007, p. 173; Yli-Vakkuri and Hawthorne 2020, pp. 569–571). The challenge is then to spell out these constraints and the underlying pragmatic mechanisms in detail (Lampert, 2019, pp. 704–705). This is an area where further research is needed on both sides.

3.2 Arguments for Nonvacuism

Counterpossibles in Philosophy. Philosophers often debate over theses that are noncontingent. For example, most philosophers agree that either abstract objects necessarily exist, or they necessarily do not exist. Each side wants to draw problematic consequences from the other's view. Often, this is done through counterpossibles ("If abstract objects had (not) existed. . . "). This suggests that nonvacuism is implicitly presupposed in many philosophical disputes (Nolan, 1997; Merricks, 2001; Kim and Maslen, 2006; Brogaard and Salerno, 2013).

One rarely (if ever) *needs* to use counterpossibles in these disputes; one could just as well use the material (or perhaps indicative) conditional. But philosophers generally feel *permitted* to use counterpossibles to draw out consequences of noncontingent views. Unsurprisingly, this raises similar issues to those raised concerning reductio counterfactuals. So vacuists could accommodate counterpossibles in philosophy if they can provide a plausible pragmatics for counterpossibles more generally.

Duality. Both of the following principles governing "could-counterfactuals" (i.e., counterfactuals of the form "If A were the case, B could/might be the case") seem plausible at first.

Duality
Could-counterfactuals are the dual of would-counterfactuals.

$$A \diamondrightarrow B \Leftrightarrow \neg(A \boxright \neg B)$$

Would Entails Could
Would-counterfactuals entail their could-counterparts.

$$A \boxright B \Rightarrow A \diamondrightarrow B$$

Yet these principles conflict for counterpossibles (Zagzebski, 1990; Vander Laan, 2004). Even nonvacuists maintain the sentences in (11) are true.

(11) a. If it were raining and not raining, it would be raining.
b. If it were raining and not raining, it would not be raining.

By Would Entails Could, these entail:

(25) a. If it were raining and not raining, it might be raining.
b. If it were raining and not raining, it might not be raining.

But by Duality, the sentences in (11) also contradict the sentences in (25).

The standard vacuist semantics validates Duality, and so invalidates Would Entails Could. Many nonvacuists have found this implausible, since the sentences in (25) seem true, and instead reject Duality (Cohen, 1987, 1990; Zagzebski, 1990; Vander Laan, 2004).

Vacuists have two responses available, both of which seem viable. First, they can explain away the plausibility of Would Entails Could since Would Entails Could only fails for counterpossibles on the standard semantics. Second, they can reject Duality on independent grounds (Mandelkern, 2019).

This would require giving up the standard semantic accounts, but not necessarily in a way that entails giving up vacuism.

Counterpossibles in Science. Some nonvacuists have argued that counterpossibles figure in scientific explanations. Tan (2019) gives examples of countermetaphysicals in physical explanations.[25] For instance, diamond is a poor electrical conductor because it is covalently bonded. Thus:

(26) If diamond had not been covalently bonded, it would have been a better electrical conductor.

Yet diamond is necessarily covalently bonded: that's what differentiates diamond from (say) graphene, both of which are made of carbon. Another set of examples come from idealization (p. 46). Though water is (necessarily) composed of discrete molecules, it is useful to idealize and treat water as a continuous incompressible medium so that it conforms to the Navier-Stokes equations. That is, this idealization assumption is useful because:

(27) If water were a continuous incompressible medium, it would behave in accordance with the Navier-Stokes equations.

Jenny (2018) argues that countermathematicals are needed to understand relative computability theory. Some problems are "algorithmically decidable", meaning they can at least in principle be solved using an algorithm. Others, such as the halting problem, are not.[26] But some problems become algorithmically decidable *given* the answer to other problems. For example, the validity problem for first-order logic is undecidable, yet decidable given the answer to the halting problem.[27] Jenny argues that the notion of relative computability is counterfactual: a problem P is algorithmically decidable relative to Q iff P *would* be algorithmically decidable *were* Q decidable. Such (what I'll call) **countercomputables** are counterpossibles: algorithms are abstract objects, and so the existence of an algorithm that solves this-or-that problem is a noncontingent matter.

These authors are not just claiming that scientists utter counterpossibles when explaining certain concepts or predictions of their theories. Rather,

[25] Similar examples are anticipated by Jenkins and Nolan (2012, pp. 743–745), though they do not discuss these in the context of scientific explanations in particular.

[26] Roughly, the halting problem is the problem of determining whether a given algorithm will halt on a given input.

[27] The validity problem is the problem of determining whether a given formula in first-order logic is valid.

they claim that counterpossibles are *ineliminable* to scientific theories and explanations. For instance, Tan (2019, pp. 42–43) argues that (26) is *necessary* for explaining why diamond is a poor conductor. Similarly, Jenny (2018) argues that the notion of relative computability that theorists are studying is the countercomputable one. If correct, this would be a strong argument in favor of nonvacuism.

One could argue that the use of counterpossibles in these contexts is largely pedagogical (cf. Baron et al. 2020, p. 3). This would still lend some support to nonvacuism, though it raises similar issues to those concerning counterpossibles in philosophy. Part of the debate, however, is over what it takes to give a complete explanation (Tan, 2019, p. 43), or over what concepts the scientists are aiming to investigate (Jenny, 2018, pp. 544–545), and whether these implicitly require nonvacuous counterpossibles.

4 Philosophical Applications

In the previous section, we examined a number of arguments for and against the two main camps (vacuism and nonvacuism). The end result seems inconclusive: each side has some support and there aren't yet any definitive arguments favoring one view over the other. This naturally raises the question: what hangs on this debate? Quite a lot, as it turns out. In this section, we'll explore several applications of vacuism and nonvacuism to philosophical issues.

4.1 Applications of Vacuism

Modal Epistemology. Given that some necessary truths are not a priori knowable (Kripke, 1971, 1980; Yablo, 1993), how can we know whether something is metaphysically possible? Some philosophers have argued we can't (van Inwagen, 1998; Nozick, 2003). Others have tried to salvage the a priori knowability of (at least a large swathe of) necessary truths, despite the existence of necessary a posteriori truths (Chalmers, 2002).

Williamson (2007, ch. 5) defends a counterfactual account of modal epistemology (cf. Hill 2006; Kroedel 2012). It seems plausible that we generally have the ability to know counterfactuals. Yet, on the standard semantic accounts, necessity and possibility are equivalent to counterfactuals:

Counterfactual Definition of Modality

$$\Box A \Leftrightarrow \neg A \mathrel{\Box\!\!\rightarrow} \bot$$

$$\Diamond A \Leftrightarrow \neg(A \mathrel{\Box\!\!\rightarrow} \bot)$$

In fact, Counterfactual Definition of Modality follows from Strict Entailment together with the following principle (cf. Strangeness of Impossibility):

> **Possibility Entailment**
> Suppose A is possible, and that if A were the case, B would be the case. Then B is possible.
>
> $$\Diamond A, A \mathrel{\Box\!\!\rightarrow} B \Rightarrow \Diamond B$$

Assuming that $\bot$ is remains explosive in counterfactuals (so that $A \mathrel{\Box\!\!\rightarrow} \bot$ entails $A \mathrel{\Box\!\!\rightarrow} B$ for any B), Counterfactual Definition of Modality entails Vacuism: if A is impossible, then $A \mathrel{\Box\!\!\rightarrow} \bot$ is true.[28]

Williamson uses Counterfactual Definition of Modality to argue that we can know what's possible by coming to know a certain (negated) counterfactual. Hence, we do not need to postulate a special cognitive faculty to explain how we know what's metaphysical possible: that faculty falls out of our general ability to know counterfactuals.

One source of criticism for Williamson's account concerns whether it is adequate as a modal epistemology (Jenkins, 2008; Malmgren, 2011; Peacocke, 2011; Lowe, 2012; Tahko, 2012; Clarke-Doane, 2017). For instance, one could question whether we really do have the general capacity to know counterfactuals, or wonder whether a special faculty is needed to come to know counterfactuals of the form $\neg(A \mathrel{\Box\!\!\rightarrow} \bot)$. Another source of criticism concerns whether the account requires vacuism. Berto et al. (2018) argue that if we interpret "$\bot$" to mean "an impossibility obtains", nonvacuists can accept Counterfactual Definition of Modality (cf. Kment 2006, 2014). On this account, the path from Counterfactual Definition of Modality to Vacuism is blocked by interpreting "$\bot$" in a way that's not explosive in counterfactuals.[29]

Dispositionalism. According to **dispositionalism** (or **potentialism**), metaphysical modality is analyzed in terms of dispositions (or "potentialities"): it is possible that P iff (roughly) something has a disposition whose manifestation consists in P (Borghini and Williams, 2008; Jacobs, 2010; Vetter, 2015, 2016a,b, 2018). Of course, dispositionalists also want to analyze counterfactuals in terms of dispositions. A natural proposal is this: a counterfactual

[28] Alternatively, we may replace $\neg A \mathrel{\Box\!\!\rightarrow} \bot$ with a propositionally quantified claim $\forall p(\neg A \mathrel{\Box\!\!\rightarrow} p)$ and achieve a similar effect (though see Berto et al. 2018, p. 710).

[29] Note: because of the counterfactual definition of $\Diamond$, Berto et al.'s (2018) account requires Possibility Entailment (assuming that $\neg \Diamond B, A \mathrel{\Box\!\!\rightarrow} B \Rightarrow A \mathrel{\Box\!\!\rightarrow} \bot$, which is plausible given $\bot$ means "an impossibility obtains").

is true iff (roughly) all the relevant systems that have a disposition whose stimulus consists in the antecedent are such that the manifestation of that disposition consists in the consequent (Vetter, 2016a, p. 2683).[30]

On this account, if nonvacuism is true, then some objects must have dispositions whose stimulus—and so, arguably, whose manifestation—consists in an impossibility. Some have directly defended the existence of such dispositions (Jenkins and Nolan, 2012). But this directly contradicts the right-to-left direction of the dispositionalist's analysis of possibility. Thus, dispositionalism seems to require vacuism. Vetter (2016a) defends this by arguing for epistemic nonvacuism (§2.3): counterpossibles are only nonvacuous on their epistemic reading, which is irrelevant for the dispositionalist's analysis of metaphysical modality (for critical discussion, see Wang 2015; Yates 2015; Leech 2017).

Necessity of Mathematics. Many agree that mathematical truths are necessary.[31] But what justifies this claim? Yli-Vakkuri and Hawthorne (2020) argue that *mathematical practice* is committed to the necessity of mathematical truths. Their argument is based on the observation that counterfactuals are often deployed in mathematical practice. Using Counterfactual Definition of Modality, they then argue that all truths stated in the language of pure mathematics are necessary: mathematical practice, they claim, is committed to the "informal provability" of $\neg A \mathrel{\Box\!\!\rightarrow} \bot$ (and thus, $\Box A$) from A, where "informal provability" means "there is a proof of it in the sense of 'proof' operative in actual mathematical practice" (pp. 556–558).

Yli-Vakkuri and Hawthorne's argument does not strictly require vacuism: it only requires the inference from $\neg A \mathrel{\Box\!\!\rightarrow} \bot$ to $\Box A$, which follows from Possibility Entailment (p. 561). Still, they express vacuist sympathies and give a heuristics-based account of apparently false countermathematicals (pp. 566–571). Furthermore, nonvacuists who reject Strangeness of Impossibility tend to reject Possibility Entailment anyway.[32]

One worry for Yli-Vakkuri and Hawthorne's account is that counterfactuals in pure mathematics seem dispensable in that they could always be

[30]See Vetter 2015, pp. 226–227 for an alternative analysis that starts from could-counterfactuals.

[31]Though see Field 1993; Colyvan 2000; Clarke-Doane 2017 for exceptions.

[32]Note, Strangeness of Impossibility and Possibility Entailment are not equivalent. The latter corresponds to the constraint that if A is possible, then the closest A-worlds include some possible worlds (what French et al. (2020) call the "MCP" condition). One could maintain this, but deny that if A is possible, then the closest A-worlds are *all* possible. Still, those who accept one tend to accept the other. Nonvacuists might appeal to context-dependence to say Possibility Entailment is licensed in the context of mathematical proofs

replaced with material conditionals (cf. our earlier discussion of reductio on page 15). Yli-Vakkuri and Hawthorne deny this, saying such counterfactuals are indispensable for the application of mathematics, and that "[t]he success of our practice of applying mathematics to anything whatsoever requires that we know that mathematical truths would remain true under any counterfactual suppositions whatsoever" (p. 562). As we discussed earlier, some nonvacuists explicitly deny this (Berto et al., 2018, p. 704). Furthermore, as Elgin (2021, §4) observes, the indispensability claim is in tension with the logic of counterfactuals Yli-Vakkuri and Hawthorne adopt, on which counterfactuals are (informally provably) equivalent to the material conditional. Of course, that's only for counterfactuals within the language of *pure* mathematics, but that's precisely what's at issue when justifying the necessity of mathematics.

4.2 Applications of Nonvacuism

Grounding. Metaphysical grounding claims both support and are diagnosable by counterfactuals (Schaffer 2016; Wilson 2018; see Raven 2015 for overview). Example: it is commonly thought that the existence of a set is grounded in the existence of its members. Thus, the singleton {Socrates} exists in virtue of Socrates's existence. This seems to entail:

(28) If Socrates had not existed, {Socrates} would not have existed.

By contrast, it is not in virtue of $2 + 2$ being 4 that {Socrates} exists. This is justified by the observation that (29) is false:

(29) If $2 + 2$ had not been 4, {Socrates} would not have existed.

So standard views on grounding seem to require nonvacuism.[33]

Some have even used nonvacuous counterpossibles to develop interventionist accounts of grounding (Schaffer, 2016; Wilson, 2018; Khoo, forthcoming).[34] The idea behind these accounts is to introduce "grounding graphs"

[33] There has been little discussion as to how vacuists can account for metaphysical explanation (though see Emery and Hill 2017). Wilson (2018, p. 725) suggests that vacuists will naturally tend to be grounding skeptics, though his argument for this assumes the correctness of the interventionist picture of grounding, which a grounding-friendly vacuist may wish to dispute. It is interesting that Williamson, a prominent vacuist, has expressed skepticism about truthmakers, albeit for different reasons (Williamson, 2013, §8.3).

[34] Such accounts have been explored extensively in the study of causation (Woodward, 2003; Pearl, 2009; Briggs, 2012). Fine's (2012) truthmaker semantics closely resembles the interventionist semantics (the former can even be seen as a generalization of the latter).

representing the grounding relations. Such graphs consist of some variables representing the relata of grounding (facts, entities, propositions, etc.) and structural equations representing the asymmetric counterfactual (often counterpossible) dependencies between these. On this account, a counterfactual is true iff upon "intervening" on the grounding graph to force the antecedent to come out true, the consequent comes out as true. Baron et al. (2017, 2020) develop a similar account of mathematical explanations.

Essence. It used to be thought that an object x is essentially F iff necessarily, if x exists, then x is F. Fine (1994) famously pointed out counterexamples to the right-to-left direction. For example, while it is essential to {Socrates} that Socrates exist, it is not essential to Socrates that {Socrates} exists—it's not essential to Socrates that *any* sets exist. Yet, necessarily, Socrates exists iff {Socrates} exists. Fine used this example and others to argue that necessity should be analyzed in terms of essence, not the other way around.

Brogaard and Salerno (2007, 2013) argue that a modal analysis of essence can be revived using counterpossibles. Their proposal: x is essentially F iff (1) necessarily, if x exists, then x is F (the old modal view), and (2) *if there had been no Fs, x would not exist*. They say the reason it is not essential to Socrates that {Socrates} exists is that the following is false (p. 646):

(30) If sets had not existed, Socrates would not have existed.

By contrast, the truth of (28) ensures that it's essential to {Socrates} that Socrates exists. This explanation requires nonvacuism.

The account needs refinement as it stands. First, Brogaard and Salerno seem to misapply their account in examples like the above. The F in question is *being such that {Socrates} exists*. In that case, the relevant counterfactual is not (30), but rather:[35]

(31) If {Socrates} had not existed, Socrates would not have existed.

This is not a counterpossible; but more importantly, it just seems true (Torza, 2015; Williamson, 2017; De, 2020). Second, Brogaard and Salerno predict it's essential to Socrates that he exists, which many take to be problematic for the theory of essence (De, 2020).

[35]More accurately, the antecedent should be "If there had been no things such that {Socrates} existed,. . . ", but I assume it's harmless to replace that with "If {Socrates} had not existed,. . . " in this context.

Omissive Causation. One major question in the literature on causation concerns causation by omission. Example: during the COVID-19 pandemic, I never went to campus to water the plants in my office. Unsurprisingly, they all withered and died. Arguably, my failure to water my plants caused the plants to die. But it seems incorrect to say that *your* failure to water my plants caused them to die. Why is your failure not causally responsible when mine is?

A similar puzzle arises for *impossible* omissions. For example, imagine that when Hobbes was trying to square the circle, there had been an award for the first person to succeed at the task. Arguably, Hobbes's failure to square the circle (at least in part) caused the award to go unclaimed. But Wallis (who refuted Hobbes's alleged "proof") also did not square the circle (nor did he try). Yet it seems incorrect to say his failure to square the circle in any way caused the award to go unclaimed.

Bernstein (2014, 2016) gives an analysis of omissive causation that can account for impossible omissions. Very roughly, the reason my failure to water my plants caused them to die is that (1) there's a reasonably close world where I do water my plants, and (2) had I watered my plants, they would have lived. By contrast, there's no reasonably close world where you water my plants; so your failure to do so does not cause them to die. Similarly, the reason Hobbes's failure to square the circle caused the award to go unclaimed is that (1) there's a reasonably close (impossible) world where Hobbes squares the circle, and (2) had Hobbes squared the circle, the award would not have gone unclaimed. By contrast, there's no reasonably close world where Wallis squared the circle; so his failure to do so does not cause the award to go unclaimed.

This account requires nonvacuism, for otherwise it would trivialize impossibly omissive causation—e.g., it would predict that if there's a reasonably close world where Hobbes squares the circle, Hobbes's failure to do so would *also* cause world hunger to continue. It also requires rejecting Strangeness of Impossibility, as Bernstein observes. Suppose Hobbes never thought to bribe the award committee to give him the award. Then it seems incorrect to say Hobbes's failure to bribe the committee caused the award to go unclaimed. Yet had Hobbes bribed the committee, the award would not have gone unclaimed. So in this case, the possible world where Hobbes bribes the committee is not close, even though the impossible world where Hobbes squares the circle is. Hence, an impossible world must be closer to the actual world than some possible world. Bernstein defends both of these requirements as independently plausible.

Theism. Zagzebski (1990, p. 180) observes that counterpossibles may be crucial for resolving various puzzles concerning both God's omnipotence and God's omniscience.[36]

Regarding the first: there is a tension in the claim that God is essentially omnibenevolent and omnipotent (Carter, 1985). If God is essentially omnibenevolent, then it is impossible for God to do evil; yet, this suggests there are limits on God's powers—after all, humans can do evil, so why can't God?[37] In response, Morris (1986, p. 168) argues that while God couldn't have done evil in virtue of God's good will, that doesn't mean God is not omnipotent, as the following is false (cf. Pearce and Pruss 2012; Pearce 2017):

(32) If God had wanted to do evil, God would not have been able to.

But, as Zagzebski points out, on Morris's view, this is a counterpossible precisely because God necessarily does not want to do evil. So this response requires nonvacuism (see Wierenga 1998 for a rebuttal on behalf of the vacuist-friendly theist).[38]

Regarding the second: there is a tension between the claim that God is omniscient and the claim that we have free will. If God knows what you're going to do before you do it, then you cannot do otherwise. Zagzebski (1991, pp. 159–161) proposes a solution to this problem on which one's actions can be free even if one couldn't do otherwise. On this account, one's actions are free only if one would have done them even if noncasually necessitating factors had not obtained. This means that my choices are free only if "my choices do not counterfactually depend on God's foreknowledge" (p. 162).

[36] There is also discussion over whether Aquinas's views required nonvacuism. According to Freddoso (1986, pp. 44-45), Aquinas held that "truth consists in a certain relation between world and intellect, so that if *per impossible* there were no intellects, then even if other things existed, there would be no truths". Since God is necessarily an intellect, Freddoso argues this must be a nontrivially true counterpossible (cf. Zagzebski 1990, p. 179). For criticism, see Wierenga 1998, pp. 94–98.

[37] This is related to a common objection to divine command theory, viz., it predicts that the following counterfactual is true since God's command is identical with moral goodness.

(i) If God were to command us to torture kittens, we would be morally required to do it.

Divine command theorists might respond by saying the counterfactual is actually a counterpossible, so that while it is true, such acts are still necessarily evil. See Morriston 2009 for discussion.

[38] Wierenga 1998, p. 99 argues that we do not need counterfactuals to articulate this difference: instead, it can be articulated using metaphysical dependence relations. However, as we've seen, there are reasons to think nontrivial metaphysical dependence relations require nonvacuism. See Lampert 2019 for further criticism.

For this condition to be nontrivial, we need counterfactuals of the following form to be nontrivial:

(33) If God were not omniscient and had not believed that I would ϕ at t, I would still ϕ at t.

Fiction(alism). According to the Sherlock Holmes stories, Sherlock Holmes is a detective who lives at 221B Baker St. It also seems true that Sherlock Holmes didn't have a third nostril. Yet the stories never explicitly rule this out: there are worlds compatible with everything the Holmes stories say where Sherlock has a third nostril. How do we tell what's true according to a fiction beyond what it explicitly states?

Lewis (1978, p. 42) proposes an analysis of truth according to a fiction roughly in terms of counterfactuals. The basic idea is this (although the analysis undergoes several refinements): A is true according to a fiction F iff if F had obtained, A would have obtained. Thus, it's still true according to the Sherlock Holmes stories that Holmes does not have a third nostril because had the Holmes stories obtained, Sherlock would not have a third nostril (see Friend 2007 for an overview of the fiction operator approach).

Some fictions are impossible. For example, Lewis (1978, p. 46) observes that in *The Sign of Four*, Watson has a war wound in his leg, whereas in *A Study in Scarlet*, it's in his shoulder. This seems like it might just be a mistake, but in other cases, the impossibility is intentional. Priest (1997) tells a fictional story where he finds an inconsistent object. I won't spoil it; suffice it to say, the inconsistent object plays an important role in the story (see Nolan 2020 for discussion). Thus, one might naturally suggest that Lewis's theory of truth in fiction can be extended to give an account of truth in impossible fictions—so long as nonvacuism is true.

Nonvacuous counterpossibles are also useful for fiction*alists*. According to **nominalism**, abstract objects such as numbers do not exist. Nominalists therefore deny that "3 is a prime number" is strictly speaking true. Nevertheless, nominalists do not want to throw out all of mathematics: such claims about numbers can still, in some sense, be *correct*. The strategy is to paraphrase seemingly true sentences about numbers into nominalistically acceptable sentences. Yet it is notoriously difficult to pull this off.

With nonvacuous counterpossibles, however, the task seems quite easy (Dorr, 2008). We can paraphrase "3 is a prime number" as something like the following:

(34) If there were numbers, 3 would be a prime number.

In order for this paraphrase to work, the nominalist requires nonvacuism to be true. Otherwise, the vacuous truth of (35) will predict that "3 is a composite number" should be accepted:

(35) If there were numbers, 3 would be a composite number.

Similarly strategies could be employed for fictionalism about, e.g., possible worlds (Rosen, 1990), composition (Rosen and Dorr, 2002), and (for monists) *de*composition (Schaffer, 2007).

One worry for this approach is that, very often, we want fictionalist paraphrases to be closed under entailment. Thus, from (34), we want to be able to infer:

(36) If there were numbers, there would be prime numbers.

We could guarantee the correctness of such reasoning if we could assume counterpossibles are closed under entailment; but as we saw in our discussion of the thinking-it-through objection from §3.1, nonvacuists deny this (Woodward, 2010). In response, nonvacuists might admit that even though counterpossibles are not generally closed under entailment, fictionalist paraphrases are closed under some forms of entailment (Skiba, 2019).

5 Conclusion (and Some Open Questions)

Much of the debate over counterpossibles has been fixated on one basic question: are counterpossibles ever false? We've surveyed the main options proposed in the literature (vacuism: no; nonvacuism: yes; intermediate views: it depends) and have looked at a variety of arguments for and against each option. We also saw how each position could be fruitfully employed to philosophical ends.

Details are still waiting to be filled in on all sides. Vacuists still have to provide us with more specific pragmatic mechanisms that explain our ability to communicate with counterpossibles. Nonvacuists still have to supply tractable accounts of similarity or related notions. Intermediate views go some way towards addressing these concerns, but are still relatively new and underdeveloped.

However, there is an asymmetry in terms of the work that remains to be done. For vacuists, there seems little more to do apart from investigating the pragmatics of counterpossibles and responding to specific objections. By contrast, there are a number of open questions remaining for nonvacuists.

For one, nonvacuists still need an account of the *epistemology* of counterpossibles. Many nonvacuists hold that when it comes to the impossible, anything goes: for every impossible proposition, there is an impossible world where that proposition obtains (Nolan, 1997, p. 542). Given this, how could we ever have reliable counterpossible knowledge? How could we ever know what would happen if water were hydrogen peroxide, if Hobbes had squared the circle, if it were raining and not raining, etc.? Moreover, does it make sense to have credences in counterpossibles, even when we know that the antecedent is impossible? And if so, when are such credences rationally justified? Perhaps one will say the epistemology of counterpossibles is no more problematic than the epistemology of other counterfactuals; but this requires some defense (especially in light of the "thinking it through" objection from §3.1).[39]

Another major open question for nonvacuists concerns the logic of counterfactuals. As we noted in §3.1, there is a worry that nonvacuism obliterates any nontrivial logic of counterfactuals, which strikes many as counterintuitive. But even if we do not accept this, there is still unclarity as to which principles, if any, should carry over from the logic of ordinary counterfactuals to counterpossibles (see French et al. 2020 for an investigation of the space of options). Furthermore, most work on the logic of counterpossibles has focused on the logic of simple propositional languages. Relatively little attention has been paid to the logic of counterpossibles with quantifiers. There is also work to be done clarifying how similar or different the logic of counterpossibles is to the logic of other opaque operators (belief operators, grounding claims, etc.).

A final area of exploration I will mention concerns whether there are any interesting differences between different types of counterpossibles. For example, nonvacuists disagree over whether counterlogicals are a special class of vacuous counterpossibles (Kocurek and Jerzak, 2021, p. 677). Perhaps the same goes for counteranalyticals, but matters are less clear for countermathematicals and counterconceptuals. It is also unclear whether

[39]One promising avenue is to tie the epistemology of counterfactuals to explanatory reasoning (Kment, 2014). In addition, intermediate positions offer some hope towards progress. For epistemic nonvacuists, counterpossible knowledge is only ever nontrivial on epistemic readings. But it's no mystery how we could have knowledge of counterpossibles on their *epistemic* reading, since this is the reading that is relevantly tied to our epistemic state. As for counterconventional nonvacuists, there is some hope that one might be able to reduce our ability to know counterpossibles to a more general ability to reason about alternative conventions or conceptual schemes (Kocurek and Jerzak, 2021, §7). More generally, we might try to reduce our ability to know counterpossibles to our general capacity to imagine the impossible (Kung, 2010, 2016).

one should put counter*meta*logicals in the same class as counterlogicals, especially since the former tend to be easier to interpret than the latter (Sandgren and Tanaka, 2020). Thus far, the literature on counterpossibles has tended to treat all counterpossibles the same. But it might be that certain semantic, metaphysical, or epistemological issues can be addressed more (or less) easily by different types of counterpossibles. Further investigation will hopefully yield a better understanding of how different species within the genus of counterpossibles relate.

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