No universalism without gunk? Composition as Identity and the universality of identity

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Abstract

Philosophers disagree whether Composition as Identity entails mereological universalism. Bricker [8] has recently considered an argument which concludes that Composition as Identity supports universalism. The key step in this argument is the thesis that any objects are identical to some object, which Bricker justifies with the principle of the universality of identity. I will spell out this principle in more detail and argue that it has an unexpected consequence. If the universality of identity holds, then Composition as Identity not only leads us to universalism, but also leads to the view that there are no mereological atoms.

Keywords: Composition as Identity, universalism, gunk, universality of identity, mereology

1 Introduction

What is the relation that holds between a broom and the stick and the brush which compose it? According to *Composition as Identity*, the stick and the brush not only compose the broom, but they are identical to it. *Prima facie*, this view appears to be compatible with a large number of mereological principles. For instance, it seems that a supporter of Composition as Identity can hold on to the claim that any object is ultimately composed of mereological atoms, or to the view that there are gunky objects.[1] Similarly, one has good reasons to think that Composition as Identity is consistent with mereological universalism, the position which claims that *any* objects compose some object, as well as with mereological nihilism, the doctrine according

[1] A mereological atom is an object with no proper part, [12, 39]. A gunky object is an object whose parts all have at least one proper part, [21, 20].

to which *no* objects compose, or a restricted view on composition, i.e. theories which assume that some objects compose an object, and some objects don't.[2]

Yet, the fact that it is common for authors to either accept or reject both Composition as Identity and universalism together[3] gives rise to the suspicion that the two theories are not independent from each other. Thus, a recurring question in the mereological literature is whether Composition as Identity *entails* universalism.[4] Recent discussions suggest that we should distinguish between different versions of Composition as Identity when we ask this question. On the one hand, Calosi [9] argues that *strong* Composition as Identity, which takes composition to be identical to *the* identity relation, not only entails mereological nihilism, but that the two theories are equivalent. Consequently, since universalism contradicts nihilism, strong Composition as Identity does not entail universalism. On the other hand, Bricker [8] argues that although *moderate* Composition as Identity, the view that there are different kinds of identity relations and composition is one of them, does not *entail* universalism, it gives us good reasons to assume that any objects compose some object.

In this paper, I will examine an argument that Bricker considers for the claim that Composition as Identity leads to universalism. I argue that if his argument is sound, then Composition as Identity also leads to the claim that every object is a gunky object, or in other words, that every object has parts which all have at least one proper part. This may strike the reader as a surprising result. A possible connection between Composition as Identity and the question about the existence of mereological atoms has, to the best of my knowledge, hitherto been neglected in the literature. Yet, we will see that if Composition as Identity is built on the universal notion of identity suggested by Bricker, then it not only provides reasons to endorse the principle *E Pluribus Unum* – any objects are identical to some object – but also what we might call *Ex Uno Plura* – every object is identical to, i.e. is composed by, some objects.

[2] Universalism is endorsed, for instance, by Bricker [8, 264-5], Lewis [21, 75-87], and Varzi [38, 48]. Cameron [10], Rosen and Dorr [30], and Sider [33] are among the supporters of nihilism. Restricted views of composition are defended by Korman [18], Merricks [25], and van Inwagen [36].

[3] Bricker [8], Lewis [21, §3], and Varzi [38] embrace both views. Koslicki [19, §2-3], Simons [34], [35, 60], and van Inwagen [36], [37] criticise both theories. Lando stands out as a universalist who explicitly rejects Composition as Identity, see §10-14 and the appendix in [20].

[4] Bohn [7], Merricks [26, 629-31], and Sider [31, 59-62] argue that there is such a connection, while Cameron [11] and McDaniel [23] deny that Composition as Identity entails universalism.

2 From Composition as Identity to Universalism

Moderate Composition as Identity, henceforth simply 'CAI', begins with the thought that there are different *kinds* of identity relations.[5] Besides the "ordinary", one-one identity relation (=) from first-order logic, which only holds between an object and itself, supporters of CAI postulate at least two further kinds of identity. There is many-many identity ($\approx$), a relation that may hold between many objects and many objects, as for instance, between the stick and the brush which compose a broom, and the chemical atoms which compose the same broom. Furthermore, we have many-one identity ($\simeq$). This relation can hold between many objects and one, such as a stick and a brush, and the broom they are parts of.[6] It is many-one identity which is, according to CAI, the composition relation. Thus, the central claim of CAI is the following:[7]

CAI For any objects xx and any object y, the xx compose y iff the xx are many-one identical to y

Before we look at the relation between CAI and universalism, I should point out that CAI does not fail, if the plural variable xx takes a singular value.[8] One might suspect that CAI fails in such a case because the above characterisation of many-one identity suggests that many-one identity only holds between many objects and one, or between one object and many objects.[9] However, CAI holds even when xx takes on a singular value because, in the context of Composition as Identity, we should understand composition to be an irreflexive relation.[10] In other words, if xx is assigned

[5] See [2], [3], [4], [8, 266], [14], and [15, 9-11].

[6] Given the concept of many-one identity, it is a natural question to ask whether that relation can also hold between one object and many, or whether there is a fourth kind of identity, "one-many identity". Bricker explicitly allows for many-one identity to hold between one object and many objects, [8, 268-9]. In contrast, Cotnoir distinguishes between many-one and one-many identity, [14, 303]. For our concerns here, there is no need to answer this question, though we will come back to it in the next section.

[7] I will use here, and in the following, plural variables, xx, yy, zz. Plural variables can take on singular values, such as Anne, or John F. Kennedy, as well as plural values, such as Anne and Bob, or the Kennedys. See also, [5], [22], [24], [28].

[8] I am grateful to an anonymous reviewer for highlighting the above suspicion.

[9] See fn.6 and section 3.2.

[10] Some might object that my view of composition as an irreflexive relation is a non-standard position and differs from Bricker's understanding of composition. Yet, let me briefly give some reasons why one might think that composition is an irreflexive relation. One of the central claims of Composition as Identity is that there is no additional ontological commitment to an object, given the commitment to the parts which compose it, [8, 266-7], [15, 7], [21, 81-2], [38, 47]. Taking this claim to involve a reflexive composition relation (or improper parthood) means, in my view, interpreting Composition as Identity as a trivially true and quite uninteresting position: If the objects yy which compose an object x include that x itself,

a singular value, say, the Eiffel Tower, then whatever we assign to y, it will always be the case that the object we assign to xx, the Eiffel Tower, does neither compose y, nor is it many-one identical to y. Setting this worry aside, let's turn back and see whether and how CAI relates to universalism.

CAI, the central claim of moderate Composition as Identity, does not suffice to conclude that any objects compose at least some object, i.e. universalism:[11]

MU For any objects xx, if the xx are many, then there is some object y such that the xx compose y

In order to get from CAI to universalism, we need a further thesis, one that expresses the thought that any objects are identical to some object. "E Pluribus Unum", a principle introduced by Bricker [8, 271], seems to be needed:

EPU For any objects xx, there is some object y such that the xx are identical to y

But why should we take EPU for granted? Those who have little or no sympathy for universalism will surely see no immediate reason to embrace EPU. So what motivates this principle, besides the wish to derive universalism from CAI?

Here is where Bricker introduces a principle called "the universality of identity":

> **E Pluribus Unum**–*arguably*–could be seen as an instance of the universality of identity. [8, 274] (emphasis in original)

Thus, there might be no need to postulate EPU. It seems to follow from the universality of identity, a more general principle. Yet, what is the universality of identity? Below is Bricker's characterisation:

> The universality of identity is the thesis that everything is identical with something [8, 275]

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then there cannot be any additional commitment to x, given the commitment to the yy, since x is one of the yy. At first sight, this worry might seem ungrounded since we have some yy, which don't include their composite object, for instance a stick and a brush that compose a broom. However, it strikes me as odd that, given a reflexive composition relation, the claim that a commitment to a composite object x is nothing over and above a commitment to its parts yy is trivial in some cases, if x is the only object among the yy, while it is not trivial in other cases, if x is not among the yy.

[11] Given the suggestion that composition is an irreflexive relation, and the fact that plural variables can be assigned singular values, we have to slightly adjust our formulation of mereological universalism, which differs from Bricker's, [8, 268]. We have to add the condition that the composing objects xx have to be many objects in order to compose some object y. This is necessary because the possibility that there is only one object among the xx, in which case it will not compose anything, cannot be excluded. Moreover, by adding this condition to our principle, we can hold on to it without getting into conflict with plural terms that fail to refer, such as 'Sherlock Holmes and Dr Watson' or 'the twelve Olympians', see [28, §5.3].

This sounds intuitive. Surely, everything is identical to something, since everything is identical to itself. But if we want to argue that the universality of identity entails EPU, we have to spell out this principle in more detail. In order to do this, we need two more concepts, the generalized identity relation and "neutral variables".

The generalized identity relation ($\equiv$)[12] is a way to capture the view that there are different kinds of identity. Thus, when supporters of CAI assume that there are, say, three kinds of identity relations, one-one, many-one, and many-many, then to say that a generalized identity holds simply means that either one of the three kinds of identity relations holds.

Once we allow the use of plural besides singular variables, neutral variables, α, β, γ, are just a means of abbreviation. The claim that any α is F, simply reduces to the two claims that any object x is F, and any objects xx are F. Given the duality of the quantifiers, the claim that there is some β that is F reduces to the claim that there is some object x that is F or there are some objects xx that are F.[13]

With the concepts of the generalized identity relation and neutral variables, we can now turn back to the justification for the universality of identity. In formal terms, the universality of identity can be expressed as

UI $\forall\alpha\exists\beta(\alpha \equiv \beta)$

What justifies this principle? It is a theorem of first-order logic[14] that every *object* is identical to some *object*, $\forall x\exists y(x = y)$. But if we want to work with a formal system that allows us to discuss composition, we need to go beyond first-order logic. Composition is a relation which is *collective* in its first argument place. That means that it is not the case that if some objects, say a stick and a brush, compose some object, a broom, then each one of them, the stick on its own and the brush on its own, composes the broom, [5, 21], [24, 5-6], [28, 3]. Therefore, since it is generally accepted that plural logic is the adequate framework to formalise predicates which have collective argument places, [5], [22], [24], [28], we need to take the resources of plural logic on board. This includes the theorem from plural logic that any objects

[12] Cotnoir [14] calls this relation general identity.

[13] It should be noted that Bricker uses schematic letters for variables when giving his account. To avoid possible confusion, I should point out that this disagrees with my suggested usage here when a neutral variable connects with an existential quantifier: When α is a schematic letter, $\exists\alpha F\alpha$ represents the claim that there are some objects xx that are F and that there is some object x that is F.

[14] With first-order logic, I mean the system developed by Frege [16], and presented, for instance, in [29, §12] and [32, §4-5.3].

are identical to some objects, $\forall xx\exists yy(xx \approx yy)$. Finally, if we take the idea that there is a general identity relation serious, it appears that the step from first-order to plural logic, and thus generalizing the claim from first-order logic that every object is identical to some object, naturally includes an acceptance of UI, see [8, 275].

Yet, we have to note that a formalisation of EPU, $\forall xx\exists y(xx \simeq y)$, can *not* be derived from UI.[15] Due to the nature of neutral variables, we can derive the two formulas $\forall x\exists\beta(x \equiv \beta)$ and $\forall xx\exists\beta(xx \equiv \beta)$. The first formula is a non-starter to derive EPU, since its universal quantifier is followed by a singular variable. Yet, even from the latter, we cannot derive $\forall xx\exists y(xx \equiv y)$, which would eventually lead us to EPU by substituting in the appropriate identity relation $\simeq$ for $\equiv$. Instead, we end up with the disjunction $\forall xx\exists y(xx \equiv y) \vee \forall xx\exists yy(xx \equiv yy)$, and since the second disjunct is true, we cannot conclude EPU.

However, EPU may be seen, as Bricker suggests [8, 275], as a result of the move from first-order to plural logic and CAI's deflationary notion of composition. EPU simply expresses the universality of *many-one* identity: any objects are identical to some object. Yet, if we accept CAI and its assumption that composition is an ontological flyweight, it appears that denying EPU becomes impossible for us. Thus, the universality of one-one and many-many identity, i.e. the claims that every object is identical to some object, and any objects are identical to some objects, may be taken as evidence that there is a universality principle for each one of the *kinds* of identity relations.

Although I agree with much of the above justification for EPU, it might be challenged. However, the aim of this paper is not to show that CAI leads to EPU, and hence to universalism, but that *if* CAI leads us to universalism, then it also leads us to the view that the universe is gunky. So let's move on to see how the connection between CAI and universalism leads to the thesis that reality is gunky.

3 . . . but not without gunk

Consider now a different principle which we might call *Ex Uno Plura* (EUP): Every object is many-one identical to some objects. With CAI, EUP leads to the claim that

[15] However, if we take EPU to contain schematic letters instead of neutral variables, it would be legitimate to claim that UI, or the version of UI that is formulated with *schematic letters*, entails EPU.

for any object x, there are some objects yy such that the yy compose x. In other words, any object has proper parts. This means that every object is a gunky object; or in other words, there are no mereological atoms. We might formalise *Ex Uno Plura* as follows:

EUP $\forall x \exists yy(x \simeq yy)$

In the previous section, we have seen why the universality of identity does not *entail* EPU. Due to similar reasons, UI does not entail EUP. Here is why EUP does not follow from UI: From UI, we can derive $\forall x \exists \beta(x \equiv \beta)$ and $\forall xx \exists \beta(xx \equiv \beta)$. In order to get to EUP, we have to focus on the first formula, because its universal quantifier is followed by a singular variable. Yet, we cannot derive $\forall x \exists yy(x \equiv yy)$, which eventually gives us EUP by substituting in the appropriate identity relation $\simeq$ for $\equiv$. Instead, we only get $\forall x \exists y(x \equiv y) \vee \forall x \exists yy(x \equiv yy)$, and since the first disjunct is true, we can not derive EUP.

Although we cannot deduce EUP from UI, we have good reasons to think that if EPU is the result of the move from first-order to plural logic and CAI's deflationary notion of composition, so is EUP. If we justify *E Pluribus Unum*, the claim that any objects are identical to some object, by relying on the view that many-one identity is a universal relation, then we must consider that the universality of many-one identity does not only consist in EPU, but that it includes *Ex Uno Plura*: any object is identical to some objects. After all, the thought that many-one identity is a universal relation does not favour EUP over EPU. Since they differ from each other only with respect to the position occupied by singular and plural variables they seem to be on a par. Thus, if we take CAI and UI to be reasons to embrace EPU, rejecting EUP and holding on to EPU is not an option.

Consequently, if CAI and the universality of identity lead us to the view that any objects compose, then they also lead us to "Atomlessness" [12, 48], the claim that every object has a proper part, i.e. is a gunky object. Therefore, supporters of CAI who justify their belief in universalism on the basis of its connection to UI have to take into account that this stands in conflict with the claim that there are mereological atoms, and that it comes with a commitment to Atomlessness.

A commitment to the claim that reality consists entirely of gunky objects may come as a surprise for the friend of CAI. Naturally, some might argue that we can hold on to the view that CAI leads to universalism, while also holding on to the existence of

atoms. Three strategies to achieve this seem, *prima facie*, the most natural way to go.

3.1 Is EUP not well-formed?

One way to challenge the above result concerns the way *Ex Uno Plura* is phrased. One might claim that EUP is not a well-formed expression. We said above that '$\forall x \exists yy(x \simeq yy)$' states that every object is identical to some objects, with the one object as the first relatum and the many as the second. But '$\simeq$' was introduced as the symbol for many-one identity. So, EUP represents the claim that any object is *many-one* identical to some objects. Yet, that may not sound like a well-formed expression. Should many-one identity not only be able to hold between *many* objects and *one* object? How can *one* object be *many-one* identical to *many* objects? Thus, it appears that if we consider many-one identity to be sensitive to which argument place the many objects and the one object occupy, EUP might be undermined.

This seems to be a legitimate worry.[16] Maybe '$\simeq$' is like other predicates which can take plural and singular terms in different argument places, such as 'surrounding', in the sense that it matters which term enters which argument place. Although it makes sense to say that the stick and the brush are many-one identical to the broom, it may perhaps not make sense to say that the broom is many-one identical to the stick and the brush − just like it makes sense to say that the cats surround Bob, but it does not make sense to say that Bob surrounds the cats. So should we reject Bricker's suggestion, [8, 268-9], that many-one identity can take many objects and one objects in either one of its argument places?

I think that even if we agree that many-one identity cannot take one object in its first argument place, and many objects in its second, EUP, or a principle that expresses its spirit, seems unavoidable for the supporter of CAI. As I already noted in fn.6 at the beginning of section 2, from CAI's claims that there are different kinds of identity, and that there are many-one identities, the question arises whether there is also a "one-many identity". But if we want to defend the view that many-one identity is sensitive to the number of objects it takes in its different argument places, then a commitment to one-many identities seems unavoidable. Given the acceptance of many-one identity, it would surely seem an *ad hoc* move to say that there are no one-many identities. To

[16] Bricker can apparently avoid this worry. He does not introduce a symbol in his language for many-one identity, but uses the symbol for his generalized identity relation which can take either plural or singular arguments in either place.

say that identity can hold between many objects and one, but not between one object and many objects strikes me as absurd. The one-many identity relation is simply the inverse of the many-one identity. Yet, if there are one-many identities, then a principle which shares the idea that underlies EUP, that for any object there are some objects which are one-many identical to it, $\forall x \exists yy(x \simeq^* yy)$, will be just as tightly connected to the universality of identity as *E Pluribus Unum*. Thus the objection that EUP is not a well-formed principle is not an option for the friend of CAI to avoid a commitment to EUP.

3.2 Is EUP an inadequate formalisation?[17]

It might seem that our formalisation of *Ex Uno Plura*, $\forall x \exists yy(x \simeq yy)$, is inadequate, since it reduces to the logical truth from first-order that every object is identical to some object, $\forall x \exists y(x \simeq y)$. According to the standard interpretation of plural logic, see, [28], plural variables can take plural values, e.g. the Kennedys, or Anne and Bob, but also singular values, e.g. John F. Kennedy, or Anne. Hence, the claim that some object is F entails that there are some objects that are F; or in formal terms, $\exists xFx$ entails $\exists xxFxx$. With respect to our formalisation of *Ex Uno Plura*, this might mean that EUP will not lead us to the claim that every object is gunky, since it does not represent the claim that every object is many-one identical to *some objects*. Rather, EUP simply represents the claim that every object is identical to *some object or some objects*, and is thus made true by the fact that every object is identical to itself.

In order to address this worry, one could decide to break with the orthodoxy of plural logic that allows plural variables to take singular values. If plural variables can only take plural values, then $\forall x \exists y(x \simeq y)$ does not entail $\forall x \exists yy(x \simeq yy)$, and EUP does not reduce to the claim that every object is identical to some object. Thereby one can meet the above objection against our way of formalising *Ex Uno Plura*. However, this seems to me a rather radical step to take because I think the assumption that plural variables can take singular values is well justified, see [28, §5.1].

There are two alternative, closely related, replies to the worry that EUP is an inappropriate formalisation of *Ex Uno Plura*, which I take to be more sensible. First, we can acknowledge that the formula $\forall x \exists y(x \simeq y)$ entails $\forall x \exists yy(x \simeq yy)$. However, it appears reasonable to think that this entailment is trivial because the first formula

[17] Thanks to an anonymous reviewer for pointing out this worry.

represents an absurd claim. No object x can be *many-one* identical to another object y. This becomes apparent, if we consider the truth condition for sentences, such as the one represented by EPU, which express that a many-one identity holds: A sentence expressing that a many-one identity holds is true iff an identity holds between *many* objects and *one* object (or one object and many objects). Thus, it appears in a sense to lie in the nature of many-one identities that if $\forall x \exists yy(x \simeq yy)$ is true, then it is not the case that it is true because for every object x there is some object y which is identical to it. Rather, if $\forall x \exists yy(x \simeq yy)$ is true, then it is true because for every object x there are some objects yy, which are many, such that they are identical to it.

Finally, I think we might as well agree with the worry that EUP is not an adequate representation of the principle *Ex Uno Plura*. Maybe EUP does indeed not capture the thought that underlies the principle that every object is many-one identical to some objects. Yet, following the line of thought from the previous paragraph, we might replace it with a different way of formalising the claim that every object is many-one identical to some objects. Taking O to represent the property of *being one*, we can use the following formalisation of *Ex Uno Plura*:[18]

EUP′ $\forall x \exists yy(x \simeq yy \wedge \neg O(yy))$

This formalisation of *Ex Uno Plura* is not derivable from $\forall x \exists y(x \simeq y)$. Instead of arguing that many-one identities can only hold if some many objects are identical to some object, we may hold on to the claim that every object x is many-one identical to some objects yy, mentioning explicitly that the yy cannot be one object, i.e. they must be many objects. Although this line of argument does not address the above worry – after all we agreed that EUP is not an adequate formalisation of *Ex Uno Plura* – it helps us to uphold the view that if CAI and the universality of identity support universalism, then they also support the view that reality is gunky. In other words, the argument that if CAI and the universality of identity support *E Pluribus Unum*, i.e. the claim that any object are many-one identical to some object, then CAI and the universality of identity support *Ex Uno Plura*, i.e. the claim that any object is many-one identical to some (many) objects, is not affected by the way we formalise *Ex Uno Plura*.

[18] Another alternative formalisation, using the predicate *being among* ($\prec$) commonly used in plural logic, is the following: $\forall x \exists yy(x \simeq yy \wedge \exists z_1 \exists z_2(z_1 \prec yy \wedge z_2 \prec yy \wedge z_1 \neq z_2))$.

3.3 Can we restrict EUP?

An alternative way one might try to avoid EUP is to argue that the combination of CAI and the universality of identity suggests only a weaker principle. A restricted version of EUP, one that claims that for any *composite* object, there are some objects which are identical to it

> For any object x, if x is a composite object, then there are some yy such that the yy are identical to x

is surely acceptable for the friends of CAI. After all, within CAI, this principle only states that every composite object is composed by some objects. This is without a doubt a harmless claim. Moreover, one could think that EPU, $\forall xx \exists y(xx \simeq y)$, only says that any objects are, trivially, identical to some *composite* object. So, why shouldn't EUP also hold only for composite objects?

The obvious problem with this line of defence is that we can avoid EUP in favour of the restricted version of the principle only if we restrict the universality of identity to composite objects as well. That is, we must then reject the above principle UI, and replace it with something like the following:

> For anything α, if α is a composite object, then there is something β such that α is identical to β

Yet, this principle is worrisome. It clearly goes against the spirit of the *universality* of identity because it is no longer a *universal* principle; it holds only for composite objects α. Moreover, denying the unrestricted version of the principle UI, entails a contradiction. The negation of UI is the claim that it is not the case that for every α, there is some β such that α is generally identical to β. This entails that there is either some x such that for any β, it is not the case that x is generally identical to β, or there are some xx such that for any β, it is not the case that the xx are generally identical to β. Both disjuncts lead to a contradiction. The first disjunct, $\exists x \forall \beta \neg(x \equiv \beta)$, entails the claim that there is some object x such that for any object y, it is not the case that x is generally identical to y. However, this contradicts the fact that x is identical to itself. The second disjunct, $\exists xx \forall \beta \neg(xx \equiv \beta)$, leads us to the claim that there are some objects xx such that for any objects yy, it is not the case that the xx are generally identical to the yy. This contradicts the fact the xx are identical to themselves. Hence, the disjunction which follows from the negation of UI

entails a contradiction. Therefore, we cannot deny UI for the sake of consistency. So we see that the aim to avoid the derivation of EUP by restricting the universality of identity is not successful either.

4 Concluding remarks

The debate on the relation between Composition as Identity and universalism seems to hinge on the distinction between the different versions of Composition as Identity. Bricker [8] has developed an argument that concludes that moderate Composition as Identity together with the principle of the universality of identity supports universalism. We have seen that this argument can only be defended if we accept that CAI and the universality of identity also support the claim that reality consists entirely of gunky objects.

Since universalism excludes other views about the conditions under which composition occurs, such as nihilism and restricted views about composition, CAI must exclude these views as well. This will strike many as a surprising consequence. Furthermore, CAI committing to universalism has a further consequence which might seem to be unexpected. Bohn [6] has shown that universalism excludes that reality is junky, i.e. that any object is a *proper* part of some object. Therefore, if CAI leads to universalism and universalism excludes junk, then CAI excludes junk. Although Bohn's argument is not unchallenged, [13], [39], I think it is remarkable that CAI might be incompatible with the view that reality is junky.

But how should we evaluate the claim that a connection between CAI and universalism leads to a connection between CAI and the view that every object is gunky? We have to remark that it seems, in general, disadvantageous for a theory to exclude other theories. Naturally, we prefer theories which allow us to connect with as many other standpoints as possible, and which, ideally, do not force the people we are trying to convince that our theory is true to change any of their beliefs. Yet, depending upon the views and beliefs which are inconsistent with the theory we are aiming to put forward, we might not see that as a defect of our theory. Rejecting any theory simply because it contradicts, for instance, the view that $0 = 1$, that there is more than one even prime number, or that a person can know p without p being true does not seem to be a reasonable thing to do. To the contrary, you might even welcome that a certain

theory excludes positions that you are convinced are false anyways. Therefore, the verdict about CAI's connection to the claim that every object is gunky will depend upon the acceptability of the latter view.[19]

Whether any object is a gunky object or whether there are mereological atoms is an open question. Hazen [17], Lewis [21, 21], Nolan [27], and Zimmerman [40], [41] have famously considered the possibility of reality being gunky. Yet, talk about mereological atoms, although often without an explicit commitment to the existence of atoms and against gunky objects, is ubiquitous in the literature on composition and mereology, see, for instance, [18], [19], or [25]. On the other hand, it has been shown that gunk is a concept which can be fruitfully applied in the sciences, [1, §4]. So I think that although it might surprise us that CAI may come with a commitment to gunk, or at least it does under the assumption that Bricker's argument is sound, this does not automatically refute CAI.[20]

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[19] A further complication comes into play if we consider questions about modality. If we take the universality of identity to be a necessary truth, it would seem natural to take *Ex Uno Plura*, and therefore the claim that any object is gunky, to be a necessary truth. This might be a worrisome result since even if one thinks that there are no atoms in the actual world, one might not want to exclude the possibility that there are atoms. Thanks to an anonymous reviewer for mentioning this worry.

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