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# COMPOSITION IS IDENTITY AND MEREOLOGICAL NIHILISM

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*Composition is Identity is the thesis that a whole is, strict and literally, its parts considered collectively. Mereological Nihilism is the thesis that there are no composite objects whatsoever instead. This paper argues that they are equivalent, at least insofar as Composition is Identity is phrased in a particular way. It then addresses some consequences of such equivalence.*

**Keywords:** Composition, Identity, Mereological Nihilism, Special Composition Question.

*Composition is Identity* (CII[1]) and *Compositional* (or mereological) *Nihilism* (CN) are two reductive metaphysical theses that are currently widely discussed in the metaphysics literature, as witnessed in recent works such as Sider (2013) and Baxter and Cotnoir (2014). CII[2] is the thesis that a whole just *is* (strictly and literally) its (proper) parts,[3] whereas CN is the thesis that there are no composite objects whatsoever. In this paper, I argue that these theses are equivalent. More specifically, I argue that a particular formulation of CII—to be found for example in Wallace (2011a,b) and Sider (2014) to mention a few—and CN are equivalent, i.e.,

$$\text{CII} \leftrightarrow \text{CN} \tag{1}$$

[1] Sometimes (if not often), the acronym CAI—for Composition *as* Identity—is used in the literature. I prefer to use CII in this paper for its focus will be a thesis which claims that composition *is* identity, rather than composition *is analogous* to identity. I will return to this point many times throughout the paper.

[2] Or at least, I will take it to be *this* thesis. CII comes in different varieties—see footnote 5—and some of them may not be committed to this rather strong claim.

[3] A referee for this journal notes that CII is an *interesting thesis about composition* insofar as it is a claim about the identity of a whole with its *proper* parts. Given Reflexivity of parthood and identity, it is in fact trivially true that every whole is identical with its improper part. It will be clear later on in the paper why I put the 'proper' parthood qualification in brackets.

This is not only an important result in itself; it also sheds new light on related topics. In particular, it has significant consequences on the issue of atomism and on how to answer to the so-called *Special Composition Question* (SCQ). However the paper does not provide any argument in favour or against either CII or CN.[4]

The plan is as follows. I briefly develop a formal framework (Section I), then put forward (Section II) the main argument in favour of (1), discuss some ways of resisting the argument (Section III) and finally address some of its implications (Section IV).

## I. PARTHOOD, COMPOSITION, IDENTITY

This section is devoted to a brief development of the formal tools that are necessary to give a rigorous formulation of theses, principles and arguments in the rest of the paper.

CII is a somewhat radical thesis.[5] It maintains that many things (the proper parts of something) can be strictly identical to just one thing (their mereological fusion).[6] As such, it calls for an expansion of our usual ideology. I will use plural logic and some mereological principles.[7] Furthermore, I will assume that some

[4] Though I will discuss one such argument in Section IV.

[5] There are different varieties of CII. Wallace (2011a) lists three of them: *Weak Composition Thesis* (WCT)—the predicate 'are' used to indicate compositional relation is only analogously another form of the 'is' of identity; *Strong Composition Thesis* (STC)—the predicate 'are' used to indicate composition is *literally* another form of the 'is' of identity—and *Stronger Composition Thesis* (RCT)—the predicate 'are' used to indicate composition is literally another form of the 'is' of identity. In addition, identity does not obey the Indiscernibility of Identicals—Cotnoir (2014) distinguishes three variants as well, which he calls *Weak* CAI—which is Wallace's WCT, *Moderate* CAI—the relation between the parts taken collectively and the whole is non-numerical identity and *Strong* CAI—which is Wallace SCT. Sider (2007, 2014) distinguish between *Strong* CII—*if* something is a fusion of a plurality it is strictly numerically identical to that plurality, and *Superstrong* CII—something is a fusion of a plurality *iff* it is numerically identical to that plurality. Bohn (2014) suggests that we should formulate CAI as a definition rather than a biconditional. Cotnoir (2013) suggests that CII does not involve numerical identity but rather a variant of a *generalized notion of identity*. It is an interesting question what are the logical and metaphysical relations between these different formulations. In what follows, I will take *Composition is Identity* to be Wallace's RTC, Cotnoir's *Strong* CAI and Sider's *Strong* CII. Moreover, I will simply assume that Bohn's proposal entails such a thesis. This seems also the thesis that McDaniel (2008, 2010), and Cameron (2012) have in mind when arguing against it but see Bohn (2014) for a critique of this last point. Furthermore it is surely the thesis that Merricks (1999) has in mind, for his argument there depends upon the use of the Indiscernibility of Identicals, and also the one that Borghini (2005) discusses at length in his reply to Merricks.

[6] Strictly speaking, CII maintains that the parts taken collectively are identical to the whole. Since everyone who holds this thesis also holds the thesis according to which the whole is just the fusion of its parts, it follows by transitivity of identity that the fusion of some parts and those parts are literally identical.

[7] For an introduction to mereology, see Simons (1987) and Varzi (2014a).

version of Leibniz's law for identity[8] where variables could be flanked by both singular and plural terms holds. This seems to be unavoidable if we are to make sense of the claim that one thing (the whole) is strictly identical to many things (its parts).

Let $x, y, \ldots, z$ stand for singular variables and $X, Y, \ldots, Z$ stand for plural ones. $Xy$ abbreviates '$y$ is one of the $X$',[9] or equivalently, '$y$ is among the $X$'. I take parthood as primitive[10] and write $x \prec y$ for $x$ is part of $y$. I will assume that parthood is a partial order that obeys at least the so-called *Weak-Supplementation* axiom.[11] Using the partial ordering axioms—*Reflexivity*, *Anti-Symmetry* and *Transitivity*—we can then define proper parthood,[12] overlap and fusion[13] (or sum) via

$$x \prec\prec y =_{df} x \prec y \wedge x \neq y \tag{2}$$

$$O(x, y) =_{df} \exists z(z \prec x \wedge z \prec y) \tag{3}$$

$$xFuY =_{df} \forall z(Yz \rightarrow z \prec x) \wedge \forall z(z \prec x \rightarrow \exists w(Yw \wedge O(z, w))). \tag{4}$$

A proper part of something is a part of that thing which is distinct from it, two things overlap if they share a part, and $x$ is a fusion of the $Y$ if each $Y$ is a part of $x$ and every part of $x$ overlaps at least one of the $Y$.[14] *Weak supplementation* states that if something has a proper part it has another part that does not overlap the first:

$$x \prec\prec y \rightarrow \exists z(z \prec y \wedge \sim O(z, x)) \tag{5}$$

[8] I will return to this point later on in the paper, in Sections II and III.

[9] Notation follows Sider (2014).

[10] I follow Varzi (2014a).

[11] Sider (2007) makes a substantive case in favour of the claim that CII *entails* all of them. He actually shows that CII entails the so-called *Strong Supplementation Principle* according to which if something fails to have something else among its parts it has a part that is disjoint from that thing, i.e., $\sim y \prec x \rightarrow \exists z(z \prec y \wedge \sim O(z, x))$, which in turn entails *Weak Supplementation*.

[12] Cotnoir (2010) suggests the following alternative definition: $x \prec\prec *y =_{df} x \prec y \wedge \sim y \prec x$. Given *Anti-symmetry* these turn out to be equivalent, i.e., $x \prec\prec y \leftrightarrow x \prec\prec *y$.

[13] There is also an alternative definition in the literature: $xFu * Y =_{df} \forall z(z \prec x \rightarrow \exists w(Yw \wedge O(z, w)))$. In the context of any extensional mereology, such as classical mereology, these turn out to be equivalent, i.e., $xFuY \leftrightarrow xFu * Y$. See Hovda (2009).

[14] A referee for this journal suggested that we could draw a distinction between *Proper* and *Improper Fusions*, which parallels the distinction between proper and improper part. Here is a way of formulating the distinction: $x$ is a *Proper Fusion* if it is the fusion of its *proper parts*, whereas it is an *Improper Fusion* if it is the fusion of its *improper parts*. In other words, proper fusions are composite objects. Given this distinction everything counts as an improper fusion, given that everything fuses itself. Yet, not everything counts as a proper fusion. Mereological atoms are improper fusions but not proper fusions. I will suggest a related distinction, namely that between *Proper* and *Improper Pluralities*, later on, and I will discuss their relations. Thanks to a referee for this journal here.

CII is the thesis that the fusion $x$ of some $Y$ is strictly *identical* with the $Y$, where identical, as Sider (2014) writes, is taken to be 'identical in the very same sense of identical, familiar to philosophers, logicians and mathematicians, in which I am identical to myself and 2 + 2 is identical to 4' (Sider 2014: 211). Wallace (2011a) calls it Hybrid Identity and writes: 'Hybrid Identity is transitive, reflexive, symmetric, and it obeys Leibniz's law—the exception is that the hybrid identity relation allows us to claim that many things can be identical to a singular thing' (Wallace 2011a: 810). This translates in:

$$\text{CII}\ \forall x \forall Y (x Fu Y \rightarrow x = Y). \tag{6}$$

Let me be clear right from the start. The arguments in the rest of the paper apply only insofar as (6) or something that entails (6) is taken to be as the formulation of CII. Sider (2007, 2014), Wallace (2011a,b), are examples of the first option, Bohn (2014) is an example of the second. He writes: 'Sometimes one finds Composition is Identity formulated in terms of material biconditional $\forall x \forall Y (x Fu Y \leftrightarrow x = Y)$ but such a formulation is too weak [. . . ]. I therefore prefer the stronger formulation in terms of a definition. This way there is no room for doubt as to whether $Fu$ and $=$ express the same relation' (Bohn, 2014: 145).[15]

Lewis (1991) ascribes (6) to Baxter (1988a,b) as well, but as Yi (1999) and Wallace (2011a) point out, it is not entirely clear that (6) is what Baxter had in mind there, for he envisages the possibility of abandoning Indiscernibility of Identicals. Baxter (2014) comes actually closer to (6).[16] Hovda (2008) seems to have this formulation of CII in mind too. Sider (2014) claims that (6) is actually the most interesting (and fun!) version of CII. The following arguments *do not apply straightforwardly* to other versions of CII such as the weaker thesis according to which composition is just analogous to identity,[17] or to the proposal in Cotnoir (2013) to treat composition as *generalized* identity.[18]

[15] I have replaced formal symbols with the ones used in this paper.

[16] Baxter himself writes: 'In a sense Strong Composition is a consequence of my view' (Baxter 2014: 246). But he then goes on to fiddle with Indiscernibility of Identicals and relies heavily on 'aspectival distinctions' which, he admits, makes his theory sound 'like a theory of relative identity, and in some respects it is' (Baxter 2014: 246). In that paper, Baxter actually endorses yet another version of CII which he labels 'Stranger Composition thesis' according to which the parts are 'both *individually* and collectively, cross-count-identical with the whole' (Baxter 2014: 253, emphasis added). Note that if CII entails claim (14), as I shall argue, this would count as an argument in favour of Baxter's claim. For an analysis of the peculiar variant of CII defended by Baxter in his 1988a and 1988b, see Turner (2014).

[17] WCT in Wallace's words or Weak CAI in Cotnoir's. See footnote 4.

[18] I will return to this in Section III.

CN is a radical thesis, too.[19] It maintains that there are no composite objects, i.e., objects with proper parts. Mereological atoms would be all there is, and they would be defined as entities without proper parts:

$$A(x) =_{df} \sim \exists y(y \prec\prec x). \tag{7}$$

CN turns out to be:

$$\text{CN}\ \forall x(A(x)). \tag{8}$$

CN is usually thought of as a radical answer to the aforementioned *Special Composition Question* (SCQ). The following is a way of asking that question:[20]

$$xFuX \tag{9}$$

(9) SCQ What are the necessary and sufficient conditions $\psi$ a given plurality $X$ has to meet in order for there being an $x$ such that $xFuX$?

And the answer CN provides to SCQ is the following: there are no such conditions. There are no conditions some entities have to meet to compose *something else*,[21] they *never* do.

Let me now introduce some terminology to distinguish between different pluralities. A *Proper Plurality* is a plurality that contains at least two elements, whereas an *Improper Plurality* is a plurality that contains just one element.[22]

[19] For a recent discussion and defence, see Rosen and Dorr (2002) and Sider (2013)—though Sider (2013) admits that certain particular composite objects, namely sets, exist. Van Inwagen (1990) discusses *Compositional Nihilism* at length but does not endorse it. He then goes on to endorse a variant of what I will label *Compositional Restrictedness*, according to which a given plurality has a fusion iff either (i) there is only one thing in that plurality (what I will call an Improper Plurality), or (ii) that plurality constitutes a life. Sometimes this variant of *Compositional Restrictedness* is referred to as *Organicism*. See also Merricks (2001). A classic formulation and defence of *Compositional Nihilism* is instead found in Unger (1979).

[20] See Van Inwagen (1990).

[21] It has to be a further object since everything fuses with itself. Two referees for this journal have independently noted that, interestingly, this is true of CII as well. In fact, according to CII, a given plurality does not compose a *further* object. Actually we could go as far as claiming the following: according to CN there is only one condition that a given plurality has to meet in order to compose something, namely identity. Note that, precisely for the reasons mentioned in this footnote, we cannot say: 'there is only one condition that a given plurality has to meet in order to compose something *else*, namely identity'. This foreshadows an intimate relation between CII and CN which will be spelled out in detail in the rest of the paper. Thanks to two anonymous referees for this journal.

[22] Let me relate this distinction to the distinction in footnote 14, that is, the distinction between proper and improper fusions. The relation is the following. Fusions of proper pluralities are proper fusions. Here is an argument. A proper plurality contains at least two distinct elements, say $x, y$. Suppose such a plurality has a fusion, let's say $z$. Both $x$ and $y$ are parts of $z$ by definition of fusion. Furthermore they cannot be both identical to $z$ because they are distinct. Hence one of them has to be a *proper part* of $z$. And if $z$ has proper parts (it actually follows from *Weak Supplementation* that it has at least *two disjoint proper parts*) it qualifies as a proper fusion. Improper fusions are fusions of atomic improper pluralities.

An *Atomic Plurality* is a plurality that consists solely of mereological atoms. A non-atomic plurality contains at least a composite object instead.[23] An *Improper Atomic Plurality* is then a plurality that contains just one element that is furthermore a mereological atom. That said, the following is an equivalent, somewhat redundant way of phrasing the answer that CN gives to SCQ: only atomic improper pluralities have fusions. It is better to have a name for this last claim. Let's call it FAIP, for fusions entail atomic improper pluralities.[24] Then:

$$\text{CN} \leftrightarrow \text{FAIP} \tag{10}$$

Assume the left-to-right direction doesn't hold. We would have CN but not FAIP. We then have two cases: either (i) non-atomic pluralities have fusions or (ii) proper pluralities have. Given CN non-atomic pluralities do not exist. So we're left with (ii). If proper pluralities were to have fusions these fusions would count as composite objects, against our initial assumption of CN. As for the right-to-left direction, assume again it doesn't hold. We would have FAIP but not CN. If we don't have CN there is at least a composite object. By *Weak supplementation* it would have at least two (disjoint) proper parts. That means that at least a proper plurality, the plurality of those proper parts, has a fusion contrary to our assumption that FAIP holds. This establishes (10). This equivalence will turn out to be important for the main argument in the paper.

There is yet another radical answer to SCQ. It is called *Compositional* or Mereological *Universalism* (CU) and it can be seen as being at the other end of the spectrum when it comes to answering SCQ. Roughly it maintains that there are no necessary conditions some entities have to meet to compose something else, they *always* do. Every condition is sufficient for composition. More formally it is the endorsement of the mereological principle according to which every (non-empty) plurality has a mereological fusion:

$$\text{CU}\ \forall Y(\exists w(Yw) \rightarrow \exists x(xFuY)) \tag{11}$$

[23] Suppose you endorse *Atomicity*, roughly the view that, at the bottom, everything is composed of mereological atoms: $\forall x(A(x) \vee \exists y(A(y) \wedge y \prec x))$. It would follow that, given CII, everything is identical to some plurality of atoms considered collectively. It would still not follow that every plurality is an atomic plurality. The plurality of water molecules in the Atlantic Ocean would be a non-atomic plurality, even if each of its members will be strictly identical to some collection of atoms. That said we will see that CII surprisingly entails there is no such plurality. Furthermore CII is usually taken to be compatible with *Atomlessness*, roughly the view that everything is gunky, or, equivalently, everything has proper parts: $\forall x \exists y(y \prec\prec x)$. Once again, interestingly enough, if the arguments of this paper are on the right track, this turns out not to be the case. See Section IV.

[24] We can give yet another equivalent way of phrasing CN answer to SCQ, building on the distinction between proper and improper fusions. It is the following: proper fusions do not exist.

## II. THE EQUIVALENCE ARGUMENT

This section is dedicated to put forward the main argument for (1). I shall call it the *Equivalence Argument*. We need to prove two directions of that biconditional, the right-to-left direction CN $\rightarrow$ CII and left-to-right direction CII $\rightarrow$ CN. I put them in this order for the first one is easier to prove. Let's start from CN $\rightarrow$ CII then.

According to CN there exist only mereological atoms. Now, everything is a fusion of itself.[25] Thus, every atom has a fusion. The fusion of a thing with itself is just the thing itself, so each atom has a fusion that is identical with those entities that it fuses. Given CN there cannot be other fusions beside mereological atoms, for if there were those fusions would be composite objects. It follows that every fusion is strictly identical with the things it is a fusion of, that is, CII follows.[26]

The second direction, CII $\rightarrow$ CN, is harder to prove.

Let me first put forward the bare skeleton of the argument. It is as follows:

(i) I first show that CII entails the so-called *Collapse Principle*;
(ii) I then argue that *Collapse* entails yet another principle which I label *Duplication*;
(iii) Finally I show that *Duplication* entails FAIP and thus CN, given the equivalence established in (10).

The first step is taken from Sider (2007, 2014). He argues that CII entails the *Collapse Principle* (*CP*) which I mentioned already:

$$\text{CP}\ \forall X \forall x(xFuX \rightarrow \forall y(Xy \leftrightarrow y \prec x)) \tag{12}$$

The following is basically, though not verbatim, the proof in Sider (2014).[27] It uses the so-called *Plural Covering* (PC) principle according to which if $y$ is part of $x$ it is among some $W$ whose fusion is $x$:

$$\text{PC}\ y \prec x \rightarrow \exists W(xFuW \wedge Wy) \tag{13}$$

Assume the antecedent of (12), i.e., suppose $x$ fuses $X$. If $y$ is among $X$, then by definition of fusion $y$ is part of $x$ and the left-to-right direction of the biconditional in (12) is established. On the other hand if $y$ is part of $x$, by PC

[25] To see this, just check the definition of mereological fusion.

[26] Here is another way of phrasing things which relates to the distinction between Proper and Improper Fusions. Mereological atoms are Improper Fusions which are not Proper Fusions. Now, Improper Fusions that are not Proper Fusions are strictly identical to the things they fuse, given Reflexivity of Identity. Thus, if there are only atoms as CN states, every fusion is strictly identical to the things it fuses, which is, once again, CII.

[27] Sider (2007) offers a somewhat different proof. Cotnoir (2013) responds to that proof.

there will be a plurality $W$ such that $x$ fuses $W$. By CII we get $x = W$ and $x = X$. By symmetry and transitivity of identity, we get $X = W$. Since $Wy$ holds by PC, $Xy$ follows and we are done.[28]

CP states that $y$ is one of the $X$ iff it is part of their mereological fusion.[29] Let me be somewhat sloppy when it comes to terminology and say that $x$ and $y$ are (singular) duplicates, which I shall write as $x \triangleq y$, if they have the same properties.

I now want to argue that *Collapse* entails what, as I pointed out already, I shall label as *Duplication Principle* (DP), i.e.,

$$\text{DP}\ xFuX \rightarrow (\forall y(Xy) \rightarrow x \triangleq y) \tag{14}$$

DP says that if $x$ is a fusion of a given plurality each and everything of that plurality must be a (singular) duplicate of $x$ itself. To see now that (14) holds assume for reductio otherwise. Then there is a thing in the plurality, let's say $y$, such that $x$ and $y$ do not have the same properties. Note that by definition of fusion things in the plurality are parts of their mereological fusion. Hence, there are two cases to consider. In the first case (i) $x$ has some property that at least one of its (proper) parts has not, whereas in the second case (ii) at least one of the (proper) parts of $x$ has a property that $x$ has not.

Let us start from the first case and let assume, for the sake of simplicity, that there is only one property $P$ that $x$ has and $y$ has not. Consider now the plurality $W_1$ of things that have the following property: 'being part of $x$ and $P$'. Call it 'the plurality of $P$-parts of $x$'. The crucial thing to note is that $x$ fuses $W_1$, i.e., $xFuW_1$. To see this, just check the definition of fusion in (4). On the one hand, each of the $W_1$ is part of $x$. This immediately follows from the fact that $W_1$ is the plurality of $P$- parts of $x$. On the other hand every part of

[28] Note that this last passage uses the Substitutivity of Identicals licensed by the plural variant of Leibniz's law for identity. Sider (2014) does not discuss this issue but it has been explored in the literature on CII. I will return to this in Section III.

[29] This in turn entails that there are fewer fusions than expected. To see this, consider for example the molecules of water in an ocean. Is the ocean the fusion of those molecules? The answer is in the negative. There is no such fusion, for, if there were, *Collapse* would entail that every part of that fusion is again a molecule of water. But there would be many of its parts that would not be, e.g., hydrogen and oxygen atoms. Actually, if the equivalence argument is on the right track, *Collapse* entails that there are only very few fusions, that is, mereological atoms. Note that this has profound consequences on yet another thesis associated with CII, namely that of relative counting. According to CII identity is a many-to-one relation. Hence CII theorists should adopt a *sortal-relative notion of counting* when they claim e.g., that *five trees* are identical to *one copse*, tree and copse being the relevant sortals here—the example goes back Frege (1980: §46). Let us for the sake of simplicity endorse the view that there is a one-to-one correspondence between sortals and non-empty pluralities—which is probably a controversial claim, but we need not go into details here. Then, Collapse limits the sortals CII theorists can use in their relative counting, since, as we saw, it entails there are fewer pluralities than expected. Thanks to an anonymous referee for this journal for pushing this point.

$x$ overlaps at least one of the $W_1$. By assumption $x$ has $P$ and it is part of itself, so that $x$ is among the $W_1$, that is, $W_1x$ holds. Then every part of $x$ trivially overlaps one of the $W_1$, for it overlaps $x$. So $xFuW_1$. Given *Collapse* every part of $x$ is among the $W_1$, and so $W_1y$ holds, for $y$ is a part of $x$ by assumption. But $W_1$ is the plurality of those things that have the property $P$ and $y$ by assumption does not. This yields $\sim W_1y$ contradicting our previous claim. So there cannot be a property $P$ that $x$ has but $y$ has not. This concludes our first case.

Let's move on to the second case and assume that there is a property $P$ that at least one of the proper parts of $x$, let's say $y$, has but $x$ has not. Consider the plurality $W_2$ of things that have the following property: "being part of $x$ and having a $P$-part", that is, "being part of $x$ and having a part that is $P$". By assumption $W_2x$, for $x$ is part of itself and has at least a $P$-part, namely $y$. Hence $xFuW_2$, for each $W_2$ is part of $x$ and each part of $x$ overlaps at least a $W_2$, namely $x$ itself. *Collapse* now entails that for each $z$ that is part of $x$, $W_2z$ holds. Now consider the plurality $W_3$ of $P$- parts of $x$. Once again, $xFuW_3$. Each $W_3$ is part of $x$ and each part of $x$ overlaps at least a $W_3$ because all of them have a $P$- part being one of the $W_2$. And since every part of $x$ has a $P$-part, it follows that every part of $x$ overlaps a $P$-part. But then, another application of *Collapse* would yield that each part of $x$ is a $P$- part. In particular it entails that $W_3x$, and thus that $x$ has $P$, contra our initial assumption.[30]

Hence there cannot be any property $P$ that $y$ has and $x$ has not, concluding the proof of our second case. Taken together, the two cases entail that $x$ and each of its parts have the same properties, that is, it establishes (14).[31]

It remains to show that given DP only improper atomic pluralities have a fusion, that is, it remains to show that:

$$\text{DP} \rightarrow \text{FAIP} \tag{15}$$

Assume otherwise. We would have DP but not FAIP. If we don't have FAIP there are two cases, either (i) proper pluralities have a fusion or (ii) non-atomic ones have. In both cases we would have at least a composite object, say $x$. The existence of $x$ ensures that the antecedent of DP is satisfied. Hence by the consequent of DP all proper parts of $x$ should be singular duplicate of it. But composite objects cannot have the same properties of their proper parts. Consider $x$ and one of its proper parts $y$. They cannot share the properties

[30] Here's another way to put things. It follows from $xFuW_2$ and CII that $x = W_2$. By the same argument, we would have $x = W_3$. Hence, $W_2 = W_3$. But this can be the case iff each part of $x$ is a $P$ part, against our initial assumption.

[31] Given that both (12) and (13) seem to be implausible claims when taken at face value one could wonder whether we should go *reductio* at this point. As I pointed out already, this paper is not intended either as a defence or as a critique of CII so I shall leave this line of argument aside. I just want to note that (12) and (13) are implausible iff composite objects exist. If mereological nihilism were true—and the paper argues that it is actually logically equivalent to CII—they would actually be true.

expressed by the predicates 'being a proper part of $x$',[32] or 'being a part of $y$'.[33] Hence, the consequent of DP fails and, along with that, DP itself, against our initial assumption. Thus, (15) holds.[34]

If this is correct it just amounts to say that CN holds as well, for as we saw in Section I, given (10), CN and FAIP are equivalent. So, we also have the left-to-right direction of (1). This establishes the equivalence of *Composition is Identity* and *Compositional Nihilism*.

## III. RESISTING THE EQUIVALENCE

Before moving on to investigate the consequences of the equivalence argument I want to address some of the ways in which it could be resisted. As far as I can see there can be two major concerns about the argument in Section II, one about collapse and one about duplication. I will treat them separately.

The argument for the left-to-right direction of (1) crucially depends on the *Collapse* principle (12). It might be questioned whether CII really entails that principle. The proof I presented seems, at first sight, rather straightforward. It uses the Plural Covering Principle, the fact that identity is symmetric and transitive and a particular variant of the substitutivity of identicals, licensed by Leibniz's law. I will simply take for granted that anyone who is attracted to a reductive thesis such as CII should actually want identity to be at least symmetric and transitive. The Plural Covering principle seems innocuous enough. This leaves substitutivity of identicals and Leibniz's law along with it. Hovda (2014) lists four axioms schemes:

(i) $x = y \rightarrow (\varphi(x) \leftrightarrow \varphi(y))$,
(ii) $x = Y \rightarrow (\varphi(x) \leftrightarrow \varphi(Y))$,
(iii) $X = y \rightarrow (\varphi(X) \leftrightarrow \varphi(y))$and
(iv) $X = Y \rightarrow (\varphi(X) \leftrightarrow \varphi(Y))$.

The most problematic ones seem (ii) and (iii) which involve many–one identity relations. However, the proof I presented, which follows Sider (2014), does not make use of (ii) or (iii). Rather, it involves (iv).

Yi (1999) and Sider (2007) use substutivity of identicals to actually argue that CII entails problematic consequences. Hovda (2008) attempts to rescue CII from these arguments developing an interesting general strategy. He suggests

[32] It follows from the definition of *Proper Parthood* and the partial ordering axioms that proper parthood is not reflexive.

[33] Given *Anti-symmetry*.

[34] The proof uses examples of 'mereological properties', but there are (quite) a few examples of non-mereological properties such that a composite object has them, whereas at least one of its proper parts does not, just think of having a particular electric charge or mass.

that friends of CII should not construct expressions like $Xy$ as relational expressions, but rather as relative quantifiers. This move allows him to give a semantics for a large segment of natural language in which only a few versions of substitutivity of identicals are valid. It should be then carefully addressed whether taking $Xy$ as a relative quantification would indeed deliver the version of substitutivity that is necessary to derive *Collapse* from CII. This is a delicate and profound question which cannot be addressed here. It deserves an independent scrutiny which has not been carried out yet, as far as I know. Hovda himself has recently suggested yet another alternative in Hovda (2014). He claims that friends of CII should weaken the schemas for the substitutivity of identicals I reported above. They should read:

(i) $x = y \rightarrow (\varphi(x) \leftrightarrow \varphi(y))$, *provided that formulas* $\varphi$ *do not contain the predicate 'being one of the . . . '*;
(ii) $x = Y \rightarrow (\varphi(x) \leftrightarrow \varphi(Y))$, *provided that formulas* $\varphi$ *do not contain the predicate 'being one of the . . . '*;
(iii) $X = y \rightarrow (\varphi(X) \leftrightarrow \varphi(y))$ *provided that formulas* $\varphi$ *do not contain the predicate 'being one of the . . . '*; and
(iv) $X = Y \rightarrow (\varphi(X) \leftrightarrow \varphi(Y))$, *provided that formulas* $\varphi$ *do not contain the predicate 'being one of the . . . '*.

I actually grant this would block the final step in the proof of *Collapse*.[35] However this move raises some worries. The first one might simply be an *ad-hocness* charge. In contrast to the very general proposal in Hovda (2008) to consider formulas containing the predicate 'being one of the . . . ' as relative quantified formulas, it seems to eliminate *just* that particular predicate from substitutivity axiom schemes. But why is that? As Hovda explicitly recognizes this might raise another worry, namely that it is not really identity we are talking about! He writes: 'it might be argued that the symbol = [. . . ] does not express genuine identity, since some instances of the original SID [i.e., substitutivity of identicals] axioms fail' (Hovda 2014: 209).

The same complaint is voiced by Cotnoir (2013: 307), who quotes approvingly from Sider (2007:57): 'Defenders of Strong Composition is identity must accept Leibniz's law; to deny it would arouse suspicion that their use of "is identical with" does not really express identity'.

Cotnoir then goes on to develop a proposal according to which composition is not numerical identity, i.e., the = relation, but rather *generalized identity*, which

[35] It is unclear (at least to me) whether Bohn (2014) is suggesting a similar strategy when he claims that Sider and Yi's arguments misapply PII in that they do not consider some relational structure which is implicit in the problematic prediction. This lack of clarity stems from the fact the he never explicitly mentions the Collapse principle. The following passage, however, might be taken as evidence in favour of this interpretation of Bohn's arguments: " the phrase "Genie is one of. . . " does not express the same property in "Genie is one of the Genie" as it does in "Genie is one of Tom, Jerry"" (Bohn 2014: 146–147).

he writes as $\approx$,[36] and takes it to be a genuine form of identity in that it allows substitutivity of identicals (Cotnoir 2013: 312–313). He then argues that if CII is phrased as $xFuX \rightarrow x \approx X$ it does not entail *Collapse*. On his account it is not the case that two pluralities $X$, $W$ are *generally identical* iff for every $x$, $Xx$ iff $Wx$. So the last step of the proof in favour of *Collapse* does not go through, as it stands. I simply agree. If composition is not the = relation, but rather Cotnoir's $\approx$ relation, then CII does not entail *Collapse* and a fortiori, is not logically equivalent to CN. But by explicit admission of Cotnoir himself *this is not the same relation* that Sider, Wallace, Bohn and others consider in discussing CII.

Maybe this is the road to take to try to vindicate at least the pre-analytical intuition that composition is identity, that is, trade the familiar notion of identity for some other cognate relation. I cannot do justice to such a claim here. I will rest content to point out that the equivalence argument should be considered seriously by those who actually want to stick to the familiar notion of identity, together with the SD axioms schemas licensed by a somewhat strong enough variant of Leibniz's law for identity, such as Wallace and Bohn for example, and by those who, despite the fact that they do not endorse CII, do believe that it entails *Collapse*, such as Sider (2014) or Varzi (2014b).

Let me phrase things differently. Sider (2014) explores different consequences of *Collapse*. This paper explores yet another of those consequences, arguably, the most radical one. Whether these consequences are reasons enough to abandon this formulation of CII in favour of another deserves independent attention. Let us then move on to the other worry.

In the argument in favour of (14), I associated pluralities to properties, namely the plurality of those things that have that property. Now, this seems somehow similar to what is known as the *Comprehension Principle* (ComP) for plural logic, i.e., the principle according to which provided there is at least a $\varphi$- er there is a plurality of things such that something is among them iff it is a $\varphi$- er:

$$\text{ComP}\ \exists x\varphi(x) \rightarrow \exists X\forall y(Xy \leftrightarrow \varphi(y)) \quad (16)$$

If (16) is endorsed the argument in favour of (14) goes through straightforwardly, for all the pluralities considered in the proof are non-empty by assumption. Sider (2014) notes however that there is some tension between *Collapse* and *Comprehension*, for the latter entails that there is any number of non-empty pluralities whereas the former admits only a few of them. To

[36] The following is the clearest statement of Cotnoir's proposal: "Composition, then, is MANY-ONE cross-count identity given by $\approx$". (Cotnoir 2013: 306).

overcome this tension Sider introduces a schematic form of fusion that reads:

$$xS-Fu_v\varphi =_{df} \forall z(\varphi_v(z) \rightarrow z \prec x \wedge \forall z(z \prec x \rightarrow \exists w(\varphi_v(w) \wedge O(z,w)) \tag{17}$$

that is that $x$ S-fuses the $\varphi$- ers iff each $\varphi$- er is a part of $x$ and each part of $x$ overlaps some $\varphi$- er, where $v$ and $\varphi$ are a variable and a formula of the meta-language respectively that supply a definiens whenever they are replaced by a variable and a formula in the object language. He then goes on to claim that CAI theorists could claim that there exist those pluralities which are (i) non empty, and (ii) closed under schematic fusions. We could actually write this down as:

$$\text{Weak}-\text{ComP}\, \exists x\varphi_v(x) \rightarrow \exists Y\exists z(zS-Fu_v\varphi \wedge \forall x(Yx \rightarrow x \prec z)) \tag{18}$$

Weak-ComP states that, provided there is at least a $\varphi$- er, there is a plurality of things such that it has a schematic fusion and something is among them only if it is part of their S-fusion.

Now, go back to the argument in favour of (14). In the first case I considered one plurality, the plurality of those $\varphi$-ers that have the property 'being part of $x$ and $P$', that is the plurality $W_1$ of $P$-parts of $x$. Now, there is at least a $\varphi$-er since $x$ is a $\varphi$-er itself. Weak-ComP states there is a plurality such that it has a schematic fusion and something is among them only if it is part of their S-Fusion. But note that $x$ S-fuses $W_1$, for each $\varphi$- er is part of $x$ and each part of $x$ overlaps at least a $\varphi$- er, for it at least overlaps $x$, which is a $\varphi$- er. In the second case, I considered two pluralities: the plurality $W_2$ of those parts of $x$ that have a $P$- part and the plurality $W_3$ of the $P$-parts of $x$. Those pluralities are non-empty. There is in fact at least a $\varphi$-er in both cases, namely $x$ and $y$, respectively. Furthermore, $x$ S-fuses both the pluralities in question. In all those cases then the consequent of Weak-ComP ensures these pluralities exist. Setting now $\varphi = Wv$ we get that:[37]

$$xS-Fu_vW \rightarrow xFuW, \tag{19}$$

and so we are back to the original equivalence argument.

This concludes the discussion about different ways to resist the equivalence argument of Section II. It is now time to turn to the consequences of that argument.

[37] That is, setting $\varphi = W_{1/2/3}v$ respectively.

## IV. CONSEQUENCES OF THE EQUIVALENCE

The most immediate consequence of the equivalence argument in Section II is that any argument in favour or against CII is tantamount an argument in favour or against CN and vice versa. I do not want to dwell on these possible arguments here. Rather I would like to address, however briefly, some other implications.

An important consequence is that, if the equivalence argument is on the right track, CII commits to (i) the existence of atoms on the one hand, and to (ii) the impossibility of gunk[38] on the other.

Despite the fact that the present paper is intended neither as a critique nor a defence of CII (or CN) there is at least a consequence of the arguments I presented that seems important in that respect and that I want to address. One of the most forceful arguments against CII is a general argument that appeals to the Indiscernibility of Identicals. Wallace (2011a) provides one of the clearest reconstruction of such an objection. Let me quote her at length:[39]

'Here is the general form of an IIA Indiscernibility of Identicals- argument against CI.[40] TEMPLATE:

(i) If CI then $o_1, o_2, o_3, \ldots, o_n = O$(Definition of CI[41])
(ii) If $o_1, o_2, o_3, \ldots, o_n = O$, for any property $P$, $o_1, o_2, o_3, \ldots, o_n$ have $P$ if $O$ has $P$ (Indiscernibility of Identicals)
(iii) For some property $R$, either ($o_1, o_2, o_3, \ldots, o_n$ have $R$ and $O$ does not) or ($O$ has $R$ and $o_1, o_2, o_3, \ldots, o_n$ do not) (Premise)
(iv) So, $o_1, o_2, o_3, \ldots, o_n \neq O$ (ii, iii, MT)
(v) So, CI is false (iv, i, MT)" (Wallace 2011a: 808).

If the equivalence argument is on the right track we would have that $o_1 = o_2 = o_3 = ... = O$[42] and, clearly, in such a case, premise (iii) is false. This would block the IIA argument against CII.

Finally, the equivalence argument has some important consequence when it comes to possible answers to the *Special Composition Question* SCQ. Contrary to what I have argued so far, there has been a widespread agreement that CII entails CU, that is *Compositional Universalism*, as witnessed in Merricks (2005), Sider (2007), Hovda (2008) and Bohn (2014) to mention a few. Hovda (2008) and Bohn (2014) maintain that one of the reason CII is attractive is because it explains why the parthood relation behaves the way it does, namely according to the laws of classical mereology, which feature CU among its axioms.

[38] The term gunk is due to Lewis (1991). A gunky object is an object whose parts have further proper parts.
[39] Numbering is changed to avoid possible confusions.
[40] CII in the terminology used in this paper.
[41] Where $o_1, \ldots, o_n$ are the (proper) parts of $O$.
[42] $A(O)$, that is, O is a mereological atom, would also follow.

Cameron (2012) puts it nicely: 'The thought is this: *of course* whenever you've got some things, the Xs, you've got their sum, for their sum is *just* the Xs! Whenever you've got some things, you've got those things; so, if a sum *just is* its parts, whenever you've got some things you've got their sum, which is universalism' (Cameron 2012: 532, italics in the original).

Recently, however this agreement has been questioned, for example in McDaniel (2010) and Cameron (2012). The argument in Section II helps us take side with McDaniel and Cameron. Actually I want to argue that, given the equivalence argument, (i) there is a simpler argument in the vicinity of the one McDaniel gives and (ii) Cameron is right in maintaining that CII does not entail CU but wrong in holding that CII does not settle SCQ.

McDaniel (2010) argues that the following jointly consistent theses, i.e., *Modest Pluralism*, *Property Extensionalism* and *Compositional Nihilism*, together entail CII and are jointly inconsistent with CU. Hence, he concludes, CII does not entail CU. *Modest Pluralism* is the view that there are at least two non-overlapping material objects, whereas *Property Extensionalism* is the view that, necessarily, equivalent properties and relations are numerically identical. Bohn (2014) criticizes McDaniel's argument in that it uses a bad definition of CII. I will not go into the details here. For there is an argument in the vicinity of McDaniel's that does use a definition of CII, namely (6), which Bohn should be happy with.[43] This argument is even simpler for it dispenses of *Property Extensionalism* and replaces *Modest Pluralism* with *Very Modest Pluralism*.

*Very Modest Pluralism* is the view that there are at least two material objects,[44] that is, is just the negation of what is sometimes called in the literature *Existence Monism*.[45]

Given (1) CN entails CII. Furthermore, CN and *Very Modest Pluralism* are inconsistent with CU. The argument is pretty straightforward.[46] Suppose there are $n$ atoms. CN entails there are exactly $n$ things, whereas CU entails there are $2^n - 1$things. Now $n = 2^n - 1$ iff $n = 1$. But CN and *Very Modest Pluralism* together entail that there are at least two atoms. So they are inconsistent with CU. Here's an alternative, perhaps more perspicuous way, to phrase things. Consider a world W—compatible with *Very Modest Pluralism*—that contains exactly two mereological atoms. CN entails there are exactly *two* objects in W, namely the two atoms themselves, whereas CU entails there are *three*, the atoms and their mereological fusion. Unless there is only one atom, which is ruled out by *Very Modest Pluralism*, CU and CN are incompatible. Hence the

[43] As I pointed out before, I take his own formulation to entail (6).

[44] In other words, we could simply forget about the *non-overlapping clause*, for CN would entail that for any $x, y$, if they are distinct, they do not overlap. Note also that a very similar argument could be put forward replacing the existence of two distinct objects with the mere *possibility* of their existence.

[45] See Schaffer (2010).

[46] McDaniel (2010) uses a similar argument.

conjunction of *Very Modest Pluralism* and CN is inconsistent with CU. This leads to the conclusion, CII does not entail CU. To see this, assume for reductio it does. Then also the conjunction of CII and *Very Modest Pluralism* does. But we have just seen that this is not the case. So, unless the conjunction of CII and *Very Moderate Pluralism* is inconsistent, which is not, the conclusion follows.

Cameron (2012) attempts to dismantle the arguments that allegedly show that CII entails CU.[47] On the other hand, he also argues that CII is compatible with many forms of restricted composition and SCQ is no easier to answer given CII than otherwise. *Compositional Restrictedness* (CR) can be thought of as the endorsement of the following principle:

$$CR\ \forall X((\exists w(Xw) \wedge \forall y(Xy) \rightarrow \psi(y)) \rightarrow \exists x(xFuX)) \tag{20}$$

CR says that any non-empty plurality such that each member of the plurality meets condition $\psi$, composes a further object. But if the argument in favour of (1) is sound, Cameron is wrong. CII is not compatible with *any* variant of (20) and *does* settle *Special Composition Question*. Just not in the way we thought so far.[48]

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[47] See Bohn (2014) for a critique.

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