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Composition as identity, now with all the pluralities you could want

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Abstract

According to 'composition as identity' (CAI), a composite object is identical to all its parts taken together. Thus, a *plurality* of composite objects is identical to the plurality of those objects' parts. This has the consequence that, e.g., the bricks which compose a brick wall are identical to the atoms which compose those bricks, and hence that the plurality of bricks must include each of those atoms. This consequence of CAI is in direct conflict with the standard analysis of plural definite descriptions (and hence with the standard plural comprehension schema which uses it). According to that analysis, the denotation of 'the bricks' can include only bricks. It seems, then, that if CAI is true, 'the bricks' doesn't denote anything; more generally, if CAI is true, there are fewer pluralities than we ordinarily think. I respond to this argument by developing an alternative analysis of plural descriptions (and an alternative comprehension schema) which allows the denotation of 'the bricks' to include non-bricks. Thus, we can accept CAI, while still believing in all the pluralities we could want. As a bonus, my approach to plural descriptions and plural comprehension blocks recent arguments to the effect that CAI entails compositional nihilism.

Keywords Mereology \cdot Composition as identity \cdot Plural comprehension \cdot Collapse \cdot Mereological nihilism

1 Introduction

I defend the view that composition is identity (CAI): a whole is identical to its parts (in the sense of being identical to *all* of them taken together, not to *each* of them individually). Sider (2007, 2014) and others have raised a serious problem for CAI: while the view can only be formulated using the resources of plural first-order

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languages, natural ways of understanding and applying those resources seem to rule it out. In particular, plural definite descriptions—e.g. 'the bricks which form the wall'—don't function as you'd expect (and as a standard plural comprehension schema requires), if **CAI** is true. Thus, it seems that if **CAI** is true then many of the pluralities we believe in (and which are required by the comprehension schema) don't exist (Sect. 3).

In this paper, I develop an alternative approach to both plural descriptions and plural comprehension, which is compatible with **CAI** but motivated on independent linguistic grounds (Sects. 4–7). My approach has advantages over alternatives (Sect. 8), and also blocks recent arguments that **CAI** entails compositional nihilism (Sect. 9).

2 Set-Up

I begin with a sketch of the plural language I'll be using, and a formal statement of CAI.¹

In addition to singular terms ('a', 'b', etc.) which can only denote individuals, my language contains 'inclusively' plural terms ('aa', 'bb', etc.) which can denote either individuals or pluralities thereof. (Following Calosi (2016: p. 223), say that aa denotes a 'proper plurality' if it denotes many individuals, and an 'improper plurality' if it denotes only one.)

My language also contains a term-forming operator, '@'. '@' takes two old terms to a new term which denotes together what the old ones denote individually (e.g. 'a@b' denotes a and b).²

With plural terms come (inclusive) plural variables ('xx', 'yy', etc.), which can take either singular or plural terms as substitutions. (' $\exists xxFxx'$ is read as 'Some thing(s) is/are F' and is implied both by 'Fa' and by 'Faa'.)

A plural predication, '*Faa*', has two readings. On the 'distributive' reading, *Faa*' implies '*Fa*' for each *a* among *aa* (e.g. 'Alice and Beth are people' implies both 'Alice is a person' and 'Beth is a person'). On the 'collective' reading, there's no such implication (e.g. 'Alice and Beth lifted a piano' implies neither 'Alice lifted a piano' nor 'Beth lifted a piano').

Finally, I add a two-place predicate, ' \leq ', which denotes what I'll call 'the inclusion relation': ' $aa \leq bb$ ' says that aa is/are included in bb. ' \leq ' is read distributively at its first argument-place and collectively at its second: ' $aa \leq bb$ ' implies ' $a \leq bb$ ', for any a among aa; but it doesn't imply ' $aa \leq b$ ' for any b among bb. Inclusion is assumed to be both reflexive and transitive, and is used to regiment the phrases 'is

¹ See McKay (2006), Oliver and Smiley (2016), and Yi (2005, 2006) for more detailed discussion of plural languages.

² On one view, if 'a@b' denotes *a* and *b*, then it denotes each of them individually. On a competing view, there's no such implication, and indeed, if 'a@b' denotes *a* and *b* then it *doesn't* denote either of them individually. I remain neutral on this dispute; see Oliver and Smiley (2016: ch. 6) for discussion.

one of' and 'are among'. (E.g. that Alice is one of Alice and Beth is regimented as $(a \le a@b'.)^3$

I use inclusion to define an identity predicate, '=':

Definition of '='

 $aa = bb \equiv_{df} (aa \leq bb \& bb \leq aa)$

Identity is mutual inclusion. Since ' \leq ' is read collectively at its second argumentplace, we can use this predicate to capture the idea that wholes are identical to their parts collectively, though not individually: 'a@b=c' doesn't imply 'a=c & b=c'.

The resources of a plural language allow us to give a standard definition of 'mereological fusion':

Definition of 'Fu'

 $Fu(a, bb) \equiv_{df} \forall x(x \leq bb \supset x \leq a) \& \forall y(y \leq a \supset \exists z(z \leq bb \& y \circ z))$

a is a fusion of *bb* (or, *a* fuses *bb*) just in case: (i) everything included in *bb* is a part of *a*; and (ii) every part of *a* overlaps something included in *bb*.⁴ Now, a mereological atom (i.e. an object whose only part is itself, and so lacks *proper* parts) is its own fusion, by this definition. So, I say that a composite object is a fusion with two or more proper parts, and I formulate **CAI** as the general claim that a fusion is (collectively) identical to the thing(s) it fuses.

Composition is Identity (CAI)⁵ $\forall x \forall yy(Fu(x, yy) \supset x = yy)$

3 Tensions

While we needed plural resources to formulate **CAI**, Sider (2007, 2014) and others have shown that **CAI** conflicts with natural approaches to the meaning and logic of plural expressions. In particular, it conflicts with natural approaches to (i) the analysis of 'distributive' plural definite descriptions, and (ii) the formulation of a plural comprehension schema.

Informally, 'F' is read distributively just in case 'Faa' implies 'Fa' for each of aa, and collectively otherwise. Using the inclusion predicate ' \leq ', we can give a formal treatment of this distinction:

³ Some distinguish more sharply between 'is one of', which only takes singular terms at its first argument-place, and 'are among', which only takes plural terms at its first argument-place (McKay, 2006: ch. 6; Yi, 2005: pp. 485–486). See Oliver and Smiley (2016: pp. 108–109) for discussion.

a overlaps b just in case they have a part in common.

⁵ **CAI** is often understood to imply the converse conditional: if x = yy, x fuses yy—see, e.g., Bohn (2014) and Wallace (2011). That conditional won't matter for our purposes.

Distributivity and Collectivity

(i) 'F' is read distributively iff ' $Faa \supset \forall xx(xx \leq aa \supset Fxx)$ ' is true

(ii) *'F'* is read collectively iff it isn't read distributively

With this treatment of collective and distributive predication in place, we can also give a formal analysis of plural definite descriptions, i.e. phrases of the form 'the Fs'.

For our purposes, I'll focus on cases where '*F*' is understood to distribute over the objects described: 'the *Fs*' denotes, not the things which are *collectively F*, but the things which are, so to speak, individually *F*.⁶ Intuitively, in such cases, 'the *Fs*' denotes those *xx* such that every *F* is one of them and every one of them is an *F*—e.g. 'the books on my shelf' denotes the things which are books on my shelf, and nothing else. Letting ' $\gamma xx(Fxx)$ ' be a predicate corresponding to predicative uses of 'the *Fs*' and 'xx(Fxx)' a term corresponding to referential uses:

Plural Definite Descriptions

(i) $\gamma xx(Fxx)aa'$ is true iff $\forall yy(yy \leq aa \equiv Fyy)'$ is true

(ii) If there is/are some *aa* such that $\gamma xx(Fxx)aa$, then 'ux(Fxx)' denotes *aa*. Otherwise, 'ux(Fxx)' denotes nothing

aa satisfy the predicate 'the books on my shelf' just in case *aa* include(s) all and only the books on my shelf. And the term 'the books on my shelf' denotes *aa* just in case they satisfy that predicate.

We can use this analysis of plural descriptions to formulate a comprehension schema for our plural language:

Comprehension

 $\exists x \varphi x \supset \exists x x \forall y (y \leq x x \equiv \varphi y)$

(' φ ' is any formula in which 'x', but not 'xx', occurs free.) The idea behind **Comprehension** is that, if there's at least one individual φ -er, then there's such a plurality as *the individual* φ -ers, or *the individuals which are* φ .⁷ This is highly intuitive: if at least one individual satisfies ' φ ', we ought to be able (in principle) to 'circumscribe' all such individuals, i.e. to single out the φ -ers as a plurality.

Comprehension is also valuable for certain theoretical purposes, e.g. in giving a first-order semantics for higher-order languages. If 'F' is satisfied by at least one individual, then by **Comprehension** there exists a plurality of individuals which satisfy it. We can treat this plurality, rather than the set or class of F-individuals, as the semantic value of 'F'. We needn't treat quantification into predicate position as quantification over sets or classes.

 $^{^{6}}$ I say 'so to speak' because, as we'll see, we can introduce the description 'the *F*s' in cases where '*F*' applies collectively to pluralities of individuals, but not to any individual.

⁷ Notice, it's equivalent to: $\exists xx(\exists x(x=xx) \& \varphi xx) \supset \exists yy \forall zz(zz \leq yy \equiv (\exists z(z=zz) \& \varphi zz)).$

Unfortunately, **Comprehension** and the analysis of plural descriptions on which it's based are in tension with **CAI**.

Taking descriptions first, **CAI** implies that every fusion fuses at most one plurality⁸:

Uniqueness

 $\forall x \forall xx (Fu(x, xx) \supset \forall yy (Fu(x, yy) \supset xx = yy))$

But **Uniqueness** makes trouble for plural descriptions. An object can be composed of different things at different 'levels of composition'. E.g., a brick wall is composed of some bricks, which are in turn composed of some atoms. Thus, the wall fuses both the atoms and the bricks. If **Uniqueness** is true, then the atoms *are* the bricks. By the definition of '=', each plurality is included in the other, and so everything included in the atoms is included in the bricks, and vice-versa. More formally:

- (1) $\forall x(x \leq \iota xx(Axx) \supset x \leq \iota xx(Bxx))$
- (2) $\forall x(x \leq \iota xx(Bxx) \supset x \leq \iota xx(Axx))$

The tension with our analysis of plural descriptions is clear. On that analysis, 'the bricks' denotes a plurality that includes all and only bricks. Since no atom is a brick, no atom is included in the bricks, *contra* (1). Likewise, 'the atoms' denotes a plurality that includes all and only atoms. Since no brick is an atom, no brick is included in the atoms, *contra* (2). Therefore, the atoms *can't* be the bricks, *contra* **CAI**.

Generalizing: an object can be composed of Fs and of non-Fs at different levels of composition. If **CAI** is true, then those Fs are identical to those non-Fs, and so each F is included in the non-Fs, and each non-F is included in the Fs. But that's impossible, given our analysis of plural descriptions.

For similar reasons, **CAI** is in tension with **Comprehension**. **Comprehension** has the following instance:

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(3) \exists x B x \supset \exists x x \forall y (y \leq x x \equiv B y)
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If there's at least one brick, then there are such things as *the bricks*, i.e. some xx which include all and only bricks. But if **CAI** is true, then (3) is false. By **CAI**, each brick is identical to the atoms which make it up. But then, any plurality which includes a brick must also include each of those atoms. No plurality can satisfy the condition laid down in (3).

Generalizing: an F can be composed of non-Fs. If **CAI** is true, that F is identical to those non-Fs, so any plurality which includes that F must also include those

⁸ If x fuses xx and x fuses yy, then by CAI, x = xx and x = yy; by the transitivity of identity, xx = yy.

non-Fs. Thus, contra **Comprehension**, there can be no such things as the Fs, no plurality which includes all and only Fs.⁹

Thus, the defender of **CAI** must apparently deny that ordinary plural descriptions like 'the bricks' refer (since no plurality could satisfy their reference conditions) and reject the highly intuitive (and theoretically useful) idea behind **Comprehension**.

These two problems are related. Our formulation of **Comprehension** was based on our analysis of plural descriptions, which in turn was based on our formal treatment of the collective/distributive distinction. All of these were seemingly natural. However, in Sect. 4–6 I'll argue that we should revise them all. I'll propose an alternative approach to distributive predication (Sect. 4) and use it to develop an alternative analysis of plural descriptions (Sect. 5) and an alternative comprehension schema (Sect. 6), each of which is acceptable to a defender of **CAI**, but also motivated on independent grounds.

4 Distributive predication revisited

It seems that the truth of a plural predication can depend on how we 'carve up' the relevant plurality. Consider (4):

(4) Rogers, Hart, and Hammerstein wrote musicals W(r@h₁@h₂)

Rogers, Hammerstein, and Hart never wrote a musical collectively, and none of them ever wrote one individually. Thus, whether we treat 'wrote musicals' as collective or distributive, in the sense we gave these phrases in Sect. 3, (4) comes out false. But it seems *true*, since Rogers wrote musicals together with each of Hart and Hammerstein.¹⁰

We can account for the truth of (4) by introducing *covers* to the semantics of plural expressions (Gillon, 1992; Schwartzchild 1996). Covers, like worlds and times, are indices with respect to which sentences are evaluated. I take a cover to be a function, δ_i , that maps every collection in the domain, *aa*, to some (possibly overlapping) collections in the domain, *bb*₁,...,*bb*_n, such that *bb*₁...,*bb*_n are collectively identical to *aa*. Thus, if *bb*₁,...,*bb*_n are all the values of $\delta_i(aa)$, then $aa = bb_1@...@bb_n$.

⁹ Variants of these arguments appear in Sider (2007: pp. 57–59, pp. 63–66; 2014: pp. 215–216) and are discussed in Calosi (2018: pp. 282–287), Carrara and Lando (2017: pp. 510–511), Cotnoir (2013: pp. 313–317), and Loss (2019: p. 4). Sider's presentation uses a principle, **Collapse**, which I haven't discussed (although see Sect. 9), and a principle of unrestricted fusion. My presentation avoids these complications.

¹⁰ *Objection*: (4) is *true* on the distributive reading; 'a wrote musicals' doesn't imply that a wrote them on their own.

Reply: Other sentences more clearly illustrate the phenomenon in which I'm interested – e.g. 'Three architects designed four buildings', which can be true even if (i) there are no four buildings such that the three architects worked collectively on each of them and (ii) none of the three architects worked on four buildings, either individually or in a team. But these involve additional complexities – e.g. the interplay between the determiner phrases 'three architects' and 'four buildings' – so I'll assume, if only for simplicity, that (4) is false on the distributive reading.

A cover is a *multivalued* function: δ_i maps *aa* to each of $bb_1,...,bb_n$ *individually*, not to all of them *collectively*. Thus, if δ_i maps *aa* to bb_1 and bb_2 , it doesn't follow that $bb_1@bb_2$ are a value of $\delta_i(aa)$; all that follows is that bb_1 is/are a value of $\delta_i(aa)$ and that bb_2 is/are, too.¹¹ I refer to the values of $\delta_i(aa)$ using commas (' $bb_1,...,bb_n$ ') rather than the term-forming operator '@' (' $bb_1@...@bb_n$ ') to indicate this.

Since covers are indices, a sentence could be true with respect to some covers and not others. E.g., let δ_1 map the plurality of Rogers, Hart, and Hammerstein to each of the men individually, and δ_2 map that plurality to (i) the plurality of Rogers and Hart and (ii) the plurality of Rogers and Hammerstein—i.e. $\delta_1(r@h_1@h_2) = r,h_1,h_2$ while $\delta_2(r@h_1@h_2) = r@h_1, r@h_2$. Then, we might say, (4) is *true* when evaluated with respect to δ_2 but *false* when evaluated with respect to δ_1 .

So far, this is merely suggestive. *Why* does (4) get different truth-values when evaluated with respect to these different covers? My suggestion is that we revise our approach to collective and distributive predication.

In Sect. 3, we understood distributive predication in terms of inclusion: 'F' is read distributively just in case '*Faa*' implies '*Fa*', for every *a* included in *aa*. This was meant to capture the intuitive, informal idea that 'F' is read distributively just in case '*Faa*' implies '*Faa*' for each of *aa*.

My alternative suggestion is that '*F*' is read distributively '*Faa*' is true, with respect to a cover δ_i , just in case '*F*' is true of each value of $\delta_i(aa)$.

Distributivity and Collectivity (Revised)

- 'F' is read distributively iff for any δ_i, 'Faa' is true w.r.t. δ_i only if, for any bb which is a value of δ_i(aa), 'Fbb' is true w.r.t. δ_i
- (ii) 'Faa' is read collectively iff it isn't read distributively

When 'F' is read distributively, we don't (necessarily) evaluate 'Faa' by considering whether 'F' is true of everything *included* in *aa*. Rather, we consider which pluralities $bb_1, ..., bb_n$ our current choice of cover maps *aa* to, and whether 'F' is true of each of those pluralities.

On this approach, (4) comes out false when evaluated with respect to δ_1 , since δ_1 maps the plurality $r@h_1@h_2$ to each of Rogers, Hart, and Hammerstein individually, and 'wrote musicals' isn't true of any of them. But (4) comes out true when evaluated with respect to δ_2 , since δ_2 maps the plurality $r@h_1@h_2$ to the pluralities $r@h_1$ and $r@h_2$, and 'wrote musicals' *is* true of each of these pluralities.¹²

¹¹ See Oliver and Smiley (2016: pp. 4–7) for discussion of multivalued functions.

¹² *Question:* Instead of multi-valued functions, could we use sets? E.g. could we say that a cover δ_i maps *aa* to a set, $\{bb_1, ..., bb_n\}$, and that '*Faa*' is true w.r.t. δ_i just in case '*Fbb*_i' is true for each member of that set?

Answer: As set theory is typically understood, each member of a set is an *individual*. This raises a problem for (4). 'Wrote musicals' needs to distribute over Rogers and Hart, on one hand, and Rogers and Hammerstein, on the other. But while Rogers and Hammerstein can be members of a set *individually*, they can't be members of a set *collectively* (and likewise for Rogers and Hart).

We could introduce *pairs*, understood as individuals distinct from the individuals that make them up.

On an alternative view, (4) involves a third kind of predication, distinct from both collective and distributive (Cotnoir, 2013; Landman, 1989). My view has the advantage of simplicity, since it treats the more traditional distributive reading of '*Faa*' from Sect. 3 as an instance of a more general phenomenon. (To recover that reading, let δ_i map *aa* to all and only the things included in *aa*.) So, we have reason to adopt this approach to distributive predication, independently of **CAI**.

5 Plural descriptions revisited

5.1 An alternative analysis

We can use this approach to distributivity to capture the intuitive application conditions of the plural description 'the Fs', in cases where 'F' distributes over the objects described:

Plural Definite Descriptions (Revised)

- (i) $\gamma xx(Fxx)aa'$ is true w.r.t. δ_i iff there's some δ_j such that, for each *bb* which is a value of $\delta_j(aa)$, *'Fbb'* is true w.r.t. some δ_k
- (ii) If there is/are some aa such that 'γxx(Fxx)aa' is true w.r.t. δ_i, then 'uxx(Fxx)' denotes aa. Otherwise, 'uxx(Fxx)' denotes nothing

Clause (i) is a bit clunky, but the idea is straightforward. ' $\gamma xx(Fxx)aa'$ is true with respect to δ_i just in case there's some way of carving *aa* into pluralities, bb_1, \dots, bb_n , such that, on some (possibly distinct) way of carving things up, '*Fbb*' is true of all and only those pluralities. That is, let bb_1, \dots, bb_n be all the things of which '*F*' is true on *any* cover. Then, ' $\gamma xx(Fxx)aa'$ is true with respect to δ_i just in case some (possibly distinct) cover maps *aa* to each of those things (and hence, *aa* is/are collectively identical to $bb_1@\dots@bb_n$).

' $\gamma xx(Fxx)aa$ ' is true with respect to δ_i only if some cover maps *aa* to all and only the *F*s. Whether there's such a cover is insensitive to our choice of δ_i . Thus (keeping all other indices constant), if ' $\gamma xx(Fxx)aa$ ' is true with respect to any cover, it's true with respect to all of them. This ensures that the denotation of 'xx(Fxx)', as understood in clause (ii), is *also* insensitive to our choice of cover, preventing awkward substitution failures.

This approach captures the intuitive application conditions of plural definite descriptions. What we want is for 'the *F*s' to denote the things that are *F*, and nothing else. Since ' $\gamma xx(Fxx)aa$ ' is true just in case $aa=bb_1@\dots@bb_n$, where

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Footnote 12 (continued)

Then, δ_i could map *aa* to $\{\langle r, h_1 \rangle, \langle r, h_2 \rangle\}$, and 'wrote musicals' could distribute over the members of this set. But if we already adopt the resources of plural languages, we should be skeptical of this move. Defenders of plural languages are traditionally opposed to views on which a collective predicate—like 'wrote *Principia Mathematica*' in 'Russell and Whitehead wrote *Principia Mathematica*'—is true, not of some *things*—i.e., Russell and Whitehead—but of some *thing*, typically a *set* with those things as members (Boolos, 1984; McKay, 2006; pp. 22–32; Oliver and Smiley, 2016; ch. 3; Yi, 2005; pp. 463–476). But if we deny that 'wrote *Principia Mathematica*' is true of a *set*, I don't see why we'd accept that 'wrote musicals' is true of a *pair* (so understood).

 $bb_1,...,bb_n$, are the things which are *F*, we get the result that 'ux(Fxx)' denotes those things and nothing else.

We also get the desirable result that all *F*s are *included* in the *F*s. Let $bb_1,...,bb_n$ be the things which are *F*. ' $\gamma xx(Fxx)aa$ ' is true just in case $aa = bb_1@...@bb_n$. Since identity is defined as mutual inclusion, it follows that $bb_1@...@bb_n \leq aa$. Since ' \leq ' is distributive at its first argument place, it follows that each of $bb_1,...,bb_n$ is/are included in *aa*.

Crucially, however, we *don't* get the result that *only* Fs are included in the Fs. Again, letting $bb_1,...,bb_n$ be the things which are F, if *aa* are the Fs then each of $bb_1,...,bb_n$ is/are included in *aa*. But *aa* may include things which aren't Fs, since some bb_i included in *aa* may themselves include non-Fs.¹³

To see that this is a feature rather than a bug, suppose you're watching a tennis match between two two-person teams. One of these teams has Alice and Beth as its members, the other has Claire and Diane as its members. Now consider the plural description, 'the teams'. What does it denote? It seems to me that it denotes the four people: Alice, Beth, Claire, and Diane. (Each two-person team, it seems to me, just *is* the people that make it up.) But this is inconsistent with the analysis of plural descriptions from Sect. 3. On that analysis, if 'the *F*s' denotes *xx*, then only *F*s are included in *xx*; so, 'the teams' can't denote the four people, since none of them is a team. By contrast, it's perfectly consistent with my analysis. On my analysis, all that's required for 'the teams' to denote the four people is that there be a cover which maps them to those pluralities $bb_1...bb_n$ such that 'is/are a team' is true of all and only those pluralities. And there is such a cover, namely that which maps them to the pairs Alice@Beth and to Claire@Diane.¹⁴

This argument generalizes. We can introduce a plural description, 'the *Fs*', in cases where '*F*' distributes over things in the plurality (i.e. 'the *Fs*' doesn't mean 'the things which are collectively *F*'), and yet '*F*' applies only to (proper) pluralities. That is, when we group together the *Fs*, we may be grouping *pluralities* together into a larger plurality. But then, since each *F*-plurality may include non-*Fs* (e.g. a team includes people who aren't teams), this larger plurality of *F*-pluralities may *also* include non-*Fs*. According to the original analysis, 'the *Fs*' can't denote such a plurality. But since it apparently *can* (e.g. 'the teams' can denote the members of the teams), the original analysis should be rejected in favour of one, like mine, which secures this result.¹⁵

¹³ There's still a sense in which nothing 'other than' *Fs* are included in the *Fs*. If $bb_1,...,bb_n$ are all the *Fs*, then nothing outside $bb_1@...@bb_n$ gets included in the *Fs*. Thus, we can circumscribe the things which are *F* and use 'the *Fs*' to refer to that plurality and nothing outside it.

¹⁴ *Objection*: Alice and Beth don't themselves exemplify the property *being a team*. Rather, they constitute an individual which *does* exemplify that property.

Reply: This view has been argued against elsewhere – see, e.g., Horden and López de Sa (2020) and Payton (2019: pp. 14–18). Here, I assume it's false.

¹⁵ On an alternative approach, talk about 'pluralities of pluralities' is captured using 'higher-level' plural terms and variables, which stand to ordinary plural ones as the latter stand to singular ones (Linnebo and Nicolas, 2008; Rayo, 2006). However, such 'higher-level' plural resources are highly controversial (Ben-Yami, 2013; McKay, 2006: pp. 137–139; Uzquiano, 2004: pp. 438–440), and my approach doesn't require them.

5.2 The tension resolved

This analysis of plural descriptions resolves the tension with CAI.

According to **CAI**, if a wall fuses both the bricks from which it's composed and the atoms from which the bricks are composed, then the bricks *are* the atoms. But given the analysis of plural descriptions from Sect. 3, that identity claim is false: *the bricks* include all and only bricks, while *the atoms* include all and only atoms; no plurality can satisfy both conditions.

By contrast, on my analysis, while 'the bricks' denotes a plurality which includes *all* the bricks, that plurality needn't include *only* bricks, so nothing prevents an atom from being included in the bricks. Likewise, the plurality denoted by 'the atoms' includes *all* the atoms, but needn't include *only* atoms, so nothing prevents a brick from being included in the atoms.

Putting the point in positive terms, what's required for the bricks to be identical to the atoms (and hence for 'the bricks' and 'the atoms' to be co-denoting) is that there are some *aa* such that (i) some cover δ_i maps *aa* to all and only the bricks, bb_1, \dots, bb_n (so $aa = bb_1 @ \dots @ bb_n$), while (ii) some cover δ_j maps *aa* to all and only the atoms, cc_1, \dots, cc_n (so $aa = cc_1 @ \dots @ cc_n$, and by the transitivity of identity, $bb_1 @ \dots @ bb_n = cc_1 @ \dots @ cc_n$). Nothing prevents both conditions from being satisfied, so there's no reason to think that the atoms and the bricks must be distinct.

6 Comprehension revisited

6.1 An alternative schema

Finally, with my alternative analysis of plural descriptions in place, we can adopt an alternative comprehension schema.

The intuitive idea behind **Comprehension**, recall, is that if there's at least one φ -er, then there must be such things as *the* φ -ers: as long as there's at least one φ -er, we should be able to single them all out as a plurality. **Comprehension** cashes this out using the original analysis of 'the φ -ers', on which it denotes a plurality which includes all and only the φ -ers. Since we have reason to prefer an alternative analysis of plural descriptions, we already have reason to prefer a comprehension schema which uses it.

There's a further reason to be dissatisfied with **Comprehension**, and to prefer a schema which uses my analysis of plural descriptions. The antecedent of **Comprehension** is ' $\exists x \varphi x$ ': it holds only when ' φ ' is true of some individual. But we should want a schema which holds when ' φ ' is collectively satisfied by a (proper) plurality. First, an analogue of the intuitive thought behind **Comprehension** still holds, in such cases—e.g. if there's at least one team, then we ought to be able (in principle) to single out the teams as a plurality; there ought to be such a plurality as *the teams*, or *the pluralities which are teams*. Second, **Comprehension** is supposed to help us give a semantics for higher-order languages on which the denotation of a predicate is just the things which satisfy it. And such a semantics is only complete if it applies to predicates collectively satisfied by (proper) pluralities.

A straightforward pluralization of **Comprehension**, which retains the original analysis of plural descriptions, won't work for these purposes.

Comprehension 2

 $\exists x x \varphi x x \supset \exists y y \forall z z (z z \leq y y \equiv \varphi z z)$

For, this schema has a false instance:

(5) $\exists xxTxx \supset \exists yy \forall zz(zz \leq yy \equiv Tzz)$

Alice and Beth are a team, so it's true that some xx are a team. But it's false that there's a plurality which includes all and only teams: since Alice and Beth are a team, any plurality which includes all the teams must include Alice and Beth collectively, and hence individually; but then, this plurality doesn't include *only* teams, since neither Alice nor Beth is a team.¹⁶

If we adopt my analysis of plural descriptions, we can do better:

Comprehension 3

If $\exists xx \phi xx'$ is true w.r.t. δ_i , then $\exists yy(\gamma zz(\phi zz)yy)'$ is true w.r.t. δ_i

Given my analysis, **Comprehension 3** expresses the intuitive thought that, if there's at least one φ -er, then there are *the* φ -*ers*: if some thing(s) is/are (collectively) φ , then there are some things, *aa*, and some cover, δ_j , such that δ_j maps *aa* to some bb_1, \dots, bb_n , where bb_1, \dots, bb_n are all and only the φ -ers.

Now, instead of (5) we get:

(5*) $\exists xxTx \supset \exists yy(\gamma zz(Tzz)yy)$

Alice and Beth are a team, so it's true that some *xx* are a team. By (5*), some *yy* satisfy the predicate 'are the teams'—or, ' $\gamma zz(Tzz)$ '. That is, for some *aa* and δ_i , the values of $\delta_i(aa)$ are all and only the teams $bb_1,...,bb_n$, and so $aa = bb_1@...@bb_n$. Since Alice and Beth are a team, they're a value of $\delta_i(aa)$, and they're included in $bb_1@...@bb_n$. But given my analysis of plural descriptions, that's consistent with $bb_1@...@bb_n$ (and hence *aa*) being the denotation of 'the teams'. So, we can say that there are such things as *the teams* (namely, $bb_1@...@bb_n$), and let this plurality serve as the semantic value of 'T'. Thus, we have good reason to adopt **Comprehension 3** independent of **CAI**.¹⁷

6.2 The tension resolved

Comprehension 3 resolves the tension with CAI.

¹⁶ Remember, plural variables are inclusive, so each of Alice and Beth can be a value for 'zz'.

¹⁷ Note: since plural variables are inclusive, **Comprehension 3** still holds when ' ϕ ' is true only of individuals.

According to **Comprehension**, if there's at least one brick, there's a plurality which includes all and only bricks. This is meant (given the analysis of plural descriptions from Sect. 3) to capture the thought that, if there's at least one brick, there are *the bricks*. But according to **CAI**, there can be no such plurality: any plurality which includes a brick will also include the atoms from which it's composed. So, **CAI** conflicts with **Comprehension**: the existence of a brick doesn't imply the existence of *the bricks*.

By contrast, **Comprehension 3** is consistent with **CAI**. It's still true that any plurality which includes a brick will also include the atoms from which it's composed. But since it's no longer required that *the bricks* include only bricks, this poses no problem for the intuitive thought that, given the existence of at least one brick, there must be such things as *the bricks*. For, there can still be some *aa* and some cover δ_i such that δ_i maps *aa* to all and only bricks. These *aa* can serve as the denotation of 'the bricks' with respect to *any* cover, and so we can preserve the intuitive thought that, given the existence of a bricks.

7 Summing up

In Sect. 3, we used standard resources of plural languages, including especially a formal treatment of the distributive/collective distinction, to develop (i) a formal analysis of distributive plural descriptions and (ii) a comprehension schema making use of that analysis. That analysis, and that schema, were in tension with **CAI**.

I've developed an alternative treatment of distributivity and collectivity, an alternative analysis of plural descriptions, and an alternative comprehension schema. I've argued that we have independent reason to adopt each component, and shown that the resulting package is consistent with **CAI**. Thus, a defender of **CAI** needn't deny that ordinary plural descriptions like 'the bricks' refer (since she needn't think that 'the bricks' denotes a plurality which includes only bricks), nor reject the intuitive idea behind plural comprehension (since she can allow that 'the bricks' refers, and hence that there are *the bricks*). We can identify wholes with their parts, and still have all the pluralities we could want.¹⁸

8 Alternatives

Extant responses to the problems from Sect. 3 typically involve rejecting **CAI**, as I've understood it, or accepting that there are fewer pluralities than we ordinarily think there are. Here, I'll briefly compare my solution to three such alternatives.

¹⁸ *Objection:* Your approach *doesn't* get us all the pluralities we could want. E.g., there's no plurality which includes *all* and *only* the bricks.

Reply: All we should want, or expect, is for there to be such a plurality as *the bricks*. What's pre-theoretically clear is that we can (in principle) single out the bricks. What's *not* pre-theoretically clear is that doing so requires that we single out a plurality which includes all and only bricks (and I've argued in Sect. 5.1 that this assumption about how plural descriptions work is false, for reasons independent of **CAI**).

8.1 Sider

Sider (2014) recommends that the defender of **CAI** bite the bullet and accept that ordinary descriptions like 'the bricks' don't refer, and that the intuitive thought behind **Comprehension** is false. He nonetheless recommends a new comprehension schema which he thinks will suit the defender's purposes.

First, Sider introduces a schematic notion of 'fusion', or 'S-fusion' (2014: p. 214):

Definition of 'S-Fu'

 $S - Fu(a, \phi) \equiv_{df} \forall x (\phi x \supset x \le a \& \forall y (y \le a \supset \exists z (\phi z \& y \circ z)))$

a S-fuses the individual φ -ers (which is *not* to say that *a* fuses the φ -ers; see below) just in case each φ -er is part of *a*, and each part of *a* overlaps a φ -er.¹⁹ Sider then formulates his comprehension schema:

Comprehension (Sider)

 $\exists x \phi x \supset \exists x x \exists y (S - Fu(y, \phi) \& \forall z(z \leq xx \equiv z \leq y))$

If there's at least one φ -er, then there exists (i) an *S*-fusion of the individual φ -ers, and (ii) a corresponding plurality, *xx*, which include all and only parts of that S-fusion. Notice, this doesn't imply that there are some *xx* which include all and only φ -ers. Given that there's at least one brick, there's an S-fusion of the individual bricks (i.e. an object which has all the bricks as parts, and all of whose parts overlap at least one brick), and a plurality which includes all and only the parts of that S-fusion. But this plurality can include things other than bricks; e.g. it will include all the atoms that are parts of the bricks (and hence parts of the S-fusion of the individual bricks).

Sider's comprehension schema gets a similar result to my **Comprehension** 3: given the existence of a φ -er, we're no longer committed to a plurality which includes all *and only* the individual φ -ers. But **Comprehension 3** is motivated by my analysis of plural descriptions from Sect. 5. Given that analysis, **Comprehension 3** says that, given the existence of a φ -er, there are *the* φ -ers. By contrast, Sider (2014: pp. 215–216) retains the original analysis of plural descriptions from Sect. 3, so the *xx* quantified over in his comprehension schema aren't (necessarily) *the* φ -ers, by his lights.

Of course, we could develop an analysis of plural descriptions to go with Sider's comprehension schema. We could claim that 'the *F*s' denotes the plurality corresponding to the S-Fusion of the individual *F*s:

Plural Definite Descriptions (Sideresque)

(i) $\gamma xx(Fxx)aa'$ is true iff $\forall yy(yy \leq aa \equiv yy \leq x(S-Fu(x, F))'$ is true²⁰

¹⁹ Sider (2014: pp. 214–215). To derive an equivalent of the original definition of '*Fu*(*a*, *bb*)', substitute ' $\lambda x.(x \le bb)$ ' for ' φ '.

²⁰ In keeping with **CAI**, I allow that many *yy* can collectively be a part of *x*.

(ii) If there is/are some *aa* such that $\gamma xx(Fxx)aa$, then ' $\iota xx(Fxx)$ ' denotes *aa*. Otherwise, ' $\iota xx(Fxx)$ ' denotes nothing

But this analysis causes trouble if distributive predication is understood as in Sect. 3.

Consider (6):

(6) The writers of *Principia Mathematica* are men

According to the Sideresque analysis, 'the writers of *Principia Mathematica*' denotes those xx which include all and only the parts of the S-fusion of writers of *Principia Mathematica*—i.e. it denotes those xx which include Russell, Whitehead, all of their proper parts, and any sums of these things there may be. Given the approach to distributive predication from Sect. 3, 'are men' is true of xx just in case everything included in xx is a man. But then (6) is false, since xx includes, e.g., all of Russell's atomic parts, none of which is a man. We could solve this problem by adopting an alternative approach to distributive predication, but it's not clear what this alternative could be.²¹

My view doesn't have this problem. The approach to distributive predication from Sect. 4 shows how (6) can be true, given **CAI**. Let δ_1 be a cover which maps r@w just to Russell and to Whitehead: $\delta_1(r@w) = r,w$. Relative to δ_1 , (6) is true just in case each of Russell and Whitehead was man, so the intuitive truth-conditions of (6) are preserved. But (6) can still be true, relative to δ_1 , even if r@w includes some things which aren't men. What matters for the truth of (6), relative to δ_1 , isn't whether 'are men' is true of each thing included in r@w, but whether it's true of each value of $\delta_1(r@w)$. My view thus gives the defender of **CAI** a satisfying treatment of distributive predication *and* plural descriptions, *and* plural comprehension.

8.2 Loss

Loss (2019) uses Sider's notion of 'S-fusion' to provide another alternative comprehension schema, but he's more restrictive about what gets included in the plurality corresponding to an S-Fusion. Loss assumes that every individual is either an atom or the fusion of some atoms, and takes this to suggest the following schema:

Comprehension (Loss)

 $\exists x \varphi x \supset \exists x x \exists y (S - Fu(y, \varphi) \& \forall z(z \leq xx \equiv z \leq y \& Atom(z))$

If there's at least one φ -er, then there exists (i) an *S*-fusion of the individual φ -ers, and (ii) some *xx* which include all and only the *atomic* parts of that S-fusion (11). As with Sider's schema (and mine), this doesn't imply that there are some *xx* which include all and *only* φ -ers: the S-Fusion of the bricks will have some atoms as proper

²¹ Sider (2007: p. 58) is well aware of the problems with combining **CAI** and the approach to distributivity from Sect. 3. I suspect he would reject the Sideresque analysis for that reason.

parts, so from the fact that there's at least one brick, it doesn't follow that any plurality includes all and *only* bricks.

Unlike with Sider's schema (and mine), there isn't even guaranteed to be a plurality which includes *any* ϕ -ers. The plurality corresponding to the S-Fusion of the bricks includes all and only the *atomic* parts of that S-Fusion, i.e. the atoms which make up the individual bricks. Since no brick is an atom, no brick is included in this plurality. Indeed, when combined with **CAI**, Loss's schema entails that the only pluralities there are, are pluralities of atoms (2019: p. 11).

It may seem that Loss's proposal, like Sider's, requires us to think that there are fewer pluralities than we'd ordinarily expect. However, Loss has a way of avoiding this result.

Following Sider (2011), Loss (2020) claims that some quantifiers are more 'metaphysically perspicuous' than others: they do a better job at 'carving nature at the joints'. Moreover, he suggests, the most joint-carving quantifiers (singular and plural) range only over atoms. Thus, Loss's comprehension schema is true if we read ' $\exists xx'$ as using the most joint-carving plural quantifier: in the most joint-carving sense of 'there are', there are only pluralities of atoms. That's consistent, however, with there being less joint-carving plural quantifiers which range over composite objects. It may be that there are such pluralities as *the bricks*, even if only in a less joint-carving sense of 'there are' (2020: p. 9).

This package of views comes at a high metametaphysical cost: we must accept, not only that reality has 'quantificational structure',²² but that the most joint-carving quantifiers range only over atoms. By contrast, my approach is motivated by linguistic evidence which is independent of any metametaphysical claims about quantificational structure.

8.3 Cotnoir

In Sect. 4 I claimed that whether a plural predication is true depends on how we 'carve up' reality. Cotnoir (2013), following Baxter (1988), claims that what *exists* (i.e. what can be quantified over) *also* depends on how we 'carve up' reality. E.g., we can carve a single portion of reality into *one thing*, a six-pack of orange juice, or into *many things*, the six individual juices. The question of what *exists* (The six-pack? The six individual juices?) has no answer, independently of which carving we choose (Baxter, 1988: pp. 200–201; 210–211).

Moreover, on this view, while we can 'carve up' a portion of reality into one thing or many (e.g. a single whole and its many parts) we can't do both at once. No acceptable domain of quantification includes both a whole and its parts. Thus, we can never say that a whole is *identical* to its parts, and so **CAI**, as I've stated it, is false. Nonetheless, a whole and its parts stand in a *kind* of identity relation: they're the same *portion of reality*. Cotnoir calls this relation 'general identity'.

²² See, e.g., Hirsch (2013), Thomasson (2014: pp. 308–317), and Warren (2016) for concerns.

To see how this works, assume that a portion of reality is simply some atoms, xx. We can carve these atoms up in different ways, e.g. into a single whole, a, or into the parts of that whole, bb, at a certain level of composition.²³ Since we can't adopt both carvings at once, we can't have both a and bb in the domain of quantification, so 'a = bb' is unstateable. What we *can* do, however, is adopt a domain of quantification that includes just the uncarved atoms and say, from this new perspective, that the terms 'a' and 'bb' denote the same portion of reality, the same collection of atoms (Cotnoir, 2013: pp. 301–306).

The problems with plural descriptions and **Comprehension** from Sect. 3 don't arise, on this view. Since we can never have both a brick and its constituent atoms in the domain of quantification, we can never have both *the bricks* and *the atoms* in the domain of quantification. Thus, we can't say that these pluralities are *identical*. But then, we can adopt the analysis of plural descriptions from Sect. 3: *the bricks* (which can only be in the domain if the atoms aren't) include all and only bricks, and *the atoms* (which can only be in the domain if the bricks aren't) include all and only atoms. Likewise, while comprehension is, in a sense, restricted (2013: 303), we can accept **Comprehension** as stated: given the existence of a brick, there's a plurality which includes all and only bricks (since no plurality which includes a brick can also include its constituent atoms).

I take my view to be better motivated. We've seen the linguistic evidence for my approaches to distributive predication, plural descriptions, and plural comprehension, and that these approaches are consistent with **CAI**. Is there reason to reject **CAI** in favour of Cotnoir's 'general identity' view?

Cotnoir rejects **CAI** on the ground that, if a whole is *identical* to its many parts, then the very same thing(s) is/are both one and many, which is impossible (2013: 301). This argument also motivates his claims that what exists is relative to a carving, and that we can't carve a portion of reality into one thing and many at once, since these claims allow us to avoid seemingly inconsistent number-ascriptions.²⁴ But I've argued elsewhere (Payton, 2019; n.d.) for a semantics of number ascriptions which renders '*a* is one thing' and '*a* is many things' *consistent*, and which does so without appeal to discrete domains of quantification or the notion of 'general identity'.²⁵

9 Nihilism

Calosi (2016: pp. 225–228) and Loss (2018: pp. 371–372) argue that **CAI** leads to compositional nihilism: composition never occurs; everything is a mereological atom, whose only part is itself.

 $^{^{23}}$ Since parthood is transitive, we can't always carve a whole into all its parts at once. E.g., we can't have *both* the bricks which compose the wall *and* the atoms which compose the bricks in our domain of quantification.

²⁴ See also Baxter (1988: p. 193).

²⁵ For further discussion of Cotnoir's view, see Carrara and Lando (2016) and Hawley (2013).

Nihilism

 $\forall x \forall y (y \le x \equiv y = x)$

Nihilism renders **CAI** completely uninteresting: 'Composite objects *would be* identical to their parts, if there were any, which there aren't.' It also undermines my claim that we can accept **CAI** while believing in such pluralities as *the bricks*. (If **Nihilism** is true, there aren't any bricks.)

Fortunately, my approach to plural descriptions and my comprehension schema block these arguments.

9.1 Calosi

CAI implies Collapse (Sider, 2007: pp. 57-58; 2014: 213):

Collapse $\forall x \forall yy(Fu(x, yy) \supset \forall z(z \le x \equiv z \le yy))$

If x fuses yy, then z is part of x just in case z is included in yy. Calosi argues that, if **Collapse** is true, every object is indistinguishable from each of its parts (i.e. if b is part of a, then a and b have all the same properties). But if some b is a proper part of a, they have different properties (e.g. a has itself as a part, but b doesn't have a as a part). So, if **Collapse** is true, nothing has proper parts; **Nihilism** is true (2016: 227-228).

Calosi's argument comes in two parts: first, if b is part of a, then (given **Collapse**) there's no property which a has but b lacks; second if b is part of a, then (given **Collapse**) there's no property which b has but a lacks. I'll only address the first part here. The second part is structurally similar to the first, and fails for the same reason.

Suppose that *a* fuses *bb*, which includes *b* (C1). By **Collapse**, *b* is part of *a* (C2). Now suppose for *reductio* that *a* has some property, call it '*P*', which *b* lacks (C3), and let '*cc*' denote a plurality which includes all and only the '*P*-parts' of *a*, i.e., the parts of *a* which possesses *P* (C4). By the definition of 'fusion', *a* fuses *cc* (C5).²⁶ But since *b* is part of *a*, *b* is included in *cc* by **Collapse** (C6). By C4, *b* a *P*-part of *a* (C7), so *b* possesses *P* (C8), contradicting our assumption (C9).

(C1)	$Fu(a, bb) \& b \leq bb$	[Assumption]
(C2)	$\therefore b \leq a$	[C1, Collapse]
(C3)	<i>Pa</i> & ~ <i>Pb</i>	[Assumption]
(C4)	$\forall x (x \leq cc \equiv (x \leq a \& Px))$	[Premise]
(C5)	\therefore Fu(a, cc)	[C3, C4, definition of 'Fu']
(C6)	$\therefore b \leq cc$	[C2, C5, Collapse]

²⁶ Proof: First, $\forall x(x \leq cc \supset x \leq a)$ follows trivially from C4. Second, we have $\forall y(y \leq a \supset \exists z(z \leq cc \& y \circ z))$: since we've assumed *Pa*, and parthood is reflexive, we have ' $a \leq a \& Pa$ '; by C4, $a \leq cc$; but then, every part of *a* overlaps one of *a*'s *P*-parts, since every part of *a* overlaps *a*.

(C7)	$\therefore b \leq a \& Pb$	[C6, C4]
(C8)	:. Pb	[C7]
(C9)	\perp	[C3, C8]

By *reductio*, if b is part of a, there's no property which a has and b lacks (2016: 226-227).

The natural reply, for a defender of **CAI**, is to reject C4, the premise that there's a plurality which includes all and only the *P*-parts of *a*. In particular, she should reject the left-to-right direction (i.e., that *cc* includes *only P*-parts of *a*) since that's what licenses the move from C3 to C5, and the move from C6 to C7.

The intuitive motivation for C4 is that, given that the notion of a *P*-part of *a* is well-defined, we're free to introduce a plural term, '*cc*' which behaves like 'the *P*-parts of *a*'. Given the analysis of plural descriptions from Sect. 3, the denotation of '*cc*' must include all and only the *P*-parts of *a*—hence C4.

But on my analysis of plural descriptions, while the denotation of '*cc*' must include *all* the *P*-parts, it needn't include *only* the *P*-parts. All that's required for '*cc*' to behave like 'the *P*-parts of *a*' is that some cover maps *cc* to all and only the *P*-parts. Equivalently: it requires only that '*cc*' denote some $bb_1,...,bb_n$ such that (i) each of them is identical to one of *a*'s *P*-parts, and (ii) each *P*-part of *a* is identical to one of them. That's consistent with there being some things included in *cc* which aren't *P*-parts. (Just as, on my view, *the bricks* include some atoms.)

Thus, on my analysis, the left-to-right direction of C4 is unmotivated; there's no reason to think that any plurality includes *only* the P-parts of *a*. But then, the moves to C5 and C7 are blocked. The *reductio*, and hence the argument for **Nihilism**, fails.

9.2 Loss

Loss's first argument (2018: 371) appeals to Calosi's notion of an improper plurality, i.e. a plurality which includes only one thing. Say that *aa* is the improper plurality of *a*—or 'IP(aa, a)'—just in case *a* is the only thing included in *aa*. Now let '*a*' denote some arbitrary object and '*aa*' its improper plurality (L1). By the definition of 'fusion', *a* fuses *aa* (L2),²⁷ so by **Collapse**, *aa* includes all and only the parts of *a* (L3). But the only thing included in *aa* is *a* (L4), so the only part *a* has is itself (L5). Generalizing, the only part *anything* has is itself; that is, **Nihilism** is true (L6).

(L1)	IP(aa, a)	[Assumption]
(L2)	\therefore Fu(a, aa)	[L1, definition of 'Fu']
(L3)	$\therefore \forall x (x \leq aa \equiv x \leq a)$	[L2, Collapse]
(L4)	$\therefore \forall x (x \leq aa \equiv x = a)$	[L1]
(L5)	$\therefore \forall x (x \le a \equiv x = a)$	[L3, L4]
(L6)	$\therefore \forall x \forall y (y \le x \equiv y = x)$	[L5, ∀-int]

²⁷ Proof: First, we have $\forall x(x \leq aa \supset x \leq a)$, since the only thing included in *aa* is *a* itself, and parthood is reflexive. Second, we have $\forall y(y \leq a \supset \exists z(z \leq aa \& y \circ z))$: by the definition of 'overlap' (n. 4), any part of *a* overlaps *a*. Since *a* is the only thing included in *aa*, it follows that any part of *a* overlaps one of those things, namely *a*.

This argument assumes that any arbitrary object has an improper plurality. (That's what licenses L1, and the generalization from L5 to L6.) The natural reply, for a defender of **CAI**, is that this assumption is false. In particular, *composite objects* don't have improper pluralities.

If *a* is a composite object, then by **CAI** it's identical to all its parts collectively, and hence includes each of them individually. But then, *a* can't have an improper plurality: any plurality which includes *a* will thereby include all of *a*'s proper parts, each of which is distinct from *a*. If **CAI** is true, the only objects which have improper pluralities are mereological atoms. L1 is licensed only if *a* is a mereological atom, and L5 only generalizes to such things. But then, the conclusion is trivial: all mereological atoms are mereological atoms.²⁸

This reply might seem cheap: 'Your *modus ponens* is my *modus tollens*'. But the claim that composite objects don't have improper pluralities is part and parcel of **CAI**: it's neither a surprising bullet to bite, nor an ad hoc claim wheeled in just to block Loss's argument.

Moreover, the only clear reason to assume that any arbitrary object *must* have an improper plurality, is that this assumption is an instance of **Comprehension**:

```
(7) \exists x(x=a) \supset \exists xx \forall y(y \leq xx \equiv (y=a))
```

(If *a* exists, then there's a plurality which includes all and only individuals identical to *a*, i.e. an improper plurality of *a*.) But if we replace **Comprehension** with **Comprehension 3**, as I've argued we should, we don't get (7). Instead, we get:

(8) If $\exists xx(xx=a)$ ' is true w.r.t. δ_i , then $\exists yy(\gamma zz(zz=a)yy)$ ' is true w.r.t. δ_i

If anything is identical to *a*, then there's a plurality *aa* and a cover δ_j such that δ_j maps *aa* to some bb_1, \dots, bb_n , where bb_1, \dots, bb_n are the things which are identical to *a*. Of course, there's only one such thing, namely *a* itself, so $\delta_j(aa) = a$. But that's consistent with there being two or more things included in *aa*, each of which is distinct from *a*. *aa* may be a *proper* plurality of things, $bb_1@\dots@bb_n$, such that $\delta_j(bb_1@\dots@bb_n) = a$.

Loss's second argument (2018: 372) appeals to a plausible mereological principle:

Weak Company

 $\forall x \forall y (x < y \supset \exists z (z < y \& z \neq y))$

If an object has at least one proper part, then it has at least two. Now, assume that **Nihilism** is false, i.e., there's at least one object with a proper part (L7), and let 'a' and 'b' denote, respectively, this object and one of its proper parts (L8). Let 'cc' denote some things such that the individuals included in cc are all and only things

²⁸ Loss (2018: pp. 372–373) considers a different kind of skeptic about improper pluralities, who grants that everything has an improper plurality, but rejects the inference from L1 to L2. By contrast, I reject L1 outright. See Loss (2019: p. 10) for his own way of blocking the road to Nihilism.

identical either to *a* or to *b* (L9). By the definition of 'fusion', *a* fuses *cc* (L10).²⁹ By **Collapse**, every part of *a* is included in *cc* (L11) and is therefore identical to either *a* or *b* (L12). Now, by the definition of 'proper part', *x* is a proper part of *a* only if it's distinct from *a*. So, by L12, any proper part of *a* must be identical to *b* (L13). Therefore, *a* has only one proper part, namely *b* (L14).

(L7)	$\exists x \exists y (y < x)$	[Assumption]
(L8)	$\therefore b < a$	$[L7, \exists$ -elim $\times 2]$
(L9)	$\forall x (x \leq cc \equiv (x = a \lor x = b))$	[Premise]
(L10)	\therefore Fu(a, cc)	[L8, L9, definition of 'Fu']
(L11)	$\therefore \forall x (x \le a \supset x \le cc)$	[L10, Collapse]
(L12)	$\therefore \forall x (x \le a \supset (x = a \lor x = b))$	[L9, L11]
(L13)	$\therefore \forall x (x < a \supset x = b)$	[L12, definition of '<']
(L14)	$\therefore \exists y \forall x (x < a \supset x = y)$	[L13, ∃-int]

This contradicts Weak Company. By reductio, L7 is false and Nihilism is true.

The natural reply is to reject L9, the premise that there's a plurality the only individuals included in which are *a* and *b*. If we assume that *b* is a proper part of *a*, then by **Weak Company**, there are some individuals $c_1...c_n$ such that each of them is a proper part of *a* and each of them is distinct from *b* (there may, of course, only be one such individual). By **CAI**, *a* is identical to $b@c_1@...@c_n$, and so it *includes* each of $c_1...c_n$. But then, no plurality meets the condition laid down in L9: any plurality which includes *a* includes each of $c_1...c_n$, each of which is distinct both from *a* and from *b*.

Again, this reply isn't as cheap as it might seem. Granting **Weak Company**, the rejection of L9 is neither a surprising bullet to bite nor an ad hoc maneuver, but simply part and parcel of **CAI**. And the only clear reason for thinking that there *must* be a plurality which satisfies L9 is that this is simply an instance of **Comprehension**:

(9) $\exists x(x=a \lor x=b) \supset \exists xx \forall y(y \leq xx \equiv (y=a \lor y=b))$

(If *a* and *b* exist, there's a plurality which includes all and only individuals identical to either *a* or *b*.) But given **Comprehension 3** we only get:

²⁹ Proof: First, we have $\forall x(x \leq cc \supset x \leq a)$: by L9, the only things included in *cc* are *a* and *b*, and *a* is part *a* by reflexivity while *b* is part of *a* by L8. Second, we have $\forall y(y \leq a \supset \exists z(z \leq cc \& y \circ z))$: since *a* is included in *cc*, every part of *a* overlaps something included in *cc*, namely *a*.

(10) If $\exists xx(xx=a \lor xx=b)$ ' is true w.r.t. δ_i , then $\exists yy(\gamma zz(zz=a \lor zz=b)yy)$ ' is true w.r.t. δ_i

If anything is identical either to *a* or to *b*, then there's a plurality *aa* and a cover δ_j such that δ_j maps *aa* to some bb_1, \dots, bb_n , where bb_1, \dots, bb_n are the things which are identical either to *a* or to *b*. Of course, there are only two such things, namely *a* and *b* themselves, so $\delta_j(aa) = a, b$. This entails that aa = a@b, so each of *a* and *b* is included in *aa*. But that's consistent with there being other individuals included in *aa*.³⁰

Thus, my analysis of plural descriptions and my comprehension schema block the road from **CAI** to **Nihilism**.³¹

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³⁰ (Let *a* be a composite object and *b* and *c* its proper parts. By **CAI**, *aa* is identical to b@c, and so *c* included in *aa*, even though it's distinct from both *a* and *b*.).

³¹ Calosi (2018: pp. 287–288) and Yi (2014: pp. 183–184; 2019: pp. 13–15) give other arguments from **CAI** to **Nihilism**, which don't obviously hinge on issues discussed in this paper. But they do rely on assumptions a defender of **CAI** should reject, e.g. that *x* is included in *y* only if *x* is identical to *y* (Payton 2019: pp. 18–19).

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