Composition, Indiscernibility, Coreferentiality

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Abstract

According to strong composition as identity (CAI), the logical principles of one-one and plural identity can and should be extended to the relation between a whole and its parts. Otherwise, composition would not be legitimately regarded as an identity relation. In particular, several defenders of strong CAI have attempted to extend Leibniz's Law to composition. However, much less attention has been paid to another, not less important feature of standard identity: a standard identity statement is true iff its terms are coreferential. We contend that, if coreferentiality is dropped, indiscernibility is no help in making composition a genuine identity relation. To this aim, we analyse as a case study Cotnoir's theory of general identity (Cotnoir, 2013), in which indiscernibility is obtained thanks to a revisionary semantics and true identity statements are allowed to connect non-coreferential terms. We extend Cotnoir's strategy for indiscernibility to the relation of *comaternity,* and we show that, neither in the case of composition nor in that of comaternity, indiscernibility contibutes to show that they are genuine identity relations. Finally, we compare Cotnoir's approach with other versions of strong CAI endorsed by Wallace, Bøhn, and Hovda, and canvass the extent to which they violate coreferentiality. The comparative analysis shows that, in order to preserve coreferentiality, strong CAI is forced to adopt a non-standard semantic treatment of the singular/plural distinction.

1 Indiscernibility *vs.* Coreferentiality

In the increasing literature on composition as identity (CAI henceforth), the principle of indiscernibility of identicals (Leibniz's Law) plays a pivotal role. "Defenders of strong composition as identity" – Theodore Sider argues – "must accept Leibniz's Law: to deny it would arouse suspicion that their use of 'is identical to' does not really express identity." (Sider, 2007, 59)

According to the influential formulation of CAI by David Lewis, *composition,* that is the relation between some entities and the whole that is their mereological fusion[1], is "strikingly analogous" (Lewis, 1991, 84) to one-one identity. However, Lewis remarks that Leibniz's Law – generally assumed as an indisputable principle for standard identity – does not hold for composition: after all, the many parts of a fusion are many, while the fusion itself is one; thus, the fusion is discernible from its parts.

A different version of CAI, labelled *strong* CAI (in contrast with Lewis's allegedly *weak* version),[2] maintains that the logical principles governing standard identity can actually be extended to composition. A single backer of strong CAI – namely Donald Baxter[3] – claims that Leibniz's Law is a false principle in general, even for standard one-one identity, and expunges in this way indiscernibility from the debate on CAI. But many others, such as Einar Bøhn, Aaron Cotnoir, Paul Hovda, and Megan Wallace,[4] accept that Leibniz's Law is a non-negotiable principle and that it is pivotal to extend it to composition in order to defend CAI in its really interesting version: to this aim, they provide a revisionary analysis of seeming counterexamples to the extension of indiscernibility to composition.

In this paper, we would like to make clear the import of a different, not less important feature of standard identity, and to assess the extent to which the various current

[1]According to Lewis's so-called *mereological monism* (as it has been labeled by Fine (1994)), mereology is the general, exhaustive theory of ontological constitution. We shall not discuss this assumption. Throughout the paper, composition is always identified with mereological fusion.

[2]For the distinction between *weak* CAI, *strong* CAI, and other possible versions, see Yi (1999) and Sider (2007). For a general introduction, see Wallace (2011a) and Cotnoir (2014).

[3]See in particular Baxter (1999).

[4]Hovda (2005); Bøhn (2009, 2014); Wallace (2009, 2011a,b); Cotnoir (2013).

approaches to strong CAI fail or manage to extend it to composition. We focus on those versions of strong CAI that are conservative with respect to the features of standard identityi and aim to show that these features can be extended to composition, making it a legitimate identity relation. Thus, we leave henceforth Baxter's revisionary rejection of Leibniz's Law aside. Our complaint against these approaches is that, while they devote so many efforts to extend Leibniz's Law to composition, they fail to pay due attention to *coreferentiality*: an identity statement is true iff its terms have the same referent.

This feature of standard identity *should* be extended by the backers of strong CAI to composition. If a relational predicate is allowed to combine two terms standing for different things in a true statement, then it does not express a genuine identity relation. And if that relational predicate expresses composition, then composition cannot be legitimately regarded as an identity relation. Thus, coreferentialty should be seen as a constraint on the debate on strong CAI:

Coreferentiality Constraint The terms of a true identity statement must be coreferential.

The Coreferentiality Constraint is never explicitly discussed by the defenders of strong CAI, and some strategies to extend Leibniz's Law to composition risk leading to an open violation of the Coreferentiality Constraint. In order to make clear the import of this constraint and to see how it happens that strong CAI risks violating it, we consider Aaron Cotnoir's recent theory of *general identity* (Cotnoir, 2013) as a case study to be analysed in depth. In fact, Cotnoir's general identity violates the Coreferentiality Constraint in the most clear-cut way. Then, we compare Cotnoir's approaches with other versions of strong CAI, set forth by Wallace, Bøhn, and Hovda. In these other approaches, it is more difficult to understand what happens with the Coreferentiality Constraint. As we are going to see, the constraint is sometimes respected and sometimes violated, as a side effect of other aspects of each approach.

Why does Cotnoir end up violating explicitly the Coreferentiality Constraint? In our view, the crucial defect in Cotnoir's approach – a defect which should be avoided also by alternative approaches to strong CAI – is the idea that the syntactic distinction between plural terms and singular terms is straightforwardly mirrored in the semantics, so that the singular term denotes singularly the whole and the plural term denotes plurally its parts. This leads unavoidably to drop coreferentiality and, once coreferentiality is dropped, indiscernibility does not show what is expected by the backers of strong CAI. The supporters of strong CAI should provide a more refined semantic treatment of the singular/plural distinction. Some examples of this more refined treatment are already at disposal in the literature, and we will discuss them in due course.

We shall proceed as follows. In §2 we ask what it means, in general, to show that a certain relation – different from standard one-one identity – qualifies as a genuine identity relation, analysing the successful case of plural identity. In §3 we see what is needed in order to obtain something similar in the case of composition and cognate relations, and we focus in particular on the potential counterexamples to the extension of indiscernibility which the defenders of strong CAI need to cope with. In §4 we present the case study of Cotnoir's theory of general identity and we see how it happens that it admits true general identity statements whose terms have different referents. We also discard a relative and trivial notion of coreferentiality, for which coreferentiality would not be a constraint at all. In §5 we contend that, once coreferentiality is dropped, indiscernibility is not an evidence of genuine identity. In §6 we extend Cotnoir's strategy to the relation of *comaternity*, showing how two *prima facie* discernible people with the same mother could be made indiscernible after all. In §7 we claim that his strategy does not contribute to show neither that *comaternity* is a genuine identity relation nor that general identity is such. Some instructive differences between the two cases are also discussed. In §8 we note that some dissonant formulations and hints by Cotnoir himself could point to a substantial modification of his own theory, where coreferentiality could be restored.

Then, in §9, we extend our analysis to other varieties of strong CAI and we show that our argument imposes a constraint on the semantic treatment of syntactically hybrid identity statements, a topic about which the supporters of strong CAI are not always explicit. Finally, in §10, we draw some conclusions.

2 Plural Identity as Genuine Identity: A Success Story

What is a genuine relation of identity? One-one identity is the uncontroversial model, and is that relation which anything bears to itself and to nothing else. It is symmetric and transitive as well. It can be characterized as the smallest equivalence relation on the universal domain.

Leibniz's Law is assumed as a relatively uncontroversial principle about identity. It says that if x and y are identical, then x and y instantiate exactly the same properties. But identity is just the relation which anything bears to itself and to nothing else, thus Leibniz's Law boils down to the claim that anything instantiates exactly the properties that it itself instantiates. Denying this second claim leads to a contradiction.

When we say that a relation is an equivalence relation and we formulate Leibniz's Law for it, we provide a logically adequate characterization of one-one identity.[5]

But there is a further, uncontroversial feature of one-one identity: *coreferentiality*. It concerns more directly the semantics of identity statements, by which one-one identities are expressed. It is not usually listed among the characterizing features of identity, insofar as a logical, purely syntactical characterization is to be preferred. Consider the simplest case of closed statements with no quantifier, where the identity symbol is flanked by two names or (if we are dealing with a formal language) constants. An identity statement is true iff its terms (the constants flanking the identity symbol) have the same referent. Coreferentiality is a necessary and sufficient condition for the truth of such identity

[5] Reflexivity and Leibniz's Law are actually sufficient to identify a unique relation. See Quine (1961).

statements.

Given this picture of standard, prototypical one-one identity, what happens when we are confronted with a relation that *is not* one-one identity, that is not the relation which anything has with itself and nothing else? We are expected to assess if this different relation shares with one-one identity its characterizing features.

The currently increasing interest in plural logic, after a long period of oblivion, has already led to introduce a new kind of identity, often assumed to be not less a genuine identity relation than the one-one relation subsisting between any individual and itself, to the point that the same identity symbol is commonly employed.

For any xx and yy,[6] xx are plurally identical to yy iff, for any individual z, z is one of the xx iff z is one of the yy. This definable relation is classified as a relation of identity because it obeys the principles that rule also one-one identity. Plural identity is an equivalence relation (reflexive, symmetric and transitive), and Leibniz's Law seems to hold for it: if xx are identical to yy, then, for any property P, P is instantiated by xx iff P is instantiated by yy. Take the following instance: the Bronte sisters are Anne, Charlotte, and Emily (since, for any z, z is one of the Bronte Sisters iff z is one of Anne, Charlotte, and Emily); the Bronte Sisters supported one another; so Anne, Charlotte, and Emily supported one another.[7]

Plural identity, as above defined, qualifies as a genuine identity relation because it works from a logical point of view as standard one-one identity. Also when we consider the semantic Coreferentiality Constraint, no bad surprise: a plural identity statement is true iff its terms have the same *plural* reference. Consider again our writers:

Bronte sisters = Anne, Charlotte, and Emily

The plural reference of "Bronte sisters" are those three women that are also the plural

[6] As it is common in the literature about plural quantification, "double" signs such as xx, yy, zz etc. are plural variables.

[7] The example is discussed in Oliver and Smiley (2013, 3).

reference of "Anne, Charlotte, and Emily." Coreferentiality springs unproblematically from the logical characterization of plural identity.

3 Composition, Portions of Reality, Indiscernibility

Let us go back to CAI and see how indiscernibility enters the stage as a crucial testbed for strong CAI. A basic intuition laying behind CAI is that, when we are compiling an exhaustive but non-redundant catalogue of what there is in reality or in a certain portion of reality, we should not countenance both something and its parts, because this would not make our catalogue more exhaustive: it would be a redundancy. What is there in Europe? Well, Netherlands, Luxembourg, and Belgium are among the pieces of Europe. Benelux is a piece of Europe as well, and the individual molecules making up Benelux are pieces of Europe too. But our catalogue should not include *all* these pieces: Benelux, Netherlands, Luxembourg, Belgium, and the molecules. Benelux is enough, Netherlands, Luxembourg and Belgium are collectively enough, the molecules are collectively enough. The intuition is that our list is dealing with one and the same *portion* of Europe that can be subdivided or partitioned in different ways, but is nonetheless that same portion of Europe, *as much as* Netherlands is the same portion as Netherlands itself. If our catalogue of what there is in Europe were to include Netherlands twice (even if the second occurrence were under a different name, such as "the country of tulips"), the catalogue would be redundant as well. Anything is the same *portion of reality* as itself, as much as any whole is the same portion of reality as its parts.

What does this "striking" analogy show?[8] Should it lead to introduce a more comprehensive notion, embracing both composition and standard identity? Is composition on a par with plural identity? Does it share with standard one-one identity its characterizing

[8]Lewis (1991, 84-87) dicusses several other alleged analogies between composition and identity. See also Sider (2007, 19-24). Here, for the sake of brevity, we are content to characterize only a core intuition about the analogy.

features? Is composition an equivalence relation? Does Leibniz's Law hold for it?

As a matter of fact, the debate about CAI is not focused on the fact that composition *is not* an equivalence relation. This happens because the relation really at stake in the debate *is not* composition. We have seen that what makes composition so strikingly similar to identity and makes redundant to list among what there is both a whole and its parts, or both the parts of a whole cut out in a certain way and the parts of that same whole cut out in another way, is the fact that the parts and the whole, as well as the parts cut out in a way and the parts cut out in another way, are one and the same portion of reality. And the relation of *being the same portion of reality is* an equivalence relation.[9]

However, even once this shift to being the same portion of reality is conceded, Leibniz's Law remains a serious problem: "what's true of the many is not exactly what's true of the one." (Lewis, 1991, 87) The issue concerns mainly numerical and quantitative predications on one side, and collective predications on the other. Since here we are interested only in how the extension of Leibniz's Law ends up interfering with coreferentiality, we outline only the relatively simpler case of numerical and quantitative predication.

Netherlands, Belgium, and Luxembourg are three and not one, while Benelux is one and not three. Nothing like this happens with standard one-one identity, or in the plural case: the Bronte Sisters are as many as Anne, Charlotte, and Emily. A popular way to cope with these potential counterexamples is to adopt a broadly Fregean understanding of numerical predication, so that these predications are always relative to a concept or sortal. Netherlands, Belgium, and Luxembourg are three countries, one multinational entity, a very big number of molecules; also Benelux is three countries, one multinational entity, and that same number of molecules. These seeming counterexamples to Leibniz's Law would derive from the false pretense that numerical predication is absolute. In the next

[9]Being non-symmetric, composition is not strictly speaking a subrelation of being the same portion of reality, but, for every xx and every y, if xx compose y, then – according to the intuition laying behind CAI – xx and y are the same portion of reality. The implication in the opposite direction – that is the claim that if xx and y are the same portion of reality, then xx compose y – can also be defended. See Sider (2007, 9-12), and Bøhn (2014).

section we are going to give a glance at how Cotnoir's recent theory of general identity implements this broad idea.

4 Cotnoir's General Identity: Coreferentiality Dropped

Cotnoir's theory of *general identity* (GI henceforth) extends indiscernibility to the relation of *being the same portion of reality* and succeeds in disposing of the apparent counterexamples by introducing a new notion of identity. Here we are not going to analyse in depth or dispute this achievement, but to show that a necessary condition for GI being a genuine identity relation – indiscernibility – is actually obtained at the price of renouncing another necessary condition for GI being a genuine relation – coreferentiality – leading to no further evidence in favour of strong CAI.

As Cotnoir writes, GI "is a general notion of identity that holds between portions of reality *independent* of our ways of counting it." (Cotnoir, 2013, 203) He introduces a generalized binary identity predicate $\approx$, admitting singular and plural terms in both argument positions. Then, he provides truth-conditions for GI statements of the four resulting forms (many-many, many-one, one-many, one-one). In the following equivalences, $\approx$ stands for general identity, $=$ stands for standard identity, $\bigcup$ stands for set-theoretic union, and, for any expression x, $\overline{x}$ stands for the denotation of x.

$xx \approx yy$ is true iff $\bigcup \overline{xx} = \bigcup \overline{yy}$ (many-many)

$xx \approx y$ is true iff $\bigcup \overline{xx} = \overline{y}$ (many-one)

$x \approx yy$ is true iff $\overline{x} = \bigcup \overline{yy}$ (one-many)

$x \approx y$ is true iff $\overline{x} = \overline{y}$ (one-one)

The denotation of a singular term is said to be "a chunk of atoms", while a plural term denotes a set of these chunks. For what concerns atoms, the basic idea is that individuals have some basic constituents (the atoms) and are chunks of them.[10] What is

[10]In a footnote (n. 12) Cotnoir deflates his commitment to atoms, suggesting that "propertied spacetime

a chunk? Cotnoir does not offer much detail about chunks, but, since chunks are terms of set-theoretic unions in three of the above clauses,[11] the well-formedness of these claims presupposes that chunks are simply sets. Thus, avoiding the elusive term "chunk", we can also say that the denotation of a singular term is a set of its atomic constituents, while a plural term denotes a set of some sets of atoms.

A portion of reality corresponds to a certain domain of atoms (the basic constituents of the portion). This domain gets partitioned in chunks. There are several partitions, corresponding to "our ways of counting." Benelux can be counted as one multinational entity (Benelux), as three countries, or as a very big number of molecules. Cotnoir makes the example of a tiled floor instead, where the tiles compose a certain number of squares. The floor, the tiles and the squares correspond to different ways of counting one and the same portion of reality. In the floor-partition there is only one set of atoms; in the square-partition there are as many sets of atoms as squares; in the tile-partition there are as many sets of atoms as tiles.

The truth-conditions for GI statements resort to the set-theoretic union of the denoted set of chunks when a plural term is involved. What we obtain is the set of all the atoms which are in at least one of the sets (chunks) that are elements of the set of chunks denoted by the plural term. For a case of many-many GI take the plural term for the tiles of the floor and the plural term for the squares of that same floor. The plural term for the tiles denotes a set of sets of atoms, one set of atoms for each tile, while the plural term for the squares denotes another set of sets of atoms, one set of atoms for each square. The GI statement in which these two terms occur is true, since the union of the first set of sets is identical to the union of the second set of sets: it is the set of the atoms of the floor, one and the same however we count that portion of reality.

How does it happen that coreferentiality fails? In all the three cases where at least one

points" could replace mereological atoms. It is not clear at this stage (Cotnoir aims to explore this alternative in future work) how this could work if mereology is expected to involve also abstract entities.

[11] In another part of Cotnoir (2013), the denotation of a singular term (a chunk) is said to be included in other sets (see the definitions of "is-covered-by" and "is-part-of", p. 305).

plural term appears, the sets denoted by the terms of a true identity statements are allowed to be different sets. They differ from the viewpoint of the standard, uncontroversial identity conditions for sets, according to which two sets are identical iff they have the same elements. In the two cases (many-one, one-many) where one term is singular and the other plural, we have that one term denotes a set of atoms and the other denotes a set of sets of atoms. In the many-many case the two terms are allowed to denote two different sets of sets of atoms. In the example of the floor, the set of the tile-sets of atoms *is not* the set of the square-sets of atoms. They have something in common, namely that the atoms constituting the tiles are also the atoms constituting the squares, but they are different sets nonetheless. Coreferentiality is warranted only in the one-one case, where the truth of the statement requires the two singular terms to denote the same chunk of atoms.

But is this enough to conclude that coreferentiality fails? We think so, but it is important to anticipate a reply that Cotnoir might make. Cotnoir might insist that the notion of coreferentiality should be adapted to his own revisionary pluralism about identity. Cotnoir's proposal is that GI is a genuine identity relation. Thus, identity can be said in more than one way: there is standard, singular identity; there is plural identity; and then there is also general identity. While these varieties of identity agree in being equivalence relations and in connecting only indiscernible items (provided that Cotnoir's strategy for extending indiscenibility is successful), they are nonetheless *different* notions of identity. Anne, Charlotte, and Emily are plurally (but not singularly) identical to the Bronte sisters. Analogously, the tiles of the floor are generally (but neither singularly nor plurally) identical to the squares of the floor.

Such *pluralism about identity* – Cotnoir might argue – should be integrated with a correlative kind of pluralism about coreferentiality. Then, two terms will be singularly coreferential iff their referents are singularly identical. Two terms will be plurally coreferential iff their referents are plurally identical. Finally, two terms will be generally coreferential iff their referents are generally identical.

Now, the terms of true GI statements are *generally coreferential*. The truth of GI statements *consists* in the general identity of their terms. Coreferentiality would be easily achieved, and there is nothing surprising in this achievement. What happens is that a certain relation is declared to be a genuine identity relation, and then we are said that coreferentiality should be redefined accordingly, so that two terms are coreferential iff their referents are in that relation. Coreferentiality would be simply the linguistic mirror of the alleged genuine identity relation. If coreferentiality is so trivialized, then the Coreferentiality Constraint is so easily met that it is not a discriminating constraint at all.

But should coreferentiality be construed in this relativized way, and so deprived of its role? Our contention is that it should not; and that in any case, if it is construed in this way, then this does not contribute to show that general identity is governed by the same principles that govern standard identity.

The idea behind the Coreferentiality Constraint for identity is that there is one thing (or there are some things, in the plural case) that is (are) the referent(s) of both the terms of a true identity statement. No theory of identity should be *presupposed* by this constraint. Once the referent(s) of one of the terms of a true identity statement is (are) determined, also the referent(s) of the other term is (are) determined, without the intermediation of any theory of identity. By contrast, if the notion of coreferentiality were redefined with respect to GI, then, in order to assure coreferentiality in our many-many true GI statement, I should check that the set of tile-sets of atoms and the set of square-sets of atoms are generally identical according to Cotnoir's theory of GI, while they fail to be identical in the standard, one-one sense.

Given pluralism about identity, there is nothing really surprising in the bare claim that the two sets are different with respect to a certain notion of identity (singular identity), but identical with respect to another (general identity). But the problem is that, in the case of one-one identity, the coreferentiality of the terms of a true identity statement consists simply in the fact that, once the referent of one term is individuated, the referent of the other term is individuated as well. By contrast, in the case of general identity, one needs to make appeal to a theory, which provides truth-conditions for various cases of GI statements. The theory-ladenness of this operation is so heavy that one needs also to embrace pluralism about identity, insofar as the referents of the terms of a true general identity statements are sometimes *different* from the viewpoint of standard one-one identity. This is enough to conclude that GI is not as conservative in its treatment of coreferentiality as the backers of strong CAI should expect.

Thus, one should distinguish, according to the preferred construal of coreferentiality, two cases.

(a) Coreferentiality is construed as usual, in an absolute way that makes it a significant constraint on candidate identity relations. Coreferentiality consists in the fact that there is one entity (or more than one entity, in the plural case) that is (are) the referent(s) of both the terms of true identity statements. As a result, to identify the referent of one term is also to identify the referent of the other term, without any intermediate, theory-laden step. In this case, Cotnoir's GI fails to meet the Coreferentiality Constraint.

(b) Coreferentiality is relativized to different notions of identity. Take general identity: Two terms are generally coreferential iff their referents are generally identical. Then, coreferentiality can never fail for any candidate identity relation, and, as a consequence, is not a discriminating test or constraint for candidate identity relations. But coreferentiality can be ascertained only through the mediation of specific theories of identity (such as Cotnoir's GI theory) and the adoption of pluralism about identity. As a result, the role of general coreferentiality for GI is different from that played by coreferentiality for standard one-one identity and standard plural identity.

While we think that case (a) is the right way to understand coreferentiality when assessing if a certain candidate identity relation is adequate to the role, it is worth noting that in both cases GI and standard identity turn out to be heterogeneous.

Henceforth, we will assume that coreferentiality is a test for candidate identity relations and should be construed as in (a), in an absolute way (and not relatively to various alleged identity relations). In §8, we will see that some hints in what Cotnoir writes could point to a way to emend his approach and to restore coreferentiality in this sense, but there is no doubt that GI in its actual form drops it: the reference of true GI statements are, in some cases, different sets with different elements.

5 What Does Indiscernibility Show?

What about indiscernibility? The possibility of dividing one and the same domain of atoms in several ways is at the basis of Cotnoir's extension of indiscernibility to any case of GI, including the one-many and many-one cases corresponding, respectively, to the relation of a whole with its parts and *vice versa*. The evaluation of any sentence where a predicate seems to be satisfied only by one of the terms of a true GI statement and not by the other should be relativized to a certain way of dividing the domain of atoms.[12] Thus, *prima facie* the squares are 242 and distributively bigger than my left foot, while the tiles are 24200 and distributively smaller than my left foot, and thus they are not 242 and they are not distributively bigger than my left foot. This does not count as an exception to indiscernibility between squares and tiles of one and the same floor, since the evaluation of sentences such as "The tiles are 242" and "The squares are 242" should take account of this relativization.

[12] The ways of dividing the domain of atoms to which the predicates are relativized are not partitions but "covers": in a partition, the sets of atoms are disjoint, while in a cover they are allowed to overlap. This distinction is important in Cotnoir's semantic analysis of collective and cumulative predication (Cotnoir, 2013, 309), but nothing in our analysis depends on it.

This can happen in two ways. Either in an indexical form, so that “The tiles are 242” is false because there is a contextual parameter that makes the evaluation relative to the division of the floor in tiles, while “The squares are 242” is true because there is a contextual parameter that makes the evaluation relative to the division of the floor in squares. Or in a subvaluational form, where it is enough for the truth that *there is* a division of the floor such that its pieces are 242, so that both “The tiles are 242” and “The squares are 242” come out true. Admittedly, the subvaluational route leads to the hardly digestible result that both the tiles and the squares are both 242 and 24200, but this can be attributed to the well-known logical peculiarities of sub-valuational (and super-valuational) approaches, and, as usual in these cases, the expected incompatibilities are preserved within the perimeter of each single evaluation.

In both cases, Leibniz’s Law holds. In the indexical variant, the alleged exception to indiscernibility comes out as a misleading appearance, that fades once we consider the appropriate contextual parameter. In the subvaluational variant, the terms of true GI statements can actually be substituted *salva veritate*, so that the alleged exception is instead a confirmation of Leibniz’s Law.

But let us take a step back and ask: Is indiscernibility desirable at all? Once attained, what does it show? When standard identity is at stake, the principle of indiscernibility is seen as non-negotiable insofar as it boils down to the hardly controversial claim that anything has just the properties which it has. However, the principle does not say *exactly* this: it says that anything has just the properties which anything identical to it has. This can be turned into the platitude that anything has the properties which it itself has only if identity is meant, as usual, as that relation which anything has with itself and with nothing else. However, Cotnoir’s GI is not such a relation. What are the terms of the GI relation expressed by $\approx$? Well, as in any other statement with a relational predicate, the terms of the relation are the denotations of the terms that are arguments of the relational predicate. Thus, in the example of the floor, we have the set of the tile-sets of atoms on one-side, and the set of the square-sets of atoms on the other. They are different sets, with different elements. Now, why should indiscernibility between such different sets be desirable at all? Why should we complicate our semantics to make them indiscernible?

Moreover, let us concede that Cotnoir's rich semantic framework is independently motivated (e.g. by the needs of the semantic analysis of certain predications) and succeeds in vindicating indiscernibility for the relation labelled by Cotnoir as "general identity". What would this show? We would have a statement about different sets, and his framework would make them indiscernible. Does this provide any evidence for the claim that they are genuinely identical, in spite of the fact that they are undeniably non-identical from a set-theoretic point of view?

Obviously, Cotnoir does not mean indiscernibility as the exclusive or most important *motivation* for strong CAI. Indiscernibility is not meant as a proof of genuine identity, but as a necessary condition for holding seriously the claim that being the same portion of reality is a genuine identity relation. Strong CAI is *already* motivated by the allegedly "striking analogy" between one-one identity and the relation of being the same portion of reality. The will to defend and develop this "striking analogy" meets several challenges, and the extension of Leibniz's Law is perceived as the most important and perhaps difficult among them. But, if indiscernibility is obtained through a semantic framework that delivers true alleged identity statements whose terms are not coreferential, no step forward is really made.

Even worse, we suggest that the neat balance of the exchange between indiscernibility and coreferentiality is negative. We have seen that, according to Sider, a defender of strong CAI who denies Leibniz's Law "would arouse the suspicion that their use of 'is identical to' does not really express identity." (Sider, 2007, 59) But this *same* suspicion is aroused by the claim that a sentence obtained filling the gaps in "... is (generally) identical to ..." with referential expressions can be true also if the referents of these expressions are different, and is aroused exactly in the struggle of impeding that suspicion from being aroused by Leibniz's Law. The problem seems to us that, once conceded that the denotations of the arguments of $\approx$ are different, no evidence can be provided in favour of the thesis that the relation expressed by $\approx$ is an identity relation.

The concession made by Cotnoir when he drops coreferentiality can be compared to the concession made from the beginning in Max Black's counterexample to the identity of indiscernibles.[13] Black's thought-experiment involves *by design* or stipulation two numerically different spheres. Once this concession is made, the role of indiscernibility is not any more that of providing evidence in favour of the claim that the spheres are identical. In the case of Black's spheres, indiscernibility counts simply as an evidence against the principle of identity of indiscernibles.[14]

The situation is only partially different in the case of GI. The concession that the denotations of the arguments of $\approx$ are (sometimes) different is not a stipulation in a thought-experiment, but is made in the struggle to defend at the semantic level the independently motivated claim that a certain relation is a genuine identity relation, against the objection that Leibniz's Law does not hold for that relation. But it is still the concession that the terms of that relation are *different*, and, after this concession, we should not care about indiscernibility as a necessary condition for genuine identity: that relation cannot be an identity relation since it is allowed to hold between different things.

6 An Extension: Sean and Naes

Cotnoir's strategy can be trivially extended to *prima facie* arbitrarily discernible entities, and used to show that they are in fact indiscernible. As Katherine Hawley (Hawley, 2013) has remarked, some extensions of this kind are as easy as uninteresting. She outlines the

[13]Black (1951).

[14]This does not mean that the attempt to defend the principle of identity of indiscernibles by insisting that the spheres are, after all, numerically identical is completely worthless. See O'Leary-Hawthorne (1995) and Della Rocca (2005). But, within this attempt, indiscernibility can not be adduced as an evidence of genuine identity.

case of *antipodean counterparts.* The antipodean counterpart of a given object a is the object b, if any, which is located on the exact opposite side of the Earth from a. If a is a female person and b a male person, Cotnoir's strategy would show that, *relatively to its antipodean counterpart* b, a is a male person too. As Hawley writes, "no-one would mistake this for real indiscernibility", insofar as "it does not satisfy the 'same portion of reality' constraint." (326)

We agree. However, we are going to devise a different extension, in which the assimilation between standard identity and a relation subsisting between *prima facie* discernible entities has a certain degree of independent plausibility. Moreover, as we are going to see, the terms in the true sentences expressing this relation are coreferential. As a result, from this specific point of view, the affinity between this relation and standard identity is stricter than that between GI and standard identity. It will be quite evident that Cotnoir's method does not lead to the conclusion that the relation at stake in the extension is a genuine identity relation. But neither – we are going to claim – this conclusion can be reached for GI. After presenting the extension, we will make explicit the instructive differences between GI and the extension.

The relation we are going to focus on is *comaternity.* Two people are comaternal iff they have the same mother. Let us imagine that Sean Connery has a brother, Naes. They have the same mother. They are very, very similar: same eye color shade, same form of the nose, and so on. However, they are not (at least *prima facie*!) indiscernible: Naes is 6 feet and 3 inches high, while Sean is 1 inch shorter than Naes. A neo-aristotelian philosopher happens to think that comaternity is a very intimate relation: comaternals share the most relevant aspect of their biological origins. Being a peculiarly materialist kind of neoaristotelian, he thinks that: a) within conception, the matter comes from the feminine element, while the form comes from the masculine; b) the matter is the only important component, while form is of no importance. This counts as an analogy with one-one identity: Sean shares its biological origins with Naes, as well as anything shares its origins with itself.

Should we push this analogy to the point of classifying comaternity as a genuine identity relation? Let us investigate the logic of comaternity. Comaternity (unlike brotherhood) is an equivalence relation. What about Leibniz's Law? Sean and Naes seem to differ in height. But comaternity is such an intimate relation, and the sharing of origins is so strikingly ingrained with identity, that discernibility can not be but a misleading appearance. We can dispel it by revising our semantics.

Some sentences concerning British citizens should be evaluated relatively to passports, each identified by its number n. In particular, the sentences that need this treatment attribute to British citizens the physiognomic features declared in the passport itself. The passport, whose number is 123456789, is at the name of Sean Connery and says that the bearer of that passport is 6 feet and 2 inches high, while the passport, whose number is 987654321, is at the name of Naes Connery and says that its bearer is 6 feet and 3 inches high. No law forbids a single individual to be the bearer of multiple passports.

It is important to keep in mind that we are developing the assumption that Sean and Naes are, in a sense, identical: they are – adapting the usual reference to *portions of reality* in the debate about CAI – one and the same *matter.*

The semantics can be developed indexically or subvaluationally. Given an atomic sentence $P(t)$ constituted by a constant and a monadic predicate, $P(t)$ is true under the contextual parameter relative to the passport n iff the passport n attributes to $\bar{t}$ (the denotation of t) the predicate P. Thus, it is true under the contextual parameter relative to the passport 123456789 that Sean is 6 feet and 2 inches high, since that passport is at the name of Sean and says that its bearer (Sean) is 6 feet and 2 inches high. As well, it is true under the evaluation relative to the passport 987654321 that *Sean* is 6 feet and 3 inches high, since that passport is at the name of Naes and says of its bearer (Naes *alias* Sean: remember that we are assessing the hypothesis that they are, in a sense, identical and verifying if Leibniz's law holds for this instance of identity) that he is 6 feet and 3 inches high. By contrast, it is false under the evaluation relative to the passport 123456789 that Naes (*alias* Sean) is 6 feet and 3 inches high, since that passport is at the name of Sean and says of its bearer (Sean *alias* Naes) that he is 6 feet and 2 inches high: 1 inch shorter than required for the truth of our sentence. Under one and the same contextual parameter (under one and the same passport), Sean and Naes satisfy the same height predicates. We can get a failure of indiscernibility between Sean and Naes only if we disregard the contextual parameter.

If we go subvaluational, $P(t)$ is true iff there is an evaluation relative to a passport n (that is: there is a passport n) such that the passport n attributes to $\bar{t}$ the predicate P. It is true that Naes is 6 feet and 3 inches high, since there is an evaluation (a passport: 987654321) such that Naes is said to be 6 feet and 3 inches high. It is also true that *Sean* is 6 feet and 3 inches high, since there is an evaluation (a passport: 987654321) under which Sean (by hypothesis, identical to Naes, and thus denotation of "Naes") is said to be 6 feet and 3 inches high. As well, thanks to the evaluation relative to the passport 123456789, it is true that Sean is 6 feet and 2 inches high and it is true that Naes is 6 feet and 2 inches high. Also in this case, the expected incompatibility of the property of being 6 feet and 2 inches high with the property of being 6 feet and 3 inches high is preserved within the perimeter of each single evaluation (no passport attributes two different heights to one and the same person). Thus, we have avoided any failure of Leibniz's Law. What did we show?

7 Comaternity and Composition Are Not Genuine Identity Relations

There are at least two differences between comaternity and GI:

(1) Cotnoir's semantics is independently motivated by the needs of the semantic treatment of certain predications; the general idea that numerical predication is relative

to a concept or a sortal has a relatively high degree of independent plausibility. By contrast, the idea of evaluating the sentences about some physical features of people relatively to passports is not independently motivated. It is an *ad hoc* move, justified only by the firm conviction of the neoaristotelian philosopher that comaternity is analogous to identity, and that any evidence to the contrary cannot be but misleading.

(2) The semantics for GI admits true GI statements whose arguments are not coreferential. The numerical difference between the referents depends simply upon the general identity conditions for sets, and nothing has less controversial identity conditions than sets (two sets are identical iff they have the same elements). In the case of comaternity, we do not presuppose at all that "Sean" and "Naes" have different denotations. We make the opposite presupposition instead, since we aim to verify if the hypothesis that comaternity is a genuine identity relation survives to the test of Leibniz's Law. There is nothing viciously circular in our method. Presupposing the coreferentiality of "Sean" and "Naes" is just coherent with the hypothesis we find plausible for independent reasons.

Difference (1) shows that Cotnoir's indexical or subvaluational semantic treatment of some sentences is plausible, while our semantics is, well, not very promising in itself. Difference (2) marks a disadvantage for Cotnoir's approach instead: dropping coreferentiality in order to get indiscernibility makes indiscernibility extraneous to identity.

We are happy to concede that there is a difference also in the initial, intuitive motivations. We have simply pretended that the analogy between comaternity and identity is independently motivated, but obviously this would presuppose an independent defence of neoaristotelian materialism. By contrast, the general intuition that inserting in a general catalogue of what there is in reality or in a portion of reality both a whole and its parts (or, *analogously*, the same thing listed twice) would be a pernicious form of double-counting is something like a *datum*, which any credible stance about CAI should take into account. Nothing like this holds for *comaternity as identity*.

Comaternity (under the label of "maternal identity") is already discussed by Lewis in *Parts of Classes*, but from an interestingly different point of view. Lewis discusses an objection to his weak version of CAI in which the objector attempts to trivialize it comparing identity with other equivalence relations, including comaternity. Magpie and Possum (two cats that are used as preferred examples throughout Lewis's discussion of CAI) are "maternally identical."

> You could do the same trick with any old relations. Possum is 'maternally identical' to Magpie, if by that you just mean that something that is mother of one is identical to something that is mother of the other. [...] So what? (Lewis, 1991, 84)

Lewis's reply to this attempted trivialization is simply that "the mereological relations [...] are something special. They are unlike the same-mother relation [...]. Rather, they are strikingly analogous to ordinary identity." (*Ibid.*)

But the circumstance that the analogy between composition and identity is tighter than the analogy between comaternity and identity, and that it is in general "striking" makes simply *weak* CAI, as endorsed by Lewis himself, much more plausible than a putative weak form of *comaternity as identity*. When we move to investigate the logical workings of identity, composition and comaternity, in order to distinguish genuine relations of identity from those that are only analogous to them, Cotnoir's strategy seems to work even better for comaternity than for composition. Let us see if and how this can be repaired, and how much it costs.

8 Coreferentiality, Sets, Hyperplurals

We have shown in §4 that true GI statements are allowed to connect non-coreferential terms, at least if coreferentiality is meant in an absolute way that does not presuppose a certain theory of identity. Our interpretation, being based on a straightforward analysis of truth-conditions for GI statements as provided by Cotnoir himself, could seem beyond doubt. However, some *dissonant declarations* and *hints of alternative* possible *developments* can be found in his Cotnoir (2013) and raise some doubts. While the declarations are simply inconsistent with the prevailing part of Cotnoir's doctrine, the alternative developments could provide an independently motivated way to restore coreferentiality.

First, sometimes Cotnoir tends to say instead that the terms of true GI statements have the same reference. As we have already seen, he writes, in so many words, that "$\approx$ is a general notion of identity that holds between portions of reality *independent* of our ways of counting it." In some passages of his paper, Cotnoir writes also that singular and plural expressions refer to portions of reality.[15] Cotnoir aims to clarify the concept of *portion of reality* in terms of atoms: general identicals are the same portion of reality insofar as they are constituted by the same ultimate constituents. Is then GI a relation that holds *directly* between portions of reality, taken as atoms? Do the syntactical arguments of $\approx$ denote atoms directly?

This, for sure, would not be consistent with Cotnoir's own definitions. Let us look again, as an example, to the clause providing truth-conditions for many-many GI statements:

$xx \approx yy$ is true iff $\bigcup \overline{xx} = \bigcup \overline{yy}$

The atoms are the elements of $\bigcup \overline{xx}$ and of $\bigcup \overline{yy}$, but these two sets (the result of the set-theoretic unions) are not the terms of the relation. The terms of the relation (the denotations of the arguments of $\approx$) are different sets, whose unions are identical. If

[15]For example: "On my proposal, plural expressions only ever refer to a portion of reality under a way of counting." (Cotnoir, 2013, 316)

Cotnoir wants to claim that terms such as xx and yy refer directly to a portion of reality instead, he should be aware that this is not consistent with his own use of $\overline{\quad}$ as a symbol for the function associating an expression with its denotation.

But why does Cotnoir *restrain* from developing the idea that every term of a GI statement refers simply to a set of atoms? This would comply with the Coreferentiality Constraint in a straightforward way. "The tiles", "the squares", "the floor" would denote all a single set, whose elements are the atomic constituents in that single portion of reality.[16]

We think that this simple modification of Cotnoir's semantics is a step in the right direction and that, in general, the need to comply with the Coreferentiality Constraint should force the backers of strong CAI to adopt a non-standard treatment of the singular/plural distinction. The simple declaration that every term in a GI statement denotes the atoms in the portion of reality at stake would be the roughest variety of this approach.

In a few pages we are going to see that Cotnoir's hints to alternative developments of a semantics for GI point to a rather refined (though controversial) way to attribute to every term the set of atoms in a portion of reality as a referent. This more refined way consists in providing a semantic differentiation between coreferential terms. Namely, "the tiles", "the squares", and "the floor" would be coreferential, but the semantic difference between them would consist in the way in which they denote the same things.

But before trying to develop Cotnoir's suggestion, let us ask why Cotnoir should not follow the simplest route instead. If portions of reality are nothing else than atoms, why should the way in which portions of reality are divvied up in groups/sets of atoms should be reflected in the semantics of terms at all? Why should not the terms of a GI statements refer to atoms without other complications?

First of all, the resulting semantics would risk either being *non-compositional* or endowing some sentences with wrong truth-conditions. The atoms in the floor are *prima facie* neither 242 nor 24200. Nonetheless, a credible semantics should account for the

[16] "The floor" denotes this set also in Cotnoir's present formulation.

intuitive truth of "the tiles are 24200" and "the squares are 242". But if the ways of subdividing the portion of reality are not codified in any way in the semantics of the terms, where else should it be codified? Perhaps nowhere, and then the truth of these sentences would not depend on the meanings and syntactic relations of its constituent expressions, leading to a failure of semantic compositionality. Otherwise, it could be codified in the predicate, namely the numeric predicates in these cases. Thus, we could say that some atoms satisfies the predicate "are 24200" iff *there is* a way to group them in 24200 sets/groups. This would lead us a step beyond the above noted counterintuitivity of the sub-valuational variant of Cotnoir's semantics. In that case, both "the tiles are 242" and "the tiles are 24200" come out true, because *there is* a way to group the atoms in 242 sets (namely, tile-sets) and *there is* a way to group the atoms in 24200 sets (namely, square-sets).

But now, since by hypothesis no information about actual or possible groupings of atoms would be codified in the semantics of "the tiles", we would be forced to say that, *at least* for any number x minor or equal to the number of the atoms, "the tiles are x" is true, since atoms can be grouped in sets in whatever way.[17] And there is not a different level at which the expected incompatibilities are restored (as it happens within single evaluations in Cotnoir's subvaluational semantics).

Moreover, the *semantic revisionism* of this approach would not be easily confined to GI statements and to certain kinds of predications (such as numerical and collective predications). A minimum of *semantic innocence* requires that the referents of terms such as "the squares" or "the Bronte sisters" is the same also in other, plausibly non-intensional contexts. Thus, even within the sentences "The squares are nicely manufactured" or "The Bronte sisters died long time ago", terms would denote flat, unstructured sets of atoms only. The speaker would be – plausibly – ignorant about these atoms and, as a

[17]The specification "at least" is required because, as already noted at n. 12, the ways in which atoms are grouped in sets are, according to Cotnoir, covers and not partitions, *i.e.* they are allowed to overlap. As a consequence, the number of allowed sets of atoms could increase dramatically.

consequence, about the referents of his own expressions.

Cotnoir's semantics is in itself rather revisionary and seems to require a kind of systematic *error theory* about reference (the referents are sets and sets of sets, which the speakers would not identify as referents of their terms), but to a significantly lower degree.[18] The intuitive speaker's referent of "the tiles" (that is, the tiles themselves) is replaced by something at least structurally similar (for each tile, there is a tile-set of atoms). By contrast, if every term is made to denote a set of atoms, the speaker's referent gets simply ignored.[19]

Thus, it seems that there is something right in restraining from mirroring too straightforwardly in the semantics the singular/plural distinction between, e.g., "the tiles" and "the floor". But it does not do to simply declare that every term of a GI statement denotes a set of atoms, without changing *something else* in the semantics of the terms.

In order to envisage a more refined route to coreferentiality, let us consider Cotnoir's suggestion about alternative ways to develop a semantics for GI. Could the abandonment of coreferentiality be a bad consequence of the resort to set-theoretic tools? After all, the problem is that the true GI statements where plural terms are involved are not true iff the terms are coreferential; they are true iff a set-theoretic manipulation (namely the union) of the denotation of a plural term is identical (in the standard, set-theoretic sense) either to the denotation of a singular term or to the analogous set-theoretic manipulation of the denotation of another plural term. But Cotnoir at a point deflates the importance of his resort to set theory: "[F]or those with ontological qualms about using set theory in semantics", the semantics for GI statements "could be done with hyperplurals" (p. 301), and refers to Rayo (2006) as a suitable implementation.

Our analysis is not motivated by ontological worries about sets, but perhaps corefer-

[18] For a general overview of error theory, see Liggins (2008); Daly and Liggins (2010).

[19] The worries about semantic revisionism could be deflated if these semantic tools were limited to a mereological calculus, or to some other formal language built on purpose. But this does not seem to be the case for Cotnoir, whose overall defense of CAI contemplates, for example, the identification of a way to express many-one identity statements in English, with the help of free relatives (Cotnoir, 2013, 298-300).

entiality can be restored simply by getting rid of sets. There are two points in Cotnoir's semantics where one can try to dispense with sets. The first ((i) below) is rather simple, but of no help in restoring coreferentiality. The second (ii) is what Cotnoir points at when he refers to hyperplurals in the quotation above, but, since he does not say anything else on hyperplurals, we need to fill the details ourselves.

(i) One could observe that Cotnoir does not countenance any genuine kind of *plural reference* for plural terms. We have seen that a plural term denotes a set of things, so that – in English – "the Bronte Sisters" and "Anne, Charlotte, and Emily" would denote a set of three sets of atoms. Nonetheless, this is a way to mirror at the semantic level the syntactic plural/singular distinction: Singular terms denote sets of atoms, while plurals denote sets of sets of atoms. What happens if Cotnoir's semantics is adapted to the idea that a plural term denotes plurally many things, instead of the set of those many things? In the truth-conditions for GI statements, the denotation of plural terms would consist of several chunks-sets of atoms (in the case of "the Bronte Sisters", one set for each sister). As a result, set-theoretic union should be meant as a polyadic operation, and the resulting set will be again the same set of atoms. This modification would have no impact on coreferentiality.

(ii) The terms of GI statements could be taken to be *hyperplurals*. Hyperplurals (also known as superplurals and perplurals in the literature) are plural terms at different levels. In Rayo (Rayo, 2006) they are obtained by applying a saturating operator to certain predicates that subdivide in groups a domain of individuals in different ways of increasing complexity. The first level corresponds to standard plural terms, referring plurally to some individuals in the domain through a feature shared by them (e.g., "the pencils" is a plural term obtained by applying a saturating operator to the predicate "be a pencil"). At the second level, a saturating operator is applied to a collective predicate such as "are scattered on the table", generating a second-level hyperplural expression. This procedure could be iterated and lead always to higher levels of plurals.[20]

The purpose of the second-level term obtained saturating "are scattered on the table" is to talk about "groups" of things whose members are scattered on the table. Let us suppose that pencils are distinguished in groups (say: blue pencils, red pencils, black pencils) and that the members of each of these groups are scattered on the table, and no other group of things is scattered on the table. The idea would be that the reality referred to would consist in those same pencils that are the referents of the first-level plural expression "the pencils". The second-level hyperplural would be, in a sense, sensible to the grouping of pencils according to their colours, but the piece of reality referred to would be the same.

When applied to GI statements, the idea could be that syntactically singular terms for a whole would be – semantically – first-level plurals, while syntactically plural terms for the parts would be – semantically – second-level plurals. While Rayo does not introduce an identity sign connecting plurals at different levels, Cotnoir's reference to his work squares with the following Rayo's suggestion: "One could, if one wished, extend the formation rules of one's language to assign mixed identities as well-formed, and extend the semantics for one's language to assign mixed identities suitable truth conditions." (Rayo, 2006, 232)

First-level plurals would denote plurally the atoms, as much as "the pencils" denote the pencils. Now, what about the reference of "many" terms in GI statements? What would they denote? The second-level plural term built from the predicate "are scattered on the table" in our example would denote again the pencils. Analogously, the second-level plural terms in many-one, one-many and many-many GI statements would denote the atoms. The truth-conditions for GI statements could say that any GI statement is true iff its terms are coreferential. The difference between first-level and second-level plurals

[20]Rayo (2006, 226-228). Already at the second level, it is hard to find examples of saturated terms in natural language. See Linnebo and Nicolas (2008) and Oliver and Smiley (2013, 127-128) for some candidates. For what concerns GI, as we are going to see, there is no need to go beyond the second level.

referring to the same atoms, and that between various second-level plurals that "group" the same atoms in different ways would be relevant, e.g. in numeric predications, but would be irrelevant in GI statements, where – as much as in standard identity statements – what matters is only the referents of the syntactic arguments of the identity predicate.[21]

Thus, we get a more refined way to coreferentiality: all the terms of GI statements would refer to atoms (without any kind of set-theoretic intermediation), but these atoms would be denoted at a different level of plurality. The worries about compositionality and at least some of the worries about semantic revisionism, raised by the rougher way to coreferentiality we discussed in the first part of this section, would be greatly alleviated, thanks to a non-referential distinction between various levels of plurals. Once hyperplurals replace sets, a non-standard and more refined way to account for semantic number comes to help strong CAI in complying with the Coreferentiality Constraint.

9 Wallace, Bøhn, Hovda on Coreferentiality

The replacement of set-talk with hyperplurals could restore coreferentiality. But this solution does not come for free. Hyperplurals are controversial tools.[22] A positive solution of the lively debate about their alleged ontological innocence seems to be presupposed by the same idea that "the squares", "the tiles" and "the floor can *really* be coreferential. In which ways the various ways to divvy up the portion of reality are – so to say – encoded at different levels of plurals? Are they sets in disguise? What general kind of non-purely referential semantics is presupposed by the claim that coreferential plurals of different

[21]Perhaps some worries could be raised about the predicates needed to "build" the various terms. In Rayo (2006), hyperplurals are syntactically built from predicates and saturators. In GI, the terms would be standard singular and plural referential expressions, and different levels of plurality should concern only the semantic level. This means that the predicates could not be easily detected within the terms themselves of a GI statement. Perhaps, we could envisage complex predicates such as "be an atomic constituent of the floor" for the singular expression "the floor", "be an atomic constituent of at least a tile of the floor" for "the tiles", and "be an atomic constituent of at least a square of the floor" for "the squares".

[22]See McKay (2006, 46-53) and Uzquiano (2004) for various perplexities.

levels are semantically different?

We do not aim here to assess the overall viability of the hyperpluralist variant of GI, but only to remark that the defense of strong CAI requires the abandonment of a standard semantic treatment of the singular/plural distinction, and that this abandonment has a price. The defender of strong CAI cannot construe semantic number as Cotnoir does at a point in introducing the official, set-theoretic formulation of GI: "Let a term be semantically plural if the referent of the term is more than one object, and let it be semantically singular if the referent is only one object." (Cotnoir, 2013, 297)

In order to defend *strong* CAI, you need to construe identity statements for whole and parts, as well as for various subdivisions in parts of a same whole, in a way that makes their terms coreferential. The Coreferentiality Constraint is at least as constitutive as Leibniz's Law for identity. Weak CAI can ignore these aspects, since the "striking analogy" between composition and identity is compatible with the idea that to be the same portion of reality is not, strictly speaking, to be the same thing. While silent on the matter, Lewis was free to *deny* that the plural term "Magpie and Possum" is coreferential with the singular term for their mereological fusion.

The supporters of strong CAI do not enjoy the same freedom. Is Cotnoir alone in ignoring and violating the Coreferentiality Constraint? Not really. Nobody else is so explicit in violating it, and this is the main reason why our discussion of the Coreferentiality Constraint has been focused on GI. Some defenders are simply more elusive than Cotnoir on reference in identity statements and, as a result, their violation is harder to pinpoint. On the other hand, other approaches *preserve* coreferentiality. However, the general impression is that coreferentiality is never thematized or seen as an advantage for an approach over another.

Let us see what some other defenders of strong CAI (namely, Wallace, Bøhn, and Hovda[23]) say about reference in relevant identity statements. All of these authors care a

[23]Hovda (2005); Bøhn (2009, 2014); Wallace (2009, 2011a,b); Cotnoir (2013).

lot about the extensions of Leibniz's Law to composition, but we are not going to present their versions of CAI and their takes on indiscernibility in any detail, but only to assess to what extent their proposals satisfy the Coreferentiality Constraint.

Wallace introduces a hybrid identity predicate, $=_h$, and contends that a CAI theorist

> will intend for hybrid identity to be the classical identity relation with only one exception. 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)

While Wallaces's $=_h$ and Cotnoir's $\approx$ differ in several respects we are not going to discuss, the general strategy corresponds to that outlined in §2 on the basis of the successful case of standard plural identity: the logical principles governing standard one-one identity are shown to hold also for $=_h$. And also in this case, coreferentiality is not thematized.

But what do the terms of $=_h$ denote *de facto*? Wallace does not provide explicit truth-conditions for hybrid identity statements. However, within a discussion of possible objections to the extension of Leibniz's Law to $=_h$, she introduces a true hybrid identity statement – $b =_h O$ – meant to express the relation between her body and the molecules composing it. b is a singular term, O a plural one. Wallace claims that "'b' stands for my body, 'O' stand (collectively) for the molecules (that are part of my body)" (p. 812). Thus, a true hybrid identity statement is allowed to include non-coreferential terms.

Wallace does not resort to sets, and so it is not possible to detect the failure of coreferentiality in the clear-cut way allowed by Cotnoir's GI. It is not that the reference of b is different from the referent of O according to the uncontroversial identity conditions for sets. Wallace could try to insist that, according to CAI, the body *is* identical to the molecules, so that b and O are coreferential. After all, CAI is exactly the claim that the terms of the relation expressed by $=_h$ are identical.

However, this hypothetical rejoinder would simply assume that $=_h$ is a genuine identity predicate. But Wallace strives to *show* that $=_h$ is such. While attempting to extend Leibniz's Law to $=_h$, she declares that b stands for the body, and O stands for the molecules. It would be circular to assume at this point that $=_h$ expresses identity and that, as a consequence, its syntactic terms cannot be but coreferential. Wallace's declarations that they stand for different things should be taken at face value, and shows that her approach violates the Corefentiality Constraint.

Bøhn's way to strong CAI gives to the notion of *portion of reality* even more importance than Cotnoir's. And while Cotnoir attempts to clarify it in terms of chunks of atoms, Bøhn leaves it as a sort of primitive: "A portion of reality is whatever exists pre-set-like conceptualized, i.e. independently of certain ways of conceptualizing it." (Bøhn, 2009, ix)

The ways of conceptualizing the portions of reality play a pivotal role in Bøhn's semantic treatment of numeric (and collective) predications (in some cases, predicates are given an additional argument position for the concepts involved). By contrast, the ways of conceptualizing have no bearing on the reference of singular and plural terms.

In fact, Bøhn introduces a hybrid identity predicate (whose symbol is the standard $=$). The relation expressed by this predicate holds directly between portions of reality. The hybrid identity between some individuals and their fusion is expressed schematically by $xx = y$, and "'$xx = y$' is satisfied iff $v(xx)$ is identical with $v(y)$ where v is a primitive value assignment." (Bøhn, 2014, 144)[24]

If confronted with Wallace's example, Bøhn would say that b and O denote literally the same portion of reality, that is "whatever exists pre-set-like conceptualized." The set-theoretically conceived partitions of atoms (as a body, as many cells, as many organs) to which Cotnoir attaches great importance are here completely extraneous to reference. They are the result of a conceptualization, but this conceptualization corresponds to

[24]A preceding footnote (n. 2, pp. 143-144) clarifies that the value is the referent.

distinct referential expressions, occupying specific, additional argument places of some predicates. In the case of hybrid identity statements, they play no syntactic or semantic role at all.

As a result, Bøhn's approach respects the Coreferentiality Constraint: both the term for the whole and that for the parts simply denote the portion of reality. This comes at the price of admitting portions of reality as a primitive, but also of a non-standard semantic treatment of the singular/plural distinction. At the semantic level, there is no distinction at all. Both plural and singular terms denote a single portion of reality, and are, in this sense, equally singular.

Hovda aims to defend strong CAI from allegations of inconsistency. To this aim, he provides two ways to interpret a language including both plural and singular expressions. The sub-realist defense treats the singular/plural distinction in a highly peculiar way and respects the Coreferentiality Constraint; the realist defense treats the distinction in a more standard way and violates the Coreferentiality Constraint.

The *sub-realist* defense (also dubbed *atomist*) admits only atoms as really existent items and, as a consequence, as possible referents. The difference between plural and singular terms does not consist in the number of atoms denoted, but in the number of *instances* of reference (as a relation) involved. Plural terms "bear the reference relations many times over", while singular terms "refer only once." (p. 11)[25]

Each instance of reference can be either to one or many atoms. A singular term refers once, to one atom individually or to some atoms collectively. Thus, except for singular terms of single atoms, every other singular term refers actually to many things. On the other hand, plural terms refer "multiple times, each time to some atom or some atoms collectively." (p. 12) Thus, "the floor" would refer once collectively to the atoms composing the floor, while "the tiles" would refer multiple times, each time collectively to the atoms composing each tile of the floor.

[25] "Times" are not temporal instants, but different instances of the reference relations.

Analogously to what happens in the hyperpluralist variant of GI, “the floor”, “the tiles”, and “the squares” refer all to the same atoms. Hovda endows hybrid identity statement (the predicate is =) with truth-conditions in terms of standard plural identity. $t = s$ is satisfied just in case every atom that is among the atoms referred to by t is among the atoms referred to by s, and *vice versa*.[26] Hovda does not write simply that t and s must denote the same atoms since this would obliterate the different number of instances of reference relation between them. But the instances do not actually play any role in the semantics of hybrid identity statements. As a result, Hovda's sub-realist defense obeys the Coreferentiality Constraint.

Hovda's *realist* defence of strong CAI admits also complex items as possible referents. It does not presuppose atomism in any way. Hovda considers a plural expression such as “J_l and J_r”, built with “and” as a connective from two singular expressions J_l and J_r for the two halves of John. He writes that “J_l and J_r” “refers to two things. It refers to Johnleft, and it also refers to Johnright. It does not refer to John.” (p. 15) By contrast, “the expression ‘John’ [...] refers to one thing.” (*ibid.*) The hybrid identity statement “J_l and J_r are, collectively, identical with John” is then said to be true. Thus, Hovda's realist defense admits true hybrid identity statements whose terms are not co-referential.[27] Consistently with our analysis, the failure of coreferentiality follows from a quite standard treatment of the singular/plural distinction, according to which a singular term refers to only one thing, while a plural term denotes many things.

[26] Hovda (2005, 12) uses “among” instead of “is one of” (as in our definition of plural identity in §2). The difference is not important in this specific context.

[27] Some dissonant remarks in Hovda's unpublished work could suggest a way to restore coreferientiality. Hovda writes that “when we refer to John, we refer to those atoms [the atoms composing John] collectively. We also refer to Johnleft and Johnright, collectively. These are just many ways of describing the same fact.” (p. 14) This could mean that, e.g., both “John” and “J_l and J_r” refer both to John and to John's two halves. If properly developed (would this be a case of ambiguous reference?), this approach could lead to yet another highly non-standard treatment of semantic number and allow Hovda to respect the Coreferentiality Constraint. However, when discussing an example of hybrid identity statements, we have seen that he writes in so many words that “J_l and J_r” “does not refer to John” (p. 15), preferring a standard treatment of semantic number over this possible way to preserve coreferentiality. This missed opportunity seems to be an unresolved tension in Hovda's manuscript.

10 Conclusion

Coreferentiality is unduly neglected in the literature on CAI. While much attention is paid to Leibniz's Law, the seemingly indisputable requisite that a true identity statement can not make reference, in its two halves, to *different* things is only sparsely and randomly respected, almost as an unaware side-effect of other choices. Nonetheless, an analysis of the existent approaches from the viewpoint of the Coreferentiality Constraint proved quite instructive, and delivers a relatively coherent diagnosis.

A defender of strong CAI should always care about coreferentiality, and stay clear of standard treatments of semantic number. The costs of non-standard treatments of semantic number are heterogeneous, ranging from controversial semantic tools, such as hyperplurals or instances of reference, to ontological heavy primitives, such as atoms or portions of reality. Other options are likely to emerge. It is difficult to decide whether or not to shoulder one of these costs (that is, whether or not to defend strong CAI at all) and which one to choose. But the Coreferentiality Constraint can not be simply ignored.

Acknowledgments

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