Plurals, mass nouns and reference: philosophical issues

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Abstract

How do plurals and mass nouns refer? What kind of logic should be used in order to account for the truth-conditions of the sentences they appear in? For linguists, first-order predicate logic is adequate, provided it is supplemented by a notion of mereological sum for plurals and for mass nouns. On the contrary, according to some philosophers, new logics must be used, plural logic for plurals and mass logic for mass nouns. We survey these debates in this entry.

Keywords: count noun; mass noun; mereology; plural; plural logic; reference.

Key points:
• Compare two views about how plurals refer.
• Compare three views about how mass nouns refer.

1   Introduction

Many languages draw a grammatical distinction between mass nouns and count nouns (Gillon, 1992; Nicolas, 2002, 2024).

A defining characteristic of mass nouns, like *water*, *sand* or *furniture*, is that they are invariable in grammatical number, while count nouns, like *rabbit*, *table* and *set*, can be used in the singular and in the plural. Depending on the language, this basic morphosyntactic difference between the two types of noun is supplemented by differences as to the determiners they can combine with. Thus, in English, mass nouns can be used with determiners like *much* and *a lot of*, but neither with *one* nor *many*. On the contrary, count nouns can be employed with numerals like *one* and determiners like *many*, but not with *much*. This entry is concerned with how mass nouns and plural terms refer–or put differently, what kind of logic should be used in order to account for the truth-conditions of the sentences they appear in.

In the case of plurals, as we discuss in section 2, there are two broad camps. On one camp, plurals refer to collections of some kind. A collection is an entity that has other entities as parts or members. The collection may be a set–*the men* referring to the set of men–or a mereological sum–*the men* referring to the mereological sum of all men. The latter option is very popular in linguistics (Link, 1983; Gillon, 1992; Champollion, 2017). An attractive feature of this kind of view is that one uses the same kind of logic as one does when dealing with the rest of the semantics of the language. This may be first-order predicate logic or some enrichment based on the lambda calculus. These logics are singular insofar as a term always takes a single value when it's interpreted. For this reason, these views are sometimes described as singularist.

On the other camp, plurals have a primitive way of referring, which is irreducible to first-order predicate logic. A plural term like *The men* doesn't refer to an entity. It plurally or collectively refers to all men at once, which makes the logic genuinely plural. This view has become popular among philosophers (Boolos, 1984; Oliver and Smiley, 2001; McKay, 2006; Rayo, 2006; Yi, 2005; Oliver and Smiley, 2016; Florio and Linnebo, 2021).

In the case of mass nouns, a similar debate arises, as we discuss in section 3.

2   Plurals

As we said, according to most linguists, a plural term like *the men* refers to the mereological sum of the men. There are two simple arguments for this view. First, using sums gives us a simple and efficient way to characterize the semantics of plurals, integrating it with the rest of the semantics. One just needs to enrich the domain with special entities–mereological sums. Second, sums of concrete objects are concrete, whereas, for most, sets are abstract independently of the nature of their elements. If *The men carried the table* is true, then it's more plausible to take the agent of the event described to be the sum of the men than the set of men, since the latter is an abstract entity whose causal powers would remain mysterious.

On the other camp, plural logic is supported notably by the following intuition. While the mereological sum of men is concrete, this may seem to be a postulated entity. Whenever there are some things, why should we postulate that there be a sum of them? The view that plurals refer to sums makes this assumption, which is an axiom of classical extensional mereology (Cotnoir and Varzi, 2021). Adopting plural logic–the view that plural terms refer to several things at once, in their own primitive way–allows one to avoid this assumption altogether.

What other arguments are there, for or against either view? We begin by presenting more arguments in favor of plural logic, together with responses on behalf

of friends of the mereological approach to plurals, following closely the discussion in Florio and Nicolas (2021, sec. 3). Then we move to an argument in favor of the latter.

In our discussion below, we presuppose Link (1983)'s rendering of the mereological approach to plurals and mass terms. On that view, plurals have their own atomic mereology, based on a relation of *individual* parthood and a notion of *individual* sum. A count noun *N* denotes a set of atoms and its plural form *Ns* a set of sums of such atoms. The plural definite *the Ns* then denotes the sum of all these atoms. For instance, *grain* denotes the set of all grains, where each grain is an individual atom; and *the grains* denotes the individual sum of all grains. Likewise, *the piles of grains* denotes the individual sum of all piles of grains, where each pile is an atom. Mass terms have their own *material* mereology, which isn't atomic.

Above, we mentioned the view that postulating arbitrary mereological sums is superfluous. A similar idea can be expressed in terms of ontological commitment. On a singularist approach to plurals, a plural term refers to a collection, be it a set or a sum. A sentence involving that term is thus ontologically committed to the existence of this collection. But, says the partisan of plural logic, the sentence itself isn't so committed (McKay, 2006, 28-29). Thus, the sentence *The men met* is ontologically committed just to the existence of the men, nothing more, be it a set or sum of men.

However, intuitions about ontological commitments vary among theorists. Some have argued that plural quantification commits us to sets or set-like collections (Resnik, 1988). In a similar vein, proponents of the mereological approach can simply insist that their analysis reveals the true commitments of plural sentences. Or instead of taking sides, one may agree with Linnebo (2003) that objections based on the notion of commitment shouldn't be given significant weight.

A related objection concerns logical inference. From the truth of *Annie and Bonnie won*, it would logically follow that *Some thing won*, contrary to fact (Yi, 2005, 468-469). But inspection of the semantics shows that this, in fact, doesn't follow. On Link's semantics for plurals, since *thing* is a count noun, *Some thing won* is rendered as

(1) $\exists x(\mathbf{won}(x) \wedge \mathbf{atom}(x))$

This says that there is something which is an atom and which won. On the contrary, the truth of *Annie and Bonnie won* only entails this:

(2) $\exists x(\mathbf{won}(x))$[1]

Here, it's of course crucial to distinguish the object language (English) from its

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1. Of course, (2) can expressed in English as *Something won*, but since there is no requirement of atomicity, this is unproblematic.

translation into the formal language of the theory and from the metalanguage used to interpret the latter.

Then come *flattening* objections: plurals are analyzed using a mereological relation other than individual parthood, and this is shown to have implausible consequences. Consider these sentences inspired by examples from Rayo (2002):

(3)   The piles of grains are scattered.

(4)   The grains of sand are scattered.

Suppose the grains are neatly arranged into piles and the piles are scattered. Then the first sentence is clearly true while the second may seem false since the grains form neat piles. Yet it would seem that the sum of the piles is just the sum of the grains, predicting that the second sentence should be true as well.

However, the two sums are identical only on a material reading of the notion of sum, under which it's claimed that the stuff that makes up the piles of grains is the very same stuff that makes up the grains of sand. But this understanding of the notion of sum isn't the one operative in the semantics. The semantics is based on individual mereology, relative to which each pile of grains is an atom, each grain of sand is a distinct atom, and so the subjects of (3) and (4) have different denotations.

In the vicinity, one also finds *reflexivity* objections, which arise when one applies the semantics to certain sentences of the metalanguage. In the metalanguage, define a non-atom to be a sum of two individual atoms or more, suppose there are at least two atoms, then consider:

(5)   The atoms are the non-atoms.

(5) seems plainly false. Suppose it were an ordinary sentence of English. Then the semantics would predict it to be true, since the individual sum of all atoms would be identical to the individual sum of all non-atoms (Schein, 1993).

To avoid reflexivity objections of this kind, a simple answer is available. This is to insist that the mereological notions used in the semantics be new, namely that they not be part of the language under study. So the crucial thing is that (5) isn't a sentence of the object language, English; it's only a sentence of the metalanguage used to give the semantics. Still, an adequate account of such plural talk of *atoms* and *sums* in the metalanguage can be given by relying on a meta-metalanguage containing new mereological notions, such as *super-parthood*, *super-sum* and *super-atom*. This step must then be iterated if one wishes to analyze plural talk involving these new notions. The iteration continues, and the effect is an ontological hierarchy of mereological levels, where the sums at one level are the atoms at the next level. Here, notice that friends of plural logic are also committed to a hierarchy. On the assumption that one can quantify over absolutely everything, the model theory for a simple plural language must be expressed in a metalanguage

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which is strictly stronger (Rayo, 2006), for instance one allowing for superplural quantification and predication–quantification and predication over "pluralities of pluralities".

Following Florio and Nicolas (2021), we've seen how the main arguments against the mereological approach to plurals can be answered. Let's now mention one argument they present in favor of the latter view. As said at the beginning of this section, the mereological approach to plurals and mass terms easily integrates them with the rest of the semantics (determiners, adjectives, verbs, etc.) by enriching the domain with individual sums in the case of plurals, and material sums in the case of mass nouns. Basic predicates denote sets of entities and truth-conditions are derived by operations on such sets. By contrast, the question remains open how plural logic can be integrated with the rest of semantics. A clear obstacle is the following. The semantic value of a plural term is neither an entity nor a set of entities. Rather, it belongs to a new primitive type: "things". But an instance of this type can't be an element of a set. (While each of Russell and Whitehead can be an element of a set, Russell and Whitehead as many can't.) An important consequence is that one can no longer build complex semantic values using just set-theoretic operations. This means that plural logic can't be easily integrated with semantics as currently developed by linguists (Florio and Nicolas, 2021, 441-442). How the integration is to proceed remains to be worked out.

Before closing this section, let's note that plural logic remains an attractive, powerful tool in metaphysics, in particular in the philosophy of mathematics. For instance, Florio and Linnebo (2021, ch. 12) argue that primitive plurals allow one to give an account of sets in a broadly Cantorian way, regarding a set as "many gathered together as one". So choosing between the mereological and the plural logic approach may depend on one's purpose.

3 Mass nouns

In the case of mass nouns, a similar debate arises. On one camp, mass nouns refer to special entities. Typically, the referent is taken to be a mereological sum (Link, 1983; Gillon, 1992; Champollion, 2017). Let *M* be a mass term and *P* a predicate. If there is some M that P, then the definite description *the M that P* designates something, namely the sum of the M that P. Thus, *the water in the two bottles* refers to an entity, the sum of everything which is water in the two bottles. On a minority view, the referent is taken to be a set–e.g. the set containing any portion of water in the two bottles as element (Burge, 1972). The view that mass nouns denote sums is almost universally accepted by linguists and philosophers.[2]

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2. A quantified statement, like *Some water is hot*, asserts that there exists something which is water and which is hot, where the existential quantifier is that of first-order predicate logic.

Still, there are two less well-known alternatives. They are attractive notably for those weary of the ontological commitments of mereological sums (any objects have a sum). On one alternative, mass nouns, like plurals, are able to refer to several things at once (Nicolas, 2008).[3] Thus, *the silverware on the table* refers to several pieces of silverware at once when these pieces are what's on the table. Likewise, *the water in the bowl and the cup* refers to two entities at once, the water in the bowl and the water in the cup. The underlying logic is plural logic. The driving intuition is the same as earlier: there is no need to postulate arbitrary sums of pieces of silverware (or of portions of water), when one can refer plurally to those pieces (or portions).

On another alternative, mass nouns refer in their own primitive way (Laycock, 2006; McKay, 2015), irreducible to both first-order predicate logic and plural logic. The underlying logic is a new primitive mass logic. As McKay (2015, 3085) argues, "when I drink some water (two and a half cups of water; a lot of water) I drink some stuff, but there is no thing and there are no things that I drink, or at least the existence of a thing or things that I drink is not a semantic consequence of the claim that I drank some water. Not all quantification is quantification over things. Quantifier words indicating existence ('some') or proportion ('most') apply to stuff as readily as to things. Other mass quantification involves measurement rather than individuation and counting."

The plural logic approach to mass nouns would work in tandem with the plural logic approach to plurals, thereby yielding an attractive package for those already using plural logic, notably in metaphysics. It's therefore worth evaluating whether the plural logic to mass nouns can answer the objections that have been raised against it. As we'll argue below, the approach can indeed give satisfactory answers to all these objections except one, about counting things like furniture.

Under the plural approach, what are the portions that are being plurally referred to? In the case of the water in the bowl and the cup, a notion of maximally connected portion of water seems implicit: the portions referred to are the two maximally connected portions of water. But those don't always do the job:

(6)   The clay that was on the desk on July 1st is identical with the clay that was on the table on July 2nd.
      (Context of utterance: three solid bits of clay were on the desk on July 1st, and two solid bits of clay were on the table on July 2nd. Example inspired by one from Cartwright (1965).)

Which plurality of portions of clay could make the identity claim true? The maximally connected portions of clay that exist on each day don't work since in standard plural logic three things can't be identical to two. What about the plurality

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3. The view that mass nouns refer to sets of portions of matter (Burge, 1972) faces broadly similar challenges as the plural view. For reasons of space, we focus on the latter.

of all minimal parts of clay, i.e., the plurality of all the instances of clay that have no other instance of clay as part? However, with mass nouns like *garbage*, it isn't clear what the minimal parts would be (Pelletier and Schubert, 1989). And more crucially, one can't exclude a priori the possibility that what a given mass noun applies to may be indefinitely divisible. Indefinitely divisible matter is often called *gunk* and a predicate is said to *gunky* if, whenever it applies to some x, it also applies to some proper part of it. So, the argument goes, the semantics should not require mass nouns to have minimal parts and make gunk impossible (Bunt, 1985; Gillon, 1992).

However, with Nicolas (2008), one may insist that the truth of (6) doesn't require the clay to have minimal parts: it just requires a common decomposition of the clay on July 1st and the clay on July 2nd into some identical bits of clay. Such decompositions–called covers or coverings–are independently needed to account for the variety of readings to which sentences containing mass terms are liable–notably their collective and non-collective readings (Gillon, 1992), (Nicolas, 2008, sec. 4 & 5). The point just made would apply in the same way if *clay* were a gunky predicate.

One might think that gunk is incompatible with a plural view of mass terms for another reason, namely the assumption that the parthood relation used to define gunk must be replaced by the *among* relation between pluralities. This would require any plurality *xs* which is clay to contain a proper plurality *ys* which is also clay, making the *among* relation non-wellfounded. While the coherence of a non-wellfounded plural logic has recently been defended (Werner, 2022), it would certainly be highly non-standard and unintuitive (see Zimmerman (1995, 98-100) and Steen (2022, sec. 2.2) for an analogous argument against a set-theoretic approach to mass terms).

However, the mentioned assumption needn't be made. On the plural approach, one can accept that many portions of a mass noun *M* have parts. A key point of disagreement with the mereological approach concerns unrestricted composition, the claim that any portions of M have a mereological sum. On the plural approach (Nicolas, 2008, sec. 5), there's no need to postulate that portions which are physically separated, like the clay making up this bowl and the clay making up that cup, have a sum. It suffices to say that a term like *the clay making up the bowl and the cup* refers plurally to the two disjoint portions. Suppose there is no other clay. Then the noun *clay* itself denotes these two portions, the parts of each portion which are clay, and all pluralities of disjoint portions of clay. The same would be true if *clay* were a gunky predicate.

Another potential difficulty is the following. On the plural approach to mass terms, it turns out that mass nouns such as *lemonade* must be taken to be temporary predicates (Nicolas, 2021, sec. 4). When one mixes water, sugar and lemon, one doesn't create something new–some lemonade–, one simply mixes constituents

appropriately so that they can be described as lemonade. This may seem counter-intuitive. But given plausible assumptions about chemistry (Needham, 2010), the same then holds for all mass nouns designating matter, including *water*: they are temporary predicates, true of nuclei and electrons on the plural view, or true of sums of nuclei and electrons on the mereological view.

As said at the outset, mass nouns are always used in the singular and don't combine with numerals (**two waters*, **one furniture*). This may be taken to indicate that mass nouns are outside the system of grammatical number and that the singular is only used as the unmarked morphological default (Corbett, 2000, 172). This idea is straightforwardly adopted by the mass logic view, which claims that instances of a mass noun are neither one nor many. It can perhaps be adopted by the other views, but less easily. On the mereological and plural views, a mass term has distinct instances, so why can't these be counted, at least in some cases (Olson, 2011, sec. 3)? One answer is that these instances massively overlap (e.g. the water in a bottle and all its parts) but counting requires mereological non-overlap (Landman (2020); but see Sutton (2015) for a different assessment). The plural view can't say this about things like furniture and must either maintain that, in such cases, the impossibility of counting is a brute grammatical fact, or claim that nouns like *furniture* aren't true mass nouns and have their own semantics (McKay, 2015, 3094). Within the mereological approach, Landman (2020) develops a novel (and somewhat complex) account of mass nouns under which the extension of a mass noun like *furniture* is overlapping and counting only applies to nouns with non-overlapping extensions.

For the friend of mass logic (Laycock, 2006; McKay, 2015), these difficulties arise because one has taken the wrong lenses, those of first-order predicate logic or plural logic. The logic of mass terms is primitively mass. McKay (2015) develops diachronic principles which tell us when we have the same matter of kind M at a time t1 and at a later time t2. These principles for matter of a kind (e.g. bronze) differ from those for objects of a kind (e.g. statues). This allows him to deal with the problem of coincidence between an object and its matter in a novel way.

These principles are interesting, but they can be reformulated by the other views. Thus, Nicolas (2008, sec. 5) puts forward similar principles for the plural view of mass terms. And any formula of the putative primitive mass logic can, it seems, be reinterpreted as a formula of first-order predicate logic bearing on mereological sums. Moreover, just as for plural logic, there remains the question of how to integrate mass logic with the rest of the semantics which is usually carried out through operations on sets.

Overall, each approach to mass nouns may be seen to suffer of some defect. The choice between them may thus depend on one's purpose (and, of course, of one's assessment of the discussion of the various arguments above).

4   Conclusion

For natural language semantics, the mereological approach to plurals and mass terms offers a unified and efficient framework (Link, 1983; Gillon, 1992; Champollion, 2017).[4] For one weary of the ontological commitments of mereological sums (any objects have a sum), the plural logic and mass logic approaches are attractive. Among them, the plural logic approach has the virtue of simplicity, using a single framework for both plurals and mass nouns. The plural logic approach is also independently attractive in the philosophy of mathematics. Finally, the primitive mass logic approach may be adopted by someone who is convinced that the logic of mass nouns is essentially different from mereology and plural logic (Laycock, 2006; McKay, 2015).

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4. As indicated, Link (1983) defines an atomic mereology for plurals and a distinct mereology for mass terms. More recent approaches adopt a single mereology for both (Gillon, 1992; Rothstein, 2017; Landman, 2020). Such approaches have to explain how they can answer flattening and reflexivity objections (discussed in section 2), since the answers proposed by Florio and Nicolas (2021) make crucial use of the fact that plurals have their own atomic mereology.

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