The Mereological Approach to the Mass/count Distinction: Critical Remarks (abstract)

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In this paper, I discuss problems of a standard approach to mass and count nouns. The approach invokes the part-whole relation to give semantic accounts of both mass and count nouns. Its major proponents include, among others, Link (1983), Gillon (1992), Chierchia (1998a; 1998b; 2010), and Rothstein (2010, 2017). Link (1983) uses lattice theory to formulate mereology and models the semantics of mass and count nouns with (complete) Boolean algebras. He holds that the difference between the two kinds of nouns is that count nouns, unlike mass nouns, require *atomic* Boolean algebras, which suggests the *atomicity thesis*: singular count nouns (e.g., 'door') have only atomic denotations. Assuming this thesis, Gillon (1992) and Chierchia (1998a, 1998b) hold that count nouns differ from mass nouns in making atomic denotations grammatically accessible, and argue that this difference explains the syntactic features characterizing mass and count nouns. Recently, Rothstein (2010, 2017) criticizes their atomicity thesis but presents an account that rests on a refinement of the thesis: count nouns are not "naturally atomic" but "semantically atomic" (2010, 356). I discuss two problems common to these accounts. And I argue that the problems stem from the approach they share, the mereological approach, and note that one can resolve the problems by rejecting the approach for count nouns and abstract mass nouns.

1. Abstract mass nouns

It seems natural to invoke the part-whole relation to give the semantics of concrete mass nouns: 'water', 'furniture', etc. If two cups, C1 and C2, contain water, the water in C1 (W1) is a part of the water that is in either C1 or C2 (W2). So, it seems, 'water' has denotations (W1 and W2) one of which is a part of the other. But it is hard to see how one can give a similar account for abstract mass nouns: 'whiteness', 'vivacity', 'exactitude', 'vibrancy', 'appreciation', 'refinement', 'humanhood', 'leadership', 'patience', etc. To extend the part-whole model, Levinson (1978; 1980) holds that abstract mass nouns relate to *abstract* stuffs, which have abstract parts. Moltmann (2004) and Nicolas (2008) hold that they denote tropes or (abstract) instances of properties (e.g., John's patience). But such attempts have a serious problem. Compare (1a)–(1b) with (2a)–(2b):

(1) a. Alice has *no* patience (at all).
b. Alice has *more* patience than Bob.

(2) a. Ali has *no* water (at all).
b. Ali has *more* water than Baba.

(2a) and (2b) are incompatible, for (2b) implies 'Ali has some water.' But (1a) and (1b) are compatible. Someone who has no patience at all might still have more patience than someone who has even less patience, just as someone who is not patient at all might still be more patient than someone who is even less patient. This means that one cannot extend part-whole accounts of concrete mass nouns to abstract mass nouns.

2. The atomicity thesis

A common noun *N* is said to be *homogeneous*, if anything denoted by *N* has two non-overlapping parts that are both denoted by *N*. And a common noun *N* is said to be *atomic*, if nothing denoted by *N* has a proper part denoted by *N*. Homogeneity and atomicity are contraries for non-vacuous predicates (i.e., predicates denoting something),[1] and non-vacuous atomic nouns are not homogeneous. Link (1983), Gillon (1992), and Chierchia (1998a, 1998b) assume that singular count nouns (i.e., singular forms of count nouns) must be atomic and use complete atomic Boolean algebras to give their semantics: a singular count noun (e.g., 'door') denotes in a Boolean algebra model atoms of the model. So their accounts rest on the *atomicity thesis* for singular count nouns: singular count nouns are atomic.

As Rothstein (2010, 353ff) argues, however, there are various kinds of non-atomic singular count nouns: 'door', 'part, '(geometrical) line segment', etc. 'Door' is not atomic; some large doors are equipped with smaller doors (which are more often open). Neither is 'part'; parts of molecules (e.g., atoms) have proper parts (e.g., electrons) that are also parts of the molecules.[2] And 'line segment' is non-atomic and homogeneous; any line segment has many non-overlapping line segments as proper parts.

While rejecting the usual version of the atomicity thesis, Rothstein proposes a version of the thesis by distinguishing "semantic or count atomicity" from "natural atomicity" (*ibid*., 356). To define semantic atomicity, she holds that count nouns (unlike mass nouns) rests on a "counting context" that involves specification of "a contextually determined choice of what counts as one entity". She models the choice with selection of a set, *k*, of elements of a base model structure M (a Boolean algebra model for mass nouns). And the set, *k*, which is identified with the counting context, gives rise to the count structure B_k, a complete atomic Boolean algebra whose atoms are members of $\{ \langle d, k\rangle : d \in k \}$ $(= A_k)$. And denotations of a count noun in context *k* are required to be members of A_k. These might not be atomic in the base model M (*k* might have non-atomic elements of M). But they are atomic in the count structure B_k, which is meant to model the *semantic* part-whole relation (while M is meant to model the *natural* part-whole relation). So denotations of count nouns are *semantically* atomic (i.e., atomic on the part-whole relation in B_k).

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[1]They are not contradictories. Some non-atomic nouns (e.g., 'door') are not homogeneous.

[2]To apply the notion of *atomicity* to relational nouns such as 'part', it is necessary to extend the above definition of atomicity.

There are two problems of this formulation and defense of the atomicity thesis. First, it is one thing to specify Boolean algebra structures whose atoms are identified with potential denotations of count nouns, but quite another to show that there is a part-whole relation distinct from the natural part-whole relation on which all denotations of count nouns are atomic. And there is no good reason to think that there is such a relation that constrains the semantics of count nouns. To support this assumption, Rothstein says: "Count nouns differ from mass nouns because they allow direct grammatical counting. Counting . . . requires a contextually determined choice to *what counts as one entity*. . . . As our discussion of nouns like *fence* and *wall* showed, count nouns do not necessarily presuppose a specific set of salient atomic entities; instead, the model needs to specify a context dependent choice of *atomic elements* relative to which the count noun is derived" (ibid., 362; my emphasis). This argument rests on identifying (a) choosing what counts as *one entity* with (b) choosing what counts as *atomic*. But there is no reason to assume that whatever is one entity must be atomic on a part-whole relation constraining the semantics of count nouns.

Second, Rothstein's account yield incorrect results about some sentences about overlapping entities denoted by the same count nouns: Siamese twins, nested doors, overlapping parts of molecules, overlapping (geometrical) line segments, etc. Consider (3a)–(3c):

(3) a. The two Siamese twin boys (together) weigh 50 kg.
b. The two Siamese twin boys have a common part (e.g., a finger, a heart).
c. The parts of a water molecule include at least four parts that overlap each other.

Suppose that the two Siamese twin boys are Ali and Baba, and that they both weigh 30 kg while their common part weighs 10kg. Then they together weigh 50kg, and (3a) is true. But (3a) cannot be true on her account. Because the referent of the plural noun phrase 'the two Siamese twin boys' in the count structure B_k is the sum of two *atomic* objects in B_k (i.e., <Ali, *k*> and <Baba, *k*>), its weight in B_k is 60 kg (30 kg + 30 kg). The base model structure M has the sum of two overlapping elements (Ali and Baba) that weighs 50 kg in M, but that sum cannot be identified with the referent of the noun phrase in B_k (for context *k* has overlapping elements of M). Similarly, Rothstein's model structures can verify neither (3b) nor (3c). But both of these are consistent and true.

3. Concluding remarks

We can resolve the problems noted above by rejecting the mereological approach for count nouns and abstract mass nouns. Yi (2017) gives an account of abstract mass nouns that explains the contrast between the 'water' case and the 'patience' case by basing the semantics of abstract mass nouns (e.g., 'patience') on the semantics of the underlying base predicates (e.g., the gradable adjective 'patient'). On this account, the quantifiers 'no' and 'more' have different meanings in the two cases. Their use with abstract mass nouns stem from adverbs relating to their base predicates (e.g., 'not' in 'not patient', the 'more' in 'more patient'). Thus, on the account, (1a) and (1b) are compatible because they can be analyzed as follows:

(1′) a. Alice is *not* patient (at all).
b. Alice is *more* patient than Bob.

(Note that (1′a) and (1′b) are compatible.) We can then give an adequate account of abstract mass nouns (e.g., 'patience') by giving a proper account of gradable adjectives they derive from (e.g., 'patient'). To give an account of gradable adjectives that preserves the compatibility of (1′a)–(1′b) and the like, Yi (2017) argues that the semantics of gradable adjectives (e.g., 'patient') rests on reference to the *comparative relations* underlying the properties they refer to (e.g., being more patient than).[3] (The resulting account is called the *relational account*.)

The atomicity thesis stems from the mereological approach to plural constructions. The approach attempts to reduce plural constructions (e.g., plural forms of count nouns) to singular constructions that include mereological expressions. This approach takes 'is one of' and 'are some of' (or 'include') to refer to mereological relations, those that 'is an atomic part of' and 'is a part of' (or its converse) refer to, and concludes that denotations (e.g., Ali, Baba) of singular count nouns (e.g., 'boy') must be mereological atoms because 'Ali is one of the twin boys', for example, is true. I think the difficulty in defending the atomicity thesis is an indication of a general problem of the mereological approach to plural constructions. A more recent alternative to this approach, the *plural logic approach*, is to reject the traditional view that plural constructions are mere devices for abbreviating singular constructions to regard them as devices with substantial semantic functions that complement those of their singular cousins (Oliver and Smiley 2013; McKay 2006; Yi 2005, 2006). On this approach, 'is one of' and 'are some of' do not refer to mereological relations at all. Thus 'Ali is one of the twin boys' does not imply that Ali is an atom (on some part-whole relation), nor does the truth of 'Any water molecule has at least four parts' require four atomic and non-overlapping parts of a water molecule.

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[3]The trope account of abstract mass nouns (Nicolas 2008) can be taken to result from a trope account of comparatives (Moltmann 2004), according to which (1′b) can be analyzed as follows:

(1′) b′. Alice's patience (i.e., Alice's patience trope) exceeds Bob's.

But this analysis violates the compatibility of (1′a) and (1′b); (1′b′) implies that Alice has a patience trope, which means that she is patient.

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