

Plurality of Mass Nouns and the Grammar of Number

George Tsoulas
University of York

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1 Introduction

Nominal Mass predicates are those which have the property of cumulative reference. In Quine's (1960) words:

- (1) So called mass terms like *water*, *footwear*, and *Red* have the semantical property of referring cumulatively: any sum of parts which are water is water.

Cumulativity is defined as follows (2):

- (2) $(\forall X \subseteq U_p)(CUM(X) \iff \exists x, y(X(x) \wedge X(y) \wedge x \neq y) \wedge \forall x, y(X(x) \wedge X(y) \Rightarrow X(x \oplus_p y)))$

And following Krifka (1999), we can generalise it to n -place relations thus:

- (3) $(\forall x_1, \dots, x_n, y_1, \dots, y_n)(R(x_1, \dots, x_n) \wedge R(y_1, \dots, y_n)) \rightarrow R(x_1 \oplus y_1, \dots, x_n \oplus y_n)$

Cumulativity is a property that is shared by mass terms and count plurals.

2 Properties of mass nouns

Mass nouns are differentiated from count nouns with respect to a number of properties. Chierchia (1998a) lists the following properties. Some of these properties are clearly related but I give them in the way he does:

- (4) Availability of Plural Morphology
- (5) Compatibility with numerals
- (6) Classifiers and measure phrases

- (7) Some determiners occur only with count nouns
- (8) Some determiners occur only with Mass Nouns
- (9) Some determiners occur only with plurals and mass nouns
- (10) Some determiners are unrestricted
- (11) The mass-count distinction is independent from the structure of matter
- (12) A count noun can be made mass (the universal grinder)
- (13) A mass noun can be made count (the universal packager)

3 The debate on mass nouns

The debate regarding the semantics of mass nouns has, in general, been, on the one hand, ontological, i.e. is there a need to provide appropriate *stuff*-like referents for mass nouns, and if yes, should these constitute a separate model-theoretic domain? Thus Link (1983) has proposed that we should recognise two model theoretic domains and mass terms will take their denotation in the mass domain whereas count terms in the count domain. The basic model-theoretic structure looks like this:

- (14) A DUAL domain Model (this is a Link (1983) style approach)
 - a. $\langle \mathcal{D}, \mathcal{M}, p, g \rangle$ such that
 - b. $\mathcal{D} = \langle D, \cup_e, \leq_e \rangle$ is an atomic join semi-lattice
 1. $\forall X, X \subseteq D \rightarrow \cup X \in D$
 2. $x \cup y = \cup x, y$ (Sum)
 3. $(x) = \{y : y \leq x\}$ (Ideal generated by x)
 4. $AT(X) = x \in X : \{\neg \exists y[y \in X \wedge y \leq x]\}$ (AT: Atom)
 5. $AT(x) \neq \emptyset$ (Atomicity)
 - c. $\mathcal{M} = \langle M, \cup_M, \leq_M \rangle$ A non atomic join semi lattice
 - d. $g: D \rightarrow M$ The universal grinder
 - e. $p: M \rightarrow D$ The universal packager

One the other hand, there have been proposals according to which only one domain is needed. One recent instantiation of this view is due to Chierchia (1998a; 1998b; 2003), but see also Gillon (1987; 1992) and references therein for antecedents. See also Ojeda (2005) for a slightly different view. The story goes like this:

- (15) Singular NPs denote *sets of individuals*

To get the denotation of a plural NP, we will have to use a set forming operator and get all the possible sets containing at least 2 individuals from the extension of the singular. Therefore:

- (16) Plurals denote sets of sets of individuals. (call the sets of individuals *pluralities*)

Now, the domain of quantification will contain both the denotata of singulars and plurals and therefore it will look like this:

$$(17) \quad \begin{bmatrix} \{a, b, c\} \\ \{a, b\} & \{a, c\} & \{c, b\} \\ a & b & c \end{bmatrix}$$

this type of structure is a *complete atomic join semi-lattice*.

Given this we can represent the denotation of a singular as:

$$(18) \quad \{ a \ b \ c \}$$

and that of a plural as:

$$(19) \quad \begin{bmatrix} \{a, b, c\} \\ \{a, b\} & \{a, c\} & \{a, b\} \end{bmatrix}$$

Notice that what is missing from the denotation of the singular is the pluralities and what is missing from the plural is the singularities or atoms, as we would expect.

The operation that you need in order to get the plural from the singular is straightforward:

$$(20) \quad \text{PL}(F) = \lambda x[-F(x) \wedge \forall y[y \leq x \wedge \text{At}(y) \rightarrow F(y)]]$$

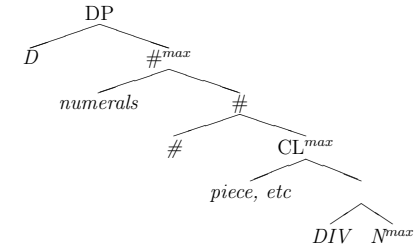
Mass nouns have a denotation which is differently structured. Namely, whereas the denotation of a singular is a subset of the set of atoms and the denotation of a plural is a subset of the set of pluralities the denotation of a mass noun is a sub-lattice of the domain, i.e. a construct with the same structure as the domain itself. in other words something that contains both atoms and pluralities.

It is in this sense that a mass noun is **lexically** or **Inherently** plural, and as such it can no more be pluralised than say **scissors** or **trousers** can be pluralised.

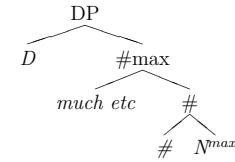
Now, both views have a lot going for them. However one thing that they have in common is that they base any explanation of the behaviour of mass terms on the nature of their denotations. This is most clear when we look at the lack of pluralisation with mass nouns. Either we will have to say that pluralisation is not defined on the mass domain (Link) or that pluralisation is superfluous because mass nouns are already plural (Chierchia).

A third view, advocated by Borer (2005) claims that one should not seek an explanation for the behaviour of mass nouns in the nature of their denotation because in fact *all* nominal denotations are *mass* denotations. Nouns become count thanks to specific structure that is projected. The absence of such structure leaves the nouns unchanged and then they behave like mass nouns. In (much) simplified form, the nominal structures that Borer proposes look like this:

$$(21) \quad \text{Count nouns.}$$



$$(22) \quad \text{Mass nouns.}$$



Obviously then, what gives rise to the (default) mass interpretation is the absence of CLASSIFIER structure.

4 Some problematic data

The cases where mass nouns do pluralise are supposed to fall, essentially, in three categories: when the interpretation of mass nouns is coerced to that of (23):

- (23) a. Standard servings, or typical units of measurement.
- b. Type.
- c. Idiomatic expressions.

The different subcases of (23) are exemplified in (24) - (26) respectively:

- (24) We ordered three waters an hour ago (i.e. glasses, bottles etc. . .)
- (25) Our restaurant serves only three waters (tap water, still mineral water, and sparkling mineral water)
- (26) Matilda's waters broke.

There are also cases that don't fall squarely within any of the above categories, as in (27) but which can be made to look like cases of (23-a) under a suitable generalisation of the latter.

$$(27) \quad \text{The Greek territorial waters}$$

But there are some even more problematic cases. In Greek typical mass nouns pluralise in their typical mass uses:

Trexoun nera apo to tavani
 drip-3rd-pl waters-pl-neut-nom from the ceiling-neut-sg
 Water is dripping from the ceiling.

- (28) To patoma itan gemato nera
 The floor was full water-pl
 The floor was full of water
- (29) Nera ke ladia sto dromo na fovase
 waters and oils on-the road SM be-afraid
 Be afraid of water and oil on the road
- (30) Me tosa nera ke xomata pos na mi gemisi to spiti laspes
 with so-many-pl water-pl and earth-pl how SM not fill-3rd the house mud-pl
 With so much water and earth how do you expect not to fill the house with mud.
- (31) Irthe katefthian apo tin amoudia mesa ke mas gemise amous
 came-he straight from the beach inside and us-cl filled sand-s
 He came from the beach straight inside and he filled the place with sand.

Clearly in the examples (28) - (31) there is no reference to standard units or types of water, oil, mud, earth (dirt), and sand, and they are not idiomatic expressions either. The meaning of *water*, *mud*, *sand*, *oil*, *earth* is that of the mass noun. The process of pluralisation of mass nouns is not, however, completely general. Thus, it is only in a list/enumeration that the plural of water or electricity is grammatical (33), not when it appears on its own (32):

- (32) Kopike to/*ta nero/*nera
 was-cut-off the water
 The water was cut off
- (33) Ase, ti na sou pw, kopikan nera, revmata, telefona ...
 leave-it, what SM you-cl say-1st, were-cut-off waters electricities, telephones ...
 tipota den ixame
 nothing neg had-1st-pl
 It was terrible, what can I say, water, electricity, telephone were cut off ... we had nothing

Furthermore, we can note that in cases of massification of a count noun, again the plural is possible:

- (34) Den mou aresi i salata me (to/ta) milo/mila
 Neg me-cl like the salad with (the-sg/pl) apple/apples
 I don't like salad with apple

Although the empirical picture needs to be sharpened there is one emerging question here, namely, what does the plural marking in mass nouns signal? is this the tell-tale sign of the count-only language or does it tell us something about the nature of number marking in

Greek. Before we attempt an answer to this question, we should first check whether nouns like *nero* (water) do behave like mass nouns

5 Other tests for mass status

In this section, we test the mass status of the nominals in question with respect to the possibility to occur with numerals, the necessity of classifier/measure phrase for counting, and their occurrence with determiners such as *much*, *little* and non-occurrence with *many*, *a* etc...

5.1 Compatibility with numerals

Let's start with the inability of mass nouns to combine with numerals (unless, of course we have an interpretation like the ones in (23-a), (23-b)). The following examples show the relevant cases:

- (35) *Dio nera trexoun apo to tavani
 Two waters run from the ceiling
 Two waters drip from the ceiling
- (36) *Vromise to spiti me epta laspes
 Dirtied-3rd the house with seven muds
 He dirtied the house with seven muds
- (37) *Fere mou trianda amus
 Bring me thirty sands
 Bring me thirty sands

We see here that Greek mass nouns behave with respect to numerals in the same way as their English counterparts.

5.2 Classifiers/measure phrases

This test refers to the fact that in order to count mass a classifier or a measure phrase is required as in (38):

- (38) * Two waters vs. Two **bottles of** water.

Of course it is possible to argue that this property is a corollary of the impossibility to use numerals with mass nouns. In the case of Greek mass nouns we observe exactly the same patterns:

- (39) *Dio nera vs. Dio **boukalia** nero
 two waters Two bottles water
 Two bottles of water.
- (40) *Exi laspes vs Exi **kuvades** laspi
 Six muds Six buckets mud

Six buckets of mud

Two further points are worth mentioning here. First that despite the liberal plural marking on mass nouns observed earlier, when a measure phrase/classifier is present the mass nouns is in the singular:

- (41) *Dio **boukalia** nera
Two bottles waters
Two bottles of water

It is, however, possible, in restricted circumstances to pluralise the mass noun even in those cases, consider the following:

- (42) Exi kuvades laspes evgala apo to spiti meta to xtisimo
Six buckets muds removed-1st from the house after the building
I removed six buckets of mud after the building work had finished
- (43) Tris dexamenes nera epesan apo to tavani
Three tanks waters fell from the ceiling
Three tankfuls of water came through the ceiling

The second point concerns the fact that it is more difficult to pluralise a mass noun which is usually found in *standard servings* like *beer*. Witness the fact that it is a lot more difficult to construct examples where the word *bires* (beers) would refer to anything other than a number of bottles/cans of beer. It is not impossible though:

- (44) Xithikan polla pota sto parti, to patoma kollage apo tis bires
Were-spilled many drinks at-the party the floor stuck from the beers
A lot of drinks were spilled at the party, the floor was sticky from the beer.

Finally let's turn to the last test, i.e. occurrence with determiners like *much* and *many*.

5.3 *Much, Many, and other Determiners*

The difficulty in applying this test resides in the choice of determiners and in finding the appropriate determiner corresponding to much/little in Greek. I will assume the following typology of determiners ¹:

(45)

¹See also Borer (2001).

Determiner type	English	Greek
Mass Determiners	much, little	Poli, Ligo
Count Determiners		
Singular	every, a, each	Kathe, enas
Plural	many, several, few, both	meriki
Mass and Plural	all, a lot, plenty, most	poli, oli, perisoteri
Unrestricted determiners	the, some, any, no	o/i/to, kapios, kanenas, Arketos, kabosos, bolikos . . .

Determiners in Greek agree in Case, number, and gender with the noun. In a sense Greek does not have a determiner corresponding exactly to *much* or *little* which are solely mass determiners.

The same determiners Poli/Ligi appear with both mass and count nouns (46), (47) respectively. Also, however, and more importantly for us the determiners classed as mass and plural can occur with a plural mass noun in its mass interpretation (48), (49).

- (46) Ipia poli/ligo nero
drank-I much/a-little water
I drank much (a lot of)/little water
- (47) Poli/ligi fitites perasan tis exetasis
Many/few students passed the exams
Many/few students passed the exams
- (48) Den exw ksanadi perissotera nera sto patoma
Neg have seen more waters on-the floor
I have never seen more water on the floor
- (49) Sfougarise prota ola ta nera ke meta vlepoume
Mop first all the waters and after see
Mop first all the water and then we will see.

at the same time, clearly count determiners do not appear with mass nouns in any context:

- (50) *Kathe nero ine axrwmo
Every water is colorless
Every water is colorless

Thus, although not entirely or strikingly conclusive due to extraneous factors, the occurrence with *much/many* test is at least suggestive of the fact that we are faced here with an occurrence of a real mass noun. another point that needs to be made here is that, as can be seen from examples such as (46), (48), (49) and also (51) plural mass nouns are not bare plurals, simply because they appear with both the definite and other determiners:

- (51) Mazepse ta rizia apo to trapezi prota ke meta skoupise to
Collect the rices from the table first ant after wipe it
Collect first the (grains of) rice from the table and then wipe it.

So, it seems that in Greek mass nouns, although they behave in several respects like their English counterparts, they do not resist pluralisation. This is an unexpected state of affairs if Chierchia (1998a; 1998b; 2003) is correct in his claim that mass nouns do not pluralise because they are inherently (lexically) already plural. It could be, however, that in Greek, plural marking is somehow an expletive, along the lines perhaps of Vergnaud and Zubizarreta (1992) who analyse the French definite determiner *le* as an expletive, incidentally, this is probably true of Greek too. Although not impossible, this line of explanation is at first sight implausible since plurality tends to be an interpretable feature of Nouns/Noun phrases. However, the reasoning that leads to suggest that the definite article in Greek is an expletive takes as its basic premise that an expletive definite determiner is one that in certain circumstances fails to signal definiteness, which in Greek is clearly the case with proper names. So we could characterise plural marking as expletive in cases where it does not denote plurality. but then why would an expletive plural marking be at all needed there?

5.4 Are plural mass nouns quantized ?

NO. if they where quantize we would expect the following:

- It should be counted without a measure phrase
- it would combine with count-only dets
- It would give rise to telic interpretations with certain predicates.

None of the above is borne out. So what is going on ?

The key difference between the two is that a singular MN can be quantized and a plural one cannot. In contexts where classifiers/measure phrases are involved there is a switch in the denotation of singular MN to the denotation of standard quantities of the stuff. This can be easily done by defining a measure μ over the boolean structure (see Higginbotham (1995) for details on one way to do it using measure theory). On the other hand any quantifier/measure phrase/classifier attached to a plural mass noun is not *counting* units but specifying amounts. Hence the translation in terms of the X-ful morphology.

5.5 S-mass and O-mass nouns

We saw that Greek clearly has S(ubstance) mass nouns. How about O(bject) mass nouns (like *furniture*)?² Greek does not have any of these as far as I can ascertain. All nouns of this type can occur in the singular or in the plural:

- (52)
- a. Epiplo vs. Epipla (furniture/s)
 - b. Maheropirouno vs. Maheropirouna (cutlery/ies) Asimiko vs. Asimika (silver(ware)/s)
 - c. etc ...

²These are the mass nouns that Chierchia in later work calls *fake* mass nouns.

5.6 More Mass Plurals

Ojeda (2005), following McCawley (1979) claims that mass plurals exist in English too in liberal quantities. here's how he explains it (*italics in the original*):

The nouns *clothes* is somewhat of an embarrassment for semantic theory. On the one hand, it is considered a mass noun. As such it would gloss Spanish *ropa*, and refer to discrete entities (one or more articles of clothing) taken in bulk rather than collectively. On the other hand, *clothes* is said to be a plural noun. As such it would refer, like its French equivalent *vêtements*, to discrete entities (two or more articles of clothing) taken collectively rather than in bulk. In short, clothes should refer to discrete entities taken in bulk rather than collectively *and, at the same time, to discrete entities taken collectively rather than in bulk*. This embarrassing predicament is the paradox of mass plurals.

Moreover, Ojeda (2005) cites the following (partial) list of mass plurals in English, taken from Jespersen (1961):

chattel(s), effects, stocks, victuals, cates (Scottish), vivers, sweetmeats, molasses, oats, hops, weeds, brains, bowels, cinders, curds, embers, grounds, dregs, hards, lees, proceeds, remains, vails, contents, belongings, (paper) hangings, leavings, sharings, sweepings, winnings, ashes, chemicals, vegetables, greens, eatables, drinkables, sweets, sours, bitters, cordials, movables, valuables, necessaries, dues, assets, goods, wages, measles, mumps, hysterics, shingles, shivers, rickets, chills, throes, vives, earlier uses of pox and smallpox (cf. pock marks, pock pitted, cowpock), blues, creeps, dumps, jumps, sulks, sullens.

Coming to think of it, how about *Semantics, Phonetics etc...*? Pity there is no *Syntacs* ...

If these observations are correct (and it is possible to take issue with various aspects of the ideas and the list) then the phenomenon of mass plurals is less exceptional than initially thought.

6 Intermediate Summary

- (53)
- a. Greek appears to be a counter-example to both Chierchia's and Borer's accounts.
 - b. Mass plurals exist.
 - c. Greek is exceptional in the sense that its mass plurals are S-mass.

7 Some Proposals

Let's begin with outlining the space of possibilities (this is not exhaustive. It represents some of the more obvious cases)

7.1 Possibilities

Possibility 1: Pluralisation freely applies to mass-nouns in some languages. In fact this is an attractive possibility within Borer's system since plural inflection signals division rather than classical number. The downside of this is that you would expect the Greek case to be a lot more general. Contrary to fact. Outside of Borer's theory one wonders what is the denotation of the MN that would allow this ?

Possibility 2: Atomicity of a lattice can be left unspecified (Krifka (1995))

Crucially in this case sub-lattices can be the only Atoms. How do you know in which language you can do this ? is the morphology enough of a signal ? Also we would need to alter the definition of the denotation of MN to something that would not be a \cup -closed set of atoms, or the definition of pluralisation should be changed.

8 An alternative

From what precedes, it should be obvious that the account we are aiming at is one that takes from Borer's proposals the idea that number (for her it is plural but I think we can generalise) inflection is not what is classically thought of as number. The effects it may have on the denotational structure can be of various types. On the other hand it is not necessary to adopt the idea that all nouns (or noun stems) are mass (but see below, it might be useful in the end).

We could propose the following:

(54) In Greek the number distinction is [+/- singular] with -singular meaning plural for the count domain and nothing for the mass domain. This underdetermines the morphological realisation.

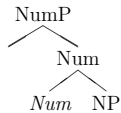
More specifically, an account might take the following form:

- Adopt a Link (1983) dual domain style of analysis.

Now, I want to propose that mass nouns are only formally marked in the lexicon as [-singular], whereas count nouns are not marked for number at all. This moves Chierchia's and Gillon's explanation from the conceptual to the formal level.

Second, Number in Greek is given through a syntactic head:

(55)



The featural specification of this head may be $[\pm\text{singular}]$.

With count nouns what happens is obvious, [-singular] is morphologically interpreted as what we call the plural, and in the semantics, the pluralisation operation will apply and yield a plural.

With mass nouns now, which are formally marked as [-sing] things a little more complex, we have the following cases:

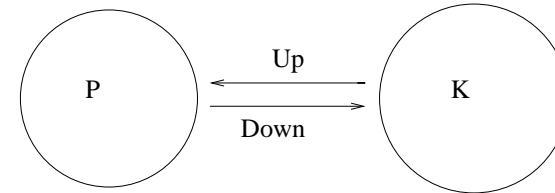
- Num is [-sing]

Semantically, this is a vacuous specification since PL does not apply to nouns interpreted in the M domain. Morphologically, however, this has a perfect interpretation, the plural morphology. Therefore we predict that plural morphology will appear more or less freely on mass nouns.

- Num is [+sing]

In this case we have a problem, there seems to be a conflict in the formal specification of the noun and in the specification of Num^o. On this case we might wonder what will be the effect of [+sing] number on a lexically plural N. One natural thing is to conceive of [+sing] number as type-shifting the lexically plural mass property to its, so to speak, singular counterpart. Now that would be a kind. We know that there is a straightforward mapping between properties and kinds:

(56)



- UP: $\cup \langle \langle s, \langle e, t \rangle \rangle, e \rangle$
- DOWN: $\cap \langle e, \langle s, \langle e, t \rangle \rangle$

Kinds are singular. Therefore, the proposal here is that the singular appearing on mass nouns is the result of type shifting. Furthermore, we expect to find in Greek bare singular kind referring nouns. This prediction is indeed borne out but in an interesting manner. Just like in several Romance languages these items are restricted to *lexically governed* positions, i.e. object positions or postverbal subjects. An overt determiner is required for these elements to appear in subject position. Why is then the determiner required? An answer to this question can be provided along the following lines. If the mechanism above is along the right track we still need to account for cases of kind referring terms in episodic frames which

fill an object level argument slot. Chierchia proposed a mechanism of *Derived Kind Predication* for precisely these types of cases, which introduces an existential quantification over instances of the kind. For him, however, this was a mechanism to account for the appearance of bare plurals in English in cases where they did not refer to kinds but to instances as in *Lions are ruining my garden*, and the operation was covert and not necessarily associated with any linguistic material. I would like to propose here that this is precisely the job that the definite determiner performs in Greek when it accompanies a kind referring bare singular derived from a mass property, i.e. introduce some kind of quantification over instances of the kind. In this case, it would be universal quantification. Given that instances kinds do not differentiate between singularities and pluralities, the result will be a mass interpretation, which explains then why Greek mass nouns behave like their English counterparts with respect to the other tests for mass status. Similar conclusions about the definite article were also proposed on a different basis by Giannakidou and Stavrou (1999). Thus a sentence like (57) will be represented as (58):

(57) Ta nera/To nero mou katastrefun/i tis agginares
 the waters/the water to-me is/are-destroying the artichokes
 The water is destroying my artichokes

(58) $\forall x[\cup^{\cap}Water(x) \wedge destroying - my - artichokes(x)]$

This result is exactly as it should be. The Greek definite article is not interpreted in the usual manner, i.e. as an ι operator. Had this been the case, given that ι is simply an extensional version of \cap , the definite article would have just type shifted $\cup^{\cap}Water(x)$ to $\cap Water(x)$.

Now, we could yet generalise this and say that [+sing] is always a type shifter from properties to kinds, with Det a shifter that shifts the kind back to a property. If this is on the right track then it follows that Greek only epiphenomenally marks number. Chierchia, has recently proposed that only languages which mark number have fake mass nouns. If this is correct, and the proposal above also is correct, then the absence of fake mass nouns in Greek that we observed earlier is an immediate consequence.

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Department of Language and Linguistic Science
 University of York
 Heslington
 York - YO10 5DD
 UK
 gt3@york.ac.uk