Mass Terms
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1 Introduction

Mass terms[1] are those such as 'water', 'computer software', 'advice', and 'knowledge'. They are contrasted with count terms such as 'person', 'computer program', 'suggestion', and 'belief'. Intuitively, mass terms refer to "stuff" while count terms refer to "objects". Since mass terms refer to stuff, they (but not count terms) allow for measurement: 'a liter of water', 'three CDs worth of computer software', 'too much advice', 'many books worth of deep knowledge'. Since count terms refer to objects, they (but not mass terms) allow for counting, quantifying and individuating: 'a person', 'three computer programs', 'each suggestion', 'that belief of his'. Philosophers from many areas within the field have found this distinction to be of interest – the metaphysical question of the primitive or primary existence of gunk vs. things is one obvious area, but also issues in the notions of identification and re-identification have been thought to be related to the distinction: is it the same building when all the concrete has been replaced with new concrete? been replaced with stone? A statue can cease to exist without its constituent matter ceasing to exist. Does this mean there are two entities here: the statue and the parcel of matter? Further afield, but still relevant, are questions about the referents of "abstract" mass terms, such as '*Curiosity* is an admirable quality to have' and in '*This cat's curiosity* made it climb onto the counter.' The fact that 'knowledge' is a mass term while 'beliefs' is a count term have led some to question the account of knowledge as a justified true belief.

The examples just given were of course from English. Not all languages follow English in their characterization of this distinction—indeed, perhaps no other language is quite like English, including even closely related languages such as German. As we will see below, even within the Indo-European language

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[1] In earlier work, I worried about the name that should be used for this topic. 'Mass nouns' is the expression normally used for it, but since some theories included more than nouns and noun phrases, it seems wrong to employ this word. In Pelletier and Schubert 1989/2003 it was suggested that 'mass term' would also be wrong since this might recall Montague's category of Term; and so 'mass expression' was used. But now that even grammars influenced by Montague do not employ a category of Term, it seems better to go with the common usage in the field and call these 'mass terms' (and to call their opposites 'count terms').

group, where this distinction most closely follows that of English, there are relevant differences. And in the wider realm of the world's languages, there are those that do not allow plural/singular marking on individual nouns but only on larger phrases. There are languages that do not have a plural/singular marking for noun phrases at all (nor agreement with verb phrases); there are languages that do not have quantifiers that operate on nouns or noun phrases; there are languages that do not have determiners like 'a(n)' and 'the' even while marking singular/plural. Thus, the examples given in the previous paragraph—which make it seem that there are clear ways to distinguish count from mass nouns—do not have the same purchase (or perhaps no purchase at all) in these languages. And this can be seen as raising questions concerning the philosophical relevance of, or interest in the distinction

Besides the possible application of features of mass vs. count terms to other areas of philosophy, within the realm of mass terms the philosophical problems traditionally associated encountered include distinguishing mass from count terms (is it a syntactic or a semantic distinction, or something else?), deciding the extent of the classification (does it include more than noun phrases?), describing the semantic underpinnings of mass terms (since they are not true of individuals, how can a model theory be developed?), and explaining the ontology presupposed by mass terms vs. count terms. Alongside these concerns, there is the meta-philosophical question of the extent to which the linguistic practices of the speakers of a language can be used as evidence for how those speakers view reality, or indeed, as evidence for what reality is.

2 +MASS and +COUNT as Syntax

Many descriptive grammars of English, e.g., Quirk et al. (1985), give a syntactic characterization of the +MASS/+COUNT distinction within the category of noun. That is, they view the fact that some noun (e.g., *water*) is a mass term as giving an explanation for why some combinations with other words are ungrammatical. For example, they might say

(1) a.   Mass nouns, unlike count nouns, do not have plural forms and thus all verb agreement is singular.[2]

b.   Mass nouns, unlike count nouns, do not admit of numeral modifiers.

c.   Mass nouns, unlike count nouns, do not allow "individuative" quantifiers

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[2]With some possible exceptions, such as *oats* and *smarts*. Two categories of nouns I'll not discuss in this entry are *collectives* and *pluralia tantum*. The former are singular count nouns that refer to multiple entities, and includes such terms as *team, committee, army, herd, alphabet, ...* The latter are inherently plural nouns that nonetheless sometimes seem to be like mass nouns. One subtype of this latter refers to "dual entities" and includes such terms as *scissors, earmuffs, pliers, binoculars, ...* Another subtype is associated with co-occurring similar objects, and includes *suds, intestines, bleachers, ruins, remains . . . .* Yet a third subtype refers to groups of objects, and includes terms like *groceries, spoils, odds and ends, valuables, contents, ...* Both groups of nouns challenge certain definitions of the +MASS/+COUNT distinction.

such as *each, every, some* (stressed[3]), *few, several, many, . . .*

d. Mass nouns, unlike singular count nouns, employ measurement terms such as *much, a lot of, (a) little*[4].

This syntactic characterization is supposed to account for the following classifications:

(2)   Mass Nouns: *water, blood, cutlery, knowledge, carpeting, advice, . . .*

(3)   Count Nouns: *person, dog, spoon, belief, carpet, suggestion, . . .*

These are all simple nouns viewed as being in the lexicon. . . *lexical nouns*, to give them a name. The +COUNT/+MASS features are viewed by Quirk et al. and others of this syntactic persuasion to be a part of the lexical characterization of the nouns. These features are to be inherited from the lexical items into the larger and larger syntactic units that are present in extended phrases. So, *blood* as a lexical entry contains the syntactic feature +MASS, and this is inherited by the common noun phrases *bright red blood* and *bright red blood that is on the floor* and the full determined phrase *the bright red blood that is on the floor*. The fact that this longer phrase is also +MASS is what ultimately explains why

(4)   *The bright red blood that is on the floor are slippery

is ungrammatical. (Because the fact that the phrase is +MASS prohibits it from being plural, as (1a) says, and hence the agreement with the verb phrase does not happen.) Violations of the constraints involving +MASS and +COUNT yield ungrammatical results that have the same status as other syntactic violations; (4) is no more a part of English than are

(5) a. *Dog the quickly
    b. *A well depending that part thus join.

It might be noted that both of the mass and count categories contain terms that are "abstract": *knowledge* and *advice* are +MASS, while *belief* and *suggestion* are +COUNT. In Quirk et al., +ABSTRACT and −ABSTRACT are also seen as syntactic features. Other descriptive grammars might consider them semantic characterizations.

3   +MASS and +COUNT as Semantics

Some descriptive grammars of English, e.g., Huddleston and Pullum (2002), think of the +MASS/+COUNT distinction as a description of the semantic properties

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[3]The stressed quantifier *some*, as in *Some student aced the exam*, is to be distinguished from the unstressed *some*, as in *John drank some water*. The literature usually spells this latter unstressed article 'sm'. In addition to being used with mass terms, *sm* can also be used with plural count nouns.

[4]*Little* and *a little* are measure terms, not size- (or importance-) indicating adjectives. (They contrast with *a lot of* rather than with *large*).

of the denotation of the terms. In this type of view, mass meanings contrast with count meanings:

(6) a. Mass meanings are *true of stuff*; count meanings are *true of things*
    b. Mass meanings are *divisive in their reference*; count meanings are *true of a unit as a whole*
    c. Mass meanings are *cumulative in their reference*; (singular) count meanings are *not true of groups of that which they are true*
    d. Stuff that mass meanings are true of *cannot be counted*; count meanings are true of *individuated items that can be counted*
    e. Stuff that mass meanings are true of *can be measured*; (singular) count meanings are *not measurable*

Some theorists take the divisiveness and the cumulativity conditions together to be called the *homogeneous in reference* condition.

The fundamental difference between mass and count terms is that count terms are true of *objects*—entities that are distinct from each other even while being of the same type, and thus one can distinguish and count them—while mass terms are true of *stuff* that is undifferentiated with respect to the term being used to describe it. This in turn explains why mass terms, unlike count terms, are *divisive* in their reference: they permit something that the mass term is true of to be arbitrarily subdivided and the term to be true of these parts as well. Taking the water in the glass to be something that *is water* is true of, it can be divided into parts and *is water* will be true of both parts. And again, mass terms, unlike count terms, are also *cumulative* in their reference: putting the water contained in two glasses into a bowl yields something of which *is water* is true. But the same is not the case with a count term like *dog*. Chopping up a dog does not yield more things of which *is a dog* is true, nor do two dogs make a thing of which *is a dog* is true.[5]

In a semantic approach, the features +MASS/+COUNT are descriptions of the semantic value of lexical nouns and the larger common noun phrases, etc. Thus, they do not figure in the syntactic well-formedness constraints of a grammar, but would emerge as a description of what the semantic values of the embedded nouns are, and how these semantic values get altered by the syntactic combination of those nouns with other words. In such a picture, these features do not syntactically rule anything out; the most that can be said is that certain combinations are "semantically anomalous", and hence can't be interpreted.

As discussed above for the syntactic version of +MASS/+COUNT, the lexicon supplies individual words with a set of syntactic features and also a set of semantic values. Larger and larger phrases that contain the noun also contain the semantic information mentioned in the lexical items, modified in accordance with rules that describe the semantic effect of being syntactically combined in the manner that is employed. For example, *boy* might be syntactically characterized as an N that is singular and masculine, with a semantic value of the set

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[5]Other than in a Frankenstein-like scenario.

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of all individual boys[6]; *smart* might be syntactically characterized as an adjective with a semantic value of being a function that selects the smart objects out of a given set of objects. Then the complex phrase *smart boy* could be syntactically characterized as a CN that is singular and masculine, and its semantic value would be the set of all individual smart boys. If we now tried to add the determiner/quantifier *many* to this CN so as to form a full NP, we discover that it can't be done because *many* has a syntactic requirement that it requires a non-singular CN as an argument. And hence **many smart boy* is syntactically ill-formed (and the question of its semantic value doesn't even arise). Using *the* to form the full NP, however, *would be* syntactically appropriate and the semantic value of *the smart boy* is the most salient smart boy in the relevant context.[7] If there is no such item then the sentence in which this NP occurs is semantically anomalous or maybe false (depending on the theory), but it retains its syntactic good standing. In this general sort of view, the semantic value of complex terms (CNPs and NPs) that contain mass or count nouns as parts are computed as some function of the semantic value of the embedded noun, the particular function depending on what the other parts of the complex are. Without involving ourselves in details of just exactly which functions are used for which syntactic combinations, we can give examples like: The semantic value of *dirty water* is describable as, or computed in accordance with, whatever the semantic value of *water* is, and whatever the semantic value of *dirty* is, when they are put together by the syntactic rule of an adjective modifying a noun to form a CN. This general account of how the syntactic well-formedness constraints work with the semantic values of syntactically simple pieces of language to construct the semantic values of the syntactically more complex items is called 'semantic compositionality', and is a touchstone for most modern semantic theories. In this type of theory, sentences that violate the "appropriateness" of the semantic features of +MASS and +COUNT are seen as grammatical but not interpretable. So the sentence (7) would *not* be ungrammatical for using an "individuative quantifier" with a mass noun phrase – it would only be "uninterpretable."

(7)   Each bright red blood that is on the floor is slippery.

The difference between +MASS/+COUNT as syntax and +MASS/+COUNT as semantics thus is whether these features are seen as syntactic well-formedness constraints that yield ungrammaticality when violated or as semantic interpretability constraints upon syntactically correct sentences that yield semantic anomaly when violated.

4   Some Problems for the Syntactic Approach

The Syntactic Approach is, well, syntax-driven. The lexical items are assigned either a +MASS or +COUNT feature, and this feature controls the syntactic admis-

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[6]The semantic value is only for the purposes of this example.

[7]Again, the semantic value is just for expository purposes.

sibility or inadmissibility of larger phrases. But there are many words that have both mass and count meanings, for instance

(8) a. Concrete terms
   (i)   a lot of chocolate / many more chocolates
   (ii) more discipline / an academic discipline
   (iii) too much paper / write a paper
   (iv) drink beer / drink a beer
  b. Abstract terms
   (i)   much discussion / three different discussions
   (ii) much justification / many justifications
   (iii) a lot of difference / two differences
   (iv) much more data / many more data

The examples in (8) are just the tip of the iceberg, There are many more of the "dual life" terms which have been illustrated in (8), and sometimes forming regular patterns, but sometimes not:

(9)   Mass terms used "countily":
  a. Pinot Noir is *wine* / Pinot Noir is *a wine*
  b. Kim produces *sculpture* / Kim is producing *a sculpture*
  c. Sandy likes *lamb* / Sandy likes *every lamb*
  d. *Beer* on the table / Three *beers* on the table / Eight *beers* on tap

(10)   Count terms used "massily"
  a. Leslie has more *car* than *garage*
  b. Chris Pronger, 6′6″ worth of *defenseman*...
  c. He's got *woman* on his mind
  d. What a hunk of *man*!
  e. Some people like *data* better than *theory*

As (Huddleston and Pullum 2002: p.335) remark "...the dual use of *chocolate* is not remotely exceptional but is representative of an extremely widespread phenomenon", and they follow this with a list of 25 examples chosen over a wide variety of types of nouns that illustrate just how wide-spread the phenomenon of a noun having two equally-salient meanings where one is +MASS but the other +COUNT.

And then there's the "universal grinder" of Pelletier (1975), which is like a meat grinder except that it can accommodate any object, no matter how large, and its teeth are so powerful and fine that it can grind anything, no matter how strong. One inserts an object that falls under any (concrete) count noun into one side...for example, a hat. Push the button, and the result is that there is hat all over the floor.[8] Another push of the button and we can have book all over the floor. An unfortunate accident might generate curious cat all over the floor.

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[8]This is true despite the fact that we might have some other term, e.g., *felt*, that also describes what is on the floor.

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One might also think of "universal packagers" in this regard, that take any item of which a mass term is true and convert it into an object. Any time there is a use for a particular type of some mass then there can be a count term that describes it – for example, *a finely-silted mud*, which can be a name for a type of mud and also a predicate that is true of all individual exemplars of this type. And if there is a standardized amount of M that is employed in some use, then there will be a count term that describes this amount, such as *a beer* or *an ice cream*. Furthermore, there seems always to be a count use for any alleged mass term M, meaning (roughly) *a kind of M*. Putting all these together, a term like *a scotch* could be true of individual servings (thus being independently true of each piece of the actual matter in the various glasses), or true of the different standardized amounts (so that two instances of the same standard one-ounce serving count as only one such standardized amount), or true of the different kinds of scotch on the table or available at the bar. Thus any of 'four', 'three', 'five' could be true answers to the question "How many scotches are on the table?"

These considerations show that the appropriate theory needs to talk about *meanings* of terms, or *uses* of the terms, or maybe *occurrences* thereof (some occurrences are +mass , others of the same word are +count). But then this is no longer a syntactic account! And the syntactic approach just doesn't work. For, it will turn out that since *any* noun can be either mass or count, a +mass/+count syntactic distinction does no work – *nothing* is ruled out by the syntactic rules.

5   Some Problems for the Semantic Approach

As we have seen above, many words have both a natural mass and a natural count sense. So the basic lexical item that gets entered into a phrase structure description of a sentence will be one of these senses. It is never very clear how this is supposed to be effected in a grammar, but we will not pause over that here, and simply assume that there is some way that this can be done. But even if we can assume this, there nonetheless seem to be some serious difficulties that are semantic mirrors of the difficulties found in the syntactic approach.

Many formal semanticists (e.g., Link 1983 Chierchia 1998a,b Pelletier and Schubert 1989/2003) take the characteristics in (6) to be best accounted for in terms of a semi-lattice theory. A semi-lattice has no lowest elements and is atomless. The idea is that anything that *water*, for example, might be true of has subparts – things in the lattice that are its parts – of which *water* is true; and any two elements in the *water*-lattice find a joined element also in the lattice that represents the merge of those two elements.

But it should be noted that many mass terms obviously are not "atomless" in the sense required by this theory. Consider

(11)   *furniture, cutlery, clothing, equipment, jewelry, crockery, silverware, footware, bedding, toast, stemware, gravel* ...

Clearly there are atomic parts of these, and yet they are considered mass terms

by any of the traditional grammars. So it cannot be an atomless mereology that accounts for the mass nature of these words; and by extension, since it doesn't account for the mass nature of these particular words, there seems to be no reason to think it accounts for the mass nature of *any* words.

Some theorists, e.g., Huddleston and Pullum (2002), take this as evidence that terms like those in (11) are of a different nature than what we have been calling 'mass terms', and are to be treated differently. Huddleston and Pullum call them 'aggregate terms' and semantically distinguish them from other mass terms by their being true of "very different sorts of things". The idea is that furniture, for example, is true of sofas, chairs, tables, carpets, and so on, and that these are "very different" from one another. But a true mass term, for example 'blood', is really true only of one kind of thing.

But one might still wonder: are *any* words at all that obey the condition on divisiveness? Or put another way, are there really any words that are atomless – whose referent has no smallest parts? Doesn't *water*, for example, have smallest parts: H_2O molecules perhaps? Certainly coffee and blood have smallest parts[9], as do other mixtures. A standard defense of the divisiveness condition in the face of these facts is to distinguish between "empirical facts" and "facts of language". It is an empirical fact that water has smallest parts, it is said, but English does not recognize this in its semantics: the word *water* presupposes infinite divisibility.

It is not clear that this is true, but if it is, the viewpoint suggests interesting questions about the notion of semantics. If *water* is divisive but water isn't, then water can't be the semantic value of *water* (can it?). In turn this suggests a notion of semantics that is divorced from "the world", and so semantics would not be a theory of the relation between language and the world. But it also would seem not to be a relation between language and what a speaker's mental understanding is, since pretty much everyone nowadays *believes* that water has smallest parts. Thus, the mental construct that in some way corresponds to the word *water* can't be the meaning of *water* either. This illustrates a kind of tension within "natural language metaphysics".[10]

Further problems with the semantic approach to the mass-count distinction comes from the fact that there are pairs of words where one is mass and the other is count and yet the items in the world that they describe seem to have no obvious difference that would account for this. On the intuitive level, it seems that postulating a *semantic* difference should have some reflection in the items of reality that the terms designate. But this is just not true. There seems to be nothing in the *referent* of the following mass vs. count terms that would explain how they should be distinguished – as they intuitively are. (See McCawley 1975 for further examples).

(12) a.   Concrete terms

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[9] At least, there are volumes that contain coffee, and there are subvolumes of such a volume which are so small that they do not contain coffee. And so some sort of "continuity principle" suggests that there is a cut-off line or interval that yields smallest parts of coffee.

[10] For a description of, and defense of approaching metaphysics this way, see Bach (1986a,b).

      (i)   baklava vs. brownies
      (ii)   spaghetti vs. noodles
      (iii) garlic vs. onions
      (iv) rice vs. beans
  b.   Abstract terms
      (i)   success vs. failures
      (ii)   knowledge vs. beliefs
      (iii) flu vs. colds

To many, these examples and their surrounding facts have seemed to prove that the linguistic features of +COUNT and +MASS do not have any backing in reality. Nor any backing in people's intuitive understanding of *when* a word will be +MASS or +COUNT or *what it is* for a word to be +MASS or +COUNT. (Not everyone takes this negative or skeptical view; see below §9.3.)

6   The +MASS/+COUNT Distinction Beyond Noun Phrases

Although the +MASS/+COUNT distinction – whether it is viewed as a syntactic or as a semantic distinction – is designed to be applied to nouns and noun phrases, various authors have thought that some other categories of words and phrases manifest properties that display enough analogy so that they too might be called +MASS or +COUNT. (Quine 1960: p. 104) suggested that adjectives indicating a shape could be called +COUNT, on account of modifying only objects; and some others have mentioned this with approval, although it has not been adopted by many scholars, both because of the few adjectives involved and because of the worry that some +MASS nouns in fact *are* easily modified by shape adjectives:

(13) a.   Bring me the triangular furniture first, before the square furniture.
      b.   Our machines can produce steel that is cylindrical as well as flat.
      c.   Look at that perfectly spherical hail!

Some have pointed to adjectives that are divisive, such as *light, short* and *small* as +MASS. Others have mentioned cumulativity, making *heavy, tall* and *large* be +MASS. Bunt (1980 and 1985: p.229) prefers homogeneity as the test for being a +MASS adjective.

Many theorists have focused on the semantic criterion of 'divisiveness' in giving an intuitive account of why certain verb phrases should or should not be considered +MASS/+COUNT. (Leech 1969: p.134), (Verkuyl 1972: pp.54–61), Mourelatos (1978) Carlson (1980) Åqvist and Guenthner (1978) Gabbay and Moravcsik (1979) Hoepelman (1976) Taylor (1977) Bach (1986a,b), following the seminal work of Vendler (1967), suggest that verbs denoting processes be marked +MASS while those denoting achievements be marked +COUNT. The idea is that an event is the primitive verb-phrase denotation, and events can be part of larger events or contain subevents themselves. Some of these events, the ones which are processes like *to eat* and *to run*, have parts that are events denoted by the same verb. Others, the ones which are achievements like *to prove* and

to prepare, are naturally bounded in the sense that they describe actions that involve change toward a final goal. So they do not have parts that are events denoted by the same verb. This is, of course to apply the divisiveness criterion to entire verb phrases, not simply the lexical verb. Implicit in these discussions is also the possibility of carrying the cumulativity criterion to verb phrases.

(ter Meulen 1980: Ch. 4) points out that either type of verb phrase can take either +MASS or +COUNT subjects. More interesting, she finds that while the (direct) objects of the verb can be of either type, which one it is determines whether the entire verb phrase is +COUNT or +MASS. Thus *eating cake* is +MASS, *eating a cake* is +COUNT; *preparing dinner* is +MASS, *preparing a dinner* is +count. And thus the object dominates the simple verb (*eating* was +MASS, *preparing* was +COUNT).[11] Following Hoepelman [1976; 1978], who in turn is following Verkuyl [1972], ter Meulen considers certain adverb phrases to be either +MASS/+COUNT. Generally this means that the spatial or temporal extension or duration of the adverb is unbounded (or bounded). For instance, the adverb phrase *for hours* is temporally unbounded; the phrase *along the road* is spatially unbounded; the phrase *in an hour* is temporally bounded; the phrase *to the city* is spatially bounded. Generally, ter Meulen suggests, one should look for a final state that will be reached through the action described by the verb phrase in question; if so, then the adverb is +COUNT. ter Meulen notes that any verb (+COUNT/+MASS) can take either type of adverb phrase (+COUNT/+MASS); but it appears that the feature of the adverb phrase dominates the one of the verb. The next question is whether the feature of the entire verb phrase generated by using some +COUNT/+MASS direct object will combine correctly with either type of adverb. The results are a bit complicated and the judgements involved seem to be somewhat unreliable, but the answers seem to be this: the entire verb phrase is dominated by the adverb phrase; regardless of whether the verb and direct object are +MASS or +COUNT. Two possible exceptions to this are: (a) when the verb and the direct object are +MASS and the adverb phrase is +COUNT, we get some sort of anomaly: *John ate cake in an hour* – one needs some special understanding to interpret it, and (b) when the verb and adverb are +COUNT but the object is +MASS, one gets what ter Meulen calls an iterative reading, which is +COUNT. A sentence like *Henry repaired furniture in an hour* would be interpreted, she says, as "Henry could repair furniture in an hour, which is obviously [an achievement] rather than [a process]."

7 +COUNT and +MASS Semantic Theories

A rather heterogeneous group of topics has been included within the subject matter of the semantics of +MASS vs. +COUNT terms. Given that the general topic concerns the content of lexical items, we can expect that much of the

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[11] Jim McCawley has pointed out that the +MASS/+COUNT distinction for verb phrases also depends on the specific verb: *It takes two hours to bake/*eat bread*. He suggests that the difference lies in whether the verb denotes a process that consumes the object a bit-at-a-time or affects the object all at once.

discussion will differ from that of the more traditional compositional semantic theories.

The older philosophical literature on mass terms (and many other terms) tended to find different meanings for the terms under consideration, depending on what role they had in a sentence. For example, mass noun theorists would consider one of the following types of uses of a mass term:

- As names, as in *Water covers most of the globe*
- As predicates true of quantities/portions of matter, as in *John drank some water*
- As predicates true of objects, as in *This ring is gold*
- As predicates true of kinds/substances, as in *Claret is wine*
- As predicate modifiers, as in *She is wearing a gold bracelet*

To some this suggested that +MASS terms were ambiguous.

> In general, a mass term in predicative position may be viewed as a general term which is true of each portion of the stuff in question, excluding only the parts too small to count ... A mass term used in subject poition differs none from such singular terms as 'mama' ..., unless the scattered stuff that it names be denied the status of a single sprawling object. (Quine 1960: pp.97–98)

To others it suggested that a theory should on one these ways that mass terms are used in sentences as basic and either ignore the others or try to generate them by some "semantico-syntactic trick". Parsons (1970) took them always to be names of substances ("in the chemistry sense"), but when a mass noun M was "in predicate position" such an occurrence was transformed into *is a quantity of M*. (This same transformation occurred in other positions also). One of the earliest attempts to employ mereology as a tool for representing mass terms was Moravcsik (1973). In such a framework nouns (and adjectives) designated mereological wholes and the copular connection becomes *is a part of*. Pure mereological approaches have been found wanting, because of the problem of "minimal parts" – classical mereology has no minimal parts other than the empty part, yet it is generally assumed that the designations of ordinary-language +MASS nouns do have minimal parts. So Moravcsik invoked a notion of *is a part having relevant structural properties*. This has also been found wanting (see Montague 1973 Pelletier 1974), but more clever ways of operating do seem to avoid these problems (e.g., Bunt 1979, 1985; see also Burge 1972 Ojeda 1993 Moltmann 1998). A parallel – and related – development has been the notion of a (join) semi-lattice to support part-whole structures. This was first urged onto the mass term semantics world by Link (1983) and picked up by Pelletier and Schubert (1989/2003) Landman (1991) and many others.

The existence of this general sort of formalism brings up a further related topic that we will not discuss deeply: its possible use to show some unity in the +MASS/+COUNT realm. It might be noted that +MASS nouns and +PLURAL +COUNT nouns share certain syntactic features: they both can be modified by

the unstressed *sm*, they both admit measurement terms such as *a lot of, (a) little*, and neither allows the nominal quantifier *each*. To some, this shows that there is a semantic commonality that should be captured. Gillon (1992, 1999) adopts a syntactic view of +MASS/+COUNT and assigns -PLURAL to +MASS terms. Lexical +COUNT nouns are assigned the set of atomic entities they are true of, but quantified +COUNT nouns are assigned aggregations (a technical term in Gillon) of these atoms; and the choice of aggregation (in part) determined by +PLURAL +COUNT. When the noun is +PLURAL +COUNT, the interpretation is unconstrained, but if it is -PLURAL +COUNT, then the semantic value of the term is the constrained to be the *least* aggregate–i.e., the set of individuals. Quantified +MASS noun phrases also range over elements in the aggregation formed from the denotation of the noun phrase's mass noun, which is the greatest aggregate in the domain of discourse of which the mass noun is true. This viewpoint yields a "common semantics" for +MASS and +COUNT nouns.

A different way to get a common semantics is pursued by Chierchia (1998a,b). Here the underlying picture is that +MASS nouns are in fact *inherently* plural and the "common semantics" amounts to their both having a semilattice structure (very akin to Gillon's aggregations). The difference then between +MASS and +PLURAL +COUNT nouns is the existence of "minimal parts" – where but this is in turn "vague". Interested readers can find an updated view in Chierchia's (2010).

What one really wants here is an answer to the question of what the *lexical* meaning of a +MASS term should be.[12] And then whatever are the relevant "tricks" should come to the fore. But the fundamental question is, What is the lexical meaning of a mass term – or to broaden the scope of the question, What is the mass-meaning of any lexical item (where one might think of lexical items being unspecified as to +MASS/+COUNT, but one still wants to know how to represent a mass-meaning once the word is in a clearly "+MASS context")?

One understudied aspect of this concerns "abstract" mass nouns (*advice, knowledge, freedom, information, . . .*). Many theorists wish to invoke a mereology or a semi-lattice as the relevant semantic structure for concrete mass nouns such as *water, sand, blood, steel, . . .*, but mereology (in particular) seems completely out of place for abstract nouns. One attitude that comes to mind is that, intuitively, +MASS is independent of whether the noun is ±ABST, and therefore any semantic technique that is correct for concrete mass terms should be applicable to abstract mass terms. Differences between abstract and concrete mass terms should be due to the ±ABST, and not be a part of +MASS. But mereology just doesn't apply to +ABST,+MASS terms; hence, it should not be a defining semantic feature of -ABST (concrete) +MASS terms. And so, mereology would *not* be a part of the semantics of +MASS, but at most a consequence of the interaction of a more general semantic account of +ABST and +MASS. Some attempts towards an account of the semantics for +ABST, +MASS terms using the semantics of comparatives can be found in Nicolas (2008); an account using the methodology of Natural Semantic Metalanguage (Wierzbicka 1996) can be found in Goddard

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[12]As well, we'd like answers to the lexical meaning of +COUNT terms, but consensus seems to be (among the formally-oriented anyway) that the extensional meaning of such terms is a set of objects.

and Wierzbicka (2010). I think all these authors would admit that their account needs to be expanded before it can truly be said to describe +ABST, +MASS nouns in general.

Accounts of the meaning of items that are lexically +MASS can be divided into two sorts: those that view themselves as part of formal semantics and those that think of giving a more "ordinary language" account of the meaning. The former will try either to employ existing constructs from formal semantics or else will recommend the use of some novel logical or mathematical machinery to be incorporated into formal semantics. The latter will offer more of a "dictionary sense" to these lexical entries, often phrased in terms of some set of cross-cultural semantic primitives.

This latter methodology has been most deeply developed within the Natural Semantic Metalanguage (NSM) framework of Wierzbicka (1996). Indeed, many of the works within this framework have concerned themselves directly with the issue of the meaning of +MASS terms, and they have outlined a quite rich structure within the category of +MASS nouns. (See in particular Wierzbicka 1988 Goddard and Wierzbicka 2002 Goddard 2009). Although there are many who find the NSM framework to be wanting (e.g., Barker 2003 Matthewson 2003 Riemer 2006 Jackendoff 2007), the work has produced the most detailed descriptions of different types of +MASS (and +COUNT) nouns and ought to be studied for that reason alone.

Within the formal semantic group of theories, it has long been recognized that standard first-order logic seems unsuited to representing sentences involving mass terms. For example, even if one grants that (14a) is to be represented as (14b), nonetheless Tarski's classic (15a) can't reasonably be represented as (15b), because there are no plausible values for x:

(14) a. Men are mortal.
     b. $\forall x(Man(x) \supset Mortal(x))$

(15) a. Snow is white.
     b. $\forall x(Snow(x) \supset White(x))$

For, what could be the value of x in "For all x, if x is snow, then x is white"? Intuitively, we want it to be "snowy stuff", but the idiom of classical logic is committed to the values being objects/things/entities – elements of the domain. However, those are what is designated by +COUNT nouns, not +MASS nouns.

Earlier attempts invoked relational constants into the first-order language to accommodate +MASS terms. Parsons (1970), for example, used names for substances and the relations *quantity-of* and *consitituted-by* as well as a "substance-forming operator". Burge (1975) considers two different theories along these lines: a "relational" account that analyzes sentences like (16a) as (16b)

(16) a. This ring is now gold
     b. $Gold(r, now)$

He rejects this account because it takes the basic individuals to be stages of objects. His preferred account employs the basic 3-place relation of 'x constitutes

y at (time) t', analyzing (16a) as

(17) $(\exists x)(\mathrm{Gold}(x) \wedge \mathrm{C}(x, r, \mathrm{now}))$

One or the other of these two general approaches have been adopted by a wide range of theorists who want to employ as much of ordinary first-order logic as possible.

An important topic concerns the "dual life" that many (or most, or perhaps all) nouns lead in English and similar languages. What should the semantic value of the lexical item be for such nouns? Consider *chocolate*, for example. Should its semantic value be the set of chocolates?[13] But of course not only do we have the chocolates that are delivered to one's lover on Valentine's Day, but there is the chocolate that they are made from. Here is where a first choice point arises. Should we take the set of chocolates to be basic and somehow "derive" the chocolate from them? Or should we take the chocolate stuff as basic and derive the set of chocolates from that? Or should there be two separate meanings that are each basic? Or should there be one meaning that is "unspecified for +MASS/+COUNT" thereby implicitly including both meanings?

The literature on mass nouns seems to be committed to taking one of the meanings as basic and deriving the other. The process is called "coercion" and is said to be triggered by features of the surrounding linguistic context (or, sometimes, by the non-linguistic context). For example, if the mass-meaning is taken as primitive, then a sentence like *Abelard gave Heloise seven chocolates* is said to have 'chocolate' coerced into a +COUNT meaning by the presence of the plural and the number modifier. If the sentence were *Each chocolate was made by hand*, then the presence of 'each' will coerce the basic mass meaning into a count meaning. Alternatively, if the count-meaning is taken as primitive, then a sentence like *The box contained two kilos of chocolate* would be seen as coercing the basic count meaning into the mass meaning by means of the measure phrase 'two kilos of'.

It is never clear why one meaning vs. the other is taken as primitive. It is as if the theorists have some special insight into what the true, real and underlying meaning is. It seems unlikely to be due merely to frequency; maybe it is some combination of frequency and saliency. When examples are given, they do not use nouns like *chocolate* but rather *house, child, car, ...* It then seems more plausible to say that *Sally owns too much house!* employs a coerced mass-meaning of *house* – which is "really" a +COUNT term. But this seems to become a more suspect attitude when one views the full range of "dual life" terms. Once again I recommend that the list in (Huddleston and Pullum 2002: p.335) be studied. It seems to me that the truly wide variety will make one hesitate to employ the notion of 'coercion' so rapidly.

Some theorists have thought that there should be a distinction made within +MASS nouns for those that are homogeneous vs. those that are "atomic". The sort of distinction these theorists have in mind is between words like *blood* and

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[13]Or rather, a function on possible worlds to the set of chocolates in each world. For the purposes of this section we stick with the "extensional meaning" of terms.

furniture. The idea is (as we discussed above in §5) is that some words that are intuitively seen as +MASS actually have clear atoms (like *furniture*) while others (like *blood*) are not seen in that way. We have already seen in conjunction with (11) above that Huddleston and Pullum (2002) wish to make these form separate categories within −COUNT, on the basis that these "aggregate terms" are true of "very different types of things". This issue of how a mass term can be a cover term for a variety of different subtypes, each of which is a count term, is discussed in the psychology literature under the heading of "mass nouns as superordinate terms" (see Wisniewski et al. 1996, 2003 Takatori and Schwanenflugel 2008), with an emphasis on whether there is some basis "in reality" for the notion of an 'individual' vs. 'stuff'. This is often called "natural atomicity". We discuss the psychological issues a it further, below in §9. For now let's notice that, while the atomic parts of furniture are rather large – making it seem that the natural atomicity has been fulfilled – the atomic parts of cutlery are smaller and those of gravel are very small indeed. And as I mentioned above, pretty much every English speaker believes that there are atomic parts of *any* purported mass term, even such prototypical ones as 'water' or 'blood'. What *does* seem true, however, is that for some mass nouns, 'gravel' perhaps or maybe 'coffee', just what counts as atomic parts is "vague". The idea is that while there are clear cases of the atomic parts of (most?) +COUNT nouns, and of some +MASS nouns (the clear-cut "aggregates"), and while some words perhaps designate "complete homogeneity" (maybe 'space'?), these endpoints merge into one another in the same way that any of the traditional vague predicates do. And then the issue of what nouns should be +COUNT and which should be +MASS is of the same nature as vagueness: here, the vagueness of what counts as an atomic part. This line of research is pursued by Chierchia (2010).

8   Some Diachronic and Cross-Linguistic Data

Chierchia (2010) gives a very helpful three-way division of how various languages deal with the +MASS/+COUNT distinction. Without insisting on the exhaustivity of its classification, or even on the ultimate "truth" of its vision, we can nonetheless use the labels to give general characterizations. According to this division, the world's languages fall into one of the following three groups with regards to +MASS/+COUNT.

1. Number marking languages, which have overt number features that obligatorily appear on nouns. Here the +MASS/+COUNT distinction applies to the nouns directly. (Most?) Indo-European languages, e.g., current English, are such languages.

2. Classifier languages, which do not have obligatory number marking on nouns (and arguably do not have a singular/plural contrast at all on nouns). Lexical nouns in such languages could be viewed as +MASS, although there is a +MASS/+COUNT distinction that is active more generally. (For this reason it might be better to view the lexical nouns as unspec-

ified for +mass/+count). The classifiers in these languages enforce the +mass/+count distinction, but at the level of an entire "classified noun phrase". (Most?) Asian languages, e.g., Mandarin, Japanese, and Korean, are such languages.

3. Languages lacking both obligatory number marking and obligatory classifier systems. Various Amerindian languages, e.g., the Canadian Dene Sųłiné, various South American languages, e.g., the Brazilian Karitianan, and various Austronesian languages are such languages. Some, perhaps all, of these languages can plausibly be seen as having a +mass/+count distinction, albeit on somewhat different bases than the foregoing languages.

Toyota (2009) reports that a close study of the use of mass and count terms in Old English (700–1100), early Middle English (1100–1350), late Middle English (1350–1500), early Modern English (1500-1700) and late Modern English (1700–present) shows substantial changes in the counting system of English, especially in the use of classifiers. Apparently, the earlier English did not make a distinction between mass and count nouns, using classifiers exclusively and therefore having the nouns all be +mass (or, unspecified for +mass/+count). The +mass/+count distinction eventually emerged around the border between late Middle and early Modern English (i.e., around 1500). Toyota concludes that in fact English changed from a classifier language to the current number-marking, non-classifier language, and as part of this change came to mark a +mass/+count distinction within lexical nouns.

The Germanic and Romance languages are, like (modern) English, number marking languages. They have a +mass/+count distinction which characterizes lexical nouns. Nonetheless, the different languages seem always to have various differences in the specific nouns that are said to be mass and count. Here are a few examples from French, German, and Italian.

(18)   French, German, Italian are +count; English is +mass

   a.   un meuble, ein Möbel, un mobile
        all literally translate as: *a furniture*-sg
        'a piece of furniture, furniture'

   b.   un renseignement, ein Ratschlag, un consigilo
        all literally translate as: *an information*-sg (or as *an advice*-sg)
        'a piece of information/advice'

(19)   German, Italian +count, English +mass

   a.   eine Nachricht, una notizia
        literally translate as: *a news*-sg
        'a piece of news'

(20)   French +count, English +mass

a.   les   pellicules
     literally: *the films*-pl
     'dandruff'

(21)   French +MASS, English +COUNT
     a.   la vaisselle
          literally *dish(es)*-mass
          'dishes'

Chierchia (1998b) mentions that, even though Italian matches English in having both a mass noun corresponding to *hair* (*capello*) and a count noun corresponding to *hairs* (*capelli*), in English one says

(22) a.   I cut my hair
     b.   *I cut my hairs

while in Italian one says

(23) a.   *Mi somo tagliato i capello
     b.   Mi somo tagliato i capelli

It would seem that the same activity is described in the two cases, so there can't really be anything in the choice of mass vs. count.

    Moving yet slightly further from English, the Slavic languages also have a +MASS/+COUNT distinction that nonetheless differs sometimes from English, sometimes from the just-surveyed languages.

(24)   Russian +MASS, English +COUNT
     a.   klubnika
          strawberry-mass
          'a strawberry' +COUNT

(25)   English and Russian +MASS; French, German, Italian +COUNT
     a.   mebel´
          furniture-mass
          'furniture' +MASS

    The Chinese languages and the Korean-Japanese languages are often argued *not* to make a +MASS/+COUNT distinction within the lexical noun. This is because, it is said, in these languages *no* noun can directly combine with numerals. Instead, a classifier – a word that indicates a way to "individuate" what is being discussed – is always needed. The classifier might designate a measure, or some container, or some shape (etc.) that the referent of the noun is to have. Many writers, e.g., Hansen (1976) Sharvy (1978) Krifka (1995) Chierchia (1998a,b), have concluded that the referent of the noun is therefore to be understood as

"mass stuff", waiting to be "classified" into an object or a portion or some shape, etc. This is true for nouns such as 'man' as well as ones like 'water'. And hence, the meaning of all lexical nouns is +MASS. However, the work of Cheng and Sybesma (1999) has convinced many that the appropriate place to look for the +MASS/+COUNT distinction in these languages is the classifier system itself. And thus Chierchia (2010) now writes (as mentioned above) that although it is possible to view the lexical nouns as +MASS, "there is a +MASS/+COUNT distinction that is active more generally".

Other languages have fewer syntactic constructions that would give clues as to whether a noun +MASS or +COUNT. For instance Dene Sųłiné lacks obligatory number marking and obligatory classifier usage (Wilhelm 2006a,b, 2008). A noun occurs with no marking and therefore it is "a matter of context" as to whether one item or several items, or perhaps just the 'stuff', is under discussion. And like many Athapaskan languages, there is also no nominal quantification that distinguishes (for example) *All X* from *Each X*. Thus, the sort of ways that one would distinguish +MASS from +COUNT in English (and other Indo-European languages) is not available. And there are no obligatory classifiers that would work in the way that Chinese, Japanese, Korean, etc., get +MASS or +COUNT interpretations for entire noun phrases. For instance, the same sentence would be used to assert 'I cut one hair', 'I cut several hairs', and 'I cut hair'. Nonetheless, Dene Sųłiné does have a prohibition against direct combination of a numeral with some nouns – requiring a classifier phrase for them in order to use a numeral – and this could form the basis for a (semantic) characterization of the +MASS/+COUNT distinction.[14]

In Karitiana (spoken in the Amazonian region), there is also no ±DEFINITE article or other marker making this distinction, nor any explicit singular/plural marking. Karitianan quantifiers seem to be adverbial rather than nominal: the expression which conveys universal quantification – *(ta)akatyym* – is composed of a third person anaphora (the prefix *-ta*), the verb 'to be' (*aka*) and the subordinate particle (*tyym*). So it more literally "signifies something like *those who are*" (as Müller et al. 2006: p.126 puts it). Nonetheless, like Dene Sųłiné, there is a context that is appropriate for just some nouns: when using numerals with some nouns, one must use a classifier. One can say (26b) but not (26a), despite the fact that semantically all bare nouns are cumulative: if a *pikom* (monkey) is added to another *pikom*, the result is *pikom* in exactly the way that it happens with *ese* (water).

(26) a. *J̃onso   nakaot   sypomp ese
        woman decl-bring two   water
        'The woman brought two waters'

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[14]Wilhelm calls this a semantic characterization. It seems to be a syntactic characterization to Chierchia (2010), who calls this "the signature property" of mass nouns. Chierchia also suggests (p. 108fn8) that there may be many other languages, such as the Austronesian languages, that follow this pattern.

b. J̃onso nakaot   sypomp bytypip ese
    woman decl-bring two   bowl-in water
    'The woman brought two bowls of water'

The conclusion is that in Karitiana some nouns are syntactically +mass because of the interaction between the numerals and the classifiers. This is different from the Dene Sųłiné case, where there is no interaction but rather the numeral modifiers just simply can't be applied to some lexical nouns.

But even these concessions to minimalist tests for +mass seems absent from the language Yudja (spoken in the Amazonian region, Lima 2010). This language is also a bare-noun language (nouns can occur without articles or number inflection), and although +hum nouns (but not others) can be pluralized, even this is optional. And when left off, a bare noun can be interpreted as either singular or plural. Lima gives examples such as

(27)   ali   ba'ï ixu
          child paca to eat
          'The/a/child(ren) eat(s)/ate the/a/some paca(s)

Furthermore, all nouns can be directly combined with numerals without the intervention of measure phrases or classifiers. Lima concludes that Chierchia's "signature property" is not exemplified in Yudja and therefore the +count/+mass distinction is not grammaticalized in Yudja at all.

The +mass/+count distinction has been investigated in a number of the world's languages in addition to the ones just mentioned, and the interested reader could consult

- Chen (2007) for Marsican
- Massam (2007) for Niuean;
- Mathieu (2007) for Ojibwe;
- Müller (2001) for Brazilian Portuguese;
- Nemoto (2005) and Iwasaki et al. (2010) for Japanese and Korean;
- Tsoulas (2006) for Greek;
- Wiltschko (2005) for Halkomelem Salish;

As well, there are a rather large number of works on classifiers (and +mass) in Mandarin.

9 Some Relevant Psycholinguistic Data

In this section we review some psycholinguistic data (mostly from English) that is possibly relevant to a philosophically satisfying account of the +mass/+count distinction. We will not pause to evaluate the findings, nor even to discuss them

much. The goal is merely to identify some established facts about the following topics, in languages that manifest the +mass/+count distinction.

- At what age do language learners acquire +mass/+count? Is there an effect of bilingualism?

- Can mass nouns count? And if so, when?

- What affects whether a term is judged +mass or +count?

- Reaction Times, Eye-Tracking Data, and ERP Results on +mass/+count.

- Aphasia studies on +mass/+count.

9.1   Acquiring the +mass/+count Distinction

The issue of when children acquire the +mass/+count distinction in their speech[15] has been studied in a variety of languages, although mostly in English. Gordon (1985, 1988) reports that English two- and three-year olds obey the +mass/+count distinction in their speech, as revealed by their pluralization, but can't judge appropriateness of other's speech until about five-years-old. Gathercole (1985) reports children can understand the use of *much* vs. *many* prior to the age of 8 years, and she rehearses the data from hers and Gordon's studies in Gathercole (1986). Barner and Snedeker (2005) reports that English speaking four-year-olds reliably distinguish between +mass and +count nouns. Soja (1992) Soja et al. (1992) Gathercole et al. (1995) have shown that children at around the age of three can extend nonsense nouns correctly (*a tom→toms; sm blicket→blicket*).

The issue of child-learning of the +mass/+count distinction has also been discussed for languages other than English. Hacohen (2008) replicated the methodology of Barner and Snedeker (2005) within Hebrew and studied a group of monolingual children between four and five years old. It was shown that although Hebrew-speaking adults behave exactly the same as English-speaking adults, nonetheless with Hebrew-learning children, "7–12 year olds behave similarly to English-acquiring 4 year olds. Hebrew-acquiring 4 year old children, and even children as old as 6;11, seem to be completely oblivious to the [+mass vs. +count] category of the NP."

Taking the point of view that in Chinese, the mass-count distinction is to be described within the classifier system and not with the lexical nouns – a viewpoint discussed in the previous Section and associated with Cheng and Sybesma (1999), Chien et al. (2003) investigate 80 monolingual Chinese speaking children between the ages of 3 and 8. Their conclusion is that even as young as 3 years, they honor this distinction in their choice of which classifiers to employ. Indeed, they found that the children were able to make very fine differentiations among

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[15]The question of *how* they acquire it – i.e., to what sort of evidence do the children attend and how do they use it – has also been studied, although here the data is much more unsettled. This topic will not be discussed here. See Prasada et al. (2002), for discussion; there is also some speculation that is recounted in Wisniewski (2009).

classifiers, and that there was no overall difference between mass-classifiers and count-classifiers when it comes to learning them.

Gathercole (1997) studied the learning pattern of +MASS/+COUNT in bilingual English-Spanish language-learners (ages 7 and 9), and compared them to monolingual English learners. According to Gathercole, the English and Spanish languages differ substantially in their overall character as regards to +MASS and +COUNT[16], and the question being asked concerns the extent of interference the learning of one pattern will be on the learning of the other. The monolingual English learners had already mastered the +MASS/+COUNT distinction by seven years old, but the bilingual seven-year-olds – whether they were very fluent in English or comparatively weaker[17] – "showed little attention to the +MASS/+COUNT linguistic frames. There is no difference in their response patterns in the count vs. mass syntax conditions." However, by the age of nine, the bilinguals who are strong in English did catch up with the monolinguals.

9.2   Counting vs. Measuring with +MASS Nouns

The general goal of Barner and Snedeker (2005) was to investigate the relation between conceptual development involving individuation and the +MASS/+COUNT distinction. They distinguish three views of this relation, and argue that each makes some empirically false claims. The first view is that +COUNT terms are true of "distinct, countable, individuated things" while +MASS terms are true of "non-distinct, uncountable, unindividuated things". This view is called the 'Quinian Correspondence Hypothesis' (Quine 1960). The second view is that while +COUNT terms are as Quine says, +MASS terms are lexically unspecified, and it takes world knowledge to tell one whether there are minimal parts – it is world knowledge that tells us that *furniture* but not *water* has minimal parts. This view is called "Linguistic Non-Specification" and associated with Gillon (1992, 1999). The final view again agrees about +COUNT terms but says that +MASS terms are true of pluralities of individuals, but that what counts as the minimal parts is vague. The view is associated with Chierchia (1998a).

Barner and Snedeker (2005) describe three experiments. Each of the experiments involved both adults and also children (mean age about 4;3). The first one looked at the interpretation of (what the authors called) 'object-mass terms' vs. 'substance-mass terms' vs. count terms, giving examples such as *silverware* vs. *toothpaste* vs. *shoe.* The subjects were shown pictures where there was (e.g.) a very large fork vs. three small forks, a very large gob of toothpaste vs. three small bits of toothpaste, and a very large shoe vs. three small shoes. They were asked "Who has more silverware/toothpaste/shoes?" Overwhelmingly – and as our linguistic intuitions confirm – the answers for the count terms was that the

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[16]Actually, they are both number-marking languages, to use the terminology of Section 8. They both make a +COUNT/+MASS distinction, although as is the case with other Indo-European languages, certain words are marked differently. As (Whitley 2002:p.148) puts it, "Spanish more readily 'countifies' than English." (However, in the scheme of the world's languages, one would say that English and Spanish are almost the same).

[17]As judged from a test of English proficiency that had been administered some years earlier in their education.

three shoes were more shoes and for the substance-mass terms was that the large gob was more toothpaste. But also, the answer for the object-mass terms was that the three small forks was more silverware than the very large single fork.

Experiment 2 manipulated the numbers of items shown. For example, there might be two large shoes and six tiny ones. (Where nonetheless the two large shoes occupied more two-dimensional area and depicted a larger three-dimensional volume). It also allowed that the object-mass terms were true of "different types of items" and so the silverware example might have a large fork plus two large spoons vs. three tiny spoons, a small knife, and two tiny forks. All the different types of terms behaved in the same way that they did in experiment 1, so the authors conclude that there is no issue of plurality involved nor any issue of "being true of different sorts of things."

Experiment 3 was somewhat different. The terms under consideration were (what the authors called) "flexible terms" (and what we called "dual life" terms) – words like *string, chocolate, paper, stone*, which have both natural +MASS and natural +COUNT meanings. Again, subjects were shown a picture of (say) a very large stone and three quite small stones. But now they were asked two different questions: "Who has more stone?" vs. "Who has more stones?" The +MASS syntax made the subjects answer in terms of area/volume while the +COUNT syntax made them answer in terms of number.

The authors take these results to disconfirm each of the three theories under consideration, and they offer their own alternative, which is refined in Bale and Barner (2009). As mentioned in the preceding subsection, Hacohen (2008) replicated these experiments in Hebrew, with the same results.

9.3   Cognitive Considerations in Judging Whether +MASS or +COUNT

The sorts of evidence that were brought forward in Section 5 above tells against views that take the +MASS/+COUNT distinction is a reflection of "reality", since it seems that one and the same feature of a piece of reality can sometimes be identified by a +COUNT term and sometimes by a +MASS term – both within the same language and across languages. But this "externalist" picture of semantics can also be countered with an "internalist", "conceptually based" picture. And it might be that, despite there being no distinction in reality, our "conception" of a piece of reality could make uniform use of a set of strategies to view the world in these two different ways. A body of research attempts to show that there are universal regularities embodied in human cognition that are relevant to the +MASS/+COUNT distinction, and this shows that the distinction isn't "semantically opaque".

One of the sophisticated such views is stated in Wisniewski (2009), which describes a number of experiments (many from Middleton et al. 2004) that aim at verifying the 'conceptual' view of +MASS/+COUNT. One experiment assessed whether perceptual distinguishability of elements composing aggregates predicted their +COUNT/+MASS status: subjects rated how easy it is to see individual elements of 112 common aggregate terms. Another study assessed how

often subjects interacted with just one or a few of the elements vs. with large but indeterminate numbers of the elements. Two additional studies involved ratings of perceptual distinguishability of the elements and likelihood of interacting with just one or a few, using a different set of 80 terms.

Generally speaking, aggregates designated by +count terms scored high on perceptual distinguishability of elements and with commonality of interacting with just one or a few elements at a time. There were some exceptions, such as *fleas, bacteria, maggots, lice*, that made Wisniewski conjecture that animacy might also be a factor in conceptualizing a term as +count. Further exceptions (e.g., *asprin, bacon*) suggested an effect of how the item was historically introduced. Aggregates designated by +mass terms scored quite a bit lower on perceptual distinguishability and interaction with its elements.

Middleton et al. (2004) also investigated what might *cause* a person to view a novel term as +mass or +count. A series of pairs of pictures was shown to subjects. Each pair showed drawings of a group of made-up items, where the items varied on whether they were very close together (and so, whether they were individualizable) or what their size was, or both. Accompanying such a pair of drawings, was a phrase that varied between +mass and +count syntax: 'This stuff is worgel' vs. 'These are called worgels'. Subjects were asked to identify which one of the pair of pictures was being described. +count phrases were pretty much uniformly associated with individualizability, and size seemed to play no role.

Finally, subjects were shown a pile of yellow, coarse-grained sugar. 61% said that 'We call this blicket' better described it than 'We call these blickets'. But in the experimental condition, subjects were asked to play a game with a small "hockey stick" that moved individual grains of the sugar into small holes on a game board. After 15 minutes of this, 69% of the subjects now agreed that 'We call these blickets' better described the initial pile. Wisniewski concluded that this provided direct evidence that how people interact with an aggregate affects their conceptualization of that aggregate as individuated or nonindividuated. In his 2009, Wisniewski claimed that, taken together, the findings show that there are important properties of count-noun aggregates that individually apply to each aggregate element, whereas those of mass-noun aggregates apply to arbitrary-sozed groups of the elements. He calls this 'differing in their scope of predication.'

There remain some exceptions... Wisniewski mentions *toast, firewood, money, candy* and others. This suggests that the 'individuation function' (even together with ±animacy) is not all there is to this story. And it doesn't therefore explain how there can be such cases that have become "fossilized" in the language (as Wisniewski suggests for *aspirin, Advil, Tylenol, bacon*). For, just pointing out that they started out as +mass terms and have retained this even though they are now conceptualized as individuated, doesn't explain why this happened with these but not other terms. A similar comment can be made about Wisniewski's view that certain words that are +count, despite the facts that they designate non-individuated stuff and all speakers agree that the stuff is non-individuated. As examples, Wisniewski mentions 'eyedrops' (taken to designate the contents

of a bottle) and 'tears' (as the stuff that streams out of eyes); and he suggests that the +count use can be accounted for as referring to the *uses* made of the nonindividuated substances. Again though – why with these terms and not with others of similar provenance?

9.4   Reaction Times, Eye-Tracking Data, and ERP Results

Gillon et al. (1999) explored the +mass/+count distinction by means of two on-line lexical decision experiments. The subjects were to identify quickly whether a string presented on a terminal was an English word, where each presentation was given for 200 ms (and was separated from others by 350 ms). There were 150 mass and count nouns, 150 filler terms (verbs), and 280 nonwords. The +mass nouns were subdivided into those with atomic denotations, such as *money*, those without, such as *sugar*, and "mass plurals", such as *comics*.[18] The result of this first experiment was that +mass vs. +count was a main effect for recognizing singular nouns legitimate English. However, ±plural is also a confounding factor, and Gillon et al. hypothesize that there are various effects of frequency and the nature of the task may lead subjects not to process the ±plural feature at all.

Their second experiment gave the stimuli in combination with a determiner or adjective, such as *three chairs/*three chair* and *much dirt/*many dirt*, using the same determiner phrases across noun types. The idea was that the determiners would prime features and create expectations for specific features in the target noun, and that whenever whenever a mismatch between what is activated by the determiner and what is activated by the noun, the reaction times for the noun would be slower. Again Gillon et al. found a main effect for +mass vs. +count, with +mass being significantly slower. Further, all mismatches between determiner and noun generated significantly longer reaction times. The explanation, they hypothesize, is that "atomic mass nouns are exceptional in that their denotations, being atomic, suit them for being count nouns, yet they are in fact mass nouns. We hypothesize that it is this exceptionality which accounts for their longer response times in the primed [by determiners] grammatical condition." Despite this apparent nod to the semantic notion of +mass/+count, Gillon et al. conclude with "our results show that the lexical feature [+mass] is indeed computed...", treating +mass as a syntactic feature of lexical items.

Frisson and Frazier (2005) ran two eye-tracking experiments to test the processing of +mass and of "+count nouns used as mass nouns". Their hypothesis was that in in the absence of biasing, readers would immediately assign the 'underived' sense to a noun, which would result in difficulty if the sense was shown to be wrong. Their first experiment considered 'portioning' mass nouns, as in *She spilled waters on the table*. A small and early penalty was observed

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[18]There were also distinctions made within the +count category: ones that had irregular plurals, such as *mouse*, inherent plurals, such as *trousers*. Additionally, Gillon et al. considered what nouns that they recognize as commonly being "dual", such as *candy*. All the various categories of nouns were tested against one another.

for this sort of use of +MASS nouns. Their second experiment studied 'grinding' count nouns, as in *There was brownie all over the stove.* Here, in addition to an early effect, a larger penalty appeared much later for this use of +COUNT nouns. Their conclusion is that there people have an "immediate commitment to the underived sense of polysemous words when the two senses are related by a derivational rule". They are also concerned to show that the +MASS/+COUNT case is different from other types of polysemous words.

Steinhauer et al. (2001) conducted an experiment by means of EEG/ERP methodology that used +MASS/+COUNT as stimuli. Generally speaking, syntactic processing difficulties are reflected by left anterior negativity (the "N350") and a late parietal positivity (the "P600"). Semantic-conceptual processing is reflected by a centro-parietal negativity effect (the "N400"), whose amplitude reflects difficulties in semantic integration ("semantic or conceptual anomaly"). Moving away from the "violation" paradigm, the authors used sentences such as

(28) a.   Yesterday, I translated Diane's *story* for the children
     b.   The detective shared Linda's *information* with the attorney

The idea was that, depending on whether the difference in processing a +COUNT vs. +MASS resembled either the N400 central negativity or the N350 anterior negativity, it could be inferred whether the +MASS/+COUNT distinction was semantic or syntactic. They found a robust +MASS/+COUNT effect, which they take to show the general relevance of these features in the mental lexicon. They also found that there was a stronger anterior negativity component than the more posterior N400 component. They take this to show that the +MASS/+COUNT distinction is a syntactic matter rather than semantic. Furthermore, they argue that their results cannot be attributed to different expectations concerning subsequent words, and therefore challenges the relevance of function vs. content words in these sorts of tasks.

9.5   Aphasia and +MASS/+COUNT

In Semenza et al. (1997), a patient is described who shows how it is possible to be able to retrieve a certain category of words (mass nouns) and yet to be unable to take into account, in both production and reception, the syntactic information that distinguishes that category from other categories. They argued that this dissociation is attributed to a selective loss of specific grammatical rules that are thus demonstrated to be stored and independently processed outside the lexicon. The patient had a vascular lesion in her left temporal lobe, and had been discharged from the hospital after her speech therapy was judged to be recovered, showing no signs of alexia or agraphia, and only very minor anomia. This patient scored perfectly, or nearly so, on all the grammatical tests given – both of comprehension and of production – on all aspects of her language, except for issues dealing specifically with mass nouns. Such tests asked for the appropriate singular or plural form, indefinite vs. definite articles, and the appropriate quantifiers, for use with +MASS nouns and noun phrases. A slight

modification to the task makes it also be a test for using +COUNT terms correctly. This patient got 100% of the questions involving +COUNT terms correct, but less than 25% of those involving +MASS terms. This performance was steady over the 18 month duration of the study.

10   Concluding Remarks

We have seen that the +MASS/+COUNT distinction has been thought to have philosophical ramifications within metaphysics, both as to the ultimate nature of reality and to issues of identity and re-identification. The extension of the +MASS/+COUNT distinction to the realm of verb phrases also yields a philosophically interesting area of investigation into differentiation among processes, events, achievements, and so on. We have also seen that the existence of mass nouns in natural language has challenged traditional first-order logic as a representation language, and sparked development of mereological and lattice-theoretic approaches as representational media.

There are two standard approaches to the +MASS/+COUNT distinction: syntactic and semantic. But there appear to be severe difficulties with making either of them into a general theory. Furthermore, the facts surrounding how +MASS/+COUNT is manifested in languages other than the Indo-European ones might seem to show that the basis and rationale for making the distinction – and perhaps any philosophical consequences that might seem to follow from the distinction – are not really valid as claims about reality in general or about how people might conceptualize reality.

And finally, we have reviewed the literature on the psycholinguistics of +MASS/+COUNT. Most of this work has been done in English, although there are some studies concerning how Asian speakers and an Italian speaker operate with the distinction in their languages. Further philosophical studies (and further linguistic studies) of the +MASS/+COUNT distinction in English will need to be cognizant of this work, for it provides a touchstone of empirical reality in the way speakers employ the distinction, and it cannot be ignored in favor of "a more beautiful theory."

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