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## Language, Thought and Reality after Chomsky

### 1. Introduction

In 1956, “Language, Thought and Reality”, a famous book B.L. Whorf, was published. In it, some fundamental and very hard questions were addressed, which have remained at the heart of an intense debate since. Such questions include the following:

- (1) a. What is the relationship of language to thought?
  - i. Is there thinking without language? Or does the structure of our language determine how we think?
  - ii. How are our linguistic abilities related to our general intelligence?
- b. What is the relation of language to reality?
  - i. Is language a mirror of the world?
  - ii. Or does language determine the way we view the world?
- c. What is the relation of language to culture?
  - i. Is language a cultural and historical artifact (on a par with other human institutions)?
  - ii. Is the design of language wholly and optimally functional to our communicative needs?

I am formulating these questions in an informal and impressionistic way. In the second half of the past century, they have been made considerably sharper thanks to the interaction of and debate across the disciplines that study our various cognitive abilities (disciplines like linguistics, psychology, neuroscience, philosophy, anthropology, etc.). In the present paper I would like to show how semantics in generative grammar (the research paradigm initiated by N. Chomsky nearly 50 years ago) is helping in putting some such questions on firmer grounds through an example, taken from the grammar of nouns (the mass/count distinction).

Let me begin, in the remainder of this introduction, by fleshing out a bit more the questions in (1). We interpret language quickly and with hardly any awareness of what we are doing. Decoding our language is almost as immediate as seeing. In the thousands of ways we use language in our daily life, we constantly and effortlessly go from words to meaning; and, viceversa, we put what we intend to convey into words. In doing so, we rely on some internalized way of coding information in the expressions of our language. Language embodies a systematic relation of symbols arranged in specific ways and meanings, which we take completely for granted in our own language even though it looks mysterious and complex when we look at some other languages. The questions are: how do expressions code meanings? Why are we so good at using expressions to mean in our native language, while we find it so hard when we try to do so in some other language?

There are no quick and easy answers to such questions. One traditional illustration of their difficulty is the problematic character of translation. The notion of “exact” translation is very elusive. A proof is the relatively modest successes of the attempts to translate mechanically, through machines. Lots of research (with substantive investments) has been put into the development of programs for automatic translation. And although there is progress, it is still a far cry from having truly workable tools. The problematic character of translation is a source of endless discussions. Something that clearly comes out of even a superficial look at it is that differences among languages

are not just phonetic differences (in the shape of sounds used). It's not simply that things or concepts get different phonetic labels in different languages. Many words do not readily translate from a language to the next; and when it comes to translating whole sentences, things become pretty involved. Crosslinguistic differences seem to affect the whole system of how meanings are coded. The parallel with cultural differences (in habits, institutions, traditions, history) cannot but readily come to mind. And with this parallel, naturally comes the idea that language (and more specifically the way in which language encodes information about our surroundings) embodies a world view, a conceptual frame, a form of life. This would explain the difficulty we find in translating. We view things differently, depending on our histories. And no two forms of life, world views, histories match perfectly. If languages are a cultural manifestations on a par with political institutions, wedding rituals, monetary systems, and so on, no wonder we cannot translate any more readily we can convert a currency into another or find the exact correspondent of the U.S. president among the Italian institutional figures (the Italian president has quite different functions, etc.). Whorf, building on work by Sapir and others, formulated a particularly perspicuous version of these ideas, a position that has come to be known as "linguistic relativism". According to it language, is mostly a cultural product and embodies/determines the way in which a community views reality.

While perfect translation may well not exist, it is also evident that partial ones are possible and effective. This is due, presumably, to two reasons. On the one hand, men are made alike. They have the same physical structure, the same cognitive resources, etc. Hence there will be some commonalities in the way in they process and code information. On the other hand, there typically is enough common ground across cultures, world views, etc. so as to allow, with some care, to interpret each other. The key to this is human intelligence, a complex and integrated set of cognitive resources. Such resources enable us to extract complex information from our environment and pass it to each other. This enhances our capacity to cope with our environment. Since our experiences differ, we may categorize information in different ways. Nonetheless, we are remarkably successful at such a task and we can convert our categorizations across our different experiences in a fairly successful manner.

If we were to sum up these common place observations in a form that addresses the concerns in (1), we might do it as follows:

- (2)
  - a. Men are endowed with intelligence, i.e. a uniform, plastic capacity that
    - i. enables us to extract regularities from our environment, and
    - ii. endows us with advanced problem solving skills
  - b. Language is our intelligence's reply to our need for communicating.
  - c. The specific forms that languages take reflect:
    - i. how our intelligence copes with the external environment  
[language as mirror of reality]
    - ii. how our intelligence gives shape to our forms of life  
[language as a cultural artifact]

This summary sets the Sapir/Whorf hypothesis within a broader view of how thought and language may interact, a view which enables us to do justice to the idea that language may well not be wholly cultural. We may not know (and disagree on) how much is cultural and how much is natural/instinctual in human language. But at any rate, the roughly 6-7000 languages we observe in the world are mainly the reaction of a highly developed, adaptable capacity located in the brain to external pressure from nature and to the culture we develop.

Even though this broad picture looks quite plausible, I think that it is to large extent wrong. The main thesis I will defend, in contrast with (2), is that language is a largely specialized system characterized by specific computational devices autonomous from other abilities constitutive of "human intelligence" (like statistical resources or problem solving strategies). Chomsky often talks in this connection of a sort of "language organ" located in the brain. More specifically, when it comes

to semantics, people often think of it in terms of world knowledge (be it perceptual, encyclopedic, or what have you) linked to linguistic representations in a largely conventional way. In modern generative linguistics, semantics has taken a rather different form. It is the investigation of logical forms and denotational structures (similar to those first exposed in logical semantics) linked to the syntax of particular languages by a set of universal mappings. Such structures systematically constrain the way we refer to things and reason about them.

In what follows, I discuss some relevant evidence, drawing from the mass/count distinction. Such a distinction has been discussed extensively and it lends itself particularly well to giving us a relatively quick overview of what ongoing debates are about.

## 2. Masses and individuals

One characteristic of the nominal system of many languages, including English, is that it differentiates two sorts of nouns: mass and count. Typical count nouns are *chair*, *table*, *man*, etc. Typical mass nouns are *water*, *blood*, *garbage*, etc. Count nouns seem to refer to classes of well identified, discrete objects that appear to be readily accessible to us. Mass nouns seem to refer to substances or amounts not evidently made up of discrete parts. This difference manifests itself in a number of morphosyntactic phenomena that we will now review. To talk about single tables or chairs we use the singular, while to talk about groups we have to use the plural:

- (3) a. That table is cheap
- b. Those chairs are cheap
- d. \* Those table is cheap
- e. \* That chairs are cheap

In (3a) a singular noun (*table*, *chair*) combines with a demonstrative determiner (*that*); the resulting Noun Phrase (abbreviated as NP, a syntactic unit characterized by the presence of a noun) refers to or denotes a particular entity (for example, the table we are pointing at). The plural noun phrase in (3b), instead, refers to a group. Sentences (3d, e) are deviant, and this shows that combinations of demonstratives and nouns have to match in (or agree on) singularity/plurality. While plural marking is a very useful and general device, it is subject to certain constraints; in particular, with mass nouns, we cannot readily use plural morphology:

- (4) a. This rice is tasty
- b. \*These rices are tasty
- c. The water in this tank is dirty
- d. \*The waters in this tank are dirty

The deviance of sentences (4b,d) is not absolute. It is not the case that producing and understanding sentences such as (4b) or (4d) is totally impossible. But mass nouns in the plural have a very different “feel” from ordinary count nouns in the plural. For example, we can say things like *Mary broke her waters*. But it’s an idiomatic expression; we cannot simply reconstruct its meaning from the meaning of *breaking* and the meaning of *water*. In order to understand it, we have to know that *breaking waters* refers to a particular phase (typically, the onset) of labor. We might also sometimes say, *the waters of the sea divided in front of us*. But it sounds “poetic”, it evokes biblical images. If you drop a glass of water on the floor, it would sound very funny to say *you spilled waters all over*.

A further characteristic of mass nouns is that they do not combine with numerals. Consider the following example:

- (7) a. I need three chairs
- b. Those chairs are three
- c. \* I drank three waters
- d. \* I bought 100 rices

If I ask you “how many loafs of bread did you buy?” you can answer “three”. But not if I ask you “how much bread did you buy?”. In that case you must answer something like “three loafs” or “three kilos”. In order to “count” bread, blood, rice, etc. we have to use either “measure phrases” (kilos, liters, and so on) or “classifier phrases” (i.e. things like drops of blood, loafs of bread). Classifier phrases are used to indicate countable objects typically associated with the relevant substances or “standard servings” in which such substances can be divided.

The behavior of articles is also telling. The definite article *the* combines with both count and mass nouns.

- (8) a. The rice in this tank
- b. The chair over there
- c. The tables I inherited from aunt Robertina

But the indefinite article combines only with count nouns:

- (9) a. an expensive chair
- b. \* a rice that I bought

The noun phrase in (9b) can only have the type-interpretation (a type of rice I bought). This contrast is not limited to articles. It generalizes to many components of the noun phrase. The syntactic structure of a noun phrase can be schematized as follows:

- (10) a. [Det    N ]
- the    man
- b. Det: the, a, this, every, most, one, two,...., more than three, etc.

The tree in (10) tells us that a typical noun phrase is constituted minimally by a common noun and a determiner; determiners include articles, demonstratives and things like *every*, *many*, *several*, etc. Such elements determine, roughly speaking, how many things (of the sort specified by the common noun) are under consideration. We will say that a common noun constitutes the *restriction* of a determiner in structures like (10). Some determiners are morphologically simple (i.e. single morphemes or words, like *the*, *every*, etc.); others may be complex (*more than three*, *a lot of*, etc.) Now it is easy to observe that determiners are picky as to what kinds of nouns they combine with. For example, *every chair* sounds fine; but *every blood* is weird (to the extent we can use it, it can only be understood as “every type of blood”). The determiner *all* is nearly synonymous with *every*; yet, unlike the latter *all* readily combines with mass nouns (cf. *all water*, or, in combination with the definite article, *all the water*). This “pickiness” of various determiners appears to permeate the whole system of determiners.

Consider for example determiners like *several* or *many*. They can readily be used with plural count nouns (as in, e. g. *I saw several/many students*). But not with mass. It’s strange to say *I bought several/many rices* (marginally acceptable on the “type” reading). On the other hand, the determiner *much* goes with mass (*I ate too much rice*) but not with count (*I saw too much student* is strange indeed). *Much* is quite clearly a mass counterpart of *many*. It is clear that the whole determiner system is affected by the mass/count distinction; several generalization centered on such distinction emerge.

So, overall, the mass/count distinction has a series of related morphosyntactic manifestations, having to do with plural morphology, numerals, the determiner system. It’s worth summarizing them in schematic form:

- (12) Count nouns:
- (i) take readily plural morphology
  - (ii) combine with numerals (one, two, three, ...)
  - (iii) no need to use a classifier/measure phrase for counting
  - (iv) O. K. with *a, many, ...* not O.K. with *much, little, ...* etc.
- Mass nouns:
- (i') no plural morphology
  - (ii') don't combine with numerals
  - (iii') must use use a classifier/measure phrase for counting
  - (iv') O. K. with *much, little, ....* not O.K. with *a, many, ...*, etc.

As is evident even from these cursory remarks, the contrast between mass and count nouns appears to be well entrenched in the way we speak. There are a host of patterns in which such distinction manifests itself. The question is why. Where does this restriction come from? Why do so many languages make it? In what follows, we will consider a number of possible answers that have been given.

### 3. Possible extralinguistic roots of the mass/count distinction

If we look at the world, on the one hand we find things like pebbles, dogs, chairs, etc; on the other hand, we also find substances like water, air or, if we are lucky, gold. Objects form discrete, readily countable units; substances do not. Substances tend to be scattered around, often mixed with other stuff. They do not have evident minimal parts and, consequently, are not readily countable (even though they can be measured, with appropriate devices). Maybe, language simply reflects this set up of the world. If a noun is used to refer to objects, it is count; if it is used to refer to a substance it is mass. The morphosyntactic properties summarized in (12) are merely the linguistic manifestation of extralinguistic, semantic properties of the things nouns refer to. In this kind of approach to the mass/count distinction we see a concrete exemplification of the view of language as mirror of the world (one we might apply to other grammatical distinctions). The guiding principle is that language is used to talk about reality. We attach names to things, much like we attach labels on medicines or on books in a library. Labelling is very useful, as we well know. If we label things systematically, we can identify, locate and retrieve them, as needed. Perhaps language is a somewhat complex, spontaneous form of labelling. Our capacity to mean really is our capacity to label. The mass/count contrast might well be good prima facie evidence in favor of such view.

This general approach explains in very simple terms how language comes to carry information about the world. As we attach names (i.e. symbols) to things, we can, in virtue of this implicitly assumed association, use arrays of symbols to express how things are arranged in the world. For example if A stands for John and B for Bill, we might use AB to represent that B follows A and the reverse order BA for A follows B. The different symbolic arrays AB and BA represents two different ways in which John and Bill are related. This is very, very simplistic. But you can see how the idea might be developed further and how, in fact, it can be used to code elaborate information. Perhaps language is just a rather complex code, which functions according to these principles. Versions of this view of language have been put forth very authoritatively in the history of thought, from Aristotle to Wittgenstein. As will become apparent in what follows, there is a lot that is right about this view.

There is work in cognitive, developmental psychology that may provide further support for the view of the mass/count distinction that I have sketched. In particular, Spelke (1985), Soja, Carey and Spelke (1991) among others have argued that babies a few months old (well before they speak) have an articulated theory of the world. They believe that solid objects have boundaries and are cohesive (i.e. their parts stick together); such objects move as a whole (without, e.g., splitting or merging) along continuous paths. In contrast with this, children believe (or, we should rather say, they *know*) that non

solid substances like liquids or powders are not as cohesive. As they move and contact each other, they may not retain their boundedness; they may merge or split. How can we impute such elaborate view of the world to babies? The experimental paradigm that has been used to demonstrate these claims is of the following type. Imagine an object, say a teddy bear, on a table and a screen laying flat in front of the object that slowly rotates upwards covering the teddy bear. On one condition, the screen raises all the way vertically and precludes the teddy bear from the view. This is a “normal” state of affair (the expected condition). On a second condition, some sort of magic happens (from the adult’s point of view). The screen keeps rotating and, as it were, goes through the space occupied by the teddy bear (the unexpected condition – in fact as the screen rotates upwards, the teddy bear is removed by the experimenter, without the observer being able to see the removal). It turns out that children tend to stare longer at events of this sort than at those of the normal, expected type. I.e., they show surprise at “abnormal” events, which in turn suggests that they have the expectation that objects (like teddy bears or bottles) persist in their location and are solid. What is striking is that this happens at three months of age, when they cannot possibly have elaborated a theory of solid objects from experience. M. Hauser has pushed this line of inquiry further, showing that in fact primates like rhesus monkeys are endowed with a similar theory of discrete objects vs. substances (cf. Hauser 1996). Going back to children, it is highly plausible that such knowledge, that children appear to be endowed with at birth, guides them as an identification criterion for novel objects vs. substances they encounter; and, later on, such a knowledge guides them in acquiring language. For example upon encountering a class of solid objects, say bottle openers, the child identifies some key properties of the objects (say, shape and function); then generalizes it to other objects of the same sort (forming the concept of a uniform class of objects, bottle openers in general). Upon encountering, instead, a new paste or a new powder, one again identifies some of its key properties (in this case it won’t be shape but, say, texture and what one typically does with it); then one generalizes such properties to other portions of the same substance (see, e.g. Soja, Carey and Spelke 1991). Knowing that things are set up in this way (i.e. that they are naturally sorted in substances and objects) makes identification and naming easier. When language comes in, common nouns will naturally fall in two categories accordingly.

The view we have developed so far can be summarized as follows. The world is structured in objects and substances (defined in terms of the way they behave as they move across space and interact with each other). Children (and, in fact, other primates) seem to have inborn knowledge that the world is so structured. It might be tempting to speculate on the kind of adaptive advantages that would descend from such knowledge. But be that as it may, the presence and pervasiveness of object/substance distinction seems to be uncontroversially true. The mass/count distinction registers this fact.

#### 4. The grammatical basis of mass and count.

There are two main types of argument against the position outlined in section 3. The first is based on the existence of what we might regard as “funny” substances or objects. The second on crosslinguistic variation.

The first kind of problem has to do with the observation that the mass/count distinction is operative with nouns that do not readily map into objects/substances as we have defined them. Consider for example the following pairs:

- (13) a. generosity, virtue/virtues  
b. knowledge, belief/beliefs  
c. pride, prejudice/predjudices  
d. fun, joy/joys  
etc.

We are, with the examples in (13), in the realm of abstract nouns (often derived from verbs). Now notice that the first member of each pair in (13) is typically mass; the second typically count. For example, we can say “the generosity you displayed towards me...”; we cannot say “\* a generosity you displayed towards me...”. Or we can say “I haven’t encountered much generosity there”, not “\* I haven’t

encountered many generousities there”. On the other hand, *virtue* appears to be perfectly count: “I see many virtues in you, my young apprentice”, says Obi Wan Kenobi to Anakin Skywalker. I’ll let readers construct their own examples with the items in (13). Why are these examples problematic for the view we presented in section 3? Clearly, it is hard to view, say, generosity as a “substance” and virtue as an “object” or knowledge as a substance and beliefs as objects. Certainly not in Spelke’s sense, as she bases her distinction on, for example, how things move in space. Trying to extend the object/substance distinction to abstract objects clearly involves going beyond the conceptual system that was found in prelinguistic babies and other primates.

A related issue stems from the observation that there are things that are hard to not to classify along with paste, rice, salad. And yet they are count: lentils, beans, sprouts,... There are, furthermore, things that clearly are discrete objects, but English uses a mass noun for them. Consider the chair I am sitting on. It is a comfortable chair (count). But it is also cheap furniture (mass). Furniture, footwear, cutlery, drapery, are made up of perfectly discrete objects (table and chairs, knife and forks, curtains, etc.). Yet, grammatically, they are mass nouns: they don’t pluralize naturally (and if they do, they acquire the “type of” interpretation), they don’t combine with numerals, and so on. These nouns have a collective flavor, in the sense that they are typically used to refer to a plurality of objects. But nonetheless they are mass (and contrast with count collective nouns like *bunch*, *pile*, *group*, etc.). Moreover, it is not absolutely obligatory to use nouns like *furniture* only for pluralities. I can point to a single couch and say “I inherited this furniture from aunt Robertina”. If furniture is made up of countable objects, why can’t we combine it directly with a numeral (i.e. why can’t we say “\* those three furnitures are all is left after the fire”)? It is as if the mass/count distinction ceases to be a “real” distinction and becomes a way we can categorize things.

This circumstance becomes particularly evident once we look at it from a crosslinguistic standpoint. What we find is that even closely related languages have somewhat diverging sets of mass vs. count nouns. For example, in English one says “I cut my hair”. In Italian, one has to say “mi sono tagliato i capelli” (*I cut my hairs*, plural). *Hair*, used to refer to what grows on our head, seems to be mass in English, and count in Italian. Yet clearly we are referring to the same stuff. Your hair doesn’t change, as we change language. And the prelinguistic conceptual system of infants doesn’t change either if they happen to be exposed to Italian or English. There are quite a few mismatches of this sort. Here is a small list:

COUNT	MASS
capello	hair
bagaglio	luggage
servant	servitù
mobile	furniture
calzatura	footwear
posata	cutlery
relative	parentela

In all these cases, the same entities seem to be classified as mass or count depending on the language. <sup>1</sup>

One final point. In one and the same language, often one has pairs of closely related nouns, one mass the other count. This may give us an angle as to how the crosslinguistic differences just discussed are really like:

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<sup>1</sup> An extreme case of this sort is constituted by so called classifier languages, like Chinese. In such languages, numerals cannot be directly combined with any nouns. One cannot say things like *two men* or *three tables*. One has to use a classifier:

- (15) a. liang li mi  
           two CL rice                   ‘two grains of rice’  
       b. liang zhang zhuozi  
           two CL table                   ‘two pieces of table’

For discussion of the relevant issues see, e.g. Chierchia (1998a,b). For a different view, cf. Cheng and Sybesma (1999).

- (14) a. coin change  
 b. shoe footwear  
 c. mobile ‘piece of furniture’ mobilia ‘furniture’

Perhaps, the way in which the counterpart of a count noun like *man* “feels” in a classifier language (like, say, Chinese) is similar to the contrasts in (14). In the mass counterpart of a count noun (say change vs. coin) there is a sort of neutralization of the plural/singular distinction; a set of coins may qualify as change, but sometimes a single coin can too. The most minimal pair I was able to find is the one in (14c). Italian has a lexically simple word that means, essentially, ‘piece of furniture’ next to one that means ‘furniture’.

The existence of pairs such as those in (14) is partly related to another observation. There are nouns that have both count and mass uses. Consider for example *wine*, *water*, *beer*. When we say “there is beer all over the floor”, we are using it in a mass-like way. When we say “we ordered three beers”, we are using it as a count noun. In the latter case *beer* comes to mean something like “standard serving of beer” (e.g. a pitcher, a bottle, etc.). In fact, to a certain degree, virtually every noun that has a predominant use can be pushed into the other. We have already noted that most mass nouns can be shifted in a count mold and get the “type” reading. For example, one might understand this way utterances like “in this lab we store three bloods”. We now see that shifts from mass to count can also be accomplished by conceptualizing the substance in terms of a notion of “standard serving/portion”. Let us imagine, for example, a community of English speaking vampires; in such a community, standard servings of blood might become common, so that in a bar one might well say things like “we ordered three bloods”. Viceversa, count nouns can have mass uses. For example, *apple* is count, but it has mass uses as in “there is apple in the salad”. Here too you can imagine pushing it. “After my son went through it with its tool box, there was car all over the floor”. And so on. D. Lewis talks in this connection of the Universal Meatgrinder. You put anything through it and you get a substance. By the same token, as Pelletier and Schubert (1989) point out, we also seem to have some kind of mental Universal Packager, which turns substances into discrete portions.

Summing up, we have made the following observations:

- a. The mass/count distinction doesn’t coincide with the prelinguistic notion of object vs. substance; it extends to abstract objects and eventualities, and it doesn’t coincide with the prelinguistic notion of solid object.
- b. There is crosslinguistic variation as to what is categorized as mass and what is categorized as count.
- c. Even within the same language, there are near synonymous noun pairs, one mass the other count and there can be shifts from one category to the other.

What conclusions can we draw from this? Mostly negative ones, for what we have called the view of language as mirror of the world. The world can well be made of substances and discrete entities. And the prelinguistic child may well know this (or, more accurately, the child may well be endowed with an articulated theory of objects vs. substances). But the mass count distinction is something else. For one thing, the two distinctions simply do not coincide. Moreover, languages appear to have some freedom in how they classify their nouns. We must conclude that the mass/count distinction does not appear to be readily and completely reducible to any known extralinguistic one. It obviously bears a resemblance to the object/substance distinction. But then it seems to acquire a life of its own. It becomes a formal, abstract marking (think of its application to abstract objects). This passage from a “substantive” to a “formal” distinction happens a lot in language. And may be it is the key to understanding how language works. Think for example of gender distinctions. In English, gender is simply based on natural gender (a female being is a *she*, a male one is a *he*). Then stereotypes occasionally kick in (so that a car may be referred to as a *she*). But in many languages, this becomes a formal marking. For example, in Italian *tavolo* ‘table’ is masculine and *tavola* ‘table’ is feminine, with hardly any semantic distinction. Or think



of the fact that we typically tend to package information into a topic ('as for John') and a comment ('he is a real bastard'). This is clearly related to the subject-predicate structure we see in sentences ('John is a bastard'). But the two pairs (topic/comment vs. subject/predicate) simply do not coincide.

Does it mean that once language takes over some extra linguistic concept it voids it of its original character? For example, is the mass/count distinction void of any systematic "cognitive" role (other than bearing a family resemblance to objects vs. substance)? Probably not. Otherwise, why would so many languages make it? Why would grammar fastidiously insist in making numeral expressions and other determiners behave in the complex ways we have seen, if there was no communicative purpose behind it? Moreover, with all the crosslinguistic variation we have observed, there are also fairly evident universal tendencies in this domain. Nouns of liquids, for example, do tend to always have a mass lexical entry. Furthermore, while, as we saw above, it has been argued that in some languages every noun is mass, there seems to be no language in which every noun is count (a corollary of the observation that nouns of liquids are universally mass). Universal tendencies of this sort are hard to explain if the mass/count distinction is pure morphosyntax, pure form, with no semantic effects. There is a puzzle here that would be nice to understand more in depth. On the one hand, the mass/count distinction appears to be formal, in the sense that we can apply to just about anything (the same "thing", e.g. your hair, can be viewed as mass or count, etc.) On the other hand, such a distinction does not appear to be purely formal (a pure matter of morphosyntax), for its correlation with "real" objects and substances is not arbitrary. Addressing this puzzle involves getting clearer on the relationship between semantics and cognition, a hard and controversial issue.

## 5. A semantic model

In what follows, I will first make a proposal as to what is behind the mass/count distinction, namely a universe of discourse structured in specific ways and linked to the nominal system by universal mapping principles (the "denotational structure" mentioned in section 1). Then I will discuss how an approach along such lines addresses the questions raised above.<sup>2</sup>

### 5.1. Universes of discourse.

Suppose those in fig. 1 are all the tables in the world.

(15)      **Figure of three different tables**

TABLE a	TABLE b	TABLE c
Red	brown	brown
square	square	round

With the noun phrase *this table* (a singular, definite noun phrase) I can refer to any of the tables in (15), i.e. table a, table b or table c. With the noun phrase *these tables* (a plural definite noun phrase) I can refer to any group made up of the tables in (15). For example, I can point to table a and table b and say *these tables are cheap*. Or I can point to all of them and say *I like these tables*. The same holds if I use the definite article; *the brown tables* (as in "the brown tables are made in Hong Kong") refers to table b and table c taken together. *The red table* (as in "I inherited the red table from aunt Robertina") refers to table a, etc. So, in general, singular definites can refer to any individual table, and plural definites to any group thereof. A related class of examples illustrating the same point is the following. I can point to table b in (15) and say "this is a (nice) table". Or I can say of table a and b *those are (solid) tables*. In

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<sup>2</sup> There is extensive work on the semantics of mass nouns and plurals, from which the proposal presented here draws. For a general overview and bibliographical references of both the philosophical and the linguistic approaches to the mass-count distinction, cf. Pelletier (1979) and Pelletier and Schubert (1989). The proposal presented here is articulated more extensively in Chierchia (1998a,b); its closest antecedents are Link (1983) and Landman (1991). The account of the definite article sketched below is originally due to Sharvy (1980). On the acquisition of the mass/count distinction by children, see Gathercole (1982) and Gordon (1982). I should add that I think the main point of the paper would go through on any current formal semantic analysis of the mass-count distinction.

this sort of sentences the subject is a definite Noun Phrase; the predicate is also a Noun Phrase, albeit an *indefinite* one: *a (nice) table/(nice) tables* . Noun Phrases in their predicative uses are used to classify things (rather than referring to them).

You may wonder where we are heading with these common sense observations. The important point is that given a set of objects, like the tables in (15) we can, using plurals, group them together any which way we want. It is as if we are thinking in terms of a structure of the following form:

$$(16) \quad \begin{array}{cccc} & & \{a,b,c\} & \\ \{a,b\} & & \{b, c\} & \{a, c\} \\ a & b & c & \end{array}$$

Those at the bottom represent the individual tables. The curly brackets represent all the possible ways of grouping them (i.e. all the possible sets or groups we can construct out of a, b and c; the curly bracket notation is borrowed from the theory of sets). Singular definites can refer to any of a, b or c (i.e. to tables individually taken); plurals to any of the groups or sets in curly brackets. Let us call the individual entities “atoms”. By that, I do not mean, of course, that they are atoms in the physical sense. What I mean is that in talking about *the red table*, we disregard or put in parenthesis its parts (its legs, drawers, etc.) and consider it as a unit. We can generalize this way of thinking. Whenever we engage in a conversational exchange we typically have a certain universe (or domain) of discourse in mind, i.e. a series of salient entities and groups thereof (e.g. the things we see in our environment, those that constitute the topic of our conversation, etc.). The universe of discourse will vary from context to context, depending on the circumstances of the conversation, the intentions and interests of the speakers, and so on. However, such universes will all have a structure similar to the one in (16), namely:

$$(17) \quad \begin{array}{ccccccc} & & \{a, b, c, d\} & \dots & & & \\ & \{a,b,c\} & \{a, b, d\} & \dots & & & \\ \{a,b\} & \{b, c\} & \{a, c\} & \{c,d\} & \dots & & \\ a & b & c & d & \dots & & \end{array}$$

Our domains of discourse, in other words, are populated by entities that play the role of atoms or units, (that we may refer to through singular definite noun phrases); and by groups or aggregates (that we may refer to using plural definite noun phrases). What do nouns do? Nouns like *table*, partition the set of atoms dividing tables from non tables. In the example above, supposing that the tables are a, b and c we have something that may be schematized as follows:

$$(18) \quad \text{table} \rightarrow [a, b, c]$$

I am adopting here the convention of putting in square brackets the atoms of which (*is a*) *table* is true (applies truthfully). Other nouns (e.g. chair, car, etc.) would work in the same way. The role of plural morphology is that of turning something that applies only to atoms into something that applies to the corresponding groups.

$$(19) \quad \text{tables} \rightarrow \left[ \begin{array}{ccc} \{a, b, c\} \\ \{a, b\} \quad \{b, c\} \quad \{a, c\} \end{array} \right]$$

This is the starting point. When I combine a noun like *table* with a definite determiner such as *that* or *the*, I get to refer to *particular* atoms. For example with the NP *that table* I may invite you to individuate from the class of tables the one I am pointing at . Similarly for plurals; if I say *those tables* I am inviting you to consider from the totality of tables those I am indicating. And so on.

As a picture of how nouns and noun phrases work, this is very approximate. But it arguably constitutes a step in the right direction. The role of lexical nouns (without the determiner) is that of singling out a class of objects (which will have common traits: they may share a form, a function or what have you). Plural morphology (-s, in English) turns nouns that apply to singularities into nouns that apply to groups. Simple as this may be, it has the right consequences. Suppose, for example, that *a* and *b* are tables; suppose furthermore that *c* is also a table; it then follows inesorably that *a*, *b* and *c* taken together are also tables; and also for instance *b* and *c* taken together are tables. This is something we know a priori; and it follows from our way of looking at plurality. Once we individuate through a singular noun a set of atoms, all of the groups (of various size) made up of those atoms will be something the corresponding plural is true of.

A further important consequence of this way of thinking about plurality is the following. It is immaterial whether we are talking of concrete or abstract objects. If *a* is honesty and *b* is perseverance, then *a* is a virtue and so is *b*; and *a* and *b* together (in our notation {*a*, *b*}) will be virtues (e.g. John's chief virtues). Our schema applies equally well to concrete as to abstract entities.

Where do mass nouns fit in? We seem to have created a world of neatly identified objects that seems prima facie only suitable to count nouns. Let us see. Imagine that the table and chairs in (20), a very modest dining room set, is all is left in the world after a huge fire.

(20)           FIGURE OF THREE PIECES OF FURNITURE  
                   TABLE *a*   FIRST CHAIR *b*   SECOND CHAIR *c*  
                   (Square)   (red)                    (green)

In this case, we know that *table* would apply only to *a* and *chair* to *b* and *c*. What would *furniture* apply to? The most plausible answer, it seems to me, is that it would apply indifferently to *a*, *b*, *c* and any aggregate thereof. In other words, here is the structure of what the mass noun *furniture* applies to:

(21)           furniture   →   
$$\left[ \begin{array}{ccc} & \{a, b, c\} & \\ \{a,b\} & \{b,c\} & \{a,c\} \\ a & b & c \end{array} \right]$$

This would be consistent with the observation that we can say that the table and the green chair are furniture; just like the chairs are, etc. Even the table in (20) by itself might be claimed to be (expensive) furniture, as opposed to the chairs that are cheap; and so on.

It is important to note mass nouns share the same part-whole structure as plurals. In particular, if two aggregates belong to the same category, their sum or fusion also does (if *a* and *b* are furniture, the aggregate that has *a* and *b* as parts (i.e. {*a*, *b*}) is also furniture. This common structure arguably explains, as we will see, their commonalities.

According to this view, in any given universe of discourse, a count noun individuates a set of atoms; this means that in order to use it, we must have a criterion to somehow identify singularities. A mass noun does not. A mass noun applies to aggregates of any size; This means that in order to use it, we must have a way to somehow recognize aggregates (no need to be able to single out atoms).

Brief aside. It is not the case that to use a noun we must be able to decide for each entity out there, whether it belongs to the relevant kind/class/category of things or not. It is sufficient to have a general idea of how typical members of the class might look, what function they might play, etc. That seems sufficient for the noun to perform its communicative work (and to determine the grammatical status of the noun).

Back to the main point. You see that this way of thinking extends to liquids, powders, etc. Think, for example, of *a*, *b*, and *c* in (21) as grains of sand. (To make it more realistic, you have to imagine a larger amounts; do use your imagination). Quite clearly *a*, *b*, *c* and any aggregate thereof would be sand.

Similarly, for water; a,b and c, and... might be water molecules (or whatever larger liquid aggregate of H<sub>2</sub>O we need to have water). The important thing is this. A mass noun must be associated with a criterion to identify aggregates of something, not atoms; not, that is, minimal elements of the relevant stuff.

As was the case with count nouns, this way of conceptualizing things does not apply merely to concrete entities. In principle, it applies equally well to abstract things. Let for instance *a* be a piece of information (say that the earth is round) and *b* another piece of information (say that the earth revolves around the sun); then *a* is common knowledge (where *knowledge* is an abstract mass noun) and so are *a* and *b* taken together. Even though we may be hard pressed in giving the exact criteria for what may constitute a “minimal” piece of knowledge, we know enough about what constitutes knowledge in general to be able to use the corresponding abstract mass noun in a sensible manner.

Summarizing, our possible domains of discourse have a structure like the one in (17). Some entities play the role of atoms (concrete or abstract); others of aggregates thereof. Anything that can be the reference of a singular definite noun phrase is being regarded as an atom; anything we refer to through a plural definite noun phrase is an aggregate. Basic lexical items split our universe in classes (or kinds, or categories) of objects; they categorize our domains of discourse. Lexical nouns come in two sorts. They may identify a set of atoms. In this case, they are count. Or they may identify sets of aggregates (without caring to sort out atoms from non atoms). In this case, they are mass. The denotation of a mass noun is “closed under sum”; i.e. if *a* is furniture and *b* is furniture, then their sum {*a*,*b*} is furniture. Singular count nouns are not; if *a* is a cat and *b* is a cat, then their sum is not a cat. Plurals, like mass nouns, are closed under sum. If *a* and *b* are cats, and *c* and *d* are cats, then their sum (*a*,*b*,*c*, and *d*) are also cats. Simple enough. Some readers may find this picture congenial; others will find it puzzling. The point is, however, that if you assume that something of this sort, the properties of the mass/count distinction fall arguably right into place. Let us see how.

## 5.2. Deriving the properties of the mass count distinction.

Why can't we pluralize mass nouns? The relevant observation, in this connection, is that they are, in some sense, already plural. The purpose of the plural morpheme is to make it clear that we intend to talk about aggregates; but if a noun is mass, this will be already known, if our hypothesis is correct. Pluralizing a mass noun would be like trying to pluralize a plural: tree/tree-s/[tree-s]-s. No way.

Why can we count directly tables but not furniture? Here is the idea. A set of atoms is neatly divided up in discrete, non overlapping, entities. A set of aggregates is not. They overlap, are made up of other aggregates of the same sort, etc. In order to count using language, we seem to need a domain of discrete non overlapping things. Count nouns provide domains with these characteristics; mass nouns don't.

Possible query: what about plurals, then? Plurals too refer to aggregates, just like mass nouns. But we count with plurals; in fact that's how we typically count: three chairs, four donkeys, seven sins, etc. Still there is crucial difference here. Plurals are derived from singulars. We first must understand what a table is; then we immediately understand what tables are. For mass nouns it's very different. To understand a mass noun, we must have some idea of what is a typical aggregate of that stuff like; without necessarily having much of a clue as to its minimal parts. That's why a mass noun is not good enough for counting. From plurals, instead, we know we can retrieve atoms.

Consider next the case of articles. Why can't we say “a water”? Typically, the indefinite article is either identical to the first numeral (as in Italian *uno*, ‘one’) or it historically derives from it (often through morphophonological “simplification”, like *a* in English). In either case, the indefinite article presumably means roughly the same thing as the first numeral *one*. Hence, we can't say *a water* for the same reasons why we can't say *one water*; counting (or, in the case of *one*, singling out an atom) requires an atomic noun.

The case of the definite article *the* is more complex and interesting. Consider first how it works with plurals. Imagine, for example that we are discussing the behavior of a class in a highschool and we say:

(24) Today the girls are quiet; the boys, instead are very rowdy. It must be because of the soccer match.

What is the role *the* here? It invites us to consider the *largest* group to which the accompanying name applies. For example, in (24) we are attributing rowdiness to the totality of boys (in the relevant domain, i.e. the classroom). Something very similar seems to be going on with mass nouns. If we say “the water in this region is polluted”, again we seem to refer to the totality of the water (in the place where we are); i.e. we refer to the largest aggregate of water. So far so good. With singular nouns, however, something else seems to be going on. To see it, go back to our example (15) and imagine that that’s our domain of discourse (i.e. the set of salient objects we are talking about). In such a situation, we could easily say for example “the round table is broken”; But we couldn’t say “the square table is broken too”. The reason seems to be intuitively clear. There is only one round table; but there are two square ones. Saying “the square table” doesn’t determine which of the two we mean; and hence we cannot readily interpret the sentence. We would have to say something like the square table on the right, for there is only one such table. It looks like *the* requires a noun specific enough to apply to just one object (in the relevant domain). So to use *the* felicitously with singulars we must choose a domain of discourse and a noun that guarantee that the noun is true of just one thing in that domain. This “uniqueness condition” on the use of singular definites was pointed out by Bertrand Russell and much discussed since. The upshot of these simple observations is that with mass nouns and plurals, *the* is a kind of “maximizer”; it invites us to consider a totality of objects that fall under a certain category (boys, tables, etc.). With singular it is used to refer to a single entity; the noun it combines with is accordingly required to single out such entity. Now, these two functions are natural enough. They serve useful communicative purposes, each in its own right. But why do they hang together, so to say? Why is there one single word that covers both functions, if they are distinct? Is it conceivable that there could a language in which two different words are used? One word for the singular referential *the*, one for the maximization function? As matter of fact, this doesn’t seem to happen. If a language has the definite article, it typically has a maximizing function with plural and mass nouns and is subject to a uniqueness condition with singular count nouns. It would be nice to understand why.

Our simple model provides us with an answer. Look back at the hypothesized structure that a domain of discourse has, viz. (17). Such a domain is structured in singularities and groups or aggregates. Nouns divide such a domain in kinds of object that, in some sense, belong together (they have a common trait, or function). Suppose, now, that *the* applies to a category of objects and selects out of it the largest, if there is one (and otherwise, the result is uninterpretable). Here “largest”, does not mean heaviest or fattest or tallest. It means the object that contains all the others as a part (i.e. the largest with respect to the part-whole relation naturally associated with domains of discourse). Consider now the structure of the different noun types, repeated here:

(25) table → [a, b, c]

tables →  $\left[ \begin{array}{c} \mathbf{\{a, b, c\}} \\ \{a, b\} \quad \{b, c\} \quad \{a, c\} \end{array} \right]$

furniture →  $\left[ \begin{array}{c} \mathbf{\{a, b, c\}} \\ \{a,b\} \quad \{b,c\} \quad \{a,c\} \\ a \quad b \quad c \end{array} \right]$

If we apply *the* to the plural *tables*, it will find the largest object that contains as parts all the others (the one in boldface); similarly for mass nouns like *furniture*. But if we apply it to the singular *table* in a

situation like the one in (25), we get stuck for no table has any of the others as part. Suppose on the other hand that we are in a situation in which there is only one table:

(25) table → [ b ]

Each object is (trivially) part of itself. So in such a case, *the* will find a largest object which contains all the other as part, namely b. Conclusions: *the* is always a maximizer (more precisely a supremum operator on the structure in (17)); it always selects the largest object out of a category of objects. In the case of plurals and mass noun, this will be the largest aggregate of the relevant type. In the case of a singular noun, *the* will be able to perform its function only if the noun applies to just one entity in the domain of discourse we are selecting. *The* has a uniform meaning, which, in interaction with the way singular, plural and mass nouns are structured determines how we use it.

Let us now turn to the issue of variation. Our idea is that the basic way to shift from mass to count and viceversa is the following:

(26)

count	mass																		
<table style="border-collapse: collapse; width: 100%;"> <tr> <td colspan="3" style="text-align: center; padding: 5px;">{ a, b, c }</td> </tr> <tr> <td style="padding: 5px;">{ a, b }</td> <td style="padding: 5px;">{ b, c }</td> <td style="padding: 5px;">{ a, c }</td> </tr> <tr> <td style="padding: 5px;">[ a</td> <td style="padding: 5px;">b</td> <td style="padding: 5px;">c ]</td> </tr> </table>	{ a, b, c }			{ a, b }	{ b, c }	{ a, c }	[ a	b	c ]	<table style="border-collapse: collapse; width: 100%;"> <tr> <td colspan="3" style="text-align: center; padding: 5px;">{ a, b, c }</td> </tr> <tr> <td style="padding: 5px;">{ a, b }</td> <td style="padding: 5px;">{ b, c }</td> <td style="padding: 5px;">{ a, c }</td> </tr> <tr> <td style="padding: 5px;">[ a</td> <td style="padding: 5px;">b</td> <td style="padding: 5px;">c ]</td> </tr> </table>	{ a, b, c }			{ a, b }	{ b, c }	{ a, c }	[ a	b	c ]
{ a, b, c }																			
{ a, b }	{ b, c }	{ a, c }																	
[ a	b	c ]																	
{ a, b, c }																			
{ a, b }	{ b, c }	{ a, c }																	
[ a	b	c ]																	

For concreteness sake, imagine that a, b and c are tables, and that they are all the furniture in our domain of discourse. Then the left column represents the organization of the noun *table*, the right column the one of the noun *furniture*. The same entities are structured in slightly different ways. Or, if you think of a, b, and c as water molecules, then the left column represents the organization of the compound count noun *water molecule*, the right one of the mass noun *water*. And so on. The different structuring exemplified in (26) is what is responsible for the different behavior of mass vs. count nouns, along the lines discussed above. According to this model, the components of the distinction are the same; the structuring may vary. Whence, the possibility that languages may choose somewhat different ways to organize their lexicon. Let us look at this more carefully.

The mechanism in (26) is the basic one. But it interacts in interesting ways with other mechanisms we have discussed. Think of a and b as apples (count). Now divide each of them in two halves and attach a label to each half. Each apple is now viewed as the sum (or aggregate) of its halves:

(27) Drawing of two apples, each divided in two halves.

APPLE a	APPLE b		
First half apple a	second half apple a	first half apple b	second half apple b

The half apples may constitute new atoms, and they can enter in our general schema in (26). For example, we can two half apples to bake a cake and then say “there is apple in this cake”, a typical mass use of a count noun. In this case we are viewing apples as having the structure of a mass nouns (i.e. the one on the right in (26), with the relevant apple parts as “atoms”).

Notice, that it is not necessary to *physically* split things up to have a mass use of a count nouns. You can divide them in the relevant parts in your head, so to speak. In this way, you can view just about anything as a substance. It’s D. Lewis’s universal meatgrinder. The way to turn a count noun into a mass one is to create a structure such as the one in (26). This may respect the units of the original count noun (as when we go from *piece of furniture* to *furniture*); or such units are first divided in parts and then the mass like structure is constructed out of those (as when we go from count to mass uses of *apple*).

A little warning is called for: compound nouns like *apple part* are perfectly count, which may be very confusing. Yet, grammar leaves no doubt: *apple part* pluralizes, combines with numerals, etc.. In terms of our approach, *apple* (in its basic count sense) and *apple part* both individuate atoms. They do

so in different ways: what counts as an apple part may vary greatly from occasion of use to occasion of use, while our notion of apple is more stable. However, both *apple* and *apple part* pass all the tests for countability. Our mass uses of *apple*, therefore, (i. e. “there is apple in the cake”) is not simply to be equated with “apple part”. If anything, it should be equated to “apple part or apple parts”. Such a mass use comes from conceptualizing apple parts as having the structure of mass nouns, i.e. the one schematized in the right column in (26), with a, b, and c viewed as the relevant “minimal” portions. To repeat, *apple* in its mass use applies to any aggregate of apple parts (down to the smallest ones).

It may be useful to step back and get a more general picture of what goes on, according to our model. On each context (or occasion of use), our domain of discourse has the same and by now familiar structure. What changes from one occasion to the next are the atoms. The change in atomic structure of our domain, is not necessarily a physical change in the structure of the world (though sometimes it may well be). Often enough, the change is in our head, i.e. we modify what we regard as atoms (the apples or their parts). The change concerns, in other terms, how we map out the structure of our domain of discourse into the world. In this process, we are guided by the nouns in our lexicon, which categorize the domain of discourse dividing it in masses, singularities and groups. The categorization we do via the nouns thus constrain how we set our domain up. In particular, an object a will have to have certain characteristics to count as an apple; it will have to have different ones to count as an apple part. Apples are physically separated from each other (and typically have physically undetached parts). Apple parts may be physically separated or unseparated from each other.

With this in mind, we can now understand what is behind crosslinguistic variation. Essentially the mechanism is the one in (26). English *hair* is to Italian *capello* what *furniture* is to *piece of furniture* (or to Italian *mobile*). Except that what counts as “hair unit” is somewhat flimsier than what counts as “furniture unit”. (Take a single threadlike growth on head and cut it in two. In English you have still simply hair; in Italian you’ve got to decide whether you have got two hairs or two halves of a single hair; the decision is perhaps not momentous; but grammar requires it).

At a more macroscopic level, one can perhaps see now why no language has only count nouns and why nouns of liquid are generally crosslinguistically mass. If the picture above is correct, through language we can categorize things in two ways: by singling out the smallest units (atoms) and by simply characterizing aggregates of arbitrary size. If the minimal components of a substance are not readily accessible to our perception, it would be costly to go for them, given the option. We would have to go for either a vague classification (like *water part*) or for an excessively specific one (like *water molecule*). Going for aggregates of arbitrary size is clearly simpler in this case. What these considerations suggest is that a language in which every noun is forced to be atomic would strain our perceptual apparatus without bringing any pragmatic advantage.

We have conjectured that our domain of discourse, while varying from context to context, holds constant a certain structure, represented in (17). I have characterized such a structure in a naive way, drawing pictures, describing in words how things work, etc. But in fact such a structure is known in algebra as “free atomic join semilattice”. In terms of this structure we have made a conjecture as to how mass and count nouns differ. Count nouns denote sets of atoms; mass nouns, sum-closed sublattices of the whole domain. The phenomenology of the mass/count distinction seem to follow naturally from this assumption. In particular, our proposed account of the relation between the “formal/grammatical” and “substantive” aspect of count vs. mass has the following form. Our semantics constrains how we refer to things (the denotational structure); these constraints interact with non language specific aspects of our conceptual system (our knowledge of objects and substances) to yield tangible “real world” effects (no noun of liquid is mass).

## 6. Semantic modelling and the study of cognition

So, where does the mass/count distinction come from? Here is one way of restating our main findings. In our dealing with the environment we recognize entities, classes of entities, substances, etc. Some such things are perceived as constituted of discrete components, others are not. In particular, it has emerged

in the work of cognitive psychologists like Spelke and investigators of animal cognition like Hauser that human infants (as well as other primates) have a robust notion of solid object vs. non solid substance. It is clear that the mass/count distinction has some structural properties in common with these prelinguistic notions. But it is also clear that it is not at all the same thing. It simply does not coincide with it. So, at present, there does not seem to be a reliable extra linguistic (or pre linguistic) contrast to which the mass/count distinction can be wholly reduced. One might speculate that the mass/count distinction is a phylogenetic development of the prelinguistic distinction between substances and objects that we share with many other species. But for now this is sheer speculation indeed.

Be that as it may, the main feature of the mass/count distinction, what sets it aside from the contrast solid discrete objects vs. substances is its *formal* character. “Formal” here is opposed to linked to the “material” make up of things. Even though mass and count maps naturally into the distinction between solid object/ non solid substance, it also cuts across the latter (in the sense that solid objects can be grammaticized as mass, and the other way around). In a way, the distinction ceases to be anchored to a specific domain (that of every day substances and discrete objects) and becomes applicable to any domain we can talk about, whatever its material make up.

One might be tempted to say that the mass/noun distinction is, nonetheless, rooted in our prelinguistic knowledge of objects and substances extended to other domains *by analogy*, in order to optimize communication by riding on a very pervasive and basic distinction. The problem I see with this is that there are many ways in which analogy can proceed. And there is no one best way to optimize communication. Suppose indeed we start out with our knowledge of substances and objects. A novel domain comes along, to which notions like “moving as whole through continuous paths” do not apply (say, the domain of abstract entities). Why should we extend *both* modes to such a new domain? Wouldn't it be more economical to extend just one of the two available modes? Choosing both modes seem to force us to apply the original criteria in a substantially arbitrary way (it seems in fact inappropriate to wonder whether knowledge, belief, fun, joy,... come into discrete units or not). Moreover, there are other available resources we could reasonably exploit, in a highly economical and efficient manner. For example, there are proper names (i. e. items like *Bill, London, Mars, July*). They do not display a mass/count contrast and have a morphosyntactic behavior different from that of common nouns (for example, they hardly combine with determiners, with some combinations much worse than others, cf. things like \**all the John, \*all the London* vs. *all the water, all the knowledge*, etc.). In dealing with abstract entities we might well resort to proper names, i.e. pick a way of referring to them with the same syntax as items like *John* or *London*. Yet, this doesn't happen in any language. Languages, in referring to abstract nouns, do insist in picking either a mass or a count syntax. So of the many ways in which things can be analogized and communication optimized, only *particular* ones appear to be attested. This is left unexplained by the appeal to analogy or optimization of communicative needs.

We seem to be left with one possibility. That the mass/count distinction is specific to human language and to its grammar. A feature proper of the architecture of human language. But this immediately entails that language is not merely a manifestation of intelligence or culture (for some of its features are autonomous of them).

Before addressing this big question more extensively, I would like to point out a further piece of relevant evidence. Such evidence comes from the study of language deficits. It is well known that there are specialized areas of the brain in the left hemisphere to which the language capacity appears to be linked. One is known as Broca's area and is located lower portion of the frontal area; the other, known as Wernicke's area, is located posteriorly, in the adjacency of the primary auditory cortex. Subjects that suffer from brain damage involving these areas may lose in toto or in part the capacity to speak, while sometimes retaining intact other cognitive capacities (including articulated problem solving skills). The condition that ensues is the complex syndrome known as *aphasia*, which may be temporary or permanent. The study of language deficits has proven to be a formidable source of evidence concerning language and the way it is organized in the brain. By studying the various patterns of aphasic speech, one can put to test linguistic hypotheses.



The relevance of this to the point under discussion (the mass/count distinction) is that deficits specifically affecting such a distinction have been reported in the literature. In particular, Semenza, Mondini and Cappelletti (1997) describe the case of F.A. a 73 years old housewife, speaker of a standard variety of Italian who suffered from a vascular lesion in the left temporal region of her brain. Before her illness, she was working in her husband's business (partly in accounting, partly in public relations) and she had no record of linguistic abnormalities. After the onset of her condition, she suffered from aphasia, from which she had since mostly recovered, retaining only what looked like a mild type of anomia (a difficulty in retrieving and using nouns). Upon closer scrutiny in tasks involving various noun types, it emerged that she had a specific impairment in the use of mass nouns. One of the tasks on which she was tested, for example, involved detecting grammatical errors with mass vs. count nouns. She was asked to correct sentences like "there is much desk in the classroom" vs. "there is a sand on the beach". She had no problem in detecting the problem with sentences of the first type and in correcting it appropriately ("there are many desks in the classroom"). But she had severe difficulties in detecting and correcting the problem in the second kind of sentence, involving mass nouns. This difficulty persisted across other type of tasks. For example, she was asked to produce sentences using pairs like ship/see vs. roll/butter. With the first pair she would produce perfectly grammatical sentences ("in the sea there are many ships"); with pairs of the second type, she had a remarkably high error rate ("I spread *a* butter on a roll"). The problem affected the whole range of mass nouns, from the most canonical and frequent like *water*, to the less frequent ones of the collective sort like *furniture*. All in all, F.A. seemed to have a serious impairment circumscribed to the grammar of mass noun, while having a normal performance in other linguistic and non linguistic tasks. In our terms, F.A. forced every noun into an atomic mold. For her, every noun seemed to denote classes of atoms.<sup>3</sup> Semenza et al. also report finding the opposite dissociation (i.e. severely agrammatic patients who perform like normals on tasks involving mass noun like those used in studying F.A.).

What does this tell us on the nature of the mass/count distinction? If such a distinction is the manifestation of some capacity *not* specific to language, the case of F.A. is very hard to make sense of. For one would expect that such a patient should display some kind of independent cognitive deficit, detectable in non specifically linguistic tasks. For example, there should be a difficulty in distinguishing, say, liquids and substances from discrete objects in general. Or there should be some other problem in the communicative abilities of the patient. But according to Semenza et al., this was not the case. If, on the other hand, the mass/count distinction is a specific feature of the architecture of grammar, which is realized in our brains, then it is conceivable that such a feature may be somehow damaged in isolation, while leaving relatively intact the rest of our capacities.

## 7. Concluding remarks

What does it mean to say that the conceptual distinction between mass and count is a feature specific to grammar? How does this claim mesh with the way in which language fits with the rest of our cognitive abilities? In section 1, we sketched, somewhat impressionistically, the following rough picture of such a relation. Intelligence is a generalized capacity to detect regularities in our environment and to solve problems that arise as we negotiate our survival with the environment (and with our kin). Language is the response of this generalized capacity to one of the problems that comes up in this process, that of communicating.

Evidence such as the one considered in this chapter seems to point in a different direction. Such a direction can be characterized (again in just an impressionistic and approximate way) along the following lines. Our mind is constituted by a series of relatively autonomous systems, each using a specific vocabulary and mode of operating. One of such system is language, to be viewed as a sort of mental organ; grammar constitutes our inborn knowledge of language. Particular languages arise

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<sup>3</sup> So F.A. seems to be doing something that no known language does, viz. having only count nouns. This makes her case particularly interesting. But we cannot speculate as to what might be going on in her grammar within the limits of the present work. The point crucial to our present concerns is that the grammar of mass nouns can be selectively impaired.

through the creation of particular lexica and the use the combinatorial apparatus constitutive of grammar. Such apparatus allows for a limited number of options that can be set differently across languages (called the parameters). This view of language is associated with the research program that has come to be known as generative grammar originated by Noam Chomsky some fifty years ago. And the view of intelligence as arising from the interaction of differentiated autonomous components has come to be known as the modular view.

Our hypothesis on the nature of the mass/count distinction has two components: an assumption on the structure of the domain of discourse, and an assumption on how such a structure maps onto the morphosyntax of nouns. Thanks to this, we have argued, we see how different morphosyntactic combinations (e.g. the combination of plural morphology with a lexical noun) come to have their communicative effect (their meaning) and why some combinations are impossible or require special subsidiary interpretive procedures. I have used throughout without much discussion notions like reference, denotation and truth which have come to be central in the study of linguistic meaning. Such notions have brewed in the tradition of logic and philosophy of language. It is out of the encounter of such a tradition with generative grammar that modern linguistic semantics has emerged. The analysis of the mass/count distinction informally sketched here is a first, rough exemplification of how semantics works. The main idea that has emerged is that the way in which we refer to things (the way in which we categorize through nouns, etc.) is partly constrained by grammar. In the specific case under discussion, there are two ways in which the reference of nouns may be set (classes of atoms vs. classes of aggregates closed under sum). One such way (the mass one) is obviously better suited to conceptualize liquids than the other. But this makes sense only because grammatical modes of reference exist autonomously.

The structure we have hypothesized is a good candidate to being universal, a way in which humans structure domains of discourse. This exposes one of the key methodological assumptions of research paradigm exemplified here. Even though languages seem to vary indefinitely, there are limits to such a variation. Such a variation mostly concerns certain aspects of the lexicon. When it comes to structure, a considerable uniformity emerges, often in unsuspected ways. A metaphor used by Chomsky in this connection is that if a Martian were to land on earth, she would think that humans all speak the same language (apart from minor lexical differences). Accordingly, it is useful to conjecture that if a structure is present in a language, it is present in every language (albeit in different forms). We may go wrong, but we typically learn a lot by the attempt of pursuing it.

Consider the way in which this universalism applies to the case at hand. How is it compatible with the variation we observe across languages? The English word *hair* differs from its Italian translation *capello*. This difference is, if my proposal is on the right track, a semantic one. It is the same difference that manifests itself within a single language between, say, *coin* and *change* and perhaps, on larger scale, throughout the lexicon of classifier languages. Yet, this obviously does not entail a linguistically triggered difference in world views, a linguistic relativism a la Sapir/Whorf. It is, rather, a locally differentiated use of universal grammatical resources.

This last conclusion meshes well with recent psychological investigations of the Sapir/Whorf hypothesis. For example, a fascinating conjecture directly inspired by Sapir and Whorf was put forth by psychologist A. Bloom (1981) on Chinese. His idea was that since Chinese lacks a distinct way to mark counterfactual hypotheses, Chinese speakers would have difficulty in reasoning involving false premises. However, psychologist Au (1983) has shown that this is in fact not so. Chinese speakers have no trouble with counterfactuality (if the tasks are presented in properly idiomatic Chinese). She comments: "how can something so fundamental and pervasive in human thinking (i.e. reasoning about counterfactuals -- GC) be difficult in any human language?". Similarly, on the view adopted here, there is certainly no expectation that Chinese speakers have a different world view on how substances and kinds of objects are categorized. At the same time, it is not unconceivable that more "local" linguistic differences (like *hair/capello*) may have some subtle effect on non linguistic tasks. This, in turn, would leave some room to arguments aimed at showing that different vocabularies on basic color terms have an

impact on how colors are categorized (Lucy 1992) or differences in spatial terms may affect tasks of spatial orientation (Levinson 1997)

The overall outcome of our discussion can be summarized the following claims:

- a. The mass/count distinction appears to be a grammar specific property of the way in which nouns are mapped into their reference.
- b. Languages may vary in the way meanings are carved out
- c. The variation consists in (slightly) different ways of using the same universal structure.

If Chomsky is right in thinking that universal grammar is an innate schematism (a sort of mental organ located in our brains), then part of such schematism is the tendency to refer to things in specific ways.

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