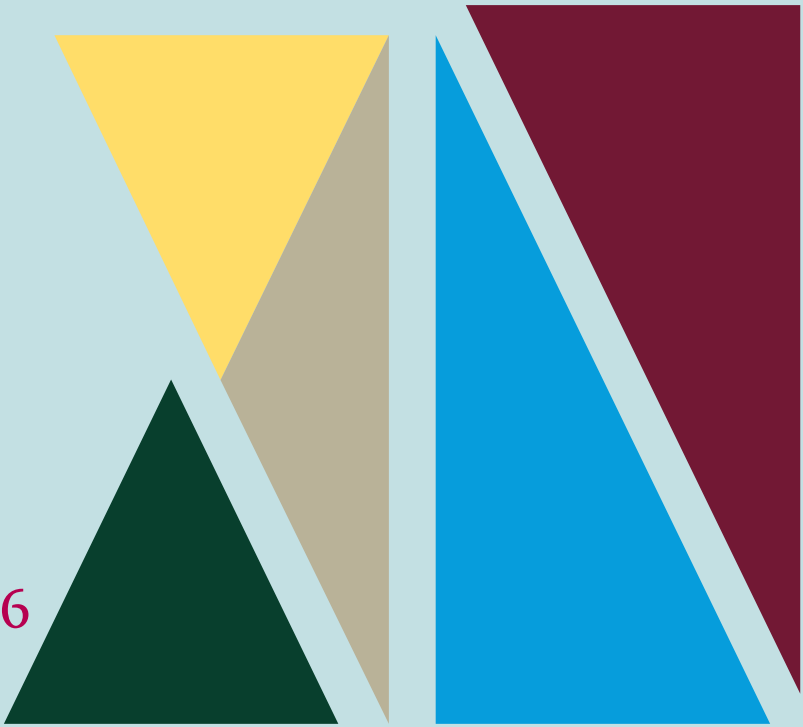
Mass and Count in Linguistics, Philosophy, and Cognitive Science

Edited by Friederike Moltmann

Language Faculty and Beyond 16

Internal and External Variation in Linguistics



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Introduction

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1. The syntactic mass-count distinction

The mass-count distinction is a morpho-syntactic distinction among nouns that is generally taken to have semantic content. This content is generally taken to reflect a conceptual, cognitive, or ontological distinction and relates to philosophical and cognitive notions of unity, identity, and counting. The mass-count distinction is certainly one of the most interesting and puzzling topics in syntax and semantics that bears on ontology and cognitive science. In many ways, the topic remains under-researched, though, across languages and with respect to particular phenomena within a given language, with respect to its connection to cognition, and with respect to the way it may be understood ontologically. This volume aims to contribute to some of the gaps in the research on the topic, in particular the relation between the syntactic mass-count distinction and semantic and cognitive distinctions,diagnostics for mass and count, the distribution and role of numeral classifiers, abstract mass nouns, and object mass nouns (*furniture, police force*, *clothing*).

In what follows, I will present the classical view about the mass-count distinction, which is mainly based on English (and related European languages) as well as Chinese. It provides the background to the contributions of the volume, some of which present serious challenges of that view, in particular from recent cross-linguistic research.

There are a range of criteria for the syntactic mass-count distinction.[1] Foremost is the inability of mass nouns to participate in a singular-plural distinction. Mass nouns do not come with a plural (unless, of course, they have been turned into count nouns, with a corresponding change in meaning):[2]

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1. See, for example, Pelletier (1979b), Bunt (1985), Link (1983), Doetjes (2012), Gillon (1992), Rothstein (2020, 2017).

2. Exceptions are 'plurale tantum' such as *belongings* or *shavings*, which are mass nouns taking the form of plurals.

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(1) a. apple,
b. rice, * rices

Mass nouns also trigger singular agreement of the verb, whereas count nouns trigger singular or plural agreement.

A second criterion is the inability of mass nouns to allow for cardinal and ordinal numerals:

(2) a. ten apples
b. *ten rice

(3) a. the first / second tree
b. * the first / second wood

Furthermore, unlike count nouns, mass nouns do not allow count quantifiers such as *few* and *many*, but take mass quantifiers such as *much* and *little*, which are excluded for count nouns:

(4) a. few / many pears
b. * a few rice / many rice
c. too much / too little apples
d. too much / too little rice

Moreover, unlike singular count nouns, mass nouns disallow singular quantifiers *every, each*, and *a*:

(5) a. every / each / a cherry
b. * every / each / a rice

Generally, mass quantifiers are taken to have a different semantics than count quantifiers. That is, *many, few* and *a* and the mass quantifiers *much, little*, and *some* do not just differ in syntactic category.

Another standard criterion for the mass-count distinction is that NPs do not permit *one*-anaphora, unlike singular count NPs:

(6) a. John ate a cherry, and Bill ate one too/ *some too.
b. John ate rice, and Bill ate *one too/ some too.

There are also some lesser known lexical semantic criteria that distinguish mass and count nouns. One of them is that predicates of size or shape are inapplicable to mass nouns when targeting the entire quantity, and that in adnominal and predicative position (Rothstein 2010; Schwarzschild 2011):[3]

3. The same holds for definite plurals. Thus (i) cannot mean that the group or plurality of children is large (Moltmann 2004, p. 766).

(i) The children are large.

(7) a. ?? the round wood
b. the round piece of wood
c. ?? the large water
d. the large amount of water

(8) a. ?? The wood (ok The piece of wood) was round.
b. ?? The water (ok The amount of water) was large.

Predicates of size and shape are applicable to certain types of mass nouns, namely object mass nouns such as *furniture* and *luggage*, nouns whose denotations consist in pluralities of individuals (or 'atoms'). However, predicates of size and shape have only a distributive reading with object mass nouns, applying to the individuals that make up the denotation of those mass nouns. (9a, b) are acceptable as long as *round* and *large* apply to individual pieces of furniture or luggage:

(9) a. round furniture
b. large luggage

(9a, b) fail to have a 'collective' reading with *round* and *large* applying to the maximal quantity of furniture or luggage.

Another lesser known lexical semantic criterion for the mass-count distinction consists in that number-related verbs, as one may call them, are inapplicable to mass nouns. First, the verb *count* hardly applies to mass NPs, as opposed to plural count NP (Moltmann 1997, Chapter 3.3.2):

(10) a. ??? John counted the wood.
b. John counted the pieces of wood.

The same holds for *outnumber* and the adjective *numerous*:

(11) a. ?? John's luggage outnumbers Mary's.
b. John's pieces of luggage outnumber Mary's.

(12) a. ?? The luggage is numerous.
b. The pieces of luggage are numerous.

Second, the verb *rank* does not apply to mass NPs, but only to plural NPs (Moltmann 1997, Chapter 3.3.2):

(13) a. ??? John ranked the decoration / the carpeting.
b. John ranked the pieces of decoration / the carpets.

This matches the semantic behavior of ordinal numerals such as *first, second*. The same holds for the related verbs *list* and *enumerate* (Moltmann 1997, Chapter 3, 3.2.):

(14) a. ??? John listed the clothing.
b. John listed the pieces of clothing.

(15) a. ??? Mary enumerated the weakness of the paper.
b. Mary enumerated the points of weakness of the paper.

Lexical generalizations of this sort indicate that object mass nouns differ from plural nouns not only syntactically but also semantically.

Mass nouns have the general ability to undergo syntactic shifts to count nouns, with corresponding shifts in meaning. Typical count uses of mass nouns are those with a standard packaging reading (16a) and a taxonomic reading (16b):

(16) a. John ordered three waters. (servings)
b. This region produces two wines. (types)

Conversely, certain count nouns can be converted into mass nouns, with a shift in meaning sometimes called 'the universal grinder' (Pelletier 1979b):

(17) John put some apple in the salad.

There is certainly a connection between an individual and the quantity (matter) it is made of. How the connection is to be understood is a topic of controversy in philosophy (with some philosophers maintaining identity, others difference between the two). Certainly, for the semantics of the count-mass shift that a noun like *apple* may undergo a function is needed mapping an individual to the matter that constitutes it (Pelletier 1979b; Link 1983).

The notion of a singular count noun is closely related to the philosophically important notion of a sortal, a predicate that provides identity conditions for entities (and allows reidentification over time or in different circumstances) (Grandy 2007; Pelletier 1979a). The notions of a sortal and of a count noun do not coincide, though. *Pile, collection*, and *quantity*, for example, are singular count nouns, but not sortals.

2. Approaches to the semantic mass-count distinction

Two sorts of approaches to the content of the mass-count distinction can be distinguished:

1. the extensional mereological approach (which can be traced to Quine 1960)
2. the integrity-based approach (which can be traced to Jespersen 1924).

The first approach distinguishes singular count, plural and mass nouns in terms of properties of their extensions, which are generally formulated in terms of extensional mereology (Link 1983; Krifka 1989; Ojeda 1993; Champollion & Krifka 2017;

Champollion 2017).[4] Mass nouns, it is generally agreed, have extensions that are cumulative, that is, the fusion of two elements in the extension of a mass noun N is again in the extension of N (Quine 1960). Cumulativity, though, obtains also for the extension of plural nouns. Divisiveness has been proposed as a distinguishing property of mass noun extensions; that is, for any element x in the extension of a mass noun N a proper part of x is again in the extension of N (Chang 1973). Cumulativity and divisiveness together define homogeneity. Divisiveness, however, is generally considered problematic in that it raises the minimal-parts problem (Bunt 1985). It is particularly implausible for object mass nouns, such as *furniture, police force, luggage, personnel, hardware*. Object mass nouns form a rather large class in English, and they challenge extensional mereological characterizations of mass nouns.

Singular count nouns are generally characterized as atomic; that is, no element x in the extension of an atomic noun N has a proper part that is again in the extension of N.

The semantic peculiarity of object mass nouns also manifests itself in comparisons: *more wine* involves measurement of quantities, whereas *more furniture* is generally evaluated in terms of pieces, rather than, say volume (Barner & Snedeker 2005). The latter, though, does not hold when the functionality of the individuals plays less of a role (*more fruit* can be evaluated by volume as well as by pieces). For the semantics of mass nouns in general, two different sorts of measure functions need to be distinguished: extensive (additive) measure functions for dimensions such as weight and volume and intensive (non-additive) measure functions for dimensions such as heat (Lønning 1987; Krifka 1998; Tovena 2001).

Atomicity, given the extensional mereological approach, is widely assumed to be the defining semantic feature of singular count nouns. But there are a range of counter examples to it. Nouns such as *entity, object, and sum* are not atomic, permitting proper parts of elements in their extension to be in their extension again (Moltmann 1997 p. 19). This also holds for nouns like *fence*, *wall*, *string, twig, stone, fence* (Rothstein 2010, 2017). Let me call this the 'divisiveness problem' for count nouns.

The extensional mereological account also faces limitations in that particular quantities or pluralities may display a semantically relevant division into substructures, often based on linguistically provided information. Thus, (18a) has a

4. Theories that take mass nouns to be inherently plural (Gillon 1992; Chierchia 1998) can be subsumed under the extensional mereological approach broadly understood. Chierchia (2015) gives an epistemic version of the extensional mereological approach. Rothstein (2017) makes use of extensional mereology, but relativizes the denotation of count nouns to a context, mainly because of nouns of the sort *fence*.

distributive reading on which different subgroups of students gathered and (18b) one on which John compares the jewelry in one box to the jewelry in another box for the different boxes:

(18) a. The students gathered.
b. John compared the jewelry in the boxes.

Such readings require augmenting the semantics of plurals and mass nouns with contextually given partitions (Gillon 1987, Moltmann 1997, Chapters 2–3).

The second approach to the semantic mass-count distinction distinguishes mass nouns and count nouns in terms of properties of entities in their extensions, such as having a boundary or integrity of some sort, a notion that goes back to Aristotelian notion of form (Simons 1987). A version of the approach can be found already in Jespersen's (1924) characterization of mass nouns: "There are a great many words which do not call up the idea of some definite thing with a certain shape or precise limits. I call these 'mass-words'; they may be either material, in which case they denote some substance in itself independent of form, such as silver, quicksilver, water, butter, gas, air, etc., or else immaterial, such as leisure, music, traffic, success, tact, commonsense" (Jespersen, 1924, p. 198). Another version of the approach has been proposed within cognitive linguistics by Langacker (1987), who makes use of the notion of a boundary.

A situation-based version of the integrity-based approach has been developed in Moltmann (1997, 1998). On that view, count nouns are taken to characterize entities as integrated wholes of one sort of another in situations of reference, whereas mass nouns specify entities as not being integrated wholes in situations of reference. The second approach does not face the divisiveness problem, since it does not make use of the notion of an atom for the characterization of singular count nouns. For some count nouns, such as *entity*, *object*, and *part* the integrity will have to come from the nonlinguistic context (e.g. connected in space) (Moltmann 1997, p. 2f). The situation-based version permits subgroups or subquantities to have integrity in situations of reference, setting up another level of structure (higher-level plurality) besides the one imposed by the noun itself.

The second approach may be considered unsatisfactory because of the vagueness of the notion of integrity. There are more substantial difficulties for the view when applying it to count nouns such as *amount, patch*, or *collection* and when applying it to the semantics of pairs like *clothes-clothing, coins-change, shoes-footwear*. The approach has similar difficulties dealing with object mass nouns as the extensional mereological approach, unless he notion of situation is modified allowing it not to represent entities with their individuating structure (Moltmann 1997, p. 21).

There is something unsatisfactory about both approaches to the mass-count distinction and that is that both take quantities and pluralities to be single entities which

make up the extension of mass nouns and plural nouns respectively. If they are single entities, then those entities should be countable, which they aren't. Quantities and pluralities can never be counted as 'one'. Thus, (19a, b) cannot have readings on which the verb *count* targets (contextually individuated) subquantities or subgroups:

(19) a. ?? John counted the jewelry. (meaning something like he counted heaps of jewelry)
b. ?? John counted the students. (meaning he counted the groups of students).

The fact that pluralities and quantities never count as one in the context of the semantics of natural language is something that mereological approaches don't seem to give justice to (whether based on extensional mereology or mereology with integrity conditions). For plurals, the recent approach of plural reference avoids the problem by taking pluralities to be 'collections as many' rather than 'collections as one', to use Russell's phrase; that is, on that approach, *the students* refers plurally to each student at once, rather than referring to a single thing that is a plurality (sum or set) (Oliver & Smiley 2013; Moltmann 2016).

3. Numeral classifiers

Numeral classifiers are a category of expressions that have an individuating function, making, it seems, counting and quantifying possible (Cheng & Sybesma 1999; Borer 2005; Doetjes 2012; Rothstein 2017). They play an important role in classifier languages such as Chinese, which lacks a syntactic mass-count distinction. At the same time, recent research shows that the presence of classifiers in a language does not strictly go along with the absence of a mass-count distinction, and vice versa. Classifier languages include most East and Southeast Asian languages, some Australian aboriginal languages and some native American languages. In general, in classifier languages numerals, are obligatorily followed by a classifier that indicates the semantic class of the host noun (Allan 1977; Downing 1996; Senft 2000; Aikhenvald 2003). Classifiers often convey properties of shape, as in the Mandarin Chinese examples below:

(20) a. yi zhang zhi/lian/chuang
one CL-flat paper/face/bed

b. yi tiao shengzi/she
one CL-long-thin rope/snake

A common view is that all nouns in classifier languages are mass or better not [+count], which means that entities in the extension of nouns in those languages can be counted only in virtue of the presence of a unit-specifying classifier.

Generally two sorts of classifiers are distinguished: sortal classifiers and mensural classifiers (Lyons 1977, Doetjes 2012). A sortal classifier is a classifier which specifies units in terms of types of entities (sorts), whereas a mensural classifier is a classifier which specifies units in terms of quantities. Sortal classifiers actualise individuation condition already belonging to the concept to which they apply, making them linguistically visible (Bisang 1999). Mensural classifiers create units by applying external scales. In English, measure phrases such as *one slice* in *one slice of bread* and *three cups* in *three cups of milk* have the function of mensural classifiers (Lehrer 1986).

Classifiers come in a range of categorisation devices, which differ, among other things, in their grammatical status, degree of grammaticalisation, meaning, and conditions of use (Aikhenvald 2003). In some languages, classifiers are morphemes or words that select nouns or verbs in syntactic constructions for counting or quantifying entities. Classifiers can also be noun categorisation devices that are syntactically associated with verbs but categorise nominal subjects or objects.

Classifiers in classifier languages require more complex syntactic structures of noun phrases. One recent proposal is that of Zhang (2013). Besides the functional projections NumP representing number and QuantP hosting quantifiers, Zhang takes the structure below DP to contain a unit phrase *UnitP*, which ensures the applicability of a numeral, as well as a delimitative phrase *DelP*, which conveys delimiting information related to size and shape. Another influential proposal regarding the syntax of classifier phrases is that of Borer (2005). Borer's proposal goes beyond classifier languages and takes nouns to be even in languages like English. Borer posits a functional head *ind* for numeral classifier phrases, which is present both in Chinese classifier constructions and in English measure phrases. *Ind* moreover serves to host singular and plural morphology in languages with a mass-count distinction such as English, where nouns are not taken to be marked as mass or count themselves. Borer's view is not uncontroversial, though, since there are languages that allow classifiers to go together with count syntax. The syntactic structure of classifier systems and the generalizations they are based on continues to be a widely debated topic in syntax. Of particularly interest in the general debate is the variation of classifier languages that there are and that may behave rather differently from Chinese.

4. Contributions in this volume

The mass-count distinction and the related topic of classifier languages raise a range of questions that the articles in this volume contribute to.

One general question the mass-count distinction raises is: what cognitive or ontological distinction does it go along with? **Srinivasan** and **Barner** in their contribution to the volume approach the question from an empirical cognitive perspective, dealing with the phenomenon of object mass nouns as well as minimal pairs of a count and a mass noun that appear to stand for the very same entities (such as (English) *hair* (mass), Italian *capelli* (count)), quantitative comparisons (which for count nouns are number-based, but for mass nouns may be measurement- or number-based), and the acquisition of counting. They argue that countability conveyed by count nouns does not just depend on syntactic and lexical representation, but that additional conceptual and pragmatic factors come into play. **Treves** and **Rothstein**'s contribution falls within the same topic. Making use of a neural network and crosslinguistic findings, they argue against the common view of a binary distinction between semantic mass and count markers to correlate with the syntactic mass-count distinction; instead they favor a graded distribution of correlations. They also argue that, crosslinguistically, there are different ways for a noun to be situated on a graded scale between pure count and pure mass. Finally, they argue against a strict correlation between mass-count syntax and (standard) semantic distinctions, and in favor of viewing the syntactic mass-count distinction as encoding a perspectival contrast between entities presented grammatically as countable and entities presented as non-countable in a context.

Another question that the mass-count distinction raises is that of the classification of categories of number itself. Most of the literature is focused on the distinction between mass, singular count, and plural. **Ojeda** in his contribution to the volume elaborates with a range of crosslinguistic cases the richness and diversity of the category of number and proposes formal semantic analyses for different number categories using extensional mereology. The categories Ojeda discusses include the dual, the co-dual, the paucal, and the multal, and the universal number, a category of nouns that applies to both individuals and pluralities. The latter, surprisingly, is found in English as well, as Ojeda points out, namely in roots of nouns, which are used in compounds such a *one-car garage, two-bedroom apartment, three-pound package*.

The mass-count distinction with its opposition to classifier systems such as that of Chinese is not as clear-cut as it first might have seemed given a broader crosslinguistic perspective, which is what **Bale** and **Gillon**'s contribution is about. Bale and Gillon show that Western Armenian lacks a mass-count distinction, yet has plural marking with a completely optional use of classifiers. Morever, they give examples of languages (Ch'ol & Mi'gmaq) where classifiers are required by the use of certain numerals, but not by nouns themselves. They suggest that the syntactic mass-count distinction may not go along with a semantic distinction at all, but rather is on a par with gender-marking.

The mass-count distinction has primarily been studied with respect to nouns for concrete objects, but not abstract nouns, such as *hope* and *joy*. **Zamparelli**'s contribution focuses on abstract mass nouns and the productive countability shifts they may undergo. **Hinterwimmer**'s contribution is a study of abstract mass nouns and their distinctive semantic behavior with respect to both mass and count quantifiers.

Mass nouns in English include one notoriously tricky subcategory, that of object mass nouns mass nouns, mass nouns whose denotations appear to consist in pluralities of well-distinguished individuals, such as *furniture, police force, footwear, hardware*. **Cohen** in her contribution points out that object mass nouns are obtained by various active morphological processes in English, French,and Hebrew and that this has consequences for how the semantics of such nouns is to be viewed. She suggests a perspectival semantics of object mass nouns, on which common functionality is emphasized and individual members are backgrounded.

Object mass nouns are also the focus of the contribution of **Rothstein** and **Pires de Oliveira**. They point out a fundamental difference in the way object mass nouns in comparatives behave in English and in Portuguese Brazilian. Whereas in English object mass nouns in comparatives are compared strictly numerically (*John has more furniture than Bill*), in Brazilian Portuguese such comparison may involve counting as well as measurement. Rothstein and de Oliveira give a semantic explanation for this difference.

Acknowledgment

The contributions in this volume go back to talks and tutorials given at the Colloquium 'Mass-Count in Linguistics, Philosophy and Cognitive Science' held in Paris on December 20–21, 2012 at Ecole Normale Supérieure, organized by Alexandra Arapinis, Lucia Tovena and myself. Thanks are due the editors and an anonymous referee for comments on an earlier version of this introduction.

Susan Rothstein has (co-)contributed two articles to this volume, and she was one of the most important contributors to the linguistic debate of the mass-count distinction in general.It is immensely regretful that she was not going to see the publication of this volume.

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Re-examining the mass-count distinction

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This paper argues that the mass-count distinction does not represent a fundamental division between the world's languages. We demonstrate that such a distinction, as commonly defined within the linguistic literature, often conflates two facts: the semantic fact, found in all languages, that some words have atomic denotations and some do not, and the morphosyntactic fact, found in languages with contrasting singular-plural morphology, that some nouns have both singular and plural forms while others have only one such form. By comparing English with Mandarin Chinese, we discuss whether this morphosyntactic distinction might correlate with the presence or absence of a rich classifier system (as well as other types of quantification). This potential correlation has greatly influenced how linguists have investigated nominal systems across languages and it has even led some to hypothesize that morphosyntactic subcategories might determine the ways in which a grammar can ``count'' and ``quantify.'' We outline some important exceptions to this proposed correlation in languages such as Ch'ol, Mi'gmaq and Western Armenian. The paper concludes by arguing not only that there is no such correlation, but that linguists should rethink how they investigate nominal systems, focusing more on lexical variation (even within a single language) than on parametric variations across languages.

Key words: quantifier distribution, allomorphy, classifier, count, mass, Ch'ol, English, Mandarin Chinese, Mi'gmaq, Western Armenian

1. Introduction

Since the 1990's, a number of authors (Krifka 1995; Chierchia 1998; Cheng & Sybesma 1999 among others) have investigated salient differences between English and Mandarin Chinese. As has been widely noted, English nouns have contrasting grammatical number morphology, while Mandarin Chinese nouns generally do not. Furthermore, whereas Mandarin Chinese has an elaborate system of classifiers, English does not. Many researchers have suggested that these differences are an instance of a fundamental division in the world's languages, namely, that languages without contrasting grammatical number, such as Mandarin Chinese,

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often have classifiers and that languages with grammatical number contrasts, such as English, often exclude them. Moreover, such researchers suggest that this division reflects differences in the types of denotations assigned to nouns in the two types of languages.

In this paper, we show, first, that the contrast between English and Mandarin Chinese has important exceptions, second, that these differences between the two languages do not necessarily bear on the kinds of denotations assigned to common nouns, and third, that it does not reflect any fundamental division between the world's languages. With respect to the last point, we shall show that there are languages whose nouns pattern neither with English nor with Mandarin Chinese. Examples of such languages are Western Armenian, an Indo-European language, Ch'ol, a Mayan language spoken in northern Chiapas in southeastern Mexico, and Mi'gmaq, an Algonquian language, spoken in the northeast of North America.

The empirical observations discussed in this paper are similar to those mentioned in Borer 2005 and Wilhelm 2008. Borer (2005) also examines Western Armenian, demonstrating how a systematic singular-plural contrast can coexist with a rich classifier system (see also Donabédian 1993). These facts will be reviewed in Section 3.1. However, unlike Borer (2005), we highlight the denotational differences between Western Armenian and English singular nouns. Furthermore, we do not make any claims about classifiers and plural marking being in complementary distribution. However, this claim is irrelevant in the context of the mass-count distinction. Similar in spirit to Borer 2005, Wilhelm (2008) observes that some languages, such as Dëne Sųłiné, a Northern Athapaskan language spoken in Northern Canada, allow, like English, for numerals to combine directly with nouns and yet, like Mandarin Chinese, do not have a singular-plural contrast. Such languages are not compatible with prototypical mass-count and classifier languages. Although we do not review the facts in Dëne Sųłiné, we review similar facts in Western Armenian (Section 3.1) and also demonstrate a complete dissociation between different means of numeral modification and nominal denotations (Section 3.2).

Our reviews of Western Armenian, Mi'gmaq and Ch'ol contribute to a growing body of literature that has called into question whether there is a parametric distinction between classifier languages on the one hand and mass-count languages on the other, especially with respect to understudied languages. However, the discussion of other languages is often clouded by a misunderstanding and oversimplification of the differences between Mardarin and English which we hope to avoid. For example, the conclusions we reach from this review are quite different from those reached by Borer (2005) and Wilhelm (2008). First, we emphasize that the mass-count distinction, a morphosyntactic one, should not be confused with the semantic division of nouns into those with atomic denotations and those without. Such confusion only muddies the waters in terms of crosslinguistic observations. Second,

we note how the existence of other types of languages such as Ch'ol, Mi'gmaq and Western Armenian weakens the claim that the mass-count distinction has any significant correlation with other parts of the grammar (i.e., the numeral system and/or the quantifier system). At best, the mass-count distinction seems to have a role similar to that of nominal features such as gender (±feminine, ±masculine) or animacy (± animate).

The aim of this paper is not to propose a new theory of the mass-count distinction, nor is it to replace the old divisions with an upgraded more nuanced partition. As a result, there is much discussion of data but no formal theory. The goal of this paper is to call into question the whole project of searching for meaningful cross-linguistic divisions with respect to the mass-count distinction. This is not to deny that such a project has borne many fruits over the last few decades – it has led to a deeper analysis of number marking, quantifier distribution and numeral modification. However, at this point it might be more productive for researchers to concentrate on the various particular phenomena thought to be involved in assessing the mass-count distinction without trying to force correlations between them, indeed without even asking the question of whether any particular language is a "mass-count language" or a "classifier language."

2. Prototypical mass-count and classifier languages

English and Mandarin Chinese are often used as prototypical examples of mass-count and classifier languages respectively. In this section we will review some of the basic facts in these languages, discussing singular-plural contrasts, quantifier distribution, numeral modification and the nature of nominal denotations. As discussed, it is important to note some of the exceptions to certain generalizations commonly made about numeral modification and nominal denotations in the two languages. Furthermore, in comparing these two languages, it is vital to keep in mind that the mass-count distinction, as it is traditionally defined, does not parallel the semantic distinction between atomic and non-atomic denotations (see Bunt 1985; Gillon 1992; Chierchia 1998; Bale & Barner 2009; Rothstein 2010; Deal 2017). Although it is clear that both types of languages have a division between atomic and non-atomic denotations, this does not hold for the division of nouns into the subcategories of mass and count.

2.1 English: A mass-count language

Before discussing the details of the grammatical properties of English noun phrases, let us bear in mind some common sense observations about quantity and counting. To simplify matters, we will confine our attention to concrete, physi-

cal things. Let's first consider ways of measuring the quantity of objects, such as eggs (as opposed to substances like oil). Although eggs could be weighed or measured by volume, the most salient way of calculating their quantity is by counting the number of objects. Critically, counting involves individuating one object from another (i.e., a method of determining under what conditions a mass of stuff counts as a single egg, see the discussion in Simons 1987; Moltmann 1997). In contrast, determining the quantity of something such as oil is a little trickier. At least to common sense, oil does not comprise a collection of individuals which are distinguishable from one another. So, in such cases, one resorts to a replicable measure, say some standard sized cup. One counts up the number of measures that are equal to the quantity of oil. These two ways of determining quantity are not mutually exclusive. Suppose that there is some rice on the counter. To determine its quantity, one can, of course, count the number of grains (something we rarely do), or alternatively, one could place the grains in a equal sized containers and count the containers (as is usually done when cooking).

English has different grammatical expressions that roughly track these two different ways of counting. For example, English speakers will often directly modify singular and plural nouns with numerals to express the counting of individuals (e.g., *one egg or five eggs*), whereas they will use measure terms to express the counting of measurements (e.g., *one cup of oil or five litres of oil*).[1] Critically, while many English common nouns, such as *egg*, admit a contrast between a singular and plural form, many others, such as *oil*, do not – at least not without a shift in meaning. (See Gillon 2012 §2 for details.) Those that do admit this contrast were dubbed *count nouns* by Otto Jespersen (Jespersen 1924 pp. 198–200) and those that do not *mass nouns*. Leonard Bloomfield was one of the first linguists to

1. We say "roughly track" different ways of counting since grammatical expressions do not always correlate with methods of verification. For example, I could verify whether it is true that there are "two thousand people in the room" by counting each person or by organizing people into groups of twenty and then counting the groups. Indeed, it is this second method which Herodotus reports to have been used by Xerxes in determining the quantity of soldiers in the army he took to invade Greece in 480 bce:

> At Doriscus Xerxes was occupied in numbering his troops. The grand total, excluding the naval contingent, turned out to be 1,700,000. The counting was done by first packing 10,000 men as close together as they could stand and drawing a circle round them on the ground; they were then dismissed, and a fence, about waist-high, was constructed round the circle; finally other troops were marched into the area thus enclosed, and dismissed in their turn, until the whole army had been counted.
>
> (Herodotus *The Histories*, translated Aubrey de Slincourt, Penguin 1954, 1972: 465–6.)

discuss thoroughly the morpho-syntactic properties of this distinction in English (see Bloomfield 1933 pp. 205–206, 252). Here, in brief, are the properties he noted:

- **Singular-Plural Contrast**: Count nouns have alternate forms corresponding to singular and plural. Mass nouns do not have alternate forms: they have only a singular form (though there are some with only a plural form).
- **Antecedents**: Only noun phrases headed by count nouns in the singular serve as antecedents for the pronouns *another* and *one*.
- **Quantifier Distribution**:
  i. The indefinite article, the determiners *each*, *every*, *either*, *neither* and the cardinal numeral *one* modify only count nouns in the singular.
  ii. The determiners *few*, *a few*, *fewer*, *many*, *several* and the cardinal numerals greater than or less than *one* modify only count nouns in the plural.
  iii. The determiners *all*, *enough* and *more* may modify mass nouns or plural count nouns, but not singular count nouns; and mass nouns and plural count nouns, but not singular count nouns, may occur without a determiner.
  iv. Finally, *little*, *a little*, *less* and *much* modify only mass nouns.

Note with respect to point (iv), it is likely that *much*, *less* and *a little* are systematically related to *many*, *fewer* and *a few* respectively. For example, these modifiers seem to share an underlying meaning as demonstrated by the relative synonymy of the pairs *too much furniture* vs. *too many items of furniture*, *less furniture* vs. *fewer items of furniture* and *a little furniture* vs. *a few items of furniture*. Given the synonymous nature of these pairs, it is plausible that the contrast between them is due to some kind of *suppletion* – e.g., *much* and *many* are phonological realizations of the same underlying morpheme. Under this analysis, the difference in how the morpheme surfaces would be triggered by the grammatical environment it appears in, in this case adjacent to a plural count noun or a mass noun (see Wellwood 2014 for more details). This phenomenon is typical of other forms of nominal subcategorization, such as gender. For example, the form of the definite determiner in French is determined by the gender and number features on the following noun: *le* before singular masculine nouns, *la* before feminine singulars, and *les* before plurals.[2]

2. One might wonder whether the form of the determiner is triggered by the denotational nature of it's complement noun. In other words, *many* appears with nouns whose denotations do have atomic minimal parts, whereas *much* appears elsewhere. However, the phonological realization of this morpheme seems to be purely syntactic. For example, the mass nouns

The mass-count distinction, as elaborated by Bloomfield, is purely morphosyntactic and should not be confused with the semantic distinction between having an atomic and non-atomic denotation. Let us explain what we mean by *atomic* and *non-atomic denotation*. By *denotation*, we mean the set of things of which the noun is true. For the sake of clarity of judgement, let us confine our discussion to common nouns for material things. The noun *shoe*, for example, is true of individual shoes, taken one at a time, but it is not true of any proper part of a shoe, say, of a shoe's heel, nor of any collection of shoes. The common noun *oil*, in contrast, is true not only of, say, the contents of a cup of oil, but also of virtually any arbitrarily chosen, observable portion of the cup's contents. We shall refer to the denotation of common nouns such as *shoe* as atomic, and to the denotation of common nouns such as *oil* as non-atomic. (For a more precise characterization of atomic denotations and a discussion of related problems, see Gillon 2012 Section 3.2, Bale and Barner 2009, Link 1983, Chierchia 1998, Rothstein 2010, among others. For those interested in the ontological question of the relation between an atom, a whole, and its parts, see Simons 1987, especially Part II as well as Moltmann 1997.)

A moment's reflection shows that the mass-count distinction, which is a morphosyntactic one, and the atomic non-atomic distinction, which is a semantic one, do not align. Thus, whereas each count noun has an atomic denotation, there are some so-called mass nouns with atomic denotations as well. Indeed, English has hundreds, if not thousands. To name just a few: *artillery, clothing, company, footwear, furniture, infantry, luggage, pottery, traffic, underwear* and *weaponry*. To determine the quantity of such things, one counts the things. Thus, for example, suppose that there are three suitcases in the lobby. Of course, if one uses the English count noun *suitcase* to express the quantity, the expression is just *three suitcase-s*. However, if one uses the English non-count noun *luggage*, the expression is neither *three luggage* nor *three luggages*. Rather, it is *three pieces of luggage*. To express the quantity of things which are denoted by a mass noun with an atomic denotation, one uses the same kind of expression as one uses with non-atomic mass nouns, but, instead of using measure terms, one uses terms such as *article, item, piece* etc. Thus, one speaks of *two articles of clothing, one piece of equipment, three items of furniture* etc.

It is important to emphasize that evidence from comparative constructions demonstrate that competent speakers of English do indeed attribute to these words an atomic denotation. As shown by Bale and Barner (2009), the mass nouns with atomic denotations permit a comparison by number in comparative sentences in

furniture and *footwear*, which have atomic denotations, cannot appear immediately after *many* (e.g., *too much furniture/footwear, *too many furniture/footwear*).

a way that is impossible for nouns with non-atomic denotations. For example, the sentences in (1a) and (1b) can be evaluated in terms of number of items. Even if John only has three small chairs, four small side tables and a small couch whereas Mary has two giant chairs and a huge couch that weighs more than all of John's items taken together, John still has more chairs and more furniture than Mary.

(1) a. John has more chairs than Mary.
b. John has more furniture than Mary.
c. John has more mud than Mary.

In contrast, nouns with non-atomic denotations, such as *mud* in (1c), never permit a comparison by number. Suppose John has five small buckets of mud whereas Mary has one huge bucket. If Mary's bucket has more mud in terms of mass or volume, then the sentence in (1c) is false no matter how the substance is divided.

Moreover, as first pointed out by Bunt (1985), adjectives such as *large*, which are true of denotationally atomic things, may be used as attributive modifiers of common nouns, whether count or mass, provided their denotation is atomic. (See also Schwarzschild 2011; Rothstein 2010; Bale & Barner 2009.) These same adjectives make no sense when used with mass nouns with non-atomic denotations, such as *metal*.

(2) a. The large chairs should go into the dining room.
b. The large equipment should be placed in the garage.
c. ? The large metal should be placed in the garage.

Another possible correlation with the mass-count distinction concerns the representation of number. In English, there is a class of bare nouns that clearly have a singular interpretation when they appear without number morphology. This can be seen with their behaviour in predicate position, where such nouns cannot be true of groups. Consider the behaviour of the count noun *boy* in (3) in contrast to the behaviour of the mass noun *furniture* in (4).

(3) a. John is a boy.
b. * John and Bill are a boy.

(4) a. This couch is furniture.
b. This couch and this chair are furniture.

The singular count noun can only be predicated of individuals whereas the singular mass noun can be predicated of either individuals or groups. It is important to point out that at least on the surface, there is a morphological distinction between the singular count nouns and mass nouns in predicate position, namely the presence of the indefinite article. However, the indefinite article in this position seems to be semantically vacuous in the sense that for any N, ⟦*is a N*⟧ is denotationally

equivalent to ⟦*N*⟧, at least with respect to number (see Partee 1987; Montague 1974; Keenan & Faltz 1985; Quine 1960, among others).[3] Furthermore, the singular nature of the denotation of these nouns appears in other contexts where the indefinite article is not present. For example, *some couch* and *the couch* can only be used to talk about singular individuals whereas *some couches, the couches, some furniture* and *the furniture* can be used to talk about pluralities. This inability to be a predicate of groups seems to be a unique property of bare count nouns.

In summary, English has a morpho-syntactic mass-count distinction that does not parallel the semantic division of nouns into those with atomic and non-atomic denotations. The morpho-syntactic distinction has five main characteristics. (1) It serves as a trigger for allomorphic variation – e.g., *much vs. many*. (2) It restricts how numerals modify nouns – e.g., count nouns allow for direct modification, mass nouns require the use of measure words. (3) It restricts the distribution of non-numeral quantifiers – e.g., some quantifiers like *each* only apply to singular count nouns and others like *several* only apply to plural count nouns. (4) It restricts the forms of pronouns – e.g., only singular count noun phrases can serve as antecedents for *another* and *one*. (5) It restricts the interpretation of bare nouns – e.g., bare count nouns have a truly singular denotation whereas bare mass nouns are unspecified for number.

2.2 Mandarin: A classifier language

Mandarin Chinese, like English, distinguishes between proper nouns and common nouns (Chao 1968, Chapter 7.1.8).[4] However, unlike English where an extremely large number of common nouns exhibit contrasting singular-plural morphology, almost no nouns in Mandarin Chinese do. There are a few exceptions, namely personal pronouns and some common nouns denoting humans, the singular versions of which are the bare noun and the plural versions of which have the suffix *-men* (Chao 1968 pp. 244–245), yet this type of plural marking is very limited

3. Partee (1987) proposes a type shifting operator that lowers the Generalized Quantifier ⟦*a N*⟧ to a set denotation that is equivalent to ⟦*N*⟧. Montague (1974) and Keenan and Faltz (1985) propose that *be* is a function that maps Generalized Quantifiers to sets. In the end, ⟦*is a boy*⟧ is equivalent to ⟦*boy*⟧. A more traditional approach does not involve any coercion operators at all. Instead it simply assumes that the indefinite article in predicate position receives no interpretation other than to signal a predicative use of *to be*. See, for example, Quine (1960).

4. Most of the observations discussed in this section have been adduced by a number of authors. They include Cheng and Sybesma 1998, 1999, 2013; Doetjes 1997, 2012; Li and Rothstein 2012; Li et al. 2009; Rullmann and You 2006. We have chosen to cite only the author we know to have adduced the observation first. In almost every case, this has been Chao Yuanren. Other observations, not found in Chao 1968, are taken from Zhang: 2012.

and far different from English. In light of the almost complete absence of number morphology in Mandarin Chinese, it comes as no surprise that it simply has no counterpart of the morphosyntactic mass-count distinction. While Mandarin has no productive plural morphology, it does have a rich system of classifiers.

To explain what the properties of classifiers are in Mandarin, let us see how Mandarin expresses quantities. Suppose that one has determined a quantity of eggs by counting them. To express this quantity in Mandarin, one uses, like English, a common noun which is true of each of the items counted, namely *jī-dàn* 'egg'. The expression for the quantity comprises a cardinal numeral for the number of eggs, followed by a classifier, followed by the word *jī-dàn*. Thus, for example, if one counts five eggs, one would say the expression in (5a). If there had been only one egg, one would use the expression in (5b).

(5) a. wǔ gè jī-dàn
five CL egg
'five eggs'

b. yī gè jī-dàn
one CL egg
'one egg'

(6) a. *wǔ jī-dàn
five egg
'five eggs'

b. *yī jī-dàn
one egg
'one egg'

Note that these expressions are typically unacceptable without the classifier, as shown in (6a) and (6b).

Slightly different from the word for egg is the one for oil, *yóu*. The denotation of this noun is not atomic and hence requires a measure word to express quantities. For example, one could specify that the oil should be counted in terms of cups, as in (7a).

(7) a. sān bēi yóu
three CUP oil
'three cups of oil'

b. sān bēi de yóu
three CUP SUBORD oil
'three cups of oil'

This is not, however, the only expression that is compatible with counting oil in terms of cups. One might equally well use the expression in (7b). The word *de* in

Mandarin is a subordinator, indicating that the constituent to its left is subordinate to the constituent on its right.

In short, when a cardinal numeral is used with a common noun, if the noun has an atomic denotation, then a suitable classifier is placed between the cardinal numeral and the noun, if the noun has a non-atomic denotation, then a measure word is placed between the cardinal numeral and the noun (Chao 1968 ch. 7.2 (2), or p. 509). This is, in fact, no different from the alternation we saw above for English mass nouns, a cardinal numeral requires a measure word for a noun with an non-atomic denotation and a pseudo-measure word for a noun with an atomic denotation. There is, of course, a difference. In English, the preposition *of* is required before the noun in each case, whereas in Mandarin, the subordinator *de* is excluded from occurring before a noun when the subordinator occurs after a classifier, and it is permitted to occur before a noun when the subordinator occurs after a measure word.[5] In addition, there is the curiosity that a classifier may be omitted before a noun with an atomic denotation when the cardinal numeral is a proper multiple of ten, as shown in (8), where the parentheses mark optional material (Chao 1968ch. 7.8 pp. 574–575).

(8) a. èr-shí (gè) rén
two-ten (cl) people
twenty people

b. sān-qián (jià) fēi-jī
three-thousand (cl) airplanes
three thousand airplanes

Another difference between measure words and classifiers is that the former have semantic content, whereas the latter have little or no semantic content. This is not to say, of course, that historically a noun and its correlated classifier do not have a semantic connection. Indeed, they do; but synchronically they do not. Again, the same point can be made with regard to mass nouns with atomic denotations and pseudo measure words in English: for example, *article*, as in *four articles of clothing*, or *item*, as in *five items of hardware*, or *piece*, as in *two pieces of furniture*.

There are many classifiers in Mandarin and the choice of classifier depends on the choice of noun. As Chao (1968, Chapter 7.2 (1), or p. 507) points out, the common noun in Mandarin determines the classifier much as the common noun in

5. An anonymous reviewer has pointed out that German, for example, does not require any morpheme to intervene between a measure word and the word for the thing measured, as shown by *zwei Flaschen Wein*, literally translated as *two glasses wine*. Our description here is one of the facts in English and Mandarin; no cross linguistic generalization has been stated, nor is one intended.

German determines the gender. Here is a sample: *gè* (for anything), *pī* (for horses), *chúang* (for beds), *bǎ* (for objects with a handle), *wèi* (for people), *dào* (for doorways), *shàn* (for doors), *běn* (for books), *bù* (for works), *kuài* (for pieces), *tiáo* (for long thin items such as ribbons, roads, rivers, trousers), *gēn* (for long thin items such as cigarettes, guitar strings), *tóu* (for pigs and livestock), *zhī* (for birds and certain animals, some utensils, vessels), *zhī* (for sticks, rods, pencils), *kē* (for pearls, corn, grains, teeth, hearts, satellites), *kē* (for trees, cabbages, plants), *zhāng* (for flat items such as sheets and for votes), and *duǒ* (for flowers, clouds).

So far, we have confined our attention to expressions of quantity using properly cardinal numerals. But Mandarin, like English, has vague cardinal numerals and other quantificational determiners. These include: *jǐ* (*several, many*), *hǎo-jǐ* (*good many*), *měi* (*each*), *hěn-shǎo* (*very few*), *hěn-duō* (*very many*), *ruò-gān* (*a certain number*), *hǎo-xiē* (*a good deal , quite a lot*), *dà-duō-shù* (*a great number*), *dà-liàng* (*great amount*), *dà-bù-fen* (*large part, most*), *quán-bù* (*whole*), *suǒ-yǒu* (*all*), *rèn-hé* (*any*), *yī-diǎn* (*a bit, a little*), *yī-xiē* (*a few, a little*) and *liáo-liáo-wú-jǐ* (*very few*).

The quantifiers *jǐ* (*several, many*), *hǎo-jǐ* (*good many*), *měi* (*each*), like the cardinal numerals, require a classifier and exclude the subordinator *de*. Moreover, they require that the common noun have an atomic denotation. Similar to these quantifiers are the expressions *dà-duō-shù* (*a great number*) and *liáo-liáo-wú-jǐ* (*very few*). They too can only modify nouns with atomic denotations, however they differ from *jǐ, hǎo-jǐ,* and *měi* in that they prohibit the use of classifiers. Only direct modification is possible.

In addition to these expressions, Mandarin has several prenominal quantifiers which, like the English words *lots*, *all* and *more*, occur with common nouns regardless of the atomicity or non-atomicity of their denotations. These include: *hěn-shǎo* (*very few*), *hěn-duō* (*very many*) *dà-liàng* (*great amount*), *dà-bù-fen* (*large part, most*), *quán-bù* (*whole*), *suǒ-yǒu* (*all*), *rèn-hé* (*any*), *yī-diǎn* (*a bit, a little*), *yī-xiē* (*a few, a little*). The last two exclude both classifiers and the subordinator *de*. Thus, they must occur immediately preceding the common noun they are construed with. The first two occur with either or with neither. The remaining occur optionally with the subordinator.

The distribution of non-numeral quantifiers bears directly on the question of the relation between the mass-count distinction and counting so widely discussed in the literature. For example, Krifka (1995), Chierchia (1998) and others have hypothesized that classifiers play a critical semantic role in reconciling the semantic values of nouns with the semantic values of the prenominal quantity expressions which go with them. Some researchers have even suggested that the nouns that seem on the surface to have atomic denotations do not, in fact, have an atomic denotation until they are in the presence of a classifier. Such a claim is not

consistent with the distributional properties of many of the prenominal quantity expressions we saw above: several of them, including all cardinal numerals which are proper multiples of ten are compatible with nouns with atomic denotations regardless of whether or not a classifier is present. In addition, two such prenominal quantity expressions downright exclude the presence of a classifier when they occur before a noun with an atomic denotation. It is much more straightforward to adopt Chao's (1968) view that classifiers are associated with nouns with atomic denotations much like gender is associated with nouns in other languages. On this view, the obvious semantic values are assigned to the various components: nouns with atomic denotations are assigned just that, the set of things of which they are true, the prenominal quantity expressions are assigned the usual values associated with such expressions from other languages. Thus, for example, *měi* (*each*) is assigned a universal quantifier, defined only over nouns with atomic denotations, *suǒ-yǒu* (*all*) is assigned a universal quantifier, defined over both atomic and non-atomic denotations, and *dà-duō-shù* (*a great number*) and *liáo-liáo-wú-jǐ* (*very few*) are assigned vague quantifiers defined only over atomic denotations. Whether or not the prenominal quantity expression takes a classifier is a subcategorization feature of the prenominal quantity expression.

Another important issue to address regarding non-numeral quantifiers is whether the distribution of *dà-duō-shù* and *liáo-liáo-wú-jǐ*, which exclude classifiers and combine only with nouns with atomic denotations, is evidence that Mandarin has the morpho-syntactic subcategories of mass and count. A possible explanation for the distribution of these quantifiers is that they select for nouns with the count feature. This would explain why such quantifiers cannot combine with other types of nominals. However, it is also possible that the meanings of *dà-duō-shù* and *liáo-liáo-wú-jǐ* semantically requires that its complement have an atomic denotation. For example, such an interpretation is given for *liáo-liáo-wú-jǐ* in (9).

(9) $[\![\text{liáo-liáo-wú-jǐ}]\!] = \lambda P\text{: ATOMIC}(P).\ \lambda Q.\ |\sigma(\text{CL}_{\vee}(P \cap Q))| = n$, where n is a contextually determined value representing a very low count, σ is a function that selects the supremum (or equivalently the unique maximal element) from a given set, and $\text{CL}_{\vee}$ is the function that returns the join closure of a set.

The meaning in (9) presupposes that the nominal argument has an atomic denotation. Its combination with a non-atomic denoting noun would result in presupposition failure. Empirically speaking, it is often difficult to distinguish catastrophic presupposition failure from true cases of ungrammaticality. Since Mandarin Chinese has no cases of allomorphy similar to the *much-many* contrast and has no minimal pairs similar to *furniture* vs. *chairs*, there is no reason to think that the patterns within the DP reflects anything other than the semantic division between

atomic and non-atomic denotations rather than the syntactic division into mass and count.

Besides the distribution of quantifiers, Mandarin is also quite different from English in that bare nouns have a univocal interpretation. Recall that in English, there is a difference between a bare noun like *chair* and one like *furniture*. Only *furniture* can be predicated of groups. In Mandarin, all nouns with an atomic denotation behave like *furniture*. The noun *háizi* ('child') in (10) is representative of the general pattern.

(10) a. Zhāngsān shì háizi
Zhangsan be child
'Zhangsan is a child.'

b. Zhāngsān hé Lǐsì shì háizi
Zhangsan and Lisi be child
'Zhangsan and Lisi are children.'

As shown in (10), *háizi* can be predicated of both groups and individuals. It is possible that this is a general property of classifier languages – i.e., they systematically lack a singular interpretation of bare nouns.[6]

In summary, unlike English, Mandarin has a rich classifier system, confines direct numeral modification to only a handful of syntactic environments, and lacks a productive distinction between singular and plural nouns. Furthermore, although a semantic distinction exists between atomic and non-atomic denotations, there is no evidence of nominal morpho-syntactic subcategories. The co-occurrence of quantifiers and nouns in DPs seems to track only the semantic distinction. There are no minimal pairs of nouns like *furniture* and *chair* where each noun has an atomic denotation but where one noun patterns with substance denoting nouns and the other does not. Similarly, there are no allomorphic variations in the quantifier system similar to *much* versus *many* where the same quantifier takes a different form depending on the subcategory of noun that it modifies. Finally, bare nouns in Mandarin have a number neutral interpretation across the board, much like English mass nouns.

6. A reviewer suggested that *shì gè háizi* would be a more appropriate counterpart to the predicate *is a child*, where *gè* is the default classifier. Implicit here is the comparison of the classifier with the indefinite article. Although this might be the more appropriate translation (since *gè* does imply singularity), our purpose here is to assess the denotational characteristics of the bare noun rather than the denotational characteristics of a phrase that includes a classifier and a noun. As argued above, the indefinite article in predicate position in English seems to be semantically vacuous with respect to number and hence the bare noun in Mandarin provides the more appropriate comparison.

3. Moving away from the prototypes

Researchers who study the mass-count distinction have done so under the very reasonable assumption that there is a connection between the list of differences discussed in Sections 2.1 and 2.2. After all, it is clear that mass-count subcategories have some correlation with whether a noun has an atomic denotation (i.e., all count nouns have atomic denotations) and it is clear in English at least that direct numeral modification correlates with one of the subcategories. It is a natural hypothesis to assume that the major differences between English and Mandarin have their roots in the mass-count distinction. However, examinations of other languages cast doubt about whether this reasonable assumption is warranted.

In this section we discuss three languages that challenge the idea that the mass-count distinction is at the root of the differences between English and Mandarin. We present evidence first discussed by Donabédian (1993) and Borer (2005) that languages with a productive plural marker can also have a rich classifier system. Like Wilhelm (2008), we also note that direct numeral modification can apply to bare nouns that are unspecified for number (once again, unlike either English or Mandarin). Finally, we discuss evidence first presented by Bale and Coon (2014) that the presence or absence of direct numeral modification is completely independent of whether the nominal system has subcategories or not.

3.1 Western Armenian

Western Armenian shares many properties with Mandarin, but also bears some similarities to English. Like Mandarin, Western Armenian has a rich classifier system, lacks true singular interpretations, and lacks most of the morphological indications of there being a syntactic mass-count distinction. However, like English, there is a productive plural marker and numerals can combine with nouns without the mediation of a classifier.

On the surface, Western Armenian looks like a classifier language without a mass-count distinction. There are no quantifiers that demonstrate an allomorphic variation that depends on nominal subcategories (as with *much* vs. *many* in English). Furthermore, there are no minimal pairs, like *furniture* vs. *chair*, where both nouns have atomic denotations but only one patterns distributionally with substance denoting nouns.[7]

7. The evidence most indicative of a mass-count distinction is the bahaviour of nouns in true partitive constructions. As discussed by Khanjian (2012), nouns that have denotations with atomic minimal parts must appear in partitive constructions with a plural marker while nouns that do not have such a denotation must not appear with the plural marker. However, it

Given these facts, it is rather unsurprising that Western Armenian has a rich classifier system. Consider the DPs in (11) and (12).

(11) a. yergu had xentsor
two CL apple
'two apples'

b. yergu kilo xentsor
two CL apple
'two kilos of apples'

(12) a. yergu təgal shakar
two CL sugar
'two spoons of sugar'

b. yergu kavat chur
two CL water
'two cups of water'

As shown in (11a), Western Armenian has a default classifier *had* that appears between numerals and nouns. This default classifier, like *gè* in Mandarin, does not impose a unit of enumeration but rather licenses counting based on the intrinsic atomic parts in the denotation of the noun. Just as in Mandarin, such classifiers occupy the same position as other measure terms, as shown in (11b) and (12). Furthermore, these classifiers differ systematically from partitive constructions with measure nouns, as in the English expressions *two slices of cake* or *two items of furniture* (see Khanjian 2012 for a discussion).

Not only does Western Armenian have a rich classifier system, but bare nouns have a number neutral interpretation similar to bare nouns in Mandarin (Donabédian 1993; Borer 2005; Bale & Khanjian 2008, 2014; Bale & Barner 2012). Consider the sentences in (13).

(13) a. Aram-ə dəgha e.
Aram-DEF boy be.PRES.3.SG
'Aram is a boy.'

b. Aram-ə yev Nanor-ə dəgha en.
Aram-DEF and Nanor-DEF boy be.PRES.3.PL
'Aram and Nanor are boys.'

is unclear whether this distinction is due to the different nature of the denotations rather than the presence of nominal subcategories. Recall that quantifiers in Mandarin are also sensitive to the atomic non-atomic distinction.

The singular noun, *dəgha*, can be predicated of both plural and singular subjects , thus indicating that the predicate is true of both groups and individuals.[8]

In contrast with these Mandarin-like properties is the presence of a productive plural marker in Western Armenian.[9] This is shown in (14a).

(14) a. John-ə yev Brad-ə dəgha-ner en.
John-DEF and Brad-DEF boy-PL are
'John and Brad are boys.'

b. *John-ə dəgha-ner e.
John-DEF boy-PL is

This marker can attach to any noun that has atomic minimal parts in its denotation. In contrast to the bare noun, the plural noun can only be predicated of plural subjects, as shown in (14b) (Bale & Khanjian 2008; Bale et al. 2011; Bale & Khanjian 2014).

Also, unlike Mandarin, classifiers are completely optional for nouns that have atomic minimal parts in their denotation. Consider the sentences in (15) and (16).

(15) a. yergu dəgha
two boy
'two boys'

b. yergu dəgha-ner
two boy-PL
'two boys'

(16) a. yergu had dəgha
two CL boy
'two boys.'

b. *yergu had dəgha-ner
two CL boy-PL
'two boys.'

Although the classifier, *had*, can appear between the numeral, *yergu*, and the noun, *dəgha*, as shown in (16a), this is not required. Numerals can combine directly either with singular nouns or plural nouns, as shown in (15). Classifiers are never necessary and the only time they are prohibited is when the noun is plural, as

8. Similarly, bare indefinite nouns are underspecified with respect to whether they quantify over plurals or groups and are the only nominal that participates in Derived Kind Predication (see Bale & Khanjian 2014 for a discussion of the facts).

9. As noted in previous sections, there is a plural marker in Mandarin, namely *-men*, however this marker can only attach to nouns and pronouns denoting humans, and thus to words with atomic denotations. Its distribution is restricted and therefore not completely productive.

shown in (16b). Borer (2005) provides a syntactic account of why plural marking cannot co-occur with classifiers. In contrast, Bale and Khanjian (2008) offer a semantic explanation, demonstrating that the plural has a more restricted denotation which prohibits it from appearing as a complement to a classifier. Doetjes (2012) observes that Borer (2005)'s syntactic account cannot hold cross-linguistically. Many languages allow plurals and classifiers to co-occur. However, the reasons for the unacceptability of (16b) does not affect our main point. The important observation is that Western Armenian has a rich classifier system but still allows numerals to combine directly with nouns.

In summary, the patterns in Western Armenian argue against a strong correlation between a rich classifier system and the lack of productive plural marking or the inability to combine numerals directly with nouns. Furthermore, there seems to be no connection between bare nouns having true singular interpretations, plural marking and direct numeral modification (cf. Wilhelm 2008). In other words, Western Armenian does not demonstrate all of the characteristics of a prototypical mass-count language, nor does it have all the characteristics of a prototypical classifier language. Western Armenian is just one example, representative of many others. A closer inspection of the properties involved in diagnosing a mass-count distinction places many other languages in neither category.

3.2 Ch'ol and Mi'gmaq

Many of the grammatical characterizations of the mass-count distinction hypothesize a correlation between properties in the nominal domain (subcategorization and number marking) and the presence or absence of a classifier system. Languages such as Mi'gmaq and Ch'ol demonstrate that this connection is not a plausible cross-linguistic generalization. In these languages, the presence or absence of a classifier is dependent on the numeral modifier and completely independent of the nominal system. In other words, classifier systems might have no connection to the nominal system, and thus should not be viewed as an indication of whether a language lacks a mass-count distinction.

As discussed in Bale and Coon (2014), Mi'gmaq numerals between one and five cannot appear with classifiers when they modify a noun, while other numerals must.[10] Compare the forms in (17) and (18): in (17a) the numeral *na'n* ('five') com-

10. It is not only the numerals from one to five that require the absence of classifiers, but also the complex numerals ending with a numeral from one to five. In other words, the property of requiring or not requiring a classifier is passed to the complex numeral based on the right-hand member.

bines directly with the noun *ji'nmug* ('men') and even acquires nominal agreement morphology, like other modifiers in the language. The classifier *te's* cannot appear between the numeral and noun, as shown in (17b).

(17) a. na'n-ijig ji'nm-ug
five-AGR man-PL

b. *na'n **te's**-ijig ji'nm-ug
five CL-AGR man-PL

(18) a. *asugom-ijig ji'nm-ug
six-AGR man-PL

b. asugom **te's**-ijig ji'nm-ug
six CL-AGR man-PL

In contrast, the numeral *asugom* 'six' cannot combine directly with a noun as shown in (18a). Rather, it must appear with the classifier *te's*, as shown in (18b).[11]

Similar facts hold for Ch'ol, although the nature of the contrast is slightly different (once again, see Bale and Coon 2014 for a discussion). Ch'ol, historically speaking, has a traditional Mayan numeral system – a base twenty system – as well as a system borrowed from Spanish. Younger Ch'ol speakers generally know and use traditional Mayan numerals only for numerals 1–6, 10, 20, 40, 60, 80, 100, and 400, the latter used for counting during the corn harvest (Vázquez Álvarez, 2011, 180). Otherwise they use the number words borrowed from Spanish.

As shown in (19), the Mayan numerals, like *cha'* ('two'), require a classifier which morphologically attaches to the numerals.

(19) a. cha'-**p'ej** tyumuty
two-CL egg

b. *cha' tyumuty
two egg

11. Since *te's* co-occurs with what appears to be a plural marker (i.e., *-ug*), one might wonder about its status as a classifier (i.e., perhaps it patterns like English measure nouns). Two points are relevant. First, *-ug* cannot attach to inanimate nouns yet can attach to verbs and adjectives. It is questionable whether it has the same status as plural markers such as English *-s*. Second, Mi'gmaq has measure nouns but they do not fit the same syntactic pattern as *te's*. Furthermore, unlike measure nouns, *te's* has no semantic content other than its measure function. In this respect, it behaves more like Mandarin default classifiers. Also, as discussed in Doetjes (2012), Borer (2005)'s hypothesis that plural markers cannot co-occur with classifiers faces many empirical challenges. Several languages permit the two types of marking to be present in the same DP.

(20) a. *nuebe-**p'ej** tyumuty
nine-CL egg
b. nuebe tyumuty
nine egg

In contrast, the Spanish-based numerals, like *nuebe* ('nine'), cannot be used with classifiers, as shown in (20). It is important to note that this is not an instance of code switching between Spanish and Ch'ol. This pattern holds for monolingual speakers of Ch'ol as well as bilingual speakers.

This tight connection between numerals and the classifiers is reflected in the morphological and syntactic structures of Mi'gmaq and Ch'ol. In Ch'ol, the classifier appears as a suffix on the numeral separate from the noun. In Mi'gmaq, the numeral and classifier form a constituent which can be displaced from the noun as in (21b), although the numeral alone cannot be displaced without the classifier (see 21c).

(21) a. Etlenm-ultijig **asugom** **te's-ijig** **ji'nm-ug**
laugh.PRES-PL six CL-AGR man-PL
'Six men are laughing.'
b. **Asugom** **te's-ijig** etlenm-ultijig **ji'nm-ug**
six CL-AGR laugh.PRES-PL man-PL
'Six men are laughing.'
c. ***Asugom** etlenm-ultijig **te's-ijig** **ji'nm-ug**
six laugh.PRES-PL CL-AGR man-PL
'Six men are laughing.'

In summary, evidence from Mi'gmaq and Ch'ol demonstrate that certain numerals select for classifiers while others do not. The choice of noun is inconsequential. For these languages, it is untenable to hypothesize that the presence or absence of classifiers is determined by the semantic properties of the noun, as in Chierchia (1998). Rather, these languages favour an analysis in the spirit of Krifka 1995, where the numerals take measure functions as arguments and classifiers grammatically instantiate these measure functions. Whether all languages have the same semantic and syntactic characteristics as Mi'gmaq and Ch'ol is an interesting empirical question, one that is impossible to address within the limits of this paper, and one which is, in any event, irrelevant to the issue at hand. What is relevant is that the mere existence of languages like Ch'ol and Mi'gmaq demonstrates that subcategorization in the nominal system (i.e., the mass-count division) is, in principle, not connected to classifier systems.

3.3 The case against parameters

The data in Mi'gmaq, Ch'ol and Western Armenian point to a more nuanced perspective regarding the differences between languages with respect to number, classifiers and plural marking. Rather than researching languages for paradigmatic

differences in the setting of certain parameters, perhaps researchers should be more focused on the semantics of individual morphemes.

At least in languages like Ch'ol and Mi'gmaq, the requirement or prohibition of classifiers is not due to a global property of the language but rather the individual properties of certain numeral modifiers.[12] Critically, numerals which require classifier and numerals which prohibit them can exist in one and the same language.

An interesting question arises with respect the flexible use of classifiers in Western Armenian. It is possible that numerals in Western Armenian are systematically ambiguous, one meaning requiring classifiers and the other not. It is also possible that the ambiguity lies with the nominal system and that classifiers in Western Armenian are fundamentally different from those in languages like Mi'gmaq and Ch'ol – one set of classifiers serving as nominal arguments and another set as numeral arguments. However, a much more elegant solution would be to hypothesize that numerals can be subcategorized to take classifiers as arguments in much the same way that verbs can be subcategorized for objects. In English, some verbs require objects (e.g., *admire*) and some verbs prohibit objects (e.g., *laugh*), while others are flexible (e.g., *eat*). Perhaps Western Armenian numerals are subcategorized in much the same way as *eat* in English – i.e. the numerals are lexically specified as being flexible. Once again, the individual properties of Western Armenian might be more about the individual specifications of morphological entries rather than a global property of the language.

Similar conclusions can be drawn with respect to the plural morpheme in Western Armenian compared to Mandarin. As mention in Section 2.2, Mandarin has a plural morpheme, namely *-men*. Unlike the plural in Western Armenian or English, *-men* can only attach to nouns that denote humans. However, this difference between Western Armenian/English on the one hand and Mandarin on the other need not be a fundamental property of the languages themselves. Rather, it could be a reflection of the idiosyncratic selectional restrictions associated with the morphemes *-s*, *-ner*, and *-men*.

In summary, it might be more productive in terms of advancing the semantic and syntactic analysis of understudied languages to consider the properties associated with the mass-count distinction to be a product of idiosyncratic lexical entries rather than a global property of certain languages. In other words, a child doesn't learn to set a parameter, but instead learns the semantics of the specific morphemes he/she is exposed to. Seemingly global patterns such as "classifier systems" and "mass-count systems" are coincidental epiphenomena of certain lexical entries.

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12. To a much more limited extent, Mandarin supports the same kind of conclusion. As mentioned in Section 2.2, numerals which are a multiple of ten can omit classifiers.

4. Conclusion

There are several conclusions that can be reached given our discussions. One concerns the consistent use of the terms *mass* and *count* when investigating and assessing different types of languages. Researchers should be careful to distinguish syntactic subcategorization from semantic divisions. The semantic division between nouns with atomic denotations and those without is a universal property of all known languages. As a universal property, it does not pattern with any language particular grammatical operation or category. The syntactic division into grammatical *mass* and *count* nouns is, for the most part, independent of the semantic distinction (although there are some implications: i.e., all count nouns have atomic denotations). This syntactic division is not a universal property of all languages.

With respect to this syntactic division, some interesting cross-linguistic questions arise. One is whether this syntactic division correlates with other grammatical properties. Previous literature either implicitly or explicitly assumes that the lack of a mass-count distinction is connected with the presence of a rich classifier system (Krifka 1995; Chierchia 1998, among others). In contrast, the presence of this distinction is connected to (i) allomorphy in the quantifier system, (ii) minimal pairs of atomic denotations, (iii) singular denotations for bare nouns, (iv) the presence of a productive plural marker, and (v) the ability for numerals to directly modify nouns without any classifiers or measure terms. The data from Western Armenian demonstrated that the presence of productive plural marking and the ability to combine numerals directly with nouns does not correlate with the other properties. The data from Ch'ol and Mi'gmaq demonstrated that the presence or absence of a rich classifier system in some languages depends solely on the semantic/syntactic nature of the numeral system. Whether nouns are divided into mass and count is completely inconsequential for these types of classifier systems.

Our discussions are not meant to suggest that classifiers are mediated by numerals in all languages. Rather, our modest point is that these languages weaken correlations between the syntax and semantics of classifiers and numerals on the on hand, and the syntactic mass-count distinction on the other. However, the consequences of this modest point are quite broad. It implies that researchers should not identify a language as having a mass-count distinction by searching for the presence or absence of plural markers or classifiers. It also implies that languages do not cleanly divide into those that are Mandarin-like and English-like. Rather, there is a continuum.

Clearly the dream of a cluster of grammatical properties around the mass-count distinction is fading as more empirical research reveals more varieties of

patterns. With this, the hope of characterizing a parameter that links the nominal division to the counting system and numeral modification also fades. Children need to assess separately whether the language they are acquiring has a classifier system, a plural marker, direct numeral modification, true singular denotations or a syntactic mass-count distinction. Children will not be able to infer one property from the other.

One wonders, given these empirical observations, what remains of the mass-count distinction. We have not seen any counter-examples to the hypothesis that bare count nouns have a singular denotation, although we should be careful not to jump to conclusions here. Only a few languages have a formal semantic analysis of their nominal system. Also, not only is it difficult to establish whether a given language has a syntactic division on top of its universal semantic division, it is also difficult to assess whether a language has a true singular denotation. A more established generalization is the connection between allomorphy in the quantificational system and the syntactic mass-count distinction. For example, the difference between *too much furniture* and *too many items of furniture* seems to be purely syntactic. There is good evidence that *much* and *many* are allomorphs of a single underlying modifier. The words are in complementary distribution and have almost identical meanings. It is unlikely that the trigger for the different surface forms of the morpheme is semantic in nature. In almost any context, the denotations of *furniture* and *items of furniture* are practically identical (the set of all singular items and all groups formed from those singulars). Rather, the phonological form of the modifier seems to be dependent on whether the modified nominal has plural count features or mass features. However, there is nothing special about the mass-count distinction in this respect. The presence of allomorphy is well attested with other nominal subcategories, such as those that involve gender or animacy features.

This analogy with other nominal subcategories brings up an interesting question. If the mass-count distinction no longer has consequences for the grammatical representation of numeral modification, then are mass-count features any different from animacy or gender features? The evidence suggests that they are not. The illusory connection to the counting system was an accident of paying too much attention to differences between Mandarin and English.

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Activewear and other vaguery

A morphological perspective on aggregate-mass

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In the literature on the mass-count distinction, some nominals that denote groupings of objects (e.g. English *furniture*) are known to display hybrid properties, exhibiting syntactic distribution akin to prototypical non-count nominals (substance-denoting, e.g. *mud*), but showing certain semantic properties associated with plurals. This paper aims to broaden our perspective on the properties of such nouns, focusing on their morphological composition in three languages, English, French, and Hebrew, where nouns of this type are frequently created through specific derivational processes. This systematic derivation suggests that the combination of properties associated with these nouns should not be seen as an idiosyncratic exception to the mass-count distinction, but as a systematic category between the two.

Keywords: aggregates, mass-count, nominalisation, derivation, morphology, English, French, Hebrew

1. Introduction

The nominal distinction between mass-count or count/non-count is, at its basis, a classification of nouns based on distributional morphosyntactic differences, primarily the availability of singular-plural forms and number quantification for count nominals (*one cup, two cups*), and for non-count nominals, the absence of such paired forms (**one mud, *two muds*). Semantic and ontological criteria have been proposed to account for this distinction, involving concepts such as discreteness, atomicity, individuation, and homogeneity (broadly, that a count noun denotes discrete, individuated items, whereas a non-count noun denotes a non-discrete homogenous substance), but these only partially correspond to the morphosyntactic division. Despite the traditional perspective, it is evident that the various properties do not converge on a clear binary distinction. A central type of noun that poses a problem for mass-count analyses involves nouns that

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denote groupings of objects (e.g. English *furniture,* frequently taken as a class prototype), since they exhibit the morphosyntactic distribution of non-count substance-denoting nominals (e.g. *water, mud*), yet their semantic properties bring them closer to count nominals that denote pluralities. This combination of properties has been a topic of growing interest in the linguistic literature on the mass-count distinction. The various labels applied to this group highlight their mixed properties, e.g., 'collective mass' (Bunt, 1985; Weise, 2012), 'mass superordinates' (Wisniewski et al., 1996), 'count mass' (Doetjes, 1997), 'mass atomic' (Gillon et al., 1999), 'unsorted stuff' (Müller & Oliveira, 2004), 'object mass' (Barner & Snedeker, 2005; Bale & Barner, 2009), 'fake mass' (Chierchia, 2010), 'aggregate' (Joosten, 2010), 'atomic mass' (Rothstein, 2010), 'functional aggregate' (Grimm & Levin, 2011, 2012). Here, I will refer to nouns of this type as aggregate-mass nouns, following Joosten and Grimm & Levin.

This paper aims to contribute a morphological perspective to the discussion, specifically to highlight systematic derivation processes common to many aggregate-mass nominals. The paper considers such processes in three languages, English, French, and Hebrew. Many of the relevant nouns in these languages are productively formed through a small set of derivation processes. In English and French, the relevant processes show some overlap, due to shared diachronic influences, but aggregate derivation remains synchronically active and productive independently in each language. Hebrew, a Semitic language, presents distinct morphology and diachronic development, with a different type of derivational process, but there too productive aggregate derivation is associated with specific patterns. I argue that the existence and prevalence of regular morphological processes indicates that nouns with this combination of properties are created systematically. Such regularity remains unaccounted for in semantic approaches that view aggregates as idiosyncratic items which must be listed in the lexicon as such (cf. Chierchia, 2010; Rothstein, 2010).

This paper intersects a range of topics that are not typically addressed together. Morphosyntactic research analysing the syntactic import of specific derivational processes is largely focused on event nominalisation and event arguments. In contrast, the study of aggregate-mass nouns is still divided across domains. On the one hand, extensive syntactico-semantic literature considers the distributional and denotational/referential properties of these nouns, but does not address their specific derivational characteristics. On the other hand, rich lexical and morphological literature examines the relevant derivation processes in terms of their morpho-phonology, historical development, semantic interpretation(s), and polysemy, but without attending specifically to the syntactico-semantic uniqueness of aggregates produced in those patterns.

The paper is not intended to propose a theoretical solution to account for the combination of aggregate properties. Rather, the aim is to bring together facts and insights from different areas and approaches that are not typically considered jointly, and broaden our perspective on the properties of these nouns, aiming to ultimately obtain a more coalesced view of aggregate-mass nouns.

Section 2 presents an overview of the concepts in the mass-count literature that are pertinent for the classification of aggregate-mass nouns, followed in section 3 by a summary of the particular combination of morphosyntactic and semantic properties associated with these nouns. Section 4 addresses the categorisation properties that distinguish aggregate-mass nouns from other collective nominals denoting groupings of individuals. Section 5 presents the most common derivational patterns used to form aggregate-mass nouns in each of the languages considered. Some of the predominant patterns that emerge from this comparison are discussed in Section 6. Finally, Section 7 provides an assessment of the emerging systematic patterns with respect to the question of idiosyncratic lexical listing for these nouns.

2. The mass-count distinction – basic concepts

The definitions of 'mass' and 'count' themselves are still under dispute, despite the vast literature on the subject, which encompasses morphosyntactic, semantic, and conceptual studies (Doetjes, 2012; Gillon, 1992; Gomeshi & Massam, 2012; Joosten, 2003; Pelletier, 2012, for overviews).[1] The basic morphosyntactic characteristics highlight different distribution between count and non-count nouns, which is related to number properties (exemplified for English): count Ns show regular singular/plural alternation without change of meaning (aside from plurality itself, e.g. *cup/cups*), whereas non-count N have no SG/PL alternation (or, more precisely, singular and plural forms of mass nouns do not simply denote multiplication of the denotation, but reflect altered meaning, such as reference to types, to pragmatically relevant units of matter, e.g., *wines*, or as implying vastness, *sands*

1. The source of the terms may be Jespersen's (1913) analysis of English. His treatment clearly gives precedence to the morphosyntactic criteria. Consequently, although he describes mass items in semantic terms, "[words] which do not call up the idea of any definite thing, having a certain shape or precise limits" (1913, p. 114), he clearly categorises *furniture* as mass (1933, p. 209).

of the desert).[2] Count nouns can be modified by cardinal numerals, appear with a singular indefinite article, and serve as antecedent for *one*, while non-count Ns cannot. Determiners are also sensitive to this distinction: count Ns appearing with determiners such as *many or few* (when in the plural form), whereas non-count Ns appear with items such as *much, less, a little.*

Semantically, mass terms have been described through concepts such as homogeneity/divisibility (a part of water is still water, but a part of a cup is not a cup) and cumulativity (added quantities of water are still water, added instances of cup do not remain a (single) cup), and count nouns through the concept of atomicity/individuation (having distinguishable items which cannot be further divided and retain the same denotation). To quote Bunt (1985, p. 46)

> the use of mass nouns is a way of talking about things as if they were a homogeneous mass, i.e. as having a part-whole structure, but without singling out any particular parts and without any commitment concerning the existence of minimal parts.

Significantly, the various morphosyntactic and semantic properties are only partially aligned, leaving a distinction that is in fact more of a continuum than a binary even within a single language. The morphosyntactic distinction, fundamentally based on number marking, is clearly not relevant in all languages (Doetjes, 2012 for review). Furthermore, comparison of the associated syntactic and semantic properties reveals low correlation cross-linguistically even in languages that mark this distinction (cf. Kulkarni et al., 2013). Consequently, the count/non-count distinction is crucially language-specific,[3] and thus not straightforwardly dependant on conceptual and encyclopaedic knowledge. The languages examined here exhibit count/non-count distinctions, marked in broadly similar morphosyntactic ways.

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2. Prototypically mass nouns can, to a certain extent, be used in some count structures in appropriate contexts, denoting discrete units or subtypes (at least in some languages). Following Bunt (1985), this phenomenon is known as 'the universal sorter'. Note that this 'sorting' option is highly sensitive to knowledge of the world, and acceptability varies depending on the noun, the structure, and the context. *Two sugars* is relatively easy to contextualise as a reference to cubes or teaspoons, but this is not the case for *two muds*, although the latter may be possible in, say, a geological context (depending on language, of course). Furthermore, while direct counting of non-count Ns is facilitated in familiar contexts, this does not automatically allow all count structures equally. Thus, while *two sugars* may be possible, *I had too many sugars* is less acceptable as reference to the same standard units. However, the same structure is easily available with another N, such as *I had too many coffees*.

3. An interesting example is the broken plural in Arabic. Whereas suffixed (external) plurals have only a count reading, broken plurals can denote either a count reading or a collective reading (see Lahrouchi & Ridouane, 2016).

3. Aggregate-mass – basic properties and distribution

The following examples briefly illustrate the various properties associated with aggregate-mass (illustrated here for English), contrasted in each case with prototypical non-count examples (in b) and prototypical count examples (in c). In their morphosyntactic distribution, aggregate-mass Ns pattern with substance non-count nouns.[4] They show no singular/plural contrast (1), which is matched by their invariant agreement (2) and evident in pronominal anaphora (3) (both singular in the examples below). In addition, they cannot be modified by cardinal numerals (4, 5), nor by the indefinite article, but are acceptable as bare (6). They accept modifiers associated with non-count Ns (e.g., *much*), but not ones associated with count nouns (e.g., *many*) (7).

(1) a. Brian needs this luggage/*these luggages.
b. Brian needs this water/*these waters.
c. Brian needs this chair/these chairs.

(2) a. Luggage {is/*are} expensive.
b. (The) water {is/*are} expensive.
c. The chair {is/*are} expensive./ (The) chairs {*is/are} expensive.

(3) a. This luggage is nice but {it's/*they're} expensive.
b. (This) water is clean but {it's/*they're} expensive.
c. This chair is nice but {it's/*they're} expensive.
c′. These chairs are nice but {*it's/they're} expensive.

(4) a. * Julie needs three luggages. /* Jamie has one luggage left.
b. * Julie needs three muds. /* Jamie has one mud left.
c. Julie needs three chairs. / Jamie has one chair left.

(5) a. * Three of the luggage would be needed.
b. * Three of the mud would be needed.
c. Three of the chairs would be needed.

(6) a. (*A) luggage is expensive. / Jamie needs (*a) luggage.
b. (*A) water is expensive. / Jamie needs (*a) water [mass reading]
c. *(A) chair is expensive. / Jamie needs *(a) chair.

(7) a. [Too much/*many] luggage would be needed.
b. [Too much/*many] water would be needed.
c. [*Too much/*many chair] would be needed.

4. Like substance-mass Ns, some aggregates could appear in count morphosyntax with an altered denotation, referring to types or to conventionalised contextually relevant units. This aspect is irrelevant for the current discussion. For the purposes of this paper, it is sufficient that they are distinct from count plurality in that they do not simply denote quantification of the SG. sense.

The problem with classifying aggregates arises when more significance is given to the associated semantic criteria: individuation and atomicity for count Ns vs. divisibility and cumulativity for non-count Ns (i.e., the denotation remains identifiable and stable even if the referent is divided or accumulated). Seen from this perspective, aggregate-mass nouns seem to pattern with the wrong category, denoting atomic, individuated objects, and not allowing divisibility.

Generally, the subcomponents of aggregates are not linguistically accessible individually, unlike those of plural count nouns. Thus, the aggregates in (8a) can only have a collective reading, whereas the plural nouns in (8b) can have either a collective or an individual reading (examples from Gillon, 1992; Rothstein, 2010).

(8) a. The curtaining and the carpeting resemble each other.
b. The curtains and the carpets resemble each other.

However, some constructions reveal that the subcomponents, individuated to a certain extent, can be linguistically accessed, allowing discontinuous modifiers (e.g., *miscellaneous*) (9), predicates involving parts (10, cf. Moltmann, 1997, p. 87–88), and individual-selecting modifiers (11), which enable a distributive reading (cf. McCawley, 1975; Doetjes, 1997; Moltmann, 1997; Schwartzschild, 2006, 2011; Chierchia, 2010; Rothstein, 2010). Individual-selecting modifiers denote properties of shape, size, and duration, which can only be predicated of discontinuous entities (Schwarzschild calls these 'stubbornly distributive predicates' or STUBs).

(9) a. The floor was covered with miscellaneous luggage.
b. * The floor was covered with miscellaneous water.
c. The floor was covered with miscellaneous tools.

(10) a. The box was hidden among the luggage.
b. * The box was hidden among the water.
c. The box was hidden among the coats.

(11) a. Carol needs small/square luggage. [distributive]
b. * Carol needs {small/round/square} water.
c. Carol needs small tools/long clothes/pointed shoes. [distributive]

Similarly, Schwarzschild (2006) notes the possibility of distributive weight and price modification of aggregate-mass nouns (12a, adapted from Schwarzschild, 2006), which is not available for substance mass terms (12b), the latter allowing only a collective subtype reading with such modification.

(12) a. Harry bought 20 cent jewellery / 10 lb. luggage. [distributive]
b. Harry bought 20 cent coffee. [type]
c. Harry bought 20 cent rings / 10 lb. chairs. [distributive]

A second aspect distinguishing aggregates is revealed in psycholinguistic studies. For substance-denoting nominals such as w*ater*, quantitative comparison may

only be based on bulk or volume, while for plural nominals, it may also be based on counting the number of individual entities forming the denoted set. Aggregate nominals behave like plurals in this respect (13), indicating that the individuals denoted are conceptually salient enough to allow comparison by number (Barner & Snedeker, 2005; Bale & Barner, 2009).

(13) a. Donna bought more furniture than me. [true if she bought a small chair and a small stool while I bought a big sofa]
b. Donna bought more tools than me. [true if she bought a screwdriver and a hammer while I bought a sickle, regardless of total bulk]
c. Donna drank more water than me. [compared only in volume]

Grimm & Levin (2011, 2012) report experiments that indicate aggregate nouns also enable comparison through functionality. That is, in comparing sets of objects, participant evaluations were influenced by various properties associated with the function of the items (e.g., a more varied or more expensive set of jewellery is interpreted as more jewellery).

However, while comparative evaluations on the basis of number or functionality indicate an *awareness* of discrete individuatable subcomponents within the denoted set, this awareness need not have structural *linguistic* realisations. Consequently, tests of distributive modification (as in 9–12) gain crucial significance as an indication that individuated subcomponents are indeed not only conceptually but linguistically accessible.[5]

In an attempt to treat the hybrid properties of this class of nouns, Chierchia (2010, p. 139) proposes that the existence of aggregate-mass nouns ('fake mass' in his terms) results from a "copy-cat effect" whereby some nouns having *unstable atomic* denotations (e.g. *furniture*) mimic the grammatical behaviour of substance-denoting nouns, which take up the singular morphology characteristic of singleton denotations. Crucially, according to Chierchia's explanation, aggregate-mass nouns need to be specifically *listed* in the lexicon as such. Along similar lines, Rothstein (2010, p. 354) argues that "since *shoes* is a near-synonym of *footwear* but a count noun, there must be a great deal of lexical idiosyncrasy underlying whether a predicate of atomic individuals is or is not marked count".

The mass-count literature typically does not define the intended class of words aside from noting its hybrid properties, and the number of nouns used to illustrate the class is relatively small. Yet, as shown in Section 5, consideration of larger sets of nouns highlights morphological patterns that are not evident otherwise.

5. The combined properties of aggregates raise a challenge to Borer's (2005) exo-skeletal model, particularly the DIV head (for discussion and alternative analyses, see de Belder, 2013, who proposes a modification of Borer, and for other approaches, Franco et al., 2019 and Grimm & Dočekal, In press).

Analysis based on lexical idiosyncrasy does not capture the morphological regularity of these forms.

Before addressing the morphology of these nouns, one should consider delimitating the relevant category of nouns, taking into account not only the syntactic and semantic criteria, but also the relation between elements in the referenced grouping. In Section 4, we follow Joosten's (2010) categorisation of nominal multi-object groupings as a working guide for this purpose.

4. Aggregate-mass nouns: Internal membership criteria

Many studies have addressed the hyponymy and meronymy of nouns referring to a multiplicity of subcomponents, variously labelled as collectives, groups, superordinates, and aggregates (Markman et al., 1980; Markman, 1985; Wierzbicka, 1988; Wisniewski et al., 1996; Moltmann, 1997; Middleton et al., 2004; Mihatsch, 2007, 2016; Joosten, 2010 a.o.). However, the definitions are far from clear, and such categorisation is much wider than the set of nouns associated with the distributional criteria noted in Section 3. Given the range of grouping types, and the fact that their denotations are on a continuum, guiding criteria are required to pinpoint the relevant set of data. The classification proposed by Joosten (2010) correlates with the properties noted above and provides further distinctive characteristics.

Joosten (2010) proposes a tripartite classification of grouping Ns, based on the combination of eight properties (Table 1), the primary among which is the interaction between hyponymy (kind of) and meronymy (part of). He terms the types of groupings 'aggregate', 'collective', and 'superordinate' nouns. The category relevant to us in this context is the aggregate.

Aggregate nouns (e.g. *furniture, jewellery, earthenware, lingerie, bétail, verrerie*) are non-countable ('transnumeral' in his terms) and lack a SG/PL variation;[6] the individual members are linked through similarity of properties (including functional properties), but could optionally be linked by an external bond (termed 'contiguity'; Joosten mentions spatio-temporal, social, cooperative, and functional contiguity). Crucially, aggregates allow both a part-of and a kind-of relation with members (e.g., a pendant is a part of the jewellery, but also a kind of jewellery); aggregates are characterised by inclusive disjunction (14b); and finally, transfer of properties between the aggregate and the individual components is usually possible (old furniture = old tables, chairs, and so on).

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6. Again, ignoring plurals that denote an altered sense (units, types). For the purposes of this paper, it is sufficient that they are distinct from count plurality in that they do not denote quantification of the SG. sense.

In accordance with the syntactic and semantic properties noted above, Joosten's aggregates are characterised by the absence of numeral morphology and the availability of conceptual access to the subcomponents of the grouping. They contrast with the other two categories in having both part-of and kind-of relations.

Collective Joosten's collective nouns (e.g. *team, archipelago, group, family, club, herd*) are numeral, showing SG/PL alternation; their individual members are linked by contiguity, but only optionally share internal properties. These Ns show a part-of relation with members, but not a kind-of relation (e.g. an island is a part of an archipelago, but not a kind of one). The collective forms a distinct entity and is not simply the sum of its members, and is therefore characterised by conjunction of members (14a). Consequently, the collective and its individual members may not share properties (old club ≠ old members).

Joosten's superordinate nouns (e.g., *vehicle, animal*) are numeral, showing SG/PL alternation; their individual members are linked by functional similarity and only show a kind-of relation, not a part-of relation (a train is a kind of vehicle, but not part of a vehicle). They are characterised by exclusive disjunction (14c).

(14) a. *archipelago* (collective) = island and island and island …
b. *lingerie* (aggregate) = a bra, or a g-string, or a bra and a g-string…
c. *vehicle* (superordinate) = car or train or boat or …

Joosten (2010, p. 39) concludes that

> aggregate nouns can be assigned a pivotal position in the middle of a continuum in which 'part of' and 'kind of' are two conflicting forces, and in which collective nouns [such as *club*] and superordinates such as *vehicle* form the extremes.

Table 1. Properties distinguishing aggregates from collectives and superordinates (adapted from Joosten, 2010)

Collective noun	**Aggregate noun**	**Superordinate**
archipelago	*lingerie*	*vehicle*
[+ part of]	[+ part of]	[– part of]
[– kind of]	[+ kind of]	[+ kind of]
[+ contiguity] necessary	[+ contiguity] optional	[– contiguity]
[– similarity] optional	[+ similarity] necessary	[+ similarity] necessary
[+ conjunction]	[+ conjunction]	[– conjunction]
[– disjunction]	[+ disjunction]	[+ disjunction]
numeral	transnumeral	numeral
More than the sum of its parts; Is its own entity	Equal to the sum of its parts; Not independent entity	Equal to the sum of its parts; Not independent entity

Note that all three categories list functionality as a parameter for the grouping of subcomponents. This shared property underlines the importance of the other parameters in distinguishing types of groupings, particularly in light of Grimm & Levin's (2011, 2012) emphasis of shared functionality in the conceptual composition of aggregates.

The selection of data for this study combined the linguistic properties outlined in Section 3 and the conceptual and categorial aspects in Section 4: nouns which denote a grouping of discrete objects that designate aggregates in Joosten's terms, that function syntactically as mass nouns, but also allow linguistic access to the individual subcomponents (e.g., through distributive modification). Excluded are multi-object nouns that (i) designate collectives or superordinates in Joosten's terms, (ii) show count morphosyntax, and (iii) do not allow distributive modification.[7] Terms such as *family, team*, are excluded on all counts. Terms designating structured groupings (e.g., *bouquet, questionnaire*) are also excluded, since they pattern as collectives in Joosten's terms, and their internal elements are not accessible. Finally, the present study focuses on non-plural inanimate artefactual terms, leaving aside natural kinds (such as *cattle*) and mass plurals (*groceries, leftovers*),[8] although some may fit the tests for individuatable distributive modification (in Section 4).

5. Morphological aspects

The following sections trace some of the active morphological processes through which aggregate-mass nouns are formed in English, French, and Hebrew, while noting a few idiosyncratic derivations as well. Examination of the data indicates that most aggregate nouns are derivational, and systematically associated with a small set of productive morphological patterns. Numerous works have examined the relevant derivation processes in all three languages from a wide range of perspectives, examining their morpho-phonology, diachronic development, and (frequently polysemous) semantic interpretation(s), although usually without specific attention to the aggregate aspect. Grouped readings are noted among the set of readings associated with the relevant processes in the literature (often without

7. It should be noted that results of these tests form a continuum rather than a clear binary distinction. For example, while both *debris* and *wreckage* take distributive modification or predication (e.g., *miscellaneous* N or *assemble* the N), this is much easier with *debris* than with *wreckage*.

8. On mass plurals, see McCawley (1975), Ojeda (2005), Lauwers and Lammert (2016).

distinguishing count and non-count, mass and aggregate), but analysis of group nouns is scarce, to my knowledge (work by Aliqout-Suengas is an exception).

5.1 English derivational patterns

Aggregate-mass nouns in English are prototypically represented in the mass-count literature by items such as *furniture, luggage, footwear, mail, bedding, jewellery, ammunition*. A wider set of lexical items reveals that most aggregate-mass nouns are derived through a small set of derivational patterns, primarily *-ware, -wear, -ing, -age,* and *-(e)ry* , all historically well-established patterns.

The first two derivational patterns, *-ware* and *-wear,* are specifically dedicated to the generation of aggregate-mass nouns and are very productive (numbering in the hundreds). They are commonly found in the language of commerce, manufacture, and advertising, but their use is not limited to those contexts. Both produce nouns from nominal, verbal, and adjectival bases (15–16).

(15) $[\text{N } \textit{-ware}]_{\text{N}}$; $[\text{V } \textit{-ware}]_{\text{N}}$; $[\text{A } \textit{-ware}]_{\text{N}}$
silverware, earthenware, kitchenware, breakfastware, tapware, giftware, software, shareware, bloatware

(16) $[\text{N } \textit{-wear}]_{\text{N}}$; $[\text{V } \textit{-wear}]_{\text{N}}$; $[\text{A } \textit{-wear}]_{\text{N}}$
footwear, neckwear, beltwear, sportswear, beachwear, swimwear, sleepwear, bridalwear, knitwear, daywear, outerwear, spacewear

-Ware is of Germanic origin, with cognates in other Germanic languages. Derivations referring to merchandise date back to Middle English (*felware* 'fur merchandise' from 1367, *iren ware* 'iron merchandise' from 1398, cf. Middle English Compendium). *-Wear* is also of Germanic origin, but its use in compounds is attested only in the mid-1800s. Both patterns receive little attention in the morphological literature, aside from the classification of derivational status for the first (cf. on *-ware,* Marchand, 1969; Lieber, 2004; Booij, 2005; on *-wear,* Gold, 2007).[9]

The second group of suffixes (*-ing, -age, -(e)ry*) are nominalisation suffixes associated with a cluster of senses; this cluster of senses tends to converge on the same derivational patterns, possibly through various processes of semantic extension (Adams, 2001, pp. 60ff; Bauer et al., 2013, ch. 10–12; Lieber, 2004, pp. 148ff; Plag, 2016; Smith, 2018; Rainer, 2005 a.o.). Part of this range is the derivation of aggregate-mass nouns, illustrated in Examples (17–19).

9. I will not go into the classification of these items as compounds, affixes or affixoid/semi-affixes (see references above). For the purposes of this paper, it is sufficient that they constitute regular morphological processes deriving aggregate nouns.

(17) -ing $[\text{V-ing}]_N$
aggregate: *lighting, bedding, piping, carpeting*

(18) -age $[\text{V-age}]_N$; $[\text{N-age}]_N$; $[\text{A-age}]_N$ (less frequent)
aggregate: *coinage, plumage, footage, wordage, surplusage; signage, trackage*

(19) *-(e)ry*[10] $[[\text{V-er}]_N\text{-y}]_N$ or $[[\text{N-er}]_N\text{-y}]_N$
aggregate: *jewellery, gadgetry, imagery, crockery, finery, fernery, knicknackery*

The suffix *-ing* is a native English form of Germanic origin, and serves in both inflectional and derivational processes. The productivity of deverbal derivational *-ing* may be due to the prevalence of its inflectional function.

The suffixes *-age* and *-(e)ry* were among the derivational forms incorporated into Middle English from French and tracing back to Latin (for a diachronic analysis of the impact of Latinate suffixes on the original Old English system and the progressive changes in meaning in both sets, see Dalton-Puffer, 1996). The degree of productivity for these suffixes is under some debate, although they are clearly less productive than *-ing*. The addition of new coinage to dictionaries is rare since the early 20th century, but corpus studies find productive use of many forms not listed in the OED (cf. Bauer et al., 2013, p. 250; Smith, 2018 for *-age*). Older derivations remain in frequent use for both forms.

All three suffixes are event nominalisers, associated with a cluster of senses in addition to aggregates and other groupings, encompassing primarily activity (*drinking, coverage, archery*), result/product (*building, wedding, coverage, lottery*), and location (*dwelling, orphanage, brewery*). Nouns ending in *-age* are also associated with status/position (*parentage, patronage*), and quantity, measure, and fees (*shortage, mileage, warehousage* (re harbour dues)), the latter senses divided between mass and aggregate-mass. For *-ing*, action nominalisation may be its primary function, given its inflectional role in verbal morphology. For *-(e)ry* and *-age,* Lieber (2004, pp. 148ff) argues that the collective meaning is their base contribution. She relates the associated polysemous clusters to a combination of the abstract nature of the semantic contribution of the affixes, their interaction with the specific properties of the bases, and added extensions through paradigmatic pressure.[11] Locations and types of behaviour are taken as extensions of the

10. This represents a set of related suffixes. For discussion of the associated morphophonological variations, see Adams (2001), Bauer et al. (2013).

11. Lieber (2004) defines paradigmatic extension as a process which takes place when speakers need to create a word with a specific meaning, but there is no particular affix in the specific language to supply this meaning. The needed words are then derived through sense extension from the closest productive affixes.

collective reading. Note that *-(e)ry* aggregates are frequently related to the agentive *-er* suffix, which typically derives professions, highlighting the association of aggregates with the language of manufacture and commerce.

Some aggregates do present individual lexical development, of course. Interestingly, this is the case for some of the prototypical examples of aggregate-mass in the mass-count literature: *furniture, ammunition.* Both nouns were loans from French, and have undergone changes of meaning, distribution, and denotational structure in English. *Furniture,* borrowed in the 16th century, was a regular count noun *fourniture(s),* meaning 'a supply', and only obtained its current sense and mass syntax in the 19th century. Its French counterpart *fourniture(s)* retains its original meaning and count morphosyntax. A similar alteration affected *ammunition*, borrowed in the 17th century from the French count noun *munition(s)* 'military supplies'. Although both suffixes belong to the set of eventive nominalisers, like *-age* and *-ing*, neither was productive in the formation of aggregate nouns in English, and these examples are isolated cases. The suffix *-(t)ure* formed action, result and instrument nouns, primarily loans from French. The affix *-(t)ion* was used to form abstract nouns, states, and actions, primarily Latinate loans. Neither pattern is productive in Present-Day English.

5.2 French derivational patterns

The English data set was compared to French aggregate-mass Ns, in light of the strong diachronic influence of French on the English derivations. While French seems to lack specialised aggregate processes comparable to English *-ware/-wear*, aggregates are productively derived through nominalisation suffixes similar to those found in English, most notably *-age, -erie,* and *-ail(le)* (the latter frequently adding a somewhat evaluative or derogatory sense).[12]

(20) -age
carrelage 'tiling', *câblage* 'cabling', *dallage* 'paving', *outillage* 'tools', *appareillage* 'instruments'

(21) -erie
argenterie 'silverware', *literie* 'bedding', *pâtisserie* 'baked goods', *voirie* 'roads', *papèterie* 'stationery', *verroterie* 'glassware', *quincaillerie* 'hardware/ironmongery'

(22) -ail(le)
ferraille 'iron-ware', *boustifaille* 'food', *muraille* 'fortifications',

12. On the connection between collective and evaluative morphology cross-linguistically, see Franco et al. (2019) and references therein.

These French nominalisation patterns show a semantic cluster similar to that noted above for English suffixes. The main senses associated with the French suffix *-age* alongside various types of groupings are activity (*lavage* 'washing'), result (*construction* 'building'), instrument (*emballage* 'wrapping'), and location (*garage* 'garage'). French *-age* is primarily studied in the context of event nominalisation, contrasted with other French nominalisation suffixes, *-ion*, *-ment*, *-ée* (cf. Ferret & Villoing, 2015 and references therein), without specific discussion of aggregates or groupings.

The suffix *-erie* attaches to nouns, adjectives, or verbs, and forms nouns denoting manner (*pruderie* 'prudery', *moquerie* 'mockery'), objects with the noted characteristic (frequent, emotional, or pejorative value), repetitive action (*tousserie* 'repeated coughing'), and professional activity/function, location or result, these mostly with a verbal base (*epicerie* 'grocery/groceries', *miroiterie* 'mirror making', *cavalerie* 'cavalry', *librairie* 'book shop/bookselling') (see work by Temple, e.g. 1996). Aggregate-mass reference is primarily related to the latter set of meanings. That set is also strongly associated with the agentive suffixes *-ier* and *-eur*.

The suffix *-aille* attaches mainly to nouns (although verbs and adjectives are also possible), forming nouns primarily denoting groupings (neutral or pejorative), but also activity (*trouvaille* 'find'), instrument (*cisaille* 'shears'), or result (*grisaille* 'monochrome, greyness'). In a study of groupings formed with *-aille, -ade, -aie,* and *-ure,* Aliquot-Suengas (2003) concludes that each derivation procedure is associated with different properties in the derived groupings. The suffix *-aille* is the only one of the set that produces aggregate-mass terms, while the others produce structured groupings (collective in Joosten's terms).

5.3 Hebrew derivational patterns

Hebrew aggregates were examined to provide a data set of unrelated morphology and diachronic development. The literature on Hebrew word formation, rich in morphological and phonological studies, analyses of innovations and productivity, and studies of diachrony and psycholinguistics, provides little to no discussion of collective and aggregate formation.[13] The analysis below is primarily based on examination of attested data, and the noun lists in Avineri (1976), Barkali (2000) and Bolozky & Becker (2006).

13. In this context, I do not address the tendency to convert some classically aggregate-mass nouns into count plurals in Modern Hebrew (e.g. *nešek* 'weaponry' vs. *nešakim* 'weapons', *rexev* 'vehicle[mass]' vs. *rexavim* 'cars', *ciyud* 'equipment' vs. *ciyudim* 'equipment.pl'); see Cohen (2006), who notes that changes from mass to count and back are attested throughout the history of Hebrew.

Hebrew word formation is largely based on non-concatenative morphology wherein a consonantal root (a non-linearised morpheme, prototypically tripartite) is inserted into a template which determines the vocalic structure, surface syllabic structure, and stress pattern. The numbers of patterns found in the literature varies greatly depending on research perspective. Schwarzwald & Cohen-Gross (2000) list some 30 productive nominal templates in Modern Hebrew. Nominal templates are not uniquely associated with particular senses, although there are some limited tendencies. The insertion of a root into a range of templates produces a range of lexical items that are (often loosely) semantically related. The discontinuous root itself is abstract and never appears in isolation, nor can any semantic content be established without examination of the associated words (for more details on Hebrew word formation and structure, see Goldenberg, 1994; Coffin & Bolozky, 2005; Arad, 2006; Bolozky, 2007; Schwarzwald, 2002, 2009; Schwarzwald & Cohen-Gross, 2000; Shatil, 2006; a.o.). The template representation used below marks the positions reserved for the root consonants as uppercase Cs and the template structure in lowercase. The sequence of Cs in the representation matches the sequence of elements in the root, for the prototypical so-called "full" three-consonant roots, such that the first element of the root goes into the first C position in the pattern, and so on. Other types of root induce morpho-phonological changes in the resultant form.

Two patterns in Modern Hebrew stand out in the systematic formation of aggregates: CiCuC (23) and tiCCoCet (24), although neither pattern is dedicated to this function.

(23) CiCuC
ipur 'makeup', *bigud* 'clothing', *kibud* 'refreshments', *ciyud* 'equipment', *rihut* 'furniture', *ricuf* 'tiling', *šilut* 'signage'

(24) tiCCoCet
tixtovet 'correspondence', *tispoket* 'supply', *taxmošet* 'ammunition'

CiCuC is the default action noun template associated with the verbal template *binyan pi'el*, and one of the most productive nominal templates in Modern Hebrew. Its primary function is the formation of action nouns (*dibur* 'speaking, speech', *likuk* 'licking', *nihul* 'management', *irgun* 'organisation'), but nouns with a wide range of senses are also derived through this pattern. Most groupings formed in this template are count nouns referring to structured collectives rather than to aggregates (*icbuv* 'innervation'). The tiCCoCet template is not eventive, but primarily used for the formation of groupings, whether aggregate or structured collectives (*tilbošet* 'outfit', *tizmoret* 'orchestra', *taxposet* 'costume').

Another set of patterns should be mentioned here, for contrastive purposes. Bolozky's (2007) survey of morphological productivity identifies three derivational patterns, suffixes rather than templates in this case, that are productive in

the formation of collectives (shown with his symbols and examples): *N+on* (*še'elon* 'questionnaire'), *N+ia* (*taklitia* 'record collection', and N+*iyada* (*xatuliyada* 'group of cats'). The properties of nouns in these patterns indicate these are not aggregates. They show count syntax, refer to an entity that is more than the sum of its parts, and do not enable linguistic access to subcomponents. Thus, these suffixes produce structured groupings (Joosten's collectives) rather than aggregate-mass. Interestingly, the latter two patterns are frequently used to form location nouns as well.

6. Discussion

The derivational patterns highlighted above are responsible for a large number of aggregates in the languages discussed. The patterns mentioned fall broadly into two groups, patterns dedicated to the formation of groupings and multiplicities (Eng. *-ware, -wear;* Heb. tiCCoCet), and patterns associated with event nominalisation (Eng. *-ing, -age, -(e)ry*; Fr. *-age, -erie*; Heb. CiCuC), with *-ail(le)* falling between the two. There is, of course, a certain degree of lexical idiosyncrasy with aggregate-mass nouns, and some items in this category do require special lexical specification. Not all aggregates are formed through regular derivation patterns, and many of these patterns are not exclusively dedicated to aggregates. We cannot predict whether a language will have a count or non-count term for an entity; nor can we predict a speaker's choice, if the lexicon supplies multiple options for the same/related referents (e.g. the classic *footwear* vs. *shoes*). However, even incomplete, the regularity and productivity of aggregate derivation is suggestive and cannot be accounted for by an approach based solely on idiosyncrasy.

The productivity of aggregate derivation would seem to indicate that the hybrid properties associated with aggregate-mass have a useful function for speakers. The pragmatic, communicative function has been raised in the literature, specifically observing the backgrounding of subcomponents as irrelevant in the context of use. Moltmann (1997, pp. 21–22, 86) argues that the conceptual meaning of a noun is influenced by the relevance of information in given communicative situations, noting that the speaker must choose the description that best conveys the part-structure they intend to communicate in a particular situation. Reid (1991) and Joosten (2010) argue that aggregates are employed when speakers are not interested in the individual "atoms" composing the aggregate. Following Reid, Joosten (2010, p. 42–3) notes that the lower conceptual salience of the individual subcomponents of aggregates is deliberate and responds to a communicative need. Reid (1991, p. 71) argues that the communicative value of aggregates lies

in the fact that they allow objects with cognitively salient boundaries to be spoken of in a highly imprecise way, divorced from their specific and idiosyncratic functions. One speaks of buying and selling furniture, storing furniture in the attic, or furniture of a particular historical style. The functional identity of these objects is being suppressed here because it is not relevant to the particular messages being conveyed.

To illustrate, reference to *makeup* allows for a more general and vague statement than reference to specific items (lipstick, eyeliner, mascara and so on). A request to *put your shoes on the rack* would bring a different situation to mind than the request to *put your footwear on the rack*. The first brings to mind a more specific, more intimate situation, probably involving a small number (most likely a single pair) of shoes. The use of *footwear* in the second is more appropriate in different contexts where the relevant items are less specific, perhaps a more public setting with multiple participants, or a general instruction not limited to the time of speech (a sign in a gym locker room, for example). The backgrounding of subcomponents allows the speaker to abstract away from details in a specific context, and to abstract away from specific contexts to a more general statement.

It is significant, in this context, to note that a great many aggregates originate from or are primarily used in the domains of commerce, business, manufacture, administration, and science,[14] where non-individuating contexts are more likely (this is also true of many of the natural-kind animate collectives).

Interestingly, many of the active derivation patterns found in the languages examined are associated with event nominalisation. The literature on nominalisations of this type focuses on the argument structure associated with argument-taking process readings, assigning them complex structures and deriving them syntactically, while the referential nominals (cf. Grimshaw, 1990, a.o) are assumed to have a simpler structure and be derived in the lexicon. There are many analyses of event nominals in the literature, but very little on referential nominals produced by the same derivations, particularly on those nominals derived of a non-verbal input.

Argument-taking event nominals prototypically show mass syntax (Grimshaw, 1990), while the "referential" (result) set allows pluralisation. This parameter is not absolute, as shown by several studies (Alexiadou et al., 2010, 2011; Ferret et al., 2010; Roy & Soare, 2010; Knittel, 2011; a.o.). These analyses correlate the properties of event nominals, particularly their prototypical mass syntax, with a

14. This aspect is in line with Mihatsch's statement (2007, p. 361) that many superordinate terms in many languages originate in scientific terminology.

range of properties—aspect, atelicity, habituality, pluractionality, intentionality, agentivity, causality, transitivity—some of which are inherited from the original verb, remaining present in the nominal structure, while others are introduced by the nominalisation process/suffix.

While aggregate-mass nouns are not argument-taking nominals, their systematic derivation from the same processes (as well as the shared unboundedness and mass properties) is noteworthy. It may be argued, in line with Grimm & Levin's (2011, 2012) emphasis on an *associated event* underlying the functional common denominator of component elements, that aggregate derivation processes (typically associated with event nominalisations) provide some functional eventive dimension, despite the fact that many of the aggregates examined are derived from non-verbal bases.

7. Conclusion

Semantic analyses of the mass-count distinction (notably Chierchia, 2010 and Rothstein, 2010) argue that aggregate-mass denotations must be listed in the lexicon as idiosyncratic properties. The morphological data discussed above argue against such an assumption as a blanket solution to all aggregate-mass nouns. The derivation patterns shown in English, Modern Hebrew, and French indicate that the complex denotation of aggregate-mass nouns is formed through systematic and productive derivation processes in many cases (albeit not all). More significantly, the presence of such specialised derivational processes indicates systematic intentional creation of nouns with this combination of properties, suggesting in turn that this mix of properties is not a marginal exception to the mass-count distinction, but a systematic category between the two. This conclusion is supported by the unique communicative function of these nouns noted in the literature (Reid, 1991, Joosten, 2010), namely reference to a multiplicity of objects with conceptual and communicative emphasis on common functionality and the communicative backgrounding of individual members.

Systematic analysis of aggregates, taking into account their morphological patterns, their syntactico-semantic properties, and their pragmatic function, could thus contribute to our understanding of this category. Similar morphological derivation patterns producing aggregate-mass nouns are known to exist across languages (e.g., De Belder, 2013 on Dutch, Franco et al., 2019 on Italian, Grimm & Dočekal, (In press) on Czech; Mihatch, 2015 for a cross-linguistic survey of forms). Examination of the cluster of senses associated with these derivation patterns (event nominalisation in particular), from the perspective of aggregate

reference may also be of interest. Such correlation could be due to the role of functionality and events in the conceptualisation of artifacts (Levin et al., 2019, a.o.). Finally, we need to examine the use of aggregate-mass nouns in discourse, taking contextual factors into account, to better understand the associated communicative function.

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A comparison of abstract and concrete mass nouns in terms of their interaction with quantificational determiners

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In this paper, I compare concrete mass nouns such as *water* with abstract mass nouns derived from gradable adjectives like *generosity* in terms of their interaction with quantificational determiners. The main focus is on vague quantifiers such as *a lot* and *little*, on the one hand, and specificity markers such as *a certain*, on the other. In both cases the crucial factor setting the abstract mass nouns apart from the concrete ones is that the latter make available only a quantity/cardinality related scale for measurement and identification. The former, in contrast, give rise to an additional reading since they are associated with a second scale – namely one that orders the states denoted by the respective noun according to the degree with which they instantiate the corresponding property.

Keywords: mass nouns, gradability, states, quantification, specificity

1. Introduction

While mass nouns denoting substances (such as *rice* or *water*) and ones denoting collections of objects (such as *jewelry* or *silverware*) have received a great deal of attention in formal semantics and philosophy of language (Quine 1960; Burge 1972, 1975; Link 1983; Bunt 1985; Pelletier and Schubert 1989; Gillon 1992, Chierchia 1998a, 2010; Barner and Snedeker 2005, Rothstein 2010, 2017; Landman 2011, among many others), there is relatively little detailed research in those disciplines that is concerned with mass nouns that are derived from adjectives or stative verbs denoting gradable properties such as *beauty, intelligence, generosity* or *understanding* (but see Moltmann 2004, 2009, 2013; Nicolas 2010; Yi ms.; Grimm 2014; Koontz-Garboden & Francez 2017; Zamparelli, this volume). In this paper I compare the two types of mass nouns in terms of the way they interact with various quantificational determiners, focusing on vague quantifiers such as *a lot, much*

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and (*a*) *little*, on the one hand, and specificity markers such as *a certain*, on the other. I show that in both cases the crucial factor setting the abstract mass nouns apart from the concrete ones is that the former, but not the latter, make available an additional dimension for measurement and identification – namely the intensity with which the respective property is instantiated in an individual. In the case of quantificational determiners such as *a lot* combining with abstract mass nouns, this has the following consequence: The initially underspecified measure functions denoted by the quantificational determiners can be either set in such a way that they map the relevant entities to cardinalities/quantities, or in such a way that they map those entities to values on a scale which can be construed on the basis of forming equivalence classes of the property instantiations under consideration. In the case of those determiners combining with concrete mass nouns, in contrast, only the former option is available.

Concerning specificity markers such as *a certain*, the identifiability (by the speaker) requirement they impose in the case of both concrete and abstract mass nouns (in contrast to count nouns) can only be met by shifting to a sub-kind reading. Crucially, however, sub-kinds can be identified on the basis of the points occupied by the respective property instantiations on the relevant intensity-related scales (cf. Tovena 2001, Anderson and Morzycki 2015), while no parallel mechanism is available for the entities denoted by concrete mass nouns, i.e. their sub-kinds cannot be identified in relation to the respective cardinality-/quantity-scales, but only on the basis of some quality of the respective substance. Consequently, specificity markers give rise to degree-readings when they are combined with abstract mass nouns, while in combination with concrete mass nouns they only give rise to quality-related sub-kind readings. Finally, I show how the analysis argued for in this paper in combination with independently motivated pragmatic principles accounts for the characteristic hedging flavor that sentences with noun phrases combining specificity markers and abstract mass nouns receive, building on a proposal in Hinterwimmer and Umbach (2015).

The paper is structured as follows: In Section 2 I present the data to be accounted for. In Section 3 I give a detailed account of the two readings that quantificational determiners such as *a lot* and (*a*) *little* give rise to when they are combined with abstract mass nouns (cf. Moltmann 1997). Section 4.1 gives some background concerning the interpretation of the specificity marker *a certain* (and its relatives in German and French), building on Ebert, Ebert and Hinterwimmer 2012 and Hinterwimmer and Umbach (2015), and in Section 4.2 I present my analysis of the way this specificity marker interacts with concrete and abstract mass nouns. Section 5 is the conclusion.

2. Data to be accounted for

2.1 Vague quantificational determiners

Consider the following examples:

(1) a. Yesterday evening, I ate a lot of meat/bought a lot of jewelry.
b. During my holiday, I ate a lot of meat/bought a lot of jewelry.

(2) a. Yesterday evening, I drank little wine/bought little jewelry.
b. During my holiday, I drank little wine/bought little jewelry.

(3) During my stay in France, I experienced a lot of generosity/understanding of my problems.

(4) a. I found little beauty in the villages that I visited during my holidays in Bavaria.
b. I find little beauty in this picture.

What is asserted in all the sentences in (1) and (2) is that the speaker consumed an amount of the relevant substance or bought a number of objects contained in a collection of the right kind that was either higher (in the case of *a lot*) or lower (in the case of *little*) than what had been expected in the contexts where the sentences are uttered. In the examples in (1a) and (2a), it is presumably (though not necessarily, of course) a single event which resulted in the respective amount of substance being consumed/the respective number of objects being bought. In the case of (1b) and (2b), in contrast, there are presumably (though not necessarily) several events such that the relevant amount/number is reached just by the mereological sum of the amount of the relevant substance consumed/number of objects bought on each event.

The difference between these cases is only indirectly relevant, though: what counts as *a lot* or *little* is presumably relative to the length of the respective time interval or the number of events. It need not be the case that the amount of the relevant substance that was consumed/the number of objects that was bought on each occasion is considered *a lot* or *little* with respect to that occasion. That is to say, concerning (1b), for example, it might even be that on each single occasion a rather small amount of meat was eaten/a small number of pieces of jewelry was bought, but that there were more such events than expected. In such cases, too, an unexpectedly large overall amount of meat was eaten/an unexpectedly large number of pieces of jewelry was bought during the time interval under consideration.

Concerning the examples in (3) and (4), both *a lot* and *little* can be interpreted in two different ways, and each of the sentences is accordingly ambiguous between two different readings. The sentences in (3), for example, both allow for a reading

on which what is said to be high with respect to some standard or to exceed expectations is the intensity of the generosity/understanding that the speaker experienced. On this reading, the sentences thus basically mean the same as *During my stay in France, somebody treated me very generously/understood my problems very well* (cf. Moltmann 1997; Nicolas 2010; Yi ms.). On the second reading what is said to be high/exceed expectations is not the intensity of one or several persons' generous behavior/understanding of the speaker's problems. Rather, it is the number of occasions on which the speaker experienced generosity/understanding. Crucially, for the sentences to be true it need not be the case that on each of the relevant occasions the speaker experienced a high degree of generosity/understanding for her problems. It might just have been a standard degree of generosity/understanding for her problems (i.e. a kind of behaviour that qualifies as an instance of generosity/understanding for the speaker's problems, but is not remarkable within the respective class), as long as there were enough such occasions.

The sentence in (4a) is likewise two-ways ambiguous between a reading on which it can be paraphrased as *I do not consider the villages that I visited during my holidays in Bavaria to be very beautiful* and a reading on which the speaker found fewer of the villages that she visited beautiful than she had expected – although some of them might have been exceptionally beautiful (cf. Moltmann 1997). On this second reading it is again the number of events on which a village met the speaker's standards for beauty that is relevant, not the question of how low each of the respective villages is to be placed on the scale associated with beauty (according to the speaker's standards).

Finally, the sentence in (4b) is two-ways ambiguous in a slightly different, but clearly related way. The first reading is fully parallel to one of the readings that the sentences in (3) and (4a) receive and can be paraphrased as *I do not consider this picture very beautiful*. On the second reading (which might be a bit harder to get in the absence of a supporting context), the picture under consideration is seen as a collection of smaller parts, and what the speaker asserts is that she considers fewer of these parts beautiful than she had expected.[1] Assuming that the picture depicts a landscape, for instance, it might be that the speaker considers some parts of this landscape to be exceptionally beautiful – the tree on the left, say, and the little hill on the right – while she thinks that the other parts are unremarkable. On this second reading, it is not a multiplicity of temporally distributed events that intuitively provides the domain of quantification (as in (3) and (4a) on one of the two available

1. I am grateful to an anonymous reviewer for pointing out the existence of this reading to me and making me aware of the connection to the work of Lucas Champollion (2015, 2017), who discusses the similarity of space and time in connection to atelicity and the distribution of *for*-phrases (see also Moltmann 1997).

readings), but rather a single state that can be decomposed into smaller states on the basis of their spatial location (see Champollion 2015, 2017 for extensive discussion of the similarity of space and time with respect to event quantification).

In this section, we have seen that vague quantificational determiners such as *a lot* and *little* allow for just one, purely quantitative reading when they combine with concrete mass nouns, while they (in principle) allow for two readings when they combine with abstract mass nouns: one on which the number of instantiations of the property denoted by the adjective/stative verb from which the respective noun is derived is relevant, and a second one on which one (or more) such instantiations are located on a scale according to the intensity with which they instantiate the respective property.

2.2 Specificity markers

Consider the following examples:

(5) a. Mary always drinks (a certain) wine for dinner.
b. I find (a certain) beauty in this picture.

(6) a. Mary went to every Asian market in town just to get (a certain) rice.
b. She moved with (a certain) grace.

Adding *a certain* to the respective mass noun has a different effect in sentences with concrete and ones with abstract mass nouns: In the case of concrete mass nouns a sub-kind interpretation is triggered, making the resulting statement more specific than the one with the bare noun, i.e. in the variant of (5a) with *a certain* a(n instance of a) particular kind of wine is required on each relevant occasion to make the sentence true, while in the variant with the bare noun any wine would do, and likewise for (6a). In the case of (5b) and (6b), in contrast, *a certain* makes the resulting statement weaker: In the variant of (5b) with *a certain*, the speaker is intuitively understood to make a slightly less positive claim about the relevant picture than in the variant with the bare noun, and likewise for (6b), where in the variant with *a certain* a lower degree of grace seems to be sufficient in order for the sentence to be true than in the variant with the bare noun. Note that there is no comparable effect in the sentences with concrete mass nouns: It is not the case that any decrease in the quantity of wine or rice under consideration is evoked by using the variant with *a certain* in contrast to the one with the bare noun. At the same time, at least at first glance, no kind-sub-kind relation seems to be involved between the variants with and the ones without *a certain* in the sentences with abstract mass nouns (but see Section 4.2 below).

As far as the interaction with *a certain* is concerned, the difference between concrete and abstract mass nouns thus seems to be even more extreme than in the cases discussed in the last section: In those cases, sentences with abstract mass

nouns just had an additional reading, while in the cases with *a certain* the sentences with abstract mass nouns seem to be interpreted in an entirely different way. As we will see in Section 4.2, however, there is a way to give a unified account of the two cases in terms of sub-kind readings being triggered by the combination of a specificity marker and a mass noun, with the differences stemming from the same fact that is also at play in the cases discussed in the last section: that abstract mass nouns, which are derived from adjectives or stative verbs denoting gradable properties, make available an additional, not quantity- or cardinality-related, but purely qualitative scale for measurement and identification.

3. Vague quantificational determiners and abstract mass nouns: The analysis

3.1 Background: Gradable adjectives and the nouns derived from them

Moltmann (2004, 2009, 2013) and Nicolas (2010) assume that abstract mass nouns derived from adjectives denoting gradable properties denote (sets of) tropes, i.e. concrete, spatially and temporally located instantiations of properties in individuals (Moltmann 2009, 2013 furthermore assumes the same denotation for the adjectives from which they are derived). Anderson and Morzycki (2015) assume that Davidsonian states, which are conceived in the same way as the more familiar Davidsonian events, i.e. as temporally and spatially located particulars (see Parsons 1990 and Landman 2000 for justification of this assumption), do basically the same job as tropes. At the present (rather coarse-grained) level of understanding of the two concepts, the choice in my view is mainly a terminological one (but see Moltmann 2015 for a different view).[2] Since most linguists are more familiar with Davidsonian states, which have also been invoked to account for many

2. One of the crucial arguments of Moltmann (2015) against the identification of states and tropes rests on the assumption that 'state-referring terms generally involve gerunds, as in *Socrates' being wise* or *the state of Socrates being wise*' (Moltmann 2015: 839). She then observes that these terms behave differently from adjective nominalizations in crucial respects and concludes that only the latter refer to tropes and that states and tropes are different. I do not find this argument convincing since terms such as *Socrates' being wise* or *the pillow's being soft* are not only more complex, but also sound far less natural and are certainly used far less often than the corresponding NPs based on adjective nominalizations, i.e. *Socrates' wisdom* and *the softness of the pillow*. It might thus well be that the differences in behavior can be derived from a complexity-based pragmatic account (see also Zamparelli, this volume): Since there is a canonical expression that can be used to refer to some entity, by using a less frequent and more complex one to refer to that entity the speaker signals automatically (or is at least

phenomena which are entirely unrelated to our concerns in this paper, I will follow Anderson and Morzycki (2015) in assuming that adjectives denote Davidsonian states, and I will assume that the abstract mass nouns derived from them have (basically; see below) the same denotation.[3] As far as I can see, nothing really hinges on that choice, i.e. replacing Davidsonian states by tropes would not change anything of importance that I want to say in this paper.

Let us thus assume that adjectives such as *generous* or *beautiful* have the denotations given in (7a) and (7b), respectively. In the sentences in (8a) and (8b), after the respective adjective has been combined with the (denotation of the) subject DP, the state-argument of the adjective is existentially quantified over (I make the simplifying assumption that the copula just denotes the identity function). The proposition in (8a), for example, thus yields the value *true* if the world it is applied to contains a state of John being generous.

(7) a. $[\![\text{generous}]\!] = \lambda x.\ \lambda s.\ \lambda w.\ \text{generous}(s, x) \wedge \text{loc}(w, s)$.
b. $[\![\text{beautiful}]\!] = \lambda x.\ \lambda s.\ \lambda w.\ \text{beautiful}(s, x) \wedge \text{loc}(w, s)$,
where *s* is a variable ranging over states, *w* is a variable ranging over possible worlds and *loc*(*w, s*) means that *w* contains *s*.

(8) a. $[\![\text{John is generous}]\!] = \lambda w.\ \exists s[\text{generous}(s, \text{john}) \wedge \text{loc}(w, s)]$.
b. $[\![\text{Mary is beautiful}]\!] = \lambda w.\ \exists s[\text{beautiful}(s, \text{mary}) \wedge \text{loc}(w, s)]$.

The reader will surely have noticed that so far I have said nothing about the fact that both adjectives in (7a–b) and (8a–b) are gradable, which is evidenced by the fact that they can be combined with comparative morphemes, as in *Susan is more generous than John* and *Mary is more beautiful than Peter*. At least in the case of adjectives, gradability has often been taken as an indication that a degree-argument is required, which is either targeted by a comparative or superlative morpheme or a modifier such as *very,* or in the absence of any such modifiers, saturated by a covert *pos*(itive) morpheme which introduces a (contextually fixed) standard degree (von Stechow 1984, Kennedy 1999, 2007, among many others). In the latter case, the degree to which the (denotation of the) subject argument satisfies the respective predicate has to be at least as high as the contextually fixed standard, i.e. in order for a sentence such as the one in (8a) to be true on that

automatically assumed to do so by the hearer) that she wants to convey something different from or going beyond the original meaning.

3. For reasons of space (and to avoid complications that are unnecessary for the main points I wish to make), I will restrict my attention to adjectives in the remainder of this paper, but I assume that basically the same analysis as the one outlined in this section applies to stative verbs denoting gradable properties such as *understand* and the nouns derived from them.

analysis, the degree to which John is generous would have to be at least as high as the contextually fixed standard.

Crucially, however, Kennedy and McNally (2005) and Kennedy (2007) argue for the existence of a class of gradable predicates which are not context-sensitive: Ones that are associated with a scale that has a lower bound such as *wet* (something is wet as soon as there is a drop of water on its surface) and ones that are associated with a scale that has an upper bound such as *full* (gradable predicates such as *tall* and *expensive* are assumed to have neither lower nor upper bounds). While adjectives such as *generous* and verbs such as *understand* surely are not associated with scales that have upper bounds (there is no such thing as the maximal degree of generosity or understanding), the standard test for the identification of gradable predicates that are associated with lower bounded scales (henceforth: minimal gradable predicates) reveals that they pattern with minimal predicates such as *wet* and *open*, not with context-sensitive ones like *tall*.

(9) a. John is taller than Mary, but he is not tall.
b. ??The table is wetter than the floor, but the table is not wet.
c. ??John is more generous than Mary, but he is not generous
d. ??John understands Mary's problems better than he understands Susan's problems, but he does not understand Mary's problems.

The reason why (9a) does not sound contradictory is that any two entities that have a vertical extension can be ordered with respect to tallness, but that only entities that (at least) satisfy some contextually fixed standard count as *tall*. In order to satisfy the (predicate denoted by the unmodified form of the) adjective *wet*, in contrast, all that is required is to be wet to the minimal degree (i. e. to have at least a drop of water on the surface). It is thus not possible for an entity to be wetter than another entity without being wet at the same time. For that reason, (9b) sounds contradictory. Since (9c) and (9d) pattern with (9b), not with (9a), we have to conclude that they denote minimal gradable predicates, i.e. ones that are associated with a lower bound (although this bound is surely not as straightforward to identify as in the case of *wet* or *open*).

Kennedy and McNally (2005) and Kennedy (2007) assume that both relative and minimal (and maximal, i.e. ones associated with an upper bounded scale) gradable adjectives come with degree arguments which are saturated by a covert pos-morpheme if the adjective occurs in unmodified form, but that a principle of interpretative economy forces the standard introduced by that morpheme to be set to the minimal or maximal degree on the respective scale, if such a value is available (otherwise, the standard has to be fixed by the context). There is a simpler alternative, though, which is better suited for our purposes: Let us follow Anderson and Morzycki's (2015) adaptation of Rett's (2014) assumption that just

in cases where the resulting denotation would otherwise be trivial (i.e. in cases of unmodified forms of gradable predicates with no lower bounds), the adjective denotation is intersected with the denotation of a covert evaluation morpheme EVAL, which (simplifying considerably) is a predicate satisfied by all states that exceed the contextually fixed standard. The contextually fixed standard corresponds to a particular equivalence class of states, i.e. a set of states that are indistinguishable in terms of the intensity with which they instantiate the respective property, where equivalence classes of states are ordered with respect to each other according to the intensity with which they instantiate the respective property (cf. Moltmann 2009, 2013 for an account of degrees in terms of equivalence classes of tropes and Moltmann 2015 for an argument that degrees cannot be derived from equivalence classes of states).[4] For a state to exceed the standard thus means to belong to an equivalence class of states that is ordered higher than the equivalence class corresponding to the standard (see Cresswell 1977 and Bale 2008 for detailed discussion of how degrees can be reconstructed in terms of equivalence classes).

Now, since in the case of minimal gradable predicates, where there is no threat of a trivial denotation (since the states satisfying the respective predicates are known to satisfy them at least to the minimal degree on the associated scale, i.e. either belong to the corresponding equivalence class or one that is ordered higher), intersection with (the denotation of) EVAL is superfluous, and we can continue with the denotations in (7) and (8).

Let us assume that turning the adjective in (7a, b) into the corresponding noun has (apart from making them available as the complements of determiners) the effect of existential quantification over their individual arguments, as shown in (10a,b):

(10) a. $[\![\text{generosity}]\!] = \lambda s.\, \lambda w.\, \exists x[\text{generous}(s, x) \wedge \text{loc}(w, s)]$.
b. $[\![\text{beauty}]\!] = \lambda s.\, \lambda w.\, \exists x[\text{beautiful}(s, x) \wedge \text{loc}(w, s)]$.

With these assumptions in place, let us now turn to the question of what happens when nouns like the ones above become the arguments of quantificational determiners such as *a lot* and *little*

3.2 The analysis

I assume that the vague quantificational determiners *a lot* (and its relatives in other languages), which applies both to mass nouns and plural count nouns, maps some (singular or plural) entity via some salient measure function to a value that counts

4. See footnote 2 for a short discussion of (one of) Moltmann's arguments against equating states and tropes.

as high in the context where the respective sentence is uttered (cf. Nicolas 2010 for a similar assumption). Concerning *little*, things are a bit more complicated: While in the default case, a sentence such as *Mary drank little wine yesterday evening* is automatically understood as conveying that Mary drank an amount of wine that was below some contextually fixed standard (this is also what was tacitly assumed in the paraphrases given in Section 2.1), a continuation like … *in fact, she drank no wine at all* does not lead to a contradiction. For that reason, I assume that what is actually asserted is just that applying the salient measure function to the respective entity does not yield a value that meets some (contextually fixed) standard. The additional assumption that the value is above zero is just implicated and thus defeasible: In cases where it is zero, it would have been more informative to convey this directly via using a negative quantifier such as *no*.

Now, in the case of concrete plural entities or concrete substances, the only salient measure functions are ones mapping the respective entities to cardinalities or quantities. States, in contrast, can be compared and ordered according to the intensity to which the respective property is instantiated in each case. Consequently, they make an additional measure function available which maps the respective state to some value on a scale which can be construed on the basis of forming equivalence classes (cf. Cresswell 1977, Bale 2008) of the states under consideration.

Lets us assume that both *a lot* and *little* take two predicates of (singular or plural) objects, which can be either individuals, events or states as arguments and returns *true* if there is an object that (a) satisfies the respective predicates and (b) is mapped by some salient measure function to a value that is either higher (in the case of *a lot*) or lower (in the case of *little*) than what is expected in the context:

(11) a. $[[\text{a lot}]]^g = \lambda P.\, \lambda Q.\, \lambda w.\, \exists x \exists e[P(x)(w) \wedge Q(x)(e) \wedge loc(w, e) \wedge g(\eta)(x) > g(n_{exp})]$,
where x is a variable ranging over (singular and plural) individuals, states and events, e is a variable ranging over eventualities, i.e. events and states, η is a variable ranging over measure functions, g is the contextually determined assignment function and $g(n_{exp})$ is a contextually determined number.

b. $[[\text{little}]]^g = \lambda P.\, \lambda Q.\, \lambda w.\, \neg\exists x \exists e[P(x)(w) \wedge Q(x)(e) \wedge loc(w, e) \wedge g(\eta)(x) \geq g(n_{exp})]$.

Combining *a lot* with the noun *generosity* thus gives us (12a), and combining *little* with the noun *beauty* gives us (12b):

(12) a. $[[\text{a lot of generosity}]]^g = \lambda Q.\, \lambda w.\, \exists s \exists e[\exists x[generous(s, x) \wedge loc(w, s)] \wedge Q(s)(e) \wedge loc(w, e) \wedge g(\eta)(s) > g(n_{exp})]$

b. $[[\text{little beauty}]]^g = \lambda Q.\, \lambda w.\, \neg\exists s \exists e[\exists x[beautiful(s, x) \wedge loc(w, s)] \wedge Q(s)(e) \wedge loc(w, e) \wedge g(\eta)(s) \geq g(n_{exp})]$

Let us now return to the Examples (3) and (4a,b) discussed in Section 2.1, repeated here as (13) and (14a,b), respectively:

(13) During my stay in France, I experienced a lot of generosity.

(14) a. I found little beauty in the villages that I visited during my holidays in Bavaria.
b. I find little beauty in this picture

Since in all cases the quantificational DPs occur in object position and can thus not be combined with the respective verbs directly, I assume that Quantifier Raising (or some equivalent mechanism) applies, which results in (15) and (16a,b) as the (simplified) initial semantic representations of the sentences in (13) and (14a,b), respectively:

(15) $\lambda w.\ \exists s \exists e[\exists x[\text{generous}(s, x) \wedge \text{loc}(w, s)] \wedge \text{experience}(e, \text{speaker}, s) \wedge \tau(e) \subseteq_{\text{temp}} \text{stay\_in\_France} \wedge \text{loc}(w, e) \wedge g(\eta)(s) > g(n_{exp})]$,
where $\tau(e)$ is the temporal trace of e and $\subseteq_{\text{temp}}$ stands for temporal inclusion.

(16) a. $\lambda w.\ \neg\exists s \exists e\ [\exists x[\text{beautiful}(s, x) \wedge \text{loc}(w, s)] \wedge \text{find}(e, \text{speaker}, s) \wedge \text{loc}(\text{villages\_in\_Bavaria}, e) \wedge \text{loc}(w, e) \wedge g(\eta)(s) \geq g(n_{exp})]$

b. $\lambda w.\ \neg\exists s \exists e[\exists x[\text{beautiful}(s, x) \wedge \text{loc}(w, s) \wedge \text{find}(e, \text{speaker}, s) \wedge \text{loc}(\text{picture}, e) \wedge \text{loc}(w, e) \wedge g(\eta)(s) \geq g(n_{exp})]$

Now, assume that (13) is uttered in a context where it is clear that there was just a single event of someone treating the speaker generously during his stay in France (by inviting him for an expensive dinner, for example), i.e. in terms of our analysis, just a single event of the speaker experiencing a state of (someone) being generous. In such a case, the most sensible measure function among those that are in principle available is one mapping the respective state to a number representing an equivalence class of states of someone being generous. This comes about as follows: since atoms are not (lexically) defined for states (see above), applying a measure function that maps entities to the number representing the cardinality of the set of atoms they consist of would not work. Since the only clearly identifiable generosity-state in the case at hand is the (temporally) maximal state of someone being generous experienced by the speaker yesterday evening, applying the measure function just mentioned to that state would yield the value 1. This, however, would make the sentence automatically false, since 1 does not count as a high number in any conceivable context. Since extensive quantity-related measure functions are not available for states (in contrast to substances and collections of objects), the only option that gives the sentence a reasonable chance of being true (which is thus the one charitable interpreters make use of) is to resolve the free

measure function variable to the intensity-related measure function mentioned above. This is shown in (17), which can be paraphrased as follows: During his stay in France, the speaker experienced a state of someone being generous that instantiates the property of being generous more intensely than what was expected in the context where the sentence is uttered.

(17) $\lambda w.\ \exists s \exists e[\exists x[\text{generous}(s, x) \wedge \text{loc}(w, s)] \wedge \text{experience}(e, \text{speaker}, s) \wedge \tau(e) \subseteq_{\text{temp}} \text{stay\_in\_France} \wedge \text{loc}(w, e) \wedge \eta_{\text{int}}(s) > g(n_{\text{exp}})]$

Now assume a context where it is a reasonable option that there were several events of Peter experiencing a state of someone being generous during his stay in France. Consequently, for each such event there is a (temporally) maximal state of someone being generous, and, accordingly, not only can the existentially quantified event variables in (15) be understood as standing for plural objects (namely the sum of all those events), but also the state and individual variables (namely as the corresponding sums of states of someone being generous and individuals participating in those states, respectively). This has the following consequence: A set of atoms becomes available that the state in (15) can naturally be decomposed into. Accordingly, resolving the free measure function variable to a measure function mapping entities to the number representing the cardinality of the set of atoms they consist of yields a result that gives the sentence a reasonable chance of being true. If that option is chosen, (13) is interpreted as shown in (18), which can (very roughly) be paraphrased as follows: There is a plurality of events of Peter experiencing a state of someone being generous during his stay in France, and the number of such states experienced by Peter is higher than what was expected in the context where the sentence is uttered. Consequently, the sentence on this reading can be true even in a situation where none of the states experienced by Peter counts as an intense instantiation of the property of being generous.

(18) $\lambda w.\ \exists s \exists e[\exists x[\text{generous}(s, x) \wedge \text{loc}(w, s)] \wedge \text{experience}(e, \text{speaker}, s) \wedge \tau(e) \subseteq_{\text{temp}} \text{stay\_in\_France} \wedge \text{loc}(w, e) \wedge |s| > g(n_{\text{exp}})]$

Concerning (14a), the same reasoning as the one just outlined applies. On the first reading, the free measure function variable in the initial semantic representation in (16a) is accordingly resolved to the intensity-related measure function. Because of the natural availability of a plurality of states (of something being beautiful), resolving the free measure function variable to the cardinality-related measure function is an option as well, giving rise to a second reading. Crucially, on this reading the sentence can even be true in a situation where some of the states of something being beautiful count as intense instantiations of the property of being beautiful, as long as the overall amount of such states is low enough.

Let us finally turn to (14b). The first reading, on which the free measure function variable in the initial semantic representation in (16b) is again resolved to the intensity-related measure function, is entirely parallel to the respective readings of (13) and (14a). The second reading is also parallel to the respective readings of (13) and (14a) insofar as the free measure function variable is resolved to a measure function mapping states to the number of atoms they can be decomposed into. There is a crucial difference, though: In the case of (13) and (14a) the respective state could naturally be decomposed into a set of temporally distributed states. This is impossible in the case of (14b), for obvious reasons. What is possible, though, is to decompose the state of the picture being beautiful into a set of spatially distributed sub-states each of which contains a relevant part of the scene depicted (cf. the discussion of the similarity of space and time with respect to event quantification in Moltmann 1997 and Champollion 2015, 2017). On the resulting reading the sentence is accordingly true if it is not the case that there is an event of the speaker finding a state *s* of the picture being beautiful such that the number of the spatially distributed sub-states of *s* meets (or exceeds) the speaker's expectations, i.e. if the speaker does not find most parts of the picture beautiful, although there might be some parts that she even considers to be exceptionally beautiful.

This concludes my account of the interaction of concrete and abstract mass nouns with vague quantificational determiners such as (*a*) *lot* and *a little*. In the following section I turn to the interpretational effects of combining specificity markers such as *a certain* with concrete and abstract mass nouns.

4. Specificity markers and mass nouns: The analysis

4.1 Background

Before we turn to an account of how specificity markers like *a certain* (and its relatives in languages like French and German) interact with concrete and abstract mass nouns, respectively, I will (very) briefly summarize the (for our current purposes) most important features of Ebert, Ebert and Hinterwimmer's (2012) (henceforth: EEH) analysis, which was developed for the German specificity marker *ein gewiss-*, but which (at least as far as the issues that are important for this paper are concerned) applies to the English and French variants *a certain* and *un certain* as well.

EEH agree with Abusch and Rooth (1997) Houghton (2000), Farkas (2002) and Jayez and Tovena (2002, 2006) that the addition of a specificity marker like *certain* to an indefinite determiner signals that the speaker is able to identify the individual introduced by the indefinite determiner in some non-trivial way (i.e.

via information that is not already entailed by the sentence containing the indefinite DP). This is captured in the following way: The speaker knows the answer to a question asking for the identity of the individual introduced by the indefinite, i.e. she can answer a question such as *Who is x*? (with *x* being the respective individual) in some informative (i.e. non-trivial) way (see Abusch & Rooth 1997 for a similar idea). Crucially, being able to identify an individual does not automatically mean knowing that individual's name, but rather being able to provide some (in the respective context) uniquely identifying description. This is formalized via Aloni's (2001, 2008) notion of *Conceptual Cover* (henceforth: *CC*), where a CC is a set of individual concepts (i.e. functions from possible worlds to individuals) that is constrained in the following way: Given a domain of individuals *D* and a set of worlds *W*, for each world of *W*, each element of *D* is identified by exactly one concept in that world. This has the consequence that different CCs whose domains are identical are different ways of conceiving of one and the same set of individuals. Being able to answer a question asking for the identity of an individual thus means being able to provide the right element of a contextually salient CC, i.e. in one context *Joanna* might be a suitable answer to the question *Who is the woman with the pink coat*?, while in another one *the woman with the pink coat* might be a suitable answer to the question *Who is Joanna*?. The second important feature of EEH's account is that based on the observation that indefinites headed by the specificity markers under consideration always take widest scope over all operators contained in the same sentence, they assume the identification requirement just sketched to be not part of the asserted content, but rather to be interpreted at the separate level where *conventional implicatures* (henceforth: CIs) in the sense of Potts (2005) such as the appositive relative clause in *I don't want Paul, a well known pickup artist, to date my daughter*, are interpreted.[5] This has the consequence that in order for the resulting proposition to be coherent, the indefinite modified by the specificity marker has to take widest scope.

Taking both ingredients together, a sentence like *Everyone of my colleagues adores a certain mathematician* can (roughly) be interpreted along the following lines: First, it is true if there is an individual *x* that is (a) a mathematician and (b) adored by everyone. At a second, separate level the information is provided that the speaker can identify (in a non-trivial way) the unique individual that is both a mathematician and adored by everyone. A lexical entry for *a certain* that is based

5. In Potts' (2005) original system, expressions that provide both at-isssue and CI-content (as assumed for *a certain* on the analysis under consideration) are not allowed. See EEH and the references cited therein for justification of the assumption that such expressions actually exist, however.

on the version of EEH's account given in Hinterwimmer and Umbach (2015), but modified for our purposes, is given in (19a), and in (19b) a (semi-)formal representation of the proposition paraphrased above is provided. Note that the bullet sign separates the proposition functioning as the at-issue content from the one functioning as a CI, i.e. as a comment on the at-issue core expressed by the respective sentence (see Potts 2005 for details).

(19) a. $[[\text{a certain}_n]]^g = \lambda P.\, \lambda Q.\, \lambda w.\, \exists x \exists e[P(x)(w) \wedge Q(x)(e)(w)] \bullet \text{know}(\text{speaker}, ?y_{g(n)}.\, y_{g(n)}(w) = \iota y.\, P(y)(w) \wedge Q(y)(e)(w))$,
where $y_{g(n)}$ is an element of the CC assigned to the free variable ranging over CCs n, $y_{g(n)}(w)$ is the result of applying the individual concept $y_{g(n)}$ to the world w and $?y_{g(n)}.\, P(y_{g(n)}(w))$ is the question asking for the individual concept in $g(n)$ that satisfies P.

b. $\lambda w.\, \exists x \exists e[\text{mathematician}(x)(w) \wedge \forall y[\text{colleague\_speaker}(y)(w) \rightarrow \text{adore}(x)(y)(e) \wedge \text{loc}(e, w)]] \bullet \text{know}(\alpha, ?y_{g(n)}.\, y_{g(n)}(w) = \iota y.\, \text{mathematician}(y)(w) \wedge \forall y[\text{colleague\_speaker}(y)(w) \rightarrow \text{adore}(x)(y)(e) \wedge \text{loc}(e, w)])$

The requirement that there must be a unique individual satisfying the two predicates P and Q in w forces the indefinite to take widest scope, as desired: If in the example above, for instance, the indefinite took scope under the universally quantified DP, such that for each colleague y there is a potentially different mathematician x that y adores, the second argument of *a certain*, which is not only interpreted on the at-issue level, but also on the CI-level, would on the CI-level contain a variable to be bound by the universally quantified DP. Assuming with Potts (2005) that binding from the at-issue level into the CI-level is not possible, the resulting representation would be ill-formed insofar as it contains a free variable in the CI-component that cannot be resolved. If, in contrast, the indefinite takes widest scope, this problem does not arise.

With these assumptions in place, let us now return to the question of how *a certain* (and its relatives) interacts with concrete and abstract mass nouns, respectively.

4.2 The analysis

Let us turn to the examples in (5) and (6) again, repeated here as (20) and (21), respectively:

(20) a. Mary always drinks (a certain) wine for dinner.
b. I find (a certain) beauty in this picture.

(21) a. Mary went to every Asian market in town just to get (a certain) rice.
b. She moved with (a certain) grace.

Recall that in the case of (20a) and (21a), the addition of *a certain* triggers a sub-kind reading making the resulting statement more specific than the variant with the bare noun. Concerning (20b) and (21b), in contrast, *a certain* makes the resulting statement intuitively weaker than the variant with the bare noun: in the variants with *a certain* less beauty/grace is required in order to make the respective sentences true than in the bare noun variants on their default interpretation.

Now, it is one of the defining characteristics of mass nouns that they cannot be combined with indefinite and cardinal determiners on their standard interpretation (see the references given in Section 1 above), i.e. in order for the resulting combination to be well-formed, a sub-kind interpretation is the only generally available option.[6] This is exactly what seems to happen in (20a) and (21a), with the added information that the speaker is able to identify the respective substance in some non-trivial way (not necessarily via naming). But what about (20b) and (21b)?

Anderson and Morcyzki (2015) argue on the basis of evidence that the same pronominal form (German *so*, for instance) is used in many languages in order to refer to manners (in combination with eventive) verbs, kinds (in combination with nouns) and degrees (in combination with gradable adjectives) that equivalence classes of states that are indistinguishable in terms of the intensity with which they instantiate the respective property just *are* (sub)kinds of states (see Tovena 2001 for a similar idea). In other words, *six feet tall*, for example, is the property counterpart of a particular sub-kind of states of being tall (which contains all possible states of being six feet tall). As we will see, this in combination with independently motivated pragmatic principles is exactly what we need to give a unified account of the examples in (20) and (21).

Let us follow Anderson and Morcyzki (2015) in applying Chierchia's (1998b) analysis of kinds (of individuals or substances) to states as well: Just as kinds of individuals are functions from possible worlds to the maximal sums of individuals or substances satisfying the relevant property in the respective world, kinds of states are functions from possible worlds to maximal sums of states satisfying the relevant property in the respective world. The bare nouns in (20a) and (20b) are thus interpreted as shown in (22a) and (22b), respectively (in Chierchia's neo-Carlsonian approach, bare plurals and mass nouns are assumed to unambiguously denote kinds).

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6. In case of some concrete mass nouns like *beer, wine* and *water*, an interpretation according to which the respective determiner quantifies over conventionally fixed quantities of the relevant substance is available as well.

(22) a. λw. ιx. wine(w, x)
b. λw. ιs. ∃x[beautiful(s, x) ∧ loc(w, s)],
where the iota-operator is assumed to return the maximal element (i.e. the one consisting of most parts) when it is applied to a set of pluralities (Link 1983).[7]

Since neither *drink* nor *find* are kind-level predicates (in contrast to predicates like (*be*) *widespread* etc.), existential quantification over realizations of the respective kind is triggered in (20a,b), i.e. over quantities of wine or states of being beautiful. The bare-noun variants of (20a,b) are thus interpreted as shown in simplified form in (23a) and (23b), respectively. Concerning (23a), I assume that quantificational adverbs such as *always* and *usually* quantify over eventualities (see Herburger 2000 and the references cited therein for discussion). Secondly, I assume that their restrictor is initially given in the form of a free variable ranging over eventuality predicates that is resolved on the basis of information structure in combination with contextual information and world knowledge, where non-focal material is preferably interpreted in the restrictor (see Beaver and Clark 2008 for details). In the case at hand, I assume the PP *for dinner* to be the only non-focal part of the sentence. Consequently, it is mapped onto the restrictor.

(23) a. λw. ∀*e* [loc(w, *e*) ∧ dinner(*e*) ∧ participant(*e*, mary) → ∃*e*′∃x[part_of (*e*, *e*′) ∧ ∩WINE(x) ∧ drink(*e*′, mary, x) ∧ loc(w′, *e*)⟧ ,
where the ∩-operator maps kinds to their realizations, i.e. to objects satisfying the predicates from which the kinds are derived, and WINE abbreviates the semantic object in (22a).
b. λw. ∃s∃*e*[loc(w, s) ∧ loc(w, *e*) ∧ ∩BEAUTY(s) ∧ find(*e*, speaker, s) ∧ loc(*e*, picture)].

Now, what about the variants of (20a,b) with *a certain*? As already said above, the presence of the indefinite determiner triggers a sub-kind interpretation of the respective noun, i.e. it is no longer interpreted as (the characteristic function of) a set of quantities/states, but rather as (the characteristic function of) a set of kinds of quantities/states (cf. Dayal 2004). Secondly, recall from above that the presence of *certain* requires the respective indefinites to take widest scope. The resulting propositions are given (in simplified form) in (24a) and (24b), respectively.

(24) a. λw. ∃k[sub_kind_of(k)(WINE)(w)∧ ∀*e* [loc(w, *e*) ∧ dinner(*e*) ∧ participant(*e*, mary) → ∃*e*′∃x[part_of(*e*, *e*′) ∧ ∩k(x) ∧ drink(*e*′, mary, x) ∧ loc(w′, *e*)⟧] • know(speaker, ?$y_{g(n)}$. $y_{g(n)}$(w) = ιk. sub_kind_of(k)

7. When it is applied to a set of atoms, the result is only well-formed if the set is a singleton (since the only member of a set is trivially the maximal one).

(WINE)(w) ∧ ∀*e* [loc(w, *e*) ∧ dinner(*e*) ∧ participant(*e*, mary) → ∃*e*′∃x[part_of(*e*, *e*′) ∧ ∩k(x) ∧ drink(*e*′, mary, x) ∧ loc(w′, *e*)]] .

b. λw. ∃k[sub_kind_of(k)(BEAUTY)(w) ∧ ∃s∃*e*[loc(w, s) ∧ loc(w, *e*) ∧ ∩k(s) ∧ find(*e*, speaker, s) ∧ loc(*e*, picture)]] • know(speaker, ?$y_{g(n)}$. $y_{g(n)}$(w) = ιk.sub_kind_of(k)(BEAUTY)(w) ∧ ∃s∃*e*[loc(w, s) ∧ loc(w, *e*) ∧ ∩k(s) ∧ find(*e*, speaker, s) ∧ loc(*e*, picture)].

According to (24a), the variant of (20a) with *a certain* is true if there is a kind of wine such that whenever Mary has dinner she drinks a quantity of this wine. Additionally, the information is provided that the speaker can identify the kind of wine under discussion in some (non-trivial) way. This seems to be adequate. According to (24b), the variant of (20b) with *a certain* is true if there is a kind of beauty such that the speaker finds an instance of this kind of beauty in the picture under consideration. Additionally, the information is provided that the speaker can identify the kind of beauty under discussion in some (non-trivial) way.

Now, recall that in the second case the relevant sub-kind corresponds to an equivalence class of states that are indistinguishable in terms of the intensity with which they instantiate the property of being beautiful. So far, so good. But what about the weakening effect mentioned above, i.e. the strong intuition that in order for the variant of (20b) with *a certain* to be true a lower degree of beauty is required in order to make the sentence true than in the variant with the bare noun? I assume that this comes about as follows: note that a realization of the kind (of states) BEAUTY is by default taken to involve a "standard", non-remarkable degree of beauty, i.e. to belong to an equivalence class of states that is placed neither particularly high nor particularly low on the corresponding intensity-scale. This is evidenced by the fact that both (25a) and (25b) sound completely natural and unremarkable: concerning (25a), the use of *but* signals that the picture's being beautiful to a low degree contradicts an implicature of the first conjunct (namely that it is beautiful to a "standard" degree). Concerning (25b), the use of *even* signals that in the context of the first sentence the picture's being very beautiful is the least likely among the available alternatives.

(25) a. There is beauty in this picture, but just a little bit of beauty.
b. There is beauty in this picture. There even is a lot of beauty in this picture.

Because of this default interpretation of the bare noun (in contexts where existential quantification over realizations of the kind it denotes is triggered), the use of *a certain* thus triggers the implicature that the position of the sub-kind introduced by the existential quantifier on the relevant intensity-scale is lower than the standard (cf. Tovena 2001, Jayez and Tovena 2002, 2006 and Hinterwimmer and

Umbach 2015 for related ideas). If it was above the standard, it would have been more informative to use the bare noun – at least if it was not considerably higher than the standard: in that case, a determiner such as *a lot* would have been the obvious choice. At the same time, if the degree was considerably lower than the standard, the determiner (*a*) *little* would have been a natural choice. Our analysis thus predicts that the use of *a certain* in combination with an abstract mass noun implicates that the speaker knows that the respective (sub-)kind of states occupies a position on the respective intensity scale that is a little, but not dramatically below the standard. This seems to be in accordance with intuitions.

Finally, recall that just like in the case of individuals or sub-kinds of substances, being able to identify the respective sub-kind of states with respect to a conceptual cover does not mean being able to identify it by naming. Certainly, with respect to sub-kinds corresponding to states, this would be an absurd requirement anyway. Rather, any contextually appropriate, non-trivial indirect description (given that with respect to the abstract properties under consideration, we have no "names" for sub-kinds such as *six feet*) will be perfect.

5. Conclusion

In this paper, we have seen that there are differences between concrete and abstract mass nouns derived from adjectives or stative verbs denoting gradable properties as far as their interaction with various quantificational determiners are concerned. We have concentrated on vague quantifiers such as *a lot* and *little* and specificity markers such as *a certain*. In the first case, an additional reading is available for DPs with abstract mass nouns because they are related to an intensity-related scale as part of their meaning, while this is not the case for concrete mass nouns. Concerning *a certain*, in contrast, the combination with a mass noun in both cases gives rise to a sub-kind interpretation of the respective noun, with the differences between the two kinds of mass nouns being due to differences in how sub-kinds are identified. The fact that in the case of abstract mass nouns sub-kinds correspond to degrees on intensity-scales derived from equivalence classes of states in combination with independently motivated pragmatic principles accounts for the weakening effect that is characteristic for sentences where *a certain* is combined with an abstract mass noun, while no comparable effect is found in sentences where *a certain* is combined with a concrete mass noun – in the latter case, sub-kinds can only be identified via some quality of the substance under consideration.

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Can mass-count syntax be derived from semantics?

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Analysing aspects of how our brain processes language may provide, even before the language faculty is really understood, useful insights into higher order cognitive functions. We have taken initial steps in this direction, focusing on the mass-count distinction. The mass-count distinction relates to the countability or un-countability of nouns in terms of their syntactic usage. Our first results show that the mass-count distinction, across a number of natural languages, is far from bimodal, and exhibits in fact complex fuzzy relations between syntax and semantics. We then tried to test the ability of a standard, biologically plausible self-organising neural network to learn such associations between syntax and semantics. A neural network that expresses competition amongst output neurons with lateral inhibition can identify the basic classes of mass and count in the syntactic markers and produce a graded distribution of the nouns along the mass-count spectrum. The network however fails to successfully map the semantic classes of the nouns to their syntactic usage, thus corroborating the hypothesis that the syntactic usage of nouns in the mass-count domain is not simply predicted by the semantics of the noun.

Keywords: mass-count distinction, syntax-semantics interaction, self-organisation, neural networks

1. Introduction

The question of how the brain acquires language can be posed in terms of its ability to discover, from exposure to a corpus, the syntactic structure of a specific natural language and its relation with semantics. This has been a subject of study and of intense debate for the past few decades (Pinker S, 1995). Natural language acquisition appears to presuppose certain cognitive abilities like rule recognition, generalisation and compositional processing. These high-level abstract capabilities should be realized in the language domain and in specific sub-domains of the language domain by general-purpose neural processing machinery, since there

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is no evidence for dedicated circuitry of a distinct type for each sub-domain of linguistic competencenor, for that matter, for language in general. How can rule recognition and generalization be implemented in standard, non-domain specific neural networks? To explore this issue, we focus our attention on a particular area of the syntax/semantics interface, the mass-count distinction. Following up on our previous study, where we investigated statistical aspects of the mass-count distinction in 6 languages, with relation to its cross-linguistic syntactic and semantic properties, we now aim to study the learnability of those syntactic properties by a basic neural network model, with the long-term goal of eventually understanding how such processes might be implemented in the brain.The intuitively plausible first assumption is that mass nouns denote substance or 'stuff' and do not denote individuated objects, whereas count nouns denote atomic entities that can be easily individuated and counted (Soja et al. 1991, Pelletier 2010, Bale & Barner 2009, Chierchia 2010, Prasada et al. 2002). This semantic difference seems to be reflected in the syntactic usage of the nouns in many natural languages since mass nouns and count nouns are associated with a different array of syntactic properties which are plausibly connected with countability and individuation. For example, in English, mass nouns are associated with quantifiers like *some, much* as in *some flour, much water,* cannot be directly modified by numerals *(*three flour(s))* and require a measure classifier (*kilos, bottles*) when used with numerals as in *six kilos of flour, three bottles/litres of water.* On the other hand count nouns are associated with determiners like *a/an*, (*a boy, an owl*), quantifiers like *many/few* (*many books, few people*) and crucially can be used with numerals without a measure classifier*three books, four boys.*. The traditional approach to the semantics of the mass-count distinction is that it can be expressed through properties of atomicity, cumulativity and homogeneity (Link 1983). Count nouns are said to be atomic. A noun is atomic when its denotation includes distinguishable smallest elements which cannot be further divided into objects which are also in the noun denotation. So *chair* is count since it includes minimal chair-objects in its denotation which cannot be subdivided into smaller chairs, and plural *chairs* inherits atomicity from its singular stem Mass nouns are said to be cumulative and homogeneous. A noun is cumulative if the sum of two separate entitiesin the noun denotation is still in the denotation of the singular noun. For example if A is water and B is water then A and B together are water. Singular count nouns are not cumulative,since if A is in *chair* and B is in *chair* the sum of A and B is not in the denotation of singular *chair.* A noun is homogeneous if an entity its denotation can be subdivided into parts which are also in its denotation. For example, a part of something which is water is water, while a part of an object in *chair* is not a chair. So mass nouns are non-atomic and exhibit properties of being homogeneous and cumulative, whereas count nouns have opposite properties. However, as many linguists have pointed

out, a simplistic mapping between homogeneity and mass syntax and/or atomicity and count syntax on the other would imply that the expressions in different languages denoting the same real world objects would be consistently count or mass cross-linguistically. This is not the case. As we showed in (Kulkarni et al. 2013), words with a similar interpretation may be associated with very different arrays of syntactic properties cross-linguistically. A noun which is associated with a count array of syntactic properties in one language may not be associated with a count array in a different language. Furthermore, over a sample of 6 different languages we saw that there is no binary divide into mass-count nouns, but rather a continuum with a group of nouns which are count with respect to all relevant properties, and then a range of nouns which are more of less count depending on how many count properties they display. This places the mass-count distinction at an interesting interface between the semantic properties of nouns and the syntax, since it raises the question of (i) what semantic properties are associated with count and mass syntax respectively, (ii) why there is variation in the noun categorization as mass or count cross-linguistically and (iii) how the knowledge of what is mass and count in a particular language is acquired.

2. Statistical analysis of cross-linguistic distribution of mass and count nouns

2.1 Data collection and distance distribution from pure count nouns

In a previous study (Kulkarni et al. 2013) we collected a database of how 1,434 nouns are used with respect to the mass-count distinction in six languages; additional informants characterized the semantics of the underlying concepts. A set of yes/no questions was prepared, in each language, to probe the usage of the nouns in the mass-count domain(e.g. does it occur with numerals, does it pluralise etc.). The questions probed whether a noun from the list could be associated with a particular morphological or syntactic marker relevant in distinguishing mass-count properties. A similar set of questions probed the semantic usage of the nouns using questions regarding the semantics properties of the nouns relevant for the mass-count distinction. Thus each nouns was associated with a binary string of 1 (Yes) and 0 (No), indicating how that particular noun is used in the mass-count space by an informant. Since the data thus obtained is high dimensional in principle, as a first approximation, we consider the hypothesis that most of the information is contained on a single dimension of 'mass' and 'count'. We collapse the high dimensional data onto a single dimension (named as the MC dimension) by calculating the Hamming distance, or fraction of discordant elements, of each noun

(i.e. of each syntactic group) from a bit string representing a pure count noun. A pure count string is one which has 'yes' answers for all questions identifying so-called 'count' properties and 'no' answers for all questions probing 'mass' properties. By plotting the distribution of nouns on this dimension we could provide a visualization of the main mass-count structure, to relate it with a linguistic interpretation. Thus a high dimensional numerical data has been compressed, albeit with some loss of information, to a representation that can readily identify the degree of "countness" of a noun. The resulting distribution of mass-count syntactic properties is seen to be graded in nature instead of either a binary or a bimodal distribution, as one might have expected intuitively. Most common nouns are strictly count in nature, in five of the six languages considered, with mass features increasingly rarer as they approach the pure mass ideal (See Kulkarni et al. 2013 for details)

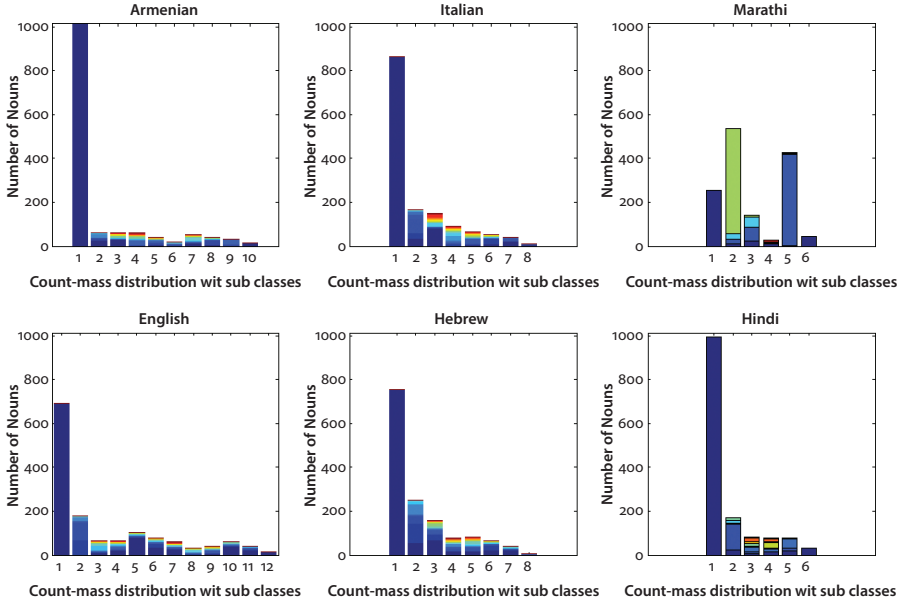

Figure 1. (Kulkarni et al. 2013). Distribution of nouns along the main mass-count dimension. Each histogram reports the frequency of nouns in the database, for a particular language, at increasing distances from pure count usage (1) and towards pure mass usage (N + 1), where N is the number of syntactic question for the language. Shades within the bars indicate the proportion of nouns in each of the syntactic classes that differ by the same number of features from the pure count string but do not match on which exact feature differs, hence appear collated at the same Hamming distance from the pure count

Figure 1 shows that for 5 out of the 6 languages considered the mass-count distinction is not even close to binary. It is not bimodal and it shows a substantial

number of nouns in the 'pure count' class, and then a decreasing proportion of nouns at increasing distance from pure counts, but distributed among several different classes. The case of Marathi is special, and has been discussed in Kulkarni et al. (2013).

2.2 Entropy and mutual information measures

A more detailed comparison between the languages, which preserves the multidimensional information, was obtained by measuring the mutual information between languages and the entropy of a language. Entropy quantifies the amount of variability, hence potential 'information', contained in a system (here, on how nouns are clustered according to their usage, as defined by the binary strings), whereas mutual information quantifies how much of this information is shared between systems; for example, between a pair of languages, indicating the extent up to which clustering is similar between the pair of languages. Higher entropy means that a language has a high number of significant clusters thus pointing towards a rich classification of nouns in that language, whereas high mutual information would imply that two languages agree to a high degree on how nouns should be classified in the mass-count domain. An illustrative example is a binary variable that takes the value 1 with a probability of 0.5, implying that it has two equiprobable classes, and has the entropy of 1 bit. If instead it takes the value 1, for example, in 20% of the cases, it has the lower entropy of $\log_2(5)-0.8*\log_2(4)$ = 0.72 bits. Thus, in a hypothetical case where the mass-count data was simply divided into two classes of mass (20% of the nouns) and count (the remaining 80%), the entropy for that dataset would be 0.72 bits. Mutual information quantifies the similarity of clustering within two different datasets, thus it will be maximal if two classifications match exactly, and it will be also 0.72 bits. Normalized to the entropy value, it will be 1, i.e., 100%. Similarly, mutual information can quantify the correspondence between syntactic classes and semantic properties. If in the example above a given semantic property could fully 'explain' the 20%–80% dichotomy observed in syntax, again the normalized mutual information between syntax (for a given language) and semantics would be 1.

The two main findings reported by Kulkarni et al. (2013) are the high entropy values in individual languages and the low normalized mutual information values between languages, or between the mass-count syntax of any given language and semantics.

Table 1 shows that the Mass-Count entropy of natural languages is in the range of 2–4 bits, which indicates the presence of the entropic equivalent of 2^2–2^4 equi-populated classes of nouns (from slightly above 4 for Hindi to just below 16 for English).In practice, syntactic classes are far from being equipopulated, i.e. including each the same number of nouns, which implies that effectively there

Table 1. (Kulkarni et al. 2013). Language–entropy relations. Entropy values in the six languages and in semantics. The * sign indicates an 'average' over five informants (three for Marathi), taken by assigning to each question and each noun the yes/no answer chosen by the majority. For semantics, the overall value (in parenthesis) has little significance, because concrete nouns are assigned to eight distinct groups and abstract to only three, and combining them distributes the abstract nouns into the two extreme concrete groups and one central group.

Language	Entropy
*Armenian	2.29
*Italian	3.02
*Marathi	2.71
English	3.92
Hebrew	3.40
Hindi	2.12
*Semantics	3.72 2.94(C) 2.34 (A)

are many more than 4 classes for Hindi or 16 for English.This quantitatively illustrates the diversity prevalent in the mass-count syntax, far beyond a dichotomous categorisation, which would have resulted in entropy values around or in fact below 1 bit.

Surprisingly, the correspondence between languages, as quantified by the normalized mutual information, was found by Kulkarni et al. (2013) to be low, roughly in the range of 0.1–0.3. That is, although all the language considered present a rich mass-count syntax, its details do not match from language to language. Correspondingly, but perhaps even more surprising from an intuitive viewpoint, also the mutual information between syntax in any language and semantics is comparably low, in the same range. This is to be expected from the low correspondence across languages, since semantic features are defined in a language-independent manner, hence they cannot simultaneously correspond to syntactic classifications that differ from each other. However, it is still striking that semantics appears to account, quantitatively, for no more than roughly 20% of the variability in syntax. This low proportion does not change much depending on how the exact measure is derived. Rather than recapitulating the full results reported by Kulkarni et al. (2013), we focus here on a simple measure which can be easily analysed: the mutual information between a single syntactic marker and a single semantic feature.

Semantic question 8, applied only to 784 concrete nouns, asked whether the noun denotes an entity (or individual quantity) that can be mixed with itself without changing properties. This somewhat loosely phrased question makes reference to homogeneity and cumulativity properties, since it can be interpreted either as

Table 2. An example of the low correspondence between a semantic attribute and a syntactic property.

Language	++	+−	−+	−−	H(Lang)	H(Sem)	MI(S,L)	Norm MI
Armenian	24	31	686	43	0.451	0.366	0.080	0.218
Italian	26	29	662	67	0.536	0.366	0.053	0.145
Marathi	25	30	559	170	0.819	0.366	0.020	0.054
English	29	26	668	61	0.503	0.366	0.046	0.126
Hebrew	29	26	682	47	0.447	0.366	0.055	0.150
Hindi	28	27	686	43	0.434	0.366	0.062	0.170

asking whether proper parts can be permuted without changing the nature of the object, or whether instantiations can be collected under the same description. The syntactic question considered concerned the most fundamental syntactic property of count nouns:whether the noun can be used with numerals, and it was present in all languages. The largest group of concrete nouns, in the −+ class, denote objects that are not homogeneous, and the nouns can be used with numerals. The relative proportion of nouns in each of the four classes, however, yields me agre normalized information values, indicating that individual attributes are insufficient to inform correct usage of specific rules.

In general, therefore, while the graded distribution is similar across languages, syntactic classes do not map onto each other, nor do they reflect, beyond weak correlations, semantic attributes of the concepts, as quantified by the low values of Mutual Information on both the MC dimension as well as the total mutual information. These findings are in line with the hypothesis that much of the mass-count syntax emerges from language-specific processes, or language-specific decisions as to what features of objects are relevant for realising a predicate as grammatically count.

3. Network modelling

The goal of the second study (Kulkarni et al. 2016) was to assess the learnability of syntactic and semantic features of the mass-count distinction using simple neural networks. Artificial neural networks have a long history as a method for neurally plausible cognitive modelling (Elman 1991, Nyamapfene 2009), and can be endowed with properties including feature extraction, memory storage, pattern recognition, generalisation, fault tolerance. Understanding how humans might acquire the capacity for handling syntax in a specific sub-domain might start from encoding syntactic/semantic knowledge into a neural network, which

self-organizes with a prescribed learning algorithm to recode that information in a neurally plausible format. That way one may draw parallels about governing principles in the brain that bring about the acquisition of syntax. Taking cues from biological neurons, most artificial neural networks employ 'Hebbian' plasticity rules, wherein the synaptic connection between two units is strengthened if they are activated nearly simultaneously, thus leading to associative learning of the conjunction or sequence of activations.

We have considered a competitive network, a simple self-organising network which through 'unsupervised' learning may produce a useful form of recoding. A competitive network, under the right conditions, is able to discover patterns and clusters in a stimulus space and to train itself to correctly identify and group inputs that share a close resemblance to each other. A competitive network is particularly interesting in our case since much linguistic information during language acquisition is 'discovered' rather than explicitly taught. Moreover, mass and count nouns have been shown to exhibit differential evoked potential responses, both with a syntactic and with a semantic stimulus (Chiarelli et al. 2011). The performance of a simple competitive network should indicate how well syntactic and semantic features can be accommodated within a single network, thus exploring if the network can indeed achieve some pattern recognition that will allow it to successfully categorise nouns in the syntactic mass-count space.

3.1 Methods

Our study is reported in detail in (Kulkarni et al. 2016) and here we just recapitulate the key ideas and results. The network consists of a single input and a single output layer. At the input layer each unit represents a syntactic feature ('numeral', 'a/an' etc) in case of the syntactic network or a semantic feature ('fixed shape', 'fluidity' etc) for the semantic network. The input layer is binary, and for each noun given as input a given unit can be active (activation value 1) to indicate that the feature can be attributed to the noun, or inactive (value 0) to indicate that it cannot. Thus a single learning event for the network includes the application of a binary input string containing the syntactic or semantic information pertaining to a single noun, activity propagation to the output units, and modification of the synaptic weights according to the prescribed learning rule. In a variant to be considered later, instead of self-organizing an output representation of nouns, we explore the self-organization of syntactic features ('markers'); in that variant, rather than an input noun with the features as components, we apply as input a single feature/marker, with the nouns as components, i.e. there are a few very long input string instead of many short strings. On the output side, the number of units is variable, set by the simulation requirements. Unlike the input units, outputs

units are graded, taking continuous values in the range of 0 to 1. A competition amongst the output units based upon their activation levels decides the final output level of each unit.

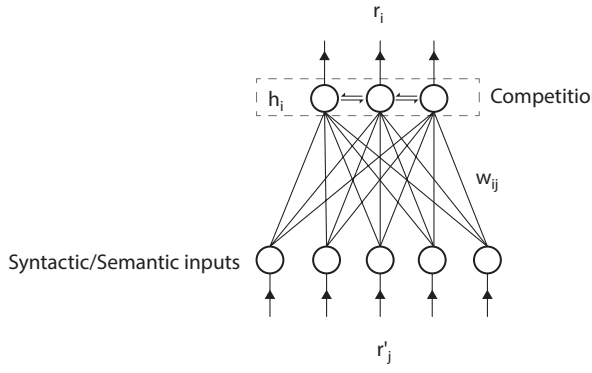

Figure 2. Schematic diagram of the artificial neural network, showing an input layer where units are binary strings containing syntactic/semantic information of nouns and an output layer where units compete with each other to produce graded firing rates based on connection weights and on competition

The weights in the network are adjusted during a learning phase according to a so-called Hebbian rule, taking into account the input and output firing rates of the units connected by that weight. The learning rule is slightly modified from the standard Hebbian rule to incorporate normalisation of the weights during learning in a biologically plausible way.

One training iteration includes presenting each noun in the list once and the above process is repeated for the desired number of iterations. A softmax function is implemented at the output stage to facilitate competition amongst output neurons which consequently lead to the strengthening of the connections between output neurons with the maximum firing rate and relevant input neurons.

We again use mutual information as a measure to analyse the correspondence between two representations, encoded either in a syntactic network trained on input information about marker usage for the nouns in a particular language, or in a semantic network trained on information about the semantic properties of the nouns (Kulkarni et al. 2013). Here we focus on systems that have undergone a slow process of self-organisation to categorise their inputs.

3.2 Results: Classification of markers

First, in what we earlier called a variant of the standard network approach, we present as input the syntactic markers used in the classification of the nouns. Here

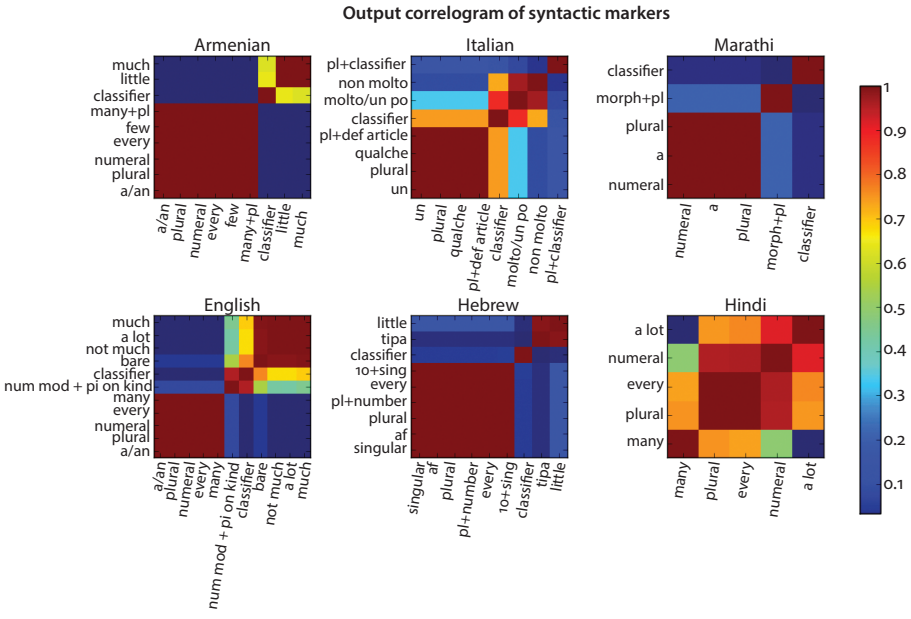

Figure 3. Correlograms for 784 concrete nouns in each of the 6 languages in our study. Dark blue regions represent complete lack of correlation (orthogonal vectors) while dark red regions represent congruent vectors. Markers that are syntactically identified as "Count" tend to be highly correlated at the output of the network. To an extent, the result is similar with markers that may be syntactically identified as "Mass"

an input vector is comprised of *n* units, where*n* is the number of nouns (784 in case of concrete nouns and 650 in case of abstract nouns), for each of the syntactic markers. Thus an input includes information on how that particular marker is used over all the nouns. Each input vector is presented once in one iteration, for 50 such iterations, which is also when the synaptic weight matrix is observed not to change with further iterations. After obtaining the output firing rates for each input marker at the end of the iterations, we calculate the correlogram, representing how correlated the output vectors are with each other, hence giving information about marker categorization. We show the mean correlograms over 50 distinct network simulations.

The correlograms in Figure 3 allow to visually identify markers that fall in the same category, as self-organized in the output of the network. High levels of correlation between two markers signify close proximity in the firing rates of the output units for that pair of markers, and are represented by warmshades towards brown. For concrete nouns in Armenian, markers like 'a/an', 'plural', 'numeral', 'few', 'every' and 'many+plural' have a correlation of 1,

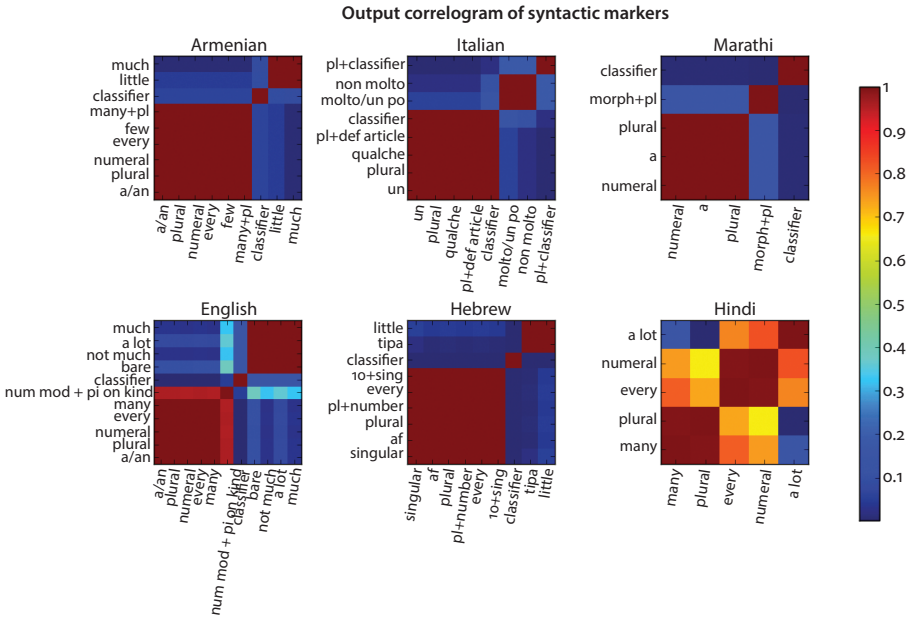

Figure 4. Correlograms, same as in Figure 3, but for 650 abstract nouns. Note that markers are ordered in the same way as in Figure 3

thus occupying the same position in the output space of the network. These are markers that can be applied to count nouns and not to mass nouns. Instead, the typical mass markers of 'measure classifier' form an independent representation, whereas 'little' and 'much' share the same position in output space but distant from the count markers. Italian, Marathi, English and Hebrew follow the same Armenian line of grouping count markers together and having separate but nearby representation for mass markers, distant from the count markers. Hindi is different, as 4 of its 5 chosen markers appear to be 'count' in nature, but all show gradation within the broad count category. Results are similar for abstract nouns except for Italian having fewer graded categorisation than for concrete nouns (Figure 4).

The competitive network can be similarly tested on semantic features based on what value each feature assumes over all the nouns. As seen in Figure 5, semantic features are neatly divided into mass and count features. Count features like 'single unit', 'boundary', 'stable shape' and 'degradation' all have a correlation of 1 with each other and 0 with mass features like 'free flow', 'container shape' and 'mixing'. While 'free flow' forms a separate representation, 'container shape' and 'mixing' have the same output activation.

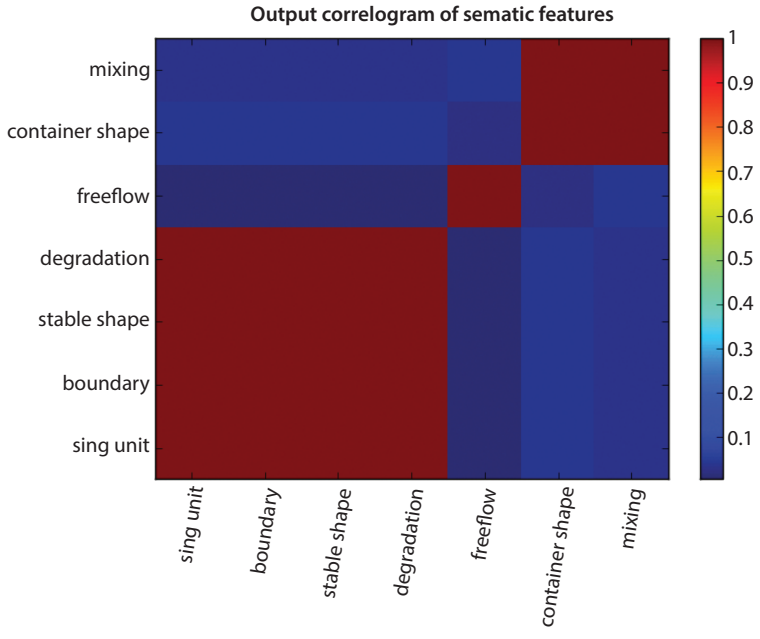

Figure 5. Correlogram of semantic markers for concrete nouns. Physical properties associated with "countable" nature of nouns are clearly separated from properties that can be associated with "fluid-like" properties

3.3 Results: Categorization of nouns

Similar to the procedure in Section 3.2, we now present nouns as input to the network and analyze the activation of the output units. The input vector here consists of *n* units for each noun, i.e., the number of markers for a language, hence containing information on how the noun is used over all the mass-count markers for that language. Figure 6 shows the position of the nouns in the 3-D output space, where each axis represents an output unit. Axes are selected such that x, y and z, respectively, represent units in descending order of variance over the values of output activation they span. The shade of each point signifies where that noun (or cluster of nouns, since nouns classified as identical are co-incident) lies on the MC dimension as defined by the Hamming distance from the pure count string (see Section 1.1 A). Black indicates a distance of 0, thus pure count, while white indicates a distance of 1, representing a 'mass noun'.

Nouns are seen to approximately fall along a single line for all languages (a predominantly linear structure for English), barring an outlier at 0 which represents inputs, all of which are inactive for a noun. Moreover we can see a gradient from black to white, which implies that nouns, even though not completely

faithful, to a great extent lie along a gradient from 'count' to 'mass'. We further visualise the distribution of nouns on this line, so as to assess the frequency of nouns in each cluster. The axis with maximum variance is selected and a histogram of the number of nouns in each cluster along this axis is plotted.

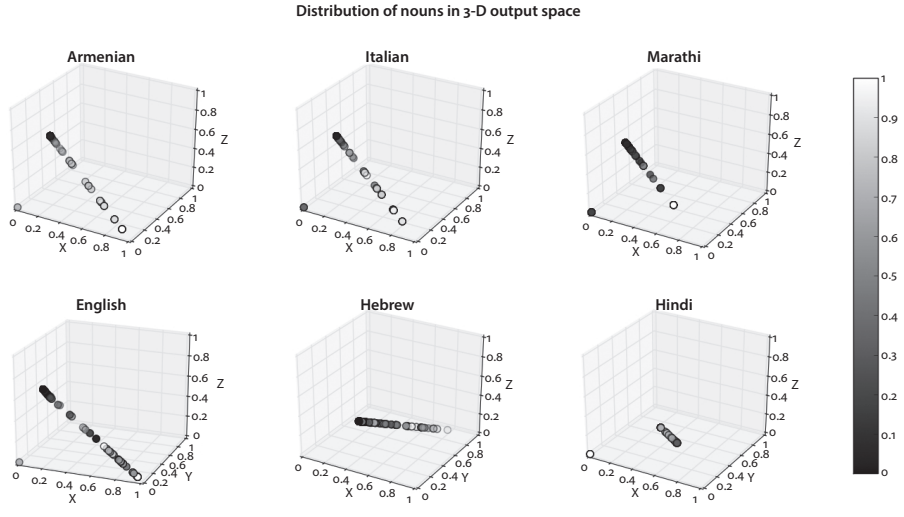

Figure 6. Position of 784 concrete nouns in the output space as defined by 3 output units in 6 languages. The gray scale indicates the Hamming distance of the noun on the MC dimension, from black = 'pure count' to white = 'pure mass'

Is it interesting to note that a dimensionally reduced, entropy preserving representation of the mass-count nouns has a notional similarity to the concept of the MC dimension as in Section 1.1A, Figure 1. The MC dimension was introduced as a concept to better understand the mass-count division in terms of the 'pure count' string, but a competitive network with the appropriate parameters is able to bring about a roughly similar distribution without needing a prior definition ad hoc.

Results for abstract nouns are similar (see Kulkarni et al. 2016).

3.4 The syntax-semantics interaction

As we saw from the information theoretical analysis, the syntax and semantics of the mass-count distinction share only a weak direct link, in the core structure of the count class (Kulkarni et al. 2013), at least based on the semantic properties which we chose to investigate (see Appendix). Thus acquiring the complete set of syntactic classes from semantic classes is not possible by any learning mechanism, due to a lack of a direct one-to-one correspondence. However it is improbable that syntax and semantics are independently learned without any mutual interaction

during learning of mass-count concepts, and there is no evidence that either one is learnt before the other (Nicolas 2010). From the classification of markers above, we see that broad categories of mass and count can indeed be extracted out of the data, interestingly for both syntax and semantics, thus rendering some semantic sense to the syntactic distinction. Classes of nouns formed from these markers do not reflect, however, mass-count information in a straightforward manner between syntax and semantics. Hypothesising an underlying commonality of the mass-count divide between markers of syntax and semantics, we thus tested the performance of the competitive network when syntax and semantics are simultaneously part of the input space during the learning phase, and test the correspondence between the syntactic and semantic classes after learning.

First, to compare with our previous results, we calculated the baseline mutual information between syntax and semantics by providing only semantic information to the network, with no syntactic information during the learning phase. The mutual information was calculated between syntactic data and the output of the semantic competitive network. When no syntactic information is present at the inputs, the resulting mutual information is about equal to the mutual information between the syntactic and semantic data, as calculated using the procedure in Kulkarni et al. (2013).

The competitive network brings about a dimensional reduction from a high dimensional input space to a lower dimensional output space defined by the number of output units.

Syntactic information was then provided to the network in a partial manner, in a proportion γ, which signifies the fraction of input units of the syntactic segment, of the input string, that are set to the activation levels of the syntactic string of a particular language. $\gamma = 0$ corresponds to when none of the syntactic input units are receiving any information and are set to 0; while $\gamma = 1$ implies that all of the syntactic information is present; for in-between cases a fraction $1-\gamma$ units are randomly selected and set to 0. Thus we were able to vary the amount of syntactic information available to the network during learning and test the effect on the syntactic-semantic mutual information and whether the relevant syntactic and semantic classes are brought together in any systematic way. We trained and tested the network by providing the same proportion γ of syntactic inputs along with the semantic ones.

The results were disappointing from the point of view that the combined syntactic-semantic inputs have only a limited influence on learning. Figure 7 depicts the performance of the network when it is tested on the semantic inputs while they are incrementally supplied with syntactic information. The green curves represent the mutual information between unprocessed semantic and syntactic input, this is the baseline mutual information between semantic and syntactic data which remains flat, i.e. independent of γ. Unprocessed inputs consist of 'binary

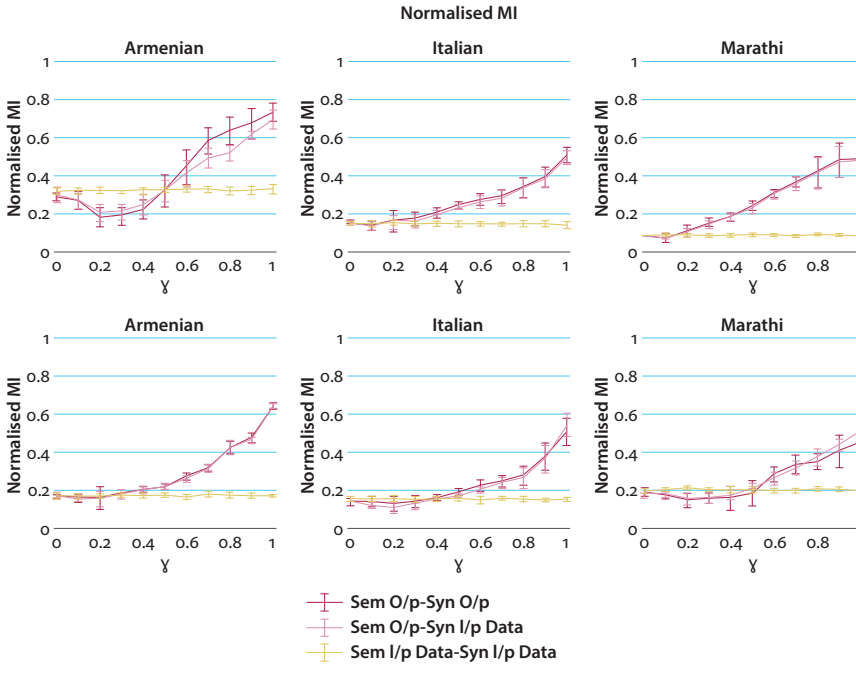

Figure 7. Mean normalised mutual information over 10 independent simulations at various γ for concrete nouns in 6 languages when γ = 1, N = 3, 10 iterations.

strings',which are the raw data. The small fluctuations seen in the baseline curve are a result of variation produced due to the sampling correction in calculating mutual information for each independent simulation (Kulkarni et al. 2013). The red curves represent the mutual information between the self-organised output of the network and unprocessed syntactic inputs while the blue curves plot the mutual information between self-organised semantic and syntactic outputs. The red and blue curvest end to follow each other closely, implying that the syntactic competitive network results in a dimensionally reduced faithful representation of the syntactic input data. The mutual information rises above the baseline as γ increases above the 0.4–0.5 region for Armenian, English, Hebrew and Hindi, and above the 0.2 region for Italian and Marathi.Thus semantic classes tend to gradually realign, with increasing γ, in such a manner that they correspond more to the syntactic classes as compared to the baseline. This reorganisation is however very limited: at γ = 1, the normalised mutual information for all languages is in the range of 0.5–0.6, which is around half way towards full agreement. Although interacting with syntax does help some reorganisation of the semantic classes, the divide between syntax and semantics is clear and almost half of the semantic information cannot be shared with syntax at γ = 1.

The performance of the network is further limited by the fact that it cannot be driven by semantic units only, with nosyntactic information during testing. A 'syntactic context' is necessary at the inputs for the network to result in a mutual information performance above baseline. When tested without syntactic information, or with only a partial amount, the drop in the normalised mutual information is significant, with only a tiny trace of learning shown by the network.

Thus, as a summary, we can see that a basic unsupervised neural network implementing a Hebbian-like learning rule and soft competition amongst output neurons is: (a) successful in classifying the syntactic and semantic markers into two separate classes (in most cases), of "mass" and "count" – implying that a feature, based on how it is used by native speakers over various nouns can represent the notion of countability or uncountability; (b) partly successful in discovering a single "Mass-Count" dimension in the data and the spectral nature of the nouns along this dimension through the usage of nouns across different syntactic features; (c) unsuccessful in its ability to predict syntax from semantics (or vice-versa), hence not discovering a map across these two domains.

4. Conclusions

This is clearly a first attempt at exploring the learnability of this specific subdomain with a simple neural network. The results lead to a number of inferences.

1. In most languages, syntactic markers tend to categorize 'spontaneously' between mass and count markers, lending validity to the intuitive perception of a quasi-binary distinction. This is not fully true, however, and particularly in Hindi the markers chosen show a graded distribution of mutual correlations.
2. Nouns, instead, tend in most languages to distribute quite closely along a line which coincides with the main mass-count dimension introduced in our previous study (Kulkarni et al. 2013). Along this line, nouns are very crowded at the count end, and scattered all along towards the mass end. Their distribution is therefore graded rather than binary, with no emergence of a single 'mass' class, but rather of several non-exclusive but distinct ways for a noun to be different from pure count. For example, in Armenian (Figure 8) nouns like 'bird' and 'ship' belong to the 'pure count' class while 'troop 'and 'lunch' are in the 9th class away from the count class. On the mass end, nouns like 'cotton' and 'milk' are at the extreme mass end of the spectrum while 'coffee' and 'wheat' are more mass-like nouns but not at the pure mass end. The exception

is English, where there are at least two clear non-equivalent dimensions of non-countability.

Both the above observations are interesting because the mass-count information in the categorisation arises on its own. The markers, in some cases, very cleanly segregate themselves into mass and count. The nouns are reduced to a one dimensional representation along a mass-count spectrum. Even though the network fails to associate specific syntactic markers with specific nouns based on the semantics, the network does develop a 'concept', if we may say, of what the mass-count classification is. The diversity and richness of this classification however, prevents a simple network to learn specific associations. This brings us to the third observation,

3. Finally, the lack of significant mutual information between semantics and syntax implies, as we have verified, that the latter cannot be extracted solely from the former. Further, when allowing the competitive network to self-organize on the basis of full semantics and partial syntactic inputs, and testing it with the full syntactic inputs, the mutual information obtained with the full syntactic usage distribution is only at most about half the corresponding entropy value. This occurs in fact only when the full syntax is given in the input also at training, and it indicates that giving also semantics information affects negatively rather than positively the performance of the network.

Overall, these observations do not clarify how mass-count syntax may be acquired by humans with neurally plausible mechanisms, on the basis of matching semantic information and syntactic properties. They reinforce the conclusions of our earlier study, that mass-count syntax is far from a rigid binary contrast. It appears as the flexible, language-specific and even, when within-language,speaker-specific usage of a variety of binary markers to a quantitatively and qualitatively graded repertoire of nouns, where being non-count can be expressed in many ways. Furthermore, the count-mass contrast cannot be derived from a set of general, abstract semantic features, such as those listed in Appendix A. One possibility, suggested by the high clustering of nouns in individual languages, but lack of mutual information between languages, is that the semantic features we chose to work with are supplemented by a series of more specific, less abstract features, salient in a particular language.In general, our results support recent work by (Rothstein 2017) arguing that the count/mass contrast is not a reflection of a contrast between atomicity and homogeneity or between objects and stuff. Instead, it reflects a perspectival contrast between entities presented grammatically as

countable and those presented as contextually non-countable.Taking the abstract properties of the referents into account is of limited use in generating grammatical generalizations.

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We dedicate this contribution to the memory of our cherished colleague, Susan, who passed away in the summer of 2019.

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Appendix A

Semantic questions

1. Is it Alive irrespective of context?
2. It is an Abstract Noun?
3. Does it have a single Unit to represent itself?
4. Does it have a definite Boundary, visually or temporally?
5. Does it have a stable Stationary shape (only if concrete)?
6. Can it Flow freely (only if concrete)?
7. Does it take the shape of a Container (only if concrete)?
8. Can it be Mixed together indistinguishably (only if concrete)?
9. Is the identity Degraded when a single unit is Divided (only if concrete)?
10. Can it have an easily defined Temporal Unit (only if abstract)?
11. Is it an Emotion/Mental process (only if abstract)?
12. Can it have an easily defined Conceptual Unit (only if abstract)?

Countability and grammatical number

An Aristotelian view and its challenges

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The purpose of this paper is to define number categories as government classes, and to interpret said categories semantically against models which are rich enough to support the desired interpretations. Defining number categories as government classes in terms of their cooccurrence with numerals leads to a system of five pairs of binary categories in complementary opposition: SINGULAR/COSINGULAR, DUAL/CODUAL, PAUCAL/COPAUCAL, MESAL/COMESAL, and UNIVERSAL/COUNIVERSAL. To support the interpretation of these ten categories we focus on Boolean models and compare those that split dualistically into atomistic and atomless portions with those that are uniformly atomless instead. After arguing that models for the interpertation of number should be uniformly atomless, we show how these models can support the interpretation of all count nouns regardless of number category. Particularly their cooccurrence with numerals. Key to such interpretations will be the ability to refer to atomistic structures embedded deeply within atomless models.

Keywords comparative grammar, semantics, grammatical number, singular, plural, dual, collective, singulative, count, mass, Boolean algebra, model-theoretic semantics.

1. Grammatical numbers as government classes

The various categories of grammatical number have been defined morphologically in terms of inflection, syntactically in terms of agreement, and semantically in terms of quantity. In this paper we explore a different way of defining grammatical numbers – one that is based on the government of nominals by numerals. This definitional approach will provide us with a systematic characterization of grammatical numbers, with a principled basis for considering mass nouns a category of grammatical number, and with a variety of empirical challenges to some of the leading interpretations of countability.

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So let us begin by saying that a noun is ***singular*** if and only if it can combine with the numeral for the number one, but cannot combine with any other numeral. Thus, the nouns *tinker, tailor, soldier*, and *spy* are all singular, as we have the collocations in (1).

(1) *one tinker / tailor / soldier / spy*
* *two tinker / tailor / soldier / spy*
* *three tinker / tailor / soldier / spy*
… … … … … … … …

Next let us say that a noun is ***plural*** if and only if it can combine with the numerals for numbers other than one, but cannot combine with any other numeral. Thus, the nouns *tinkers, tailors, soldiers* and *spies* are all plural, as we have the collocations in (2).

(2) * *one tinkers / tailors / soldiers / spies*
two tinkers / tailors / soldiers / spies
three tinkers / tailors / soldiers / spies
… … … … … … … …

Incidentally, defining plurality in terms of numbers other than one seems better than defining it in terms of numbers greater than one. For, notice that both zero and fractionary numbers invariably call for the plural rather than the singular.[1]

(3) * *Zero tinker / tailor / soldier / spy*
Zero tinkers / tailors / soldiers / spies

(4) * *Zero point five tinker / tailor / soldier / spy*
Zero point five tinkers / tailors / soldiers / spies

So even if these uses are technical extensions of ordinary use, or even if they are not meaningful, the question remains why don't they call for the singular. Defining the plural as a *cosingular* rather than a *transsingular* may provide an answer (zero and fractionary numerals are numerals other than one).

If grammatical numbers are defined in terms of numerical governance, then numbers other than the singular and the plural must be acknowledged. For notice that there is a class of nouns that combines with the numeral for two (and cannot combine with any other numeral). Such nouns must be assigned – as they indeed are – to a special grammatical number: the ***dual***. Examples of dual nouns can be

1. The enumerative construction we have in mind here should not be confused with the partitive one, where we can say *half man and half horse*. In these cases we are not referring to a number of men or horses, but only to one entity half of which is a man and the other, a horse.

found in Ancient Greek, where the dual *daktyliō:* 'two rings' contrasts with the singular *daktulios* 'ring' and the plural *daktulioi* 'rings'.

Duals can be found not just in Ancient Greek, but also in Slavic, Celtic, and Tocharian. And this is no accident, as duals have been claimed for Proto-Indoeuropean, the parent language of all these languages. And duals are not limited to Indoeuropean; they can be found in Semitic, Greenlandic, and Australian languages as well.

Incidentally, this government-based approach to number categories receives support from historical linguistics. Take for instance the well-known fact that duals tend to be rather short-lived in languages that also have a plural (Vendryes 1937). This could be explained because plurals may occur with all the numerals the duals occur with, *but not conversely*. Thus, if languages are under pressure to economize on number categories (as they often seem to be), they will dispense of the dual before they dispense of the plural. Or take the fact that the dual inflection tends to derive, historically, from the numeral for two. It follows that dual nouns tend to derive, historically, from their criterial environments – collocations with the numeral for two. A dual would in fact be the grammaticalization of such a collocation.

In addition to duals, languages can be found that contain nouns that combine with any numeral other than the one for two (and do not combine with the numeral for two). In other words, they may combine with the numeral for one and with the numeral for three – but not with the numeral for two. Following the terminology developed thus far, we may call these nouns ***codual***. Coduals are rare indeed. But they can be found in the Kiowa-Tanoan family of Native American languages. Consider for example the Kiowa nouns [álɔ̀-bɔ̀] 'one, three, or more apples' and [ɔ́-dɔ́] 'one, three, or more strands of hair' (see Watkins 1984, §3.12). Or the Class III nouns of the Tanoan languages Tewa and Towa (see Watkins 1995, 4). Coduals arise in a natural way in languages that allow two natural things – lexical duals and inverse number markings. For then, a codual is nothing but a lexical dual which has undergone inverse number marking.

So number categories include the singular, the cosingular, the dual, and the codual (where the cosingular is what is better known as the plural). But there is more. For there are nouns that combine with numerals for the lower numbers (and with no other numerals). We shall call these nouns ***paucal***.

Notice that what counts as a low number may vary from language to language, from noun to noun, and sometimes even from occasion of use to occasion of use. For some languages, the low numbers form a definite numerical range. For them the low numbers tend to be just one and two. Examples are the "plurals" of the Australian languages Mara, Kala Lagaw Ya, and Nunggubuyu (Rukeyser 1994,

p. 24; Rukeyser 1994, p. 35; Heath 1984) and the "singular/dual" of Rio Grande Tewa (Watkins 1995, p. 4) and Pamé (Cruse 1994, p. 2858).

For other languages, the range is indefinite. Here the low numbers depend on what is being counted and on the context in which they are counted. Thus, five may count as a low number for some things under some circumstances, but not for other things under other circumstances. See the paucals of Avar (Corbett 1995, §3.1) and Ngarinjin (Rukeyser 1994, pp. 33f) – as well as the Koasati "paucal plurals" in *-ki*, which are different both from the ordinary plurals in *-ha* and the "multiple plurals" in *-kiha*. An example is *icofóski* 'few nephews', which contrasts both with *icofóskiha* 'a lot of nephews', and *icofósha* nephews' (see Kimball 1991, pp. 403f, 446–449, 463). Replacive paucals may be found in Shasta, where we have [ʔe.warár] 'few boys' as opposed to [súk.ax] 'boys'. Or [yač.apxa] 'few girls' as opposed to [kíyaxáʔ] 'girls' (Silver 1966).

The paucal contrasts sharply with the class of nouns that may combine with the numerals for the high numbers (and with no other numerals). We may call this class the ***copaucal*** (or the ***multal***). As before, what counts as a high number may vary from language to language, from noun to noun, or from occasion of use to occasion of use. Consider for example the multals in the Northern Kimberley languages of Australia studied by Capell and Coate (1984); the Koasati "multiple plurals" in *-kiha* mentioned above; the unmarked "plural" of three or more in Rio Grande Tewa (Watkins 1995, p. 4) and Tzeltal reduplicate *nanatik* 'very many houses' of a base *na* 'house' (Moravcsik 1978a, p. 318). A potential English example is *police*.

(5) *There were five *(hundred) police in the streets.*
Perhaps *troops* and *personnel* behave in the same way.

In any event, things do not stop here. Languages may contain nouns that combine with numerals for numbers which are neither too low nor too high (and with no other numerals). We will gather these nouns in a set which we will call the ***mesal***. As before, what counts as too high or too low will vary from language to language, from noun to noun, and from occasion of use to occasion of use. Thus, we may have a mesal if we have 2 through 10 entities (see the *pluralis paucitatis* of Classical Arabic, the "plural" of Erza Mordvin, and the "plural" of inanimates in Amharic as described in Greenberg 1978, p. 283). Or we may have a mesal if we have only from 2 through 9 (see the "plurals" of Dinka as described in Nebel 1948, p. 90). Or if we have 2 through 6 (as in Bayso; see Hayward 1979, §3.1.2.1), 3 to 4 (the nominal "paucals" of Anindilyakwa according to Rukeyser 1994, p. 12), 3 through 15 (the "paucals" of Murrinh-Patha; see Rukeyser 1994, p. 17).

Incidentally, languages are sometimes said to contain trials and quadrials (categories of nominal number for exclusive use with numerals for three and four, respectively). See for example Beard (1992), Anderson (1985, p. 75), and Schimidt (1926, Atlas Karte XI). But perhaps they could be better analyzed as mesals. The issue is whether these nouns are used only with the numerals for three (or four) or whether they are used with a range of 'middle numbers'.

Finally, it might be argued that there are nouns that occur with numerals for numbers which are either too small or too big (and with no other numerals). If so, these nouns constitute a ***comesal***. Examples would include the "singulars" of Classical Arabic and Erza Mordvin, certain inanimates of Amharic, and certain nouns of Dinka (see Greenberg 1978, p. 283; Nebel 1948, p. 90). Yet, as I have argued elsewhere (see Ojeda 1997a and below), this analysis is suspect; the comesal does not seem to be a documented number category.

2. Further grammatical numbers: The universal and the co-universal

Defining grammatical numbers in terms of their co-occurrance with numerals provides us with principled grounds for welcoming two new categories into the family of grammatical numbers. One of these is the class of nouns that can occur with any numeral whatsoever; the other is the class of nouns that can occur with no numeral whatsoever. We will, as we must, consider both of these categories new grammatical numbers – and will call them the ***universal*** and the ***co-universal***, respectively.

The universal number has been called the *common number* (Jespersen 1924, p. 198), the *absolute number* (Ravila 1941, p. 63), the *general number* (Corbett 1992), the class of nouns with *unit reference* (Hayward 1979, §3.1.2.1), and the class of *set nouns* (Rijkhoff 1992, pp. 82ff). As to the co-universal, it is not usually regarded as a gramamtical number. Yet, it is certainly well known as a nominal category in its own right, as it is no other than the class of *uncountable, noncountable*, or *mass* nouns. The co-universal has also been called the *transnumeral,* as the nouns in this category avoid direct construction with numerals (see Greenberg 1977, pp. 285–293; Biermann 1982).

The universal number is to be expected in languages with little to no inflection. In fact, it is widespread in the languages of the world, and is seemingly more common than the singular or the plural (Rijkhoff 1992, p. 85). Outside Indo-European, the universal number has been claimed to be the norm in Uralo-Altaic (Collinder 1960, §725), Australian (Dixon 1980, p. 267), Afroasiatic (Diakonoff 1988, p. 68), and Creole (Holm 1988, p. 193). In Turkish, for example the noun

kutu, which should be glossed as 'box or boxes,' may combine, in this one form, with all counting numerals:

(6) a. *bir kutu* 'one box'
b. *iki kutu* 'two boxes'
c. *N kutu* 'N boxes' (Lewis 1967, p. 26)

In Indoeuropean, the universal number can be found systematically in Anatolian (Stur-tevant 1951, §127a), Armenian (Kogian 1949, §111), Celtic (Fife 1993, p. 21), Indic (Chowdhury 1966; Bahl 1975, p. 85), Iranian (Windfuhr 1990, p. 118) and, therefore, arguably, in Proto-Indoeuropean as well (Jacobi 1897, Hirt 1937, Lehman 1958, Gamkrelidze and Ivanov 1995, I, p. 270).

In English, universal number can be found on nouns whose instances are fairly indistin-guishable – and, therefore, largely interchangeable. Examples include nouns for military hardware or personnel (cf. *one aircraft, two cannon, three infantry*), social or ethnic groups (cf. *one youth, two faculty, three Eskimo*), numerical units (one hundred, two thousand, three million), and medication pills (cf. *one advil, two motrim, three aspirin*). See Poutsma (1914, p. 250–257), and Curme (1935, II, §59.3).

Systematic examples of nouns in the universal number may also be found in *classifiers* – nouns that mediate the combination of a numeral and a transnumeral.[2] See for example the Yucatec classifier *túul*, which may combine with the numerals for all numbers:

(7) a. *'un túul máak*
one CLASSIFIER of-man
'one man'
b. *ká'a túul máak*
two CLASSIFIER of-man
'two men' (Lucy 1992, p. 43)

Similar points can be made about the Breton classifiers *pez* 'piece', *loen* 'beast,' or *penn* 'head or unit' (Trépos 1957, p. 236) and, in English, of the morphologically invariant classifier *head*, which mediates the combination of any numeral and the transnumeral *cattle*:

(8) *one head of cattle*
two head of cattle

Notice, by the way, that pluralizing *head* on (8b) above leads to a change in meaning (two bovine heads vs. two bovines), which suggests that the noun *head* is

2. The correlation between classifiers and languages with optional plural marking was first noticed by Mary Sanches (see Greenberg 1977, 286).

ambiguous in English; only one of the two senses (the one referring to the body part) is singular and allows pluralization; the other sense (the one referring to one or more bovines) is in the universal number and does not pluralize.

In fact, the universal number may well be a linguistic universal. About a century ago, Jacob Wackernagel remarked that "when we isolate the root of a [nominal] paradigm, we must grant it both plural and singular meaning" (see Wackernagel 1920). Wackernagel's evidence included compounds like Greek *hippódamos* 'tamer of (one or more) horses' and Latin *auceps* 'catcher of (one or more) birds'. The simplest account of the numerical indeterminacy of these compounds has it stemming from the numerical indeterminacy of their roots, which must therefore be in the universal number.

Direct confirmation of Wackernagel's view comes from English, whose powerful compounding engine allows nominal roots to combine, in one and the same form, with any numeral whatsoever (cf. *one-car garage, two-bedroom apartment, three-pound package, four-bean salad*). Notice that this compounding is perfectly general. Thus, any numeral whatsoever may be substituted for *X* and any nominal root whatsoever may be substituted for *Y* in the frame below.

(9) *the X-Y conundrum*

This is all the more striking because English roots lose their numerical universality once they become full nouns – be they singular (which combine only with the numeral for one) or plural (which combine only with numerals for other numbers).[3] The view that roots of count nouns are in the universal number is not exclusive to Wackernagel. See Pott (1862, p. 165–167), Tobler (1887) and, more recently, Eschenbach (1993, p. 18) and Ojeda (1993, pp. 36f and 70ff).

To this evidence we could add the cases of languages which allow one and the same nominal root to combine with a variety of number inflections. Take for example Italian, where one and the same root *ragazz-* may combine with singulars *-o* and *-a* (to mean *boy* and *girl*, respectively) or with plurals *-i* and *-e* (to mean *boys* and *girls*, respectively). This means that the root *ragazz-* is compatible with both the singular and the plural (or neutral with respect to their difference).

As to the co-universal, no case for it needs to be made, as it is universally acknowledged in the linguistic literature. We might emphasize, however, that this nominal category is normally defined in terms of the fact that its members eschew numerical quantification, and that this very fact can be used to consider them a

3. Thus far we have defined grammatical numbers as categories of nouns. To include a nominal roots in a grammatical number, be it universal or otherwise, we must therefore extend the notion of grammatical number to nominals other than nouns.

category of grammatical number proper – *at least within the approach to grammatical number we are developing here*.

Beyond this, it might also be useful to collect, for future reference, the main properties that distinguish mass nouns (or co-universals) from all other nouns. This we do in (10).

(10)
a. Mass nouns eschew definite numerical quantification (i.e. quantification by numerals).
b. Mass nouns eschew indefinite numerical quantification (i.e. quantification by *few, several, many*, etc.).
c. Mass nouns allow nonnumerical quantification (cf. *much water* vs. **much amounts of water*; *little water* vs. **little amounts of water*).
d. Mass nouns are beyond the *secondary* oppositions of number (singular/plural, dual/codual, etc.); they partake, of course, in the *primary* opposition of number (universal/co-universal).
e. Mass nouns disallow both singular (*every, each, a, both*) and plural (*a few, each other*) quantification.
f. Material mass nouns reject modification in terms of shape (cf. **round water*).
g. Material mass nouns reject modification in terms of size (cf. **big water*).
h. Mass nouns reject ranking (cf. **the first/second water*).
i. Mass nouns cannot serve as antecedents of the anaphor *one* (cf. *the clean water and the dirty water/*one*).

We close this section with some observations about grammatical number beyond the nominal system. For languages have grammatical number in both nominal and nonnominal categories. Take verbal categories, for example. How should we define grammatical number for them? Suppose we defined verbal number in terms of the inflectional classes of the verb. If we did, then the grammatical numbers in nouns and verbs would not always match – not even in how many there are. Take English, for example. We have argued that English nouns have at least three grammatical numbers – the singular, the plural, and the uncountable. Yet, it has but two number inflections on the verb – the singular and the plural. Since English verbs must agree with their subjects, there must be some accomodation between these two systems.

One way to carry out this accomodation would be to say that number in the verb is either plural or nonplural. That way the uncountable and the singular would trigger the same inflection on the verb (as opposed to the inflection triggered by the plurals):

(11)

SINGULAR	UNCOUNTABLE	PLURAL

Alternatively, we could say that the number in the verb is either singular or non-sigular. Now the uncountable and the plural would trigger the same inflection on the verb (as opposed to the inflection triggered by the singular):

(12) SINGULAR | UNCOUNTABLE PLURAL

By and large, English makes the distinction in (11), while Bantu and Zuni make the distinction in (12). In Bantu this can be seen in a concordance class of nouns (Class 6) that contains both plurals and mass nouns. This class triggers a different agreement than its counterpart (Class 5), which contains nothing but the singulars of the plurals in Class 6 (Welmers 1973, p. 159). As to Zuni,[4] it has a distinct preference for marking mass nouns as plural with the suffix (or suffixes) *we* (and *:we*).[5]

Problems, of course, may arise. English has a substantial number of mass nouns which trigger plural inflections on verbs. The most common example is *clothes*. Other common examples are *cattle, brains* (in the sense of *smarts*), and *guts* (in the sense of *balls*). Jespersen (1954, II, §5.28) presents the following list of mass plurals – and points out that it is only partial.

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

What should we do about these nonplural nouns that trigger plural agreement? Notice that these mass nouns are all historical plurals which have been relexicalized as mass nouns (cf. the adjectives *gutsy* and *ballsy*). We might therefore be able to save the preceding account by claiming that verb agreement is sensitive to the original number (or to the grammatical number prior to the relexicalization). This can come about either through a form of fossilized agreement or, in full synchronic fashion, as an agreement with an underlying form.[6]

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4. I am indebted to Lynn Nichols (personal communication, 3/20/01, 7/22/02, 7/26/02), who provided me with all the Zuni data in this paper.

5. There is, of course, a third logical possibility: that singulars and plurals trigger one and the same verbal agreement (as opposed to the one triggered by mass nouns).

6. See Ojeda (2005) for more on these paradoxical mass plurals.

3. Interpreting the categories of grammatical number: A first pass

We will assume that the oppositions of grammatical number we have just defined are all meaningful – or, equivalently, that grammatical numbers are semantic classes. We will furthermore demand that the interpretations assigned to the nouns of the various grammatical numbers actually account for the observed cooccurrences between nouns and numerals. So even if grammatical numbers are defined syntactically in terms of cooccurrence with numerals, we will seek semantic explanations for this cooccurrence.

So what do the nouns of the various number categories mean as such? What does a singular noun mean by virtue of being singular? What does a plural? And how do we account for the facts in (10)? A simple answer to these questions was given in Chierchia (1998). Simplifying a bit, the proposal takes off by having nouns refer, not to subsets of the universe of discourse, but to families of subsets of the universe of discourse. For, if so, then we may have a singular noun refer to a set of singleton subsets of the universe of discourse; we may have a dual noun refer to a set of doubleton subsets of the universe of discourse – and so on. Thus, in a universe of discourse with four houses *a, b, c, d*, we may begin to interpret the number inflections a root *house* could in principle have as follows.

(11)
| SINGULAR(*house*) |	=	{{*a*}, {*b*}, {*c*}, {*d*}}.
| PLURAL(*house*) |	=	{{*a,b*}, {*a,c*}, {*a,d*}, {*b,c*}, {*b,d*}, {*c,d*}, {*a,b,c*}, {*a,b,d*}, {*a,c,d*}, {*b,c,d*}, {*a,b,c,d*}}.
| DUAL(*house*) |	=	{{*a,b*}, {*a,c*}, {*a,d*}, {*b,c*}, {*b,d*}, {*c,d*}}.
| CODUAL(*house*) |	=	{{*a*}, {*b*}, {*c*}, {*d*}, {*a,b,c*}, {*a,b,d*}, {*a,c,d*}, {*b,c,d*}, {*a,b,c,d*}}.
| PAUCAL(*house*) |	=	{{*a*}, {*b*}, {*c*}, {*d*}, {*a,b*}, {*a,c*}, {*a,d*}, {*b,c*}, {*b,d*}, {*c,d*}}.
| MULTAL(*house*) |	=	{{*a,b,c*}, {*a,b,d*}, {*a,c,d*}, {*b,c,d*}, {*a,b,c,d*}}.
| MESAL(*house*) |	=	{{*a,b*}, {*a,c*}, {*a,d*}, {*b,c*}, {*b,d*}, {*c,d*}, {*a,b,c*}, {*a,b,d*}, {*a,c,d*}, {*b,c,d*}}.
| COMESAL(*house*) |	=	{{*a*}, {*b*}, {*c*}, {*d*}, {*a, b, c, d*}}.

It is at this point, however, that we hit a snag. We would like to interpret the universal and the co-universal forms of the root *house*, examples of which are given in (12) and (13), respectively.

(12) *the three-house conundrum*

(13) *You can but a lot of house for that money*.

Now, as this account would have it, the mass (or co-universal) noun *house* refers to the set of all nonempty subsets of *a, b, c, d* :

(14) $|\,\mathrm{MASS}(\textit{house})\,| \quad = \quad \{\{a\}, \{b\}, \{c\}, \{d\}, \{a,b\}, \{a,c\}, \{a,d\}, \{b,c\}, \{b,d\}, \{c,d\}, \{a,b,c\}, \{a,b,d\}, \{a,c,d\}, \{b,c,d\}, \{a,b,c,d\}\}.$

This claim is what Chierchia (1998) dubs the *Inherent Plurality Hypothesis (for Mass Nouns)*. But the interpretation of the mass noun *house* in (14) is simply not possible within the present setting, as this is, *precisely*, what the universal noun *house* must refer to – at least in light of the interpretations in (11).

The gap between universal and co-universal *house* cannot be bridged. First, we have their definitions in terms of numerical government (the universal may combine with all numerals, the co-universal with none). And this is but one of the nine differences mentioned in (10). What's more, the difference between the universal and the co-universal can be explicitly recognized in the morphologies of natural languages. In Breton, for example, there is an overt morphological process of "singulative formation" that turns mass nouns into nouns in the universal number. The process consists of the suffixation of *-enn* to the mass noun. Examples can be found in (15) and (16).

(15) *dir* 'steel', *douar* 'soil', *dour* 'water', *ed* 'wheat' (French 'du blé'), *erc'h* 'snow', *geot* 'grass (French 'de l'herbe'), *glao* 'rain', *gwiniz* 'wheat' (French 'du froment'), *kolo* or *plouz* 'straw', *leton* 'grass' (French 'du gazon'), *teil* 'manure' (Trépos 1968, §133a).

(16) *direnn* 'dagger(s)', *douarenn* 'plot(s) of land', *edenn* 'stem(s) of wheat', *geotenn* 'blade(s) of grass' , *glavenn* 'drop(s) of rain', *gwinizen* 'stem(s) of wheat or field(s) of wheat', *koloenn* 'straw beehive(s)', *plouzenn* 'stalk(s) of straw', *letonenn* 'lawn(s)' (Trépos 1968, §133a).

The mass nouns in (15) are traditionally called "collectives". More revealingly, they are said to name objects which "appear ordinarily in a confused mass in which the units are difficult to discern" (Trépos 1957, p. 255), and are glossed, as indicated in (15), as mass nouns or mass nominals. As to the singulatives in (16), they are able to combine with all numerals (see for example the following behavior of the singulative *frouezhenn* 'piece of fruit').

(17) *ur frouezhenn* 'one piece of fruit'
div frouezhenn 'two pieces of fruit'
teir frouezhenn 'three pieces of fruit'
peder frouezhenn 'four pieces of fruit'

Singulatives should therefore be considered universal in number.

But singulative formation is not the only morphological process of Breton that acknowledges the difference between uncountables and universals. There is also the form of classifier compounding that we mentioned above. Thus, corresponding to the mass nouns in (18) you have the compounds in (19).

(18) *dilhad* 'clothes' / *pezdilhad* 'piece(s) of clothes'
chatal 'cattle' / *loen-chatal* 'head(s) of cattle'
moc'h 'swine' / *pennmoc'h* or *pemoc'h* 'pig(s)'

These compunds alternate with the singulatives *dilhadenn* 'piece(s) of clothes', *chatalenn* 'head(s) of cattle' and *moc'henn* 'pig(s)' (Trépos 1957, p. 236) – so much so that the compounds are sometimes said to be singulatives or sort of singulatives (Hemon 1948, §47; McKenna 1988, §424e; Fleuriot 1989, §90).

Singulatives are not limited to Breton – or to Celtic, for that matter. They can be found also in Arabic, where they have been called *ʔisma 'l waḥdati* by traditional Arab grammarians and *nomen unitatis vel individualitatis* 'noun of unity or individuality' by their Western followers (Greenberg 1977, p. 287). Take for instance the mass noun *khashab* 'wood' of Classical Arabic. Being mass (or co-universal), it may not be enumerated. Yet, it has a derivative which can. It is the singulative *khashabat* 'piece of wood' (Greenberg 1977, p. 288). Further examples of singulative formation in Classical Arabic are as follows (see Howell 1900, pp. 1057f; Wright 1933, I, p. 147).

(19) *burr* 'wheat' / *burrat* 'grain of wheat'
baqar 'cattle' / *baqarat* 'cow, bull, or ox'
thamar 'fruit' / *thamarat* 'a fruit'
dhahab 'gold' / *dhahabat* 'bit of gold, nugget'
tiban 'straw' / *tibnat* 'a straw'

As to the numerical government of singulatives, the situation has been traditionally described as follows. In Classical Arabic, nouns occur in the singular with the numeral for one, in the dual with the numeral for two, in the plural for the numerals for three to ten – and then again in the singular for the numerals from eleven on (Brockelmann 1960, §83). This pattern carries on to many contemporary Arabic vernaculars. And holds outside of the singulatives. Take for instance the nominal root *beet* 'house' in Iraqi Arabic. It combines with numerals as indicated below (Erwin 1963, §8.1).

(20) *beet waħid* 'one house'
beeteen iθneen 'two houses'
tlaθ byuut 'three houses'
daɛaš beet 'eleven houses'

What should we make of this peculiar paradigm? Notice that we cannot say that a noun that combines with numerals greater than ten is singular. Or that a noun that combines with the numerals for three to ten is plural. Our criteria for the definition of grammatical number simply forbids us from doing so. What we could say is that the nouns that combine with the numerals for three through ten are *mesal*, that the nouns that combine with the numerals other than two are *comesal* (the nouns that combine with two would of course be *dual*).

But this seems to be odd. How would such a system even arise? And how could it thrive, as it did, over time, space, and lexicon? Notice that the one other number with a discontinuous range is the codual of Kiowa-Tanoan. But here we have a natural story to tell (the languages allow lexically dual nouns and produce derived numbers by inverting lexical ones). What is more, the codual is very circumscribed in its extension (it affects certain lexical forms of very few languages). Nothing of the sort can be said about the Arabic pattern. Or about similar patterns that have been observed in Biblical Hebrew, Ugaritic, Epigraphic South Arabian, Berber, Amharic, Erza Mordvin, and Dinka (Bru-gnatelli 1982, pp. 21ff, 29ff, 59ff; Galand 1967, §2; Greenberg 1978, p. 283; Nebel 1948, p. 90).

Fortunately, there is a better alternative. As I have argued elsewhere,[7] this involves claiming that the so called *singular* of Arabic is actually a *universal*, and that the reason why this universal does not occur with the numerals for two through ten is an *Elsewhere Condition* on the rules that govern the use of singulars, duals, and mesals.

To be more specific, let us say that languages like Classical Arabic have the following rules.

Rule 1. Use the universal with all numerals
Rule 2. Use the dual with the numeral for two.
Rule 3. Use the mesal with the numerals for three to ten

With the numeral for one, we have to use the universal. And only the universal. So the universal is what we use. With the numeral for two we have a problem. ***Rule 1*** requires us to use the universal; ***Rule 2*** that we use the dual. But, notice that, of these two rules, the second is the more specific of the two. So, *if conflict among rules is to be resolved in favor of the more specific of the rules* (= The Elsewhere Condition), then ***Rule 2*** is to be preferred over ***Rule 1***, and nouns must appear in the dual with the numeral for two.

A similar outcome issues from the numerals from three to ten. By ***Rule 1***, they must govern the universal. Yet by ***Rule 3***, they must govern the mesal. By the Elsewhere Condition, they would govern the mesal. Notice that no conflicts arise with numerals from eleven on. Here ***Rule 1*** applies unchallenged, and requires these numerals to govern the universal (see Ojeda 1997a).

If the preceding analysis is on the right track, then the singulatives of Arabic, like those of Breton, would combine with all numerals. Consequently, they should be considered universal in number. But this means that they should be allowed to refer without prejudice against singularity or plurality. But then they would

7. See Ojeda (1977a).

refer to the same thing as the mass nouns they derive from – at least according to the Inherent Plurality Hypothesis of Chierchia (1998). This of course flies on the face of the very existence of the singulative inflection, that distinguishes singulatives from mass nouns. Why should a language go through the trouble of deriving singulatives from mass nouns? And why, precisely, to enable construction with numerals?

4. Models for the interpretation of grammatical number

So singulatives must be distinguished from mass nounts – and, more generally, universals should be distinguished from couniversals. One way to do so would be to claim that every noun denotes two things rather than one. The first would be the very set we have been assigning to the noun thus far; the second would be the set of individuals in the first member, where this set would be empty if and only if the noun was uncountable. Thus, if there were but four individual houses *a, b, c, d*, in our universe of discourse, then the universal noun *house* and the couniversal noun *house* would denote as follows.

(21) | UNIVERSAL(*house*) | = $< \{a,b,c,d\}^+, \{a,b,c,d\} >$
| COUNIVERSAL(*house*) | = $< \{a,b,c,d\}^+, \{\} >$
where $\{a, b, c, d\}^+$ is the family of nonempty subsets of $\{a, b, c, d\}$.

Notice that this is not only a representational difference. It is a denotational one at heart, as count nouns and mass nouns differ here in their denotations. And there is something intuitive about these differences as well (count denotations identify individuals whereas mass denotations do not). Note also that this elaboration of the Inherent Plurality Hypothesis allows us to account for the facts in (10). All that needs to be done now is to make certain phenomena sensitive to the presence (or absence) of certain sets of atoms.

The foregoing elaboration of the Inherent Plurality Hypothesis was suggested by Landman (2011), who also makes two important observations about it. The first is that individuals are present in mass denotations as well. Why can't grammatical processes reach into the first member of the pair denoted by a mass noun and identify said individuals on their own? The second is that the difference in (21) just seems to be too poor of a stimulus to trigger the count/mass opposition the world over.[8]

8. And there is also the technical problem that nonreferring count nouns would count as mass nouns in that they will call for an empty set of individuals

It therefore seems that we have to look beyond the simplest proposals regarding the semantics of grammatical number. To do that we need to say more about the models against which grammatical number should be interpreted.[9]

So let us say that ***the universe of discourse*** (***for a particular occasion of linguistic use)*** is the set of entities one can talk about (on that occasion of use). Let us furthermore say that ***the partitive relation*** (***on that universe of discourse)*** is the relation that an entity *x* (of the universe of discourse in question) bears to any entity *y* (of the universe of discourse in question) by virtue of the fact that *x* can be said to be part of *y*. We will use the is-greater-than symbol < as shorthand for this relation.

Notice that the set of entities one may talk about is not necessarily the set of entities that exist in the actual universe. Here we will be dealing with discourse about the universe, not necessarily with the universe itself. Similarly, the partitive relations we will be discussing here are the part/whole relations we can talk about, not necessarily the part/whole relations actually found among the entities in the actual universe.

With these preliminaries out of the way, we define ***model for the interpretation of grammatical number*** (***on a particular occasion of linguistic use***) as a pair $<E, \leq>$ in which *E* is the universe of discourse (for that occasion of linguistic use) and ≤ is the reflexive closure of the partitive relation (on that universe). This relation is, of course, the disjunction of $x < y$ and $x = y$.

Models for the interpretation of number have several important properties. Thus, if *w, x, y, z*, are all elements of *E*, then properties **M1** through **M8** hold.

M1. $\forall x[x \leq x]$ *(Reflexivity)*
Note: This is a direct consequence of the fact that ≤ is a reflexive closure.

M2. $\forall x \forall y[x \leq y \wedge y \leq x .\rightarrow. x = y]$ *(Antisymmetry)*
Note: This is a consequence of the fact that the partitive relation is asymmetric (no two entities can be said to be part of each other) and that ≤ is a reflexive closure of the partitive relation.

M3. $\forall x \forall y \forall z[x \leq y \wedge y \leq z .\rightarrow. x \leq z]$ *(Transitivity)*
Note: This is a consequence of the fact that the partitive relation and the identity relation are both transitive. For, if some entity can be said to be part of (or be equal to) a second, and if this second can be said to be part

9. Here we use the term *model* to refer simply to the structure against which semantics assigns interpretations. Excluded from the notion of model we have adopted is the set of lexical interpretations. In the present setting, these are the responsibility of the semantics proper.

of (resp. be equal to) a third, then, the first can be said to be part of (resp. equal to) the third.

M4. $\forall x \forall y \exists z[x \leq z \,.\wedge.\, y \leq z \,.\wedge.\, \forall w[x \leq w \wedge y \leq w \,.\rightarrow.\, z \leq w]$ *(Join Closure)*
Note: Here z is said to be a ***join*** of x and y. By antisymmetry, joins are unique. Thus, we may speak of the join of two entities x and y, and represent it as $x \cup y$. We may also invoke an operation $\cup$ that assigns, to any x, and any y, their join $x \cup y$.

M5. $\forall x \forall y \exists z[z \leq x \,.\wedge.\, z \leq y \,.\wedge.\, \forall w[w \leq x \wedge w \leq y \,.\rightarrow.\, w \leq z]$ *(Meet Closure)*
Note: Here z is said to be a ***meet*** of x and y. By antisymmetry, meets are unique. Thus, we may speak of the meet of two entities x and y, and represent it as $x \cap y$. We may also invoke an operation $\cap$ that assigns, to any x and any y, their meet $x \cap y$.

M6. $\exists x \forall y[y \leq x]$ *(Maxima)*
$\exists x \forall y[x \leq y]$ *(Minima)*
Note: x in the first clause is called a ***maximum***; x in the second clause, a ***minimum***. By antiymmetry, no poset may have more than one maximum. Or more than one minimum. We may therefore use a special constant $\top$ (read: ***top***) for the maximum and a special constant $\bot$ (read: ***bottom***) for the minimum. The maximum may be thought of as the largest (or most inclusive) entity; the minimum, as the smallest (or least inclusive) one. Notice that a maximum and a minimum need not be distinct. Yet, they will be distinct in the *intended* models for the interpretation of grammatical number.

M7. $x \cup (y \cap z) = (x \cup y) \cap (x \cup z)$ (*Distribitivity of joins over meets*)
$x \cap (y \cup z) = (x \cap y) \cup (x \cap z)$ (*Distributivity of meets over joins*)

M8. $\forall x \exists y[x \cup y = \top \,.\wedge.\, x \cap y = \bot]$ (*Complement Closure*)
Note: Here y is said to be a ***complement*** of x. By distributivity, complements are unique. Thus, we may speak of the complement of x and call it x'. We may also invoke an operation 'that assigns, to any x, its complement x'.

Taken in conjunction, **M1**–**M8** ensure that a model for the interpretation of grammatical number is, by definition, a ***Boolean lattice***.

It is generally agreed that models for the interpretation of grammatical number are Boolean lattices. Except for one thing – the existence of a bottom element. Here we adopt it for two reasons. One is convenience, as this element allows us to speak of lattices rather than semilattices and to simplify certain definitins; the other is empirical coverage. For we wish to use them in our interpretation of the numeral *zero* (and of all the nominals that incoporate it). I acknowledge, however, that the existence of an entity that is part of everything else is rather unintuitive.

But perhaps we will learn to live with this the same way we learned to live with having the empty set be a subset of every set.

Be that as it may, notice that we have defined models as order structures. We could have defined them as algebraic structures instead. If we had, a *model for the interpretation of grammatical number* (*on a particular occasion of linguistic use*) would be a sextuple <*E*, ⊤, ⊥, ‘, ∪, ∩> in which *E* is the universe of discourse (for that occasion of linguistic use), ⊤ is a maximum as defined in **M6**, ⊥ is a minimum as defined in **M6**, ‘ is the complement operation defined in **M8**, ∪ is the join operation defined in **M4**, and ∩ is the meet operation defined in **M5**. Thus defined, a model for the interpretation of number would be a ***Boolean algebra***.

5. The semantics of grammatical number: A Platonic view

Boolean lattices are of two basic kinds: *atomistic* and *atomless*. A Boolean lattice is ***atomistic*** if every element of it is a join of one or more atoms of the lattice; it is ***atomless*** if none is. An ***atom*** of a lattice is an element of the lattice that has the bottom ⊥ and nothing but the bottom as part (so the bottom itself is never an atom).

To interpret the nouns of the various grammatical numbers, early researchers assumed that models for the interpretation of grammatical number were neither atomistic nor atomless. This meant that models contained both atomistic entities and atomless entities. For, then, the atomistic elements of the lattice prevent it from being fully atomless, while the atomless elements of the lattice prevent it from being fully atomistic.[10]

Having assumed that models for the interpretation of grammatical number contain both atomistic and atomistic domains, the interpretation of numbers becomes straightforward: count nouns take their denotations from the atomistic domain and mass nouns from the atomless one. Thus, if there are but four houses *a, b, c, d* in the universe of discourse, we could take these houses as atoms of the model and begin to interpret the number inflections a root *house* could in principle have as follows.

(11′) | SINGULAR(*house*) | = {*a, b, c, d*}.

10. In addition, given join closure, these hybrid lattices would contain elements which are themselves hybrid joins of both atomistic and atomless elements. As such, they would be neither atomistic nor atomless themselves.

| PLURAL(*house*) | = {$a \cup b$, $a \cup c$, $a \cup d$, $b \cup c$, $b \cup d$, $c \cup d$, $a \cup b \cup c$, $a \cup b \cup d$, $a \cup c \cup d$, $b \cup c \cup d$, $a \cup b \cup c \cup d$}.
| DUAL(*house*) | = {$a \cup b$, $a \cup c$, $a \cup d$, $b \cup c$, $b \cup d$, $c \cup d$}.
| CODUAL(*house*) | = {a, b, c, d, $a \cup b \cup c$, $a \cup b \cup d$, $a \cup c \cup d$, $b \cup c \cup d$, $a \cup b \cup c \cup d$}.
| PAUCAL(*house*) | = {a, b, c, d, $a \cup b$, $a \cup c$, $a \cup d$, $b \cup c$, $b \cup d$, $c \cup d$}.
| MULTAL(*house*) | = {$a \cup b \cup c$, $a \cup b \cup d$, $a \cup c \cup d$, $b \cup c \cup d$, $a \cup b \cup c \cup d$}.
| MESAL(*house*) | = {$a \cup b$, $a \cup c$, $a \cup d$, $b \cup c$, $b \cup d$, $c \cup d$, $a \cup b \cup c$, $a \cup b \cup d$, $a \cup c \cup d$, $b \cup c \cup d$}.
| COMESAL(*house*) | = {a, b, c, d, $a \cup b \cup c \cup d$}.

The universal noun *house* would refer, as desired, to the set of houses taken or more at a time:

(14′) | UNIVERSAL(*house*) | = {a, b, c, d, $a \cup b$, $a \cup c$, $a \cup d$, $b \cup c$, $b \cup d$, $c \cup d$, $a \cup b \cup c$, $a \cup b \cup d$, $a \cup c \cup d$, $b \cup c \cup d$, $a \cup b \cup c \cup d$}.

And, crucially, the couniversal noun *house* would now have something different to refer to. It would be that portion of the atomless domain that corresponds to house-stuff. This would be the stuff that constitutes the houses in the universe of discourse taken jointly – *and every part thereof*. Thus, if $a \cup b \cup c \cup d$ represents the houses in the universe of discourse taken jointly, and if $m(a \cup b \cup c \cup d)$ represents the stuff that constitutes it, then the reference of the couniversal noun *house* would be the set containing $m(a \cup b \cup c \cup d)$ *and every part thereof*:

(22) | COUNIVERSAL(*house*) | = $\{x \in E: x \leq m(a \cup b \cup c \cup d)\}$.

This set is known as the ***ideal*** generated by $m(a \cup b \cup c \cup d)$, and can be represented more succinctly as

$$E|m(a \cup b \cup c \cup d).$$

Notice that the universal noun *house* would also denote an ideal – except that it would be generated by $a \cup b \cup c \cup d$ instead:

$$E|a \cup b \cup c \cup d.$$

Thus, if all count roots are universal in number (as Wackernagel proposed), then all roots, be they count or mass, would denote ideals of the model. And, since ideals are Boolean lattices in their own right, nominal roots would be miniature universes of discourse – microcosms of the universe of discourse.

Notice that this view can account for all the facts in (10) above. All that needs to be said is that grammatical processes may discriminate between atom-

istic and atomless domains of the models for the interpretation of grammatical number. Numerical quantification, for example, would require atomistic structures (or portions thereof). As would secondary oppositions of number, singular and plural quantification, modification in terms of size and shape, ranking, and *one*-anaphora. On the other hand, nonnumerical quantification in terms of *much, little*, and so on, would call for atomless structures instead.

This, in essence, is the account developed in Link (1983), which has deservedly become the classic account of the semantics of mass nouns. Similar formulations have been advanced, be it in terms of *ensembles* by Bunt (1985) or in terms of *mereologies* by Massey (1976), Wald (1977), and Ojeda (1993). Unfortunately, this account has its shortcomings as we will now see. For ease of reference, we will say that the model in question is the Platonic model. We do this on account of the dualism it invokes: a world of number for the interpretation of count nouns and a world of stuff for the interpretation of count nouns.

The Inherent Plurality Hypothesis for Mass Nouns faltered because it brought mass nouns too close to count nouns. The Platonic view stumbles because it pulls these nouns too far apart. Take *furniture* and *piece*(*s*) *of furniture*, for example. One of these nouns is mass and the other count. Under the Platonic view, they cannot be coextensional, as one of them denotes atomless entities whereas the other one denotes atomistic ones. Consequently, they are distinct. And, since they are spatial, they cannot occupy the same space at the same time. The same points can be made crosslinguistically with English *furniture* and French *meubles*. The English noun is mass and the French, count. Hence they cannot refer to entities that occupy the same space. Even if they are to be translated into one another.

Notice that we are not demanding that these nouns be synonymous (which they cannot be). In fact, we are not even demanding that they be coreferential. We are only demanding that they be coextensional (that they occupy the same space at the same time). In fact, we should demand that they be coextensional as a matter of principle, and not just as a matter of fact.

But there is another, more fundamental problem with this account. It is that everything in the universe of discourse seems to have parts. Take for example a chair. We can certainly speak of part of it. And of part of part of it. In fact, for all I know, we can continue to speak in this way indefinitely. It is true that part of a chair is not a chair anymore. But this is beside the point. What's important is not that it is a chair, but that it exists. It is true that this part-taking will have to stop in the real world, as we would hit splinters, wood molecules, carbon atoms and their elementary particles. But this does not affect talk about the world. While chairs might be finitely divisible in universes of scientific discourse, they seem to be infinitely divisible in universes of ordinary discourse.

The point can be made not just about chairs, but about anything we can talk about. Including human beings, which are the prototypical individuals. Take the speaker (on any given occasion of linguistic use). Notice that he or she may be said to have parts. Witness the following monologue.

(23) *Part of me agrees with you and part of me doesn't. Of the part of me that agrees with you, some of it is selfish and the rest selfless. Part of the part that is selfless is proud of it while the rest is sorry…*

Clearly, this monologue could be continued. Indefinitely. What this means is that the "individual" uttering this monologue is not an atom of the model, but is in fact atomless. Now, if nothing in the universe of discourse is an atom, nothing can be atomistic either, and the difference between atomless and atomistic domains collapses into a fully atomless model. And, with it, the Platoic account of the difference between count nouns and mass.

6. The semantics of grammatical number: An Aristotelian view

If every entity one can talk about is divisible *ad infinitum*, then it is clear what needs to be done: the models for the interpretation of grammatical number must be made atomless. This amounts to adding one more postulate the preceding eight. It is this.

M9. $\forall x[\bot < x \,.\!\rightarrow] \exists y[\bot < y \,.\!\wedge.\, y < x]]$ (*Atomlessness*)

But making models atomless brings us back to square one! For how are we now to interpret the difference between singulatives (universals) and collectives (couniversals)? How, indeed, are we to account for the difference between count and mass in general? For key to our account of these differences was the assumption that models for the interpretation of number had to be neither fully atomistic nor fully atomless. The inherent plurality model seemed to fail us for being fully atomistic, while the model we are presently contemplating seems to fail for being fully atomless.

Fortunately, there is a way to account for the difference between count and mass within fully atomless models. It involves carving out atomistic domains from atomless ones. To be more specific, let us assume that all models for the interpretation of grammatical number abide by **M9** and are, therefore, completely atomless. Now take any such model and pick from its universe a pairwise-disjoint subset.[11] Call this subset *F*. To keep things intuitive, make sure *F* is not empty.

11. As might be surmised, a subset of the universe is ***pairwise-disjoint*** if every pair of elements in it is ***disjoint*** – i.e. if their meet is the bottom element $\bot$ of the model.

In fact, make sure that it has at least two elements. And that none of them is the bottom element ⊥ of the model. Now close *F* under the join and meet operations defined above. This set forms an atomistic lattice under the partitive relation of the model as a whole. We have indeed carved out an atomistic structure out of an atomless one. Note that the elements of the constructed domain are *fully atomistic within the constructed structure* while remaining *fully atomless within the model as a whole*.

Structures such as the one we have just constructed can be used to interpret count nouns, as we will soon see. The atoms of the structure we have carved out are the pairwise-disjoint elements we started from. And, being pairwise disjoint, the meet of any two of these atoms will be the bottom element ⊥ of the model.

To illustrate, let us take the Breton mass noun *geot* 'grass'. Suppose we were to interpret it in a fully atomless model. We could do so by assigning it, the set of all entities (one can talk about) that are grass. This means we would assign it the set consisting of (a) the entity that represents the sum total of grass in the world, and (b) every entity that can be said to part of that sum. In other words, if *g* were the sum total of grass in the world, *geot* would be assigned $E|g$ which, as will be remembered would be the ideal in *E* generated by *g*. This ideal is an atomless structure.

To account for the singulative *geotenn* pick, for each blade of grass, the grass that constitutes that blade. Gather these amounts of grass in a set *F*. Notice that *F* is pairwise disjoint, as blades do not share the grass that makes each up. Now close *F* under joins and meets. We have an atomistic structure that consists of (the amounts of grass that constitute) each blade of grass, the sums of those amouns, and the bottom element ⊥ of the model. This atomistic structure is what the singulative *geotenn* can be given to denote.

It should be pointed out that both the denotation of *geot* and the denotation of *geoteen* are Boolean lattices in their own right. At least when taken in conjunction with the reflexive closure of the partitive relation (or with the relevant portion thereof). Just like the model as a whole. Thus, we can recover, in this atomless setting, the intuition that nominal roots are miniature universes of discourse – microcosms of the universe of discourse.

Yet, for all the similarities between them, we can still can discriminate between singulatives and collectives (or between count nouns and mass). And discriminate in an intuitive way: singulatives denote individuated domains whereas collectives denote nonindividuated ones. Thus, we can assign distinct interpretations to them. And to all the other grammatical numbers as well. The interpretations will be the same as those in (11') and (14') above. The only caveat here is that *a, b, c, d* are, like every other proper entity in the universe, atomless.

Morphologically, the singulative inflection can be taken to denote a function that maps an atomless lattice into an atomistic lattice. If the two lattices share their top – or, equivalently, if the relevant pairwise-disjoint subset *partitions* the top of the atomless lattice – then the function is a *homomorphism* that will fold the atomless lattice onto itself and telescope it into an atomistic lattice.

Incidentally, it should be clear that this singulative function is not unique, as there are many ways to telescope an atomless lattice into an atomistic one (one per partition of its top if we limit our attention to homomorphisms). But this *indeterminacy of individuation* is mirrored by the facts of language. The Arabic singulative *samakat* of a collective *samak* 'fish' may refer either to an individual fish or to an individual serving of fish – say, a dish or a portion therof (see the discussion of the *singulatives of specification* in Wright 1933, I, 147). The Breton singulative *gwinizen* of the collective *gwiniz* 'wheat' can be glossed either 'stem(s) of wheat' or 'field(s) of wheat' (see (15) and (16) above). Still, it is to be expected that not all possible individuations will be actualized. And that of the ones that are, some will be more common than others. We assume that this is to be handled by systems of knowledge and belief which are independent of grammar (see Ojeda 1992a).

It should be noted that a complete interpretation of the classifier construction is also available under the Aristotelian view: classifiers denote nouns in the universal grammatical number that combine, both with numerals and with mass nouns (say, via set-theoretical intersection). The combination of a classifier and a numeral imposes a *quantitative* restriction on the denotation of the classifier (it yields the set of entities of a particular measure); the combination of a classifier with a mass noun places a *qualitative* restriction on the denotation of the classifier (it yields the set of measured entities of a particular kind). Due to observations made originally by Greenberg, it seems that the classifier combines first with the numeral to produce a nominal that subsequently combines with the mass noun

Like its predecessor, the view we have just developed can account for all the facts in (10) above. All that needs to be said, again, is that grammatical processes may discriminate between atomistic and atomless domains of the models for the interpretation of grammatical number. Numerical quantification, for example, would require atomistic domains (or portions thereof). As would secondary oppositions of number, singular and plural quantification, modification in terms of size and shape, ranking, and *one*-anaphora. On the other hand, nonnumerical quantification in terms of *much, little*, and so on, would call for atomless domains instead. The only thing to bear in mind is that the domains in question are, in the present setting, *sublattices* rather than *ideals* of the model.[12]

12. A subset of a lattice is a ***sublattice*** thereof if the subset in question is closed under joins and meets (as taken in the lattice as a whole).

By the way, here we reach a point where it actually makes a descriptive difference whether we take models to be lattices or Boolean algebras. For, notice that the domains against which count nouns and mass nouns are to be interpreted are sublattices of the model (seen as a lattice); they are not subalgebras of the model (seen as an algebra). The reason for this is that subalgebras need to be closed under absolute complementation (i.e. complementation as taken in the algebra as a whole); sublattices do not have to. Even if they are Boolean. Boolean sublattices only have to be closed under relative complementation (i.e. complementation as taken in the sublattice). So speaking of lattices rather than algebras gives us natural substructures (i.e. sublattices) to interpret nouns against.

Finally, it should be borne in mind that the difference proposed between count and mass nouns is not so wide so as to prevent them from being coextensional. For, if all the grass comes in the form of blades and all blades are made entirely of grass, then *geot* and *geotenn* both denote the one and only entity that represents the sum total of the grass in the world. The difference between them is only that one individuates this sum while the other one does not (it partitions it fully instead).

7. The collective numbers

The view we have just developed draws heavily from Krifka (1989) and has much to recommend it. Yet, it comes at a price. It is that we need to recognize that count nouns are not interpreted in terms of ideals, but in terms of weaker (or more general) structures: sublattices. Now, as it turns out, this need for weaker structures comes solely from count nouns. For they are to be interpreted in terms of structures defined not in terms of *atomicity* but only in terms of the weaker (or more general) property of *pairwise-disjointness*.

Interestingly, the choice of pairwise-disjointness over atomicity could have been justified independently of the difference between count nouns and mass nouns. In fact, it could have been made with yet another family of grammatical numbers. They are what we will call the collective numbers.

To introduce this new number, let us point out that some languages have two series of numerals; one to count individuals and the other to count collections of individuals. In English, we may see this second series of numerals, albeit faintly, in enumerations by pairs or by sets:

(24) *one pair of scissors, two pairs of pants, three pairs of glasses, …*

In other languages, the collective series is distinguished *morphologically* from the series of individual numerals, and is therefore easier to spot. Languages marking this morphological distinction can be found in the Italic, Germanic, Baltic, Slavic,

and Indic branches of Indo-European (Brugmann 1907). Beyond Indo-European, languages marking this distinction are Finnish (Hurford 2003, §3.3.3.3), Mongolian (Bosson 1964, §11.6), and Greenlandic (Kleinschmidt 1871). The first numerals from each of these series are given, in citation form, in (25) for Latin, in (26) for Icelandic, and in (27) for Finnish.[13]

(25) INDIVIDUAL: *ūnus, duo, trēs, quattuor, …*
COLLECTIVE: *ūnī, bīnī, trīnī, quaternī (or quadrīnī) …*

(26) INDIVIDUAL: *einn, tveir, þrír, fjórir,…*
COLLECTIVE: *einir, tvennir, þrennír, fernir,…*

(27) INDIVIDUAL: *yksi, kaksi, kolme, neljä,…*
COLLECTIVE: *yhdet, kahdet, kolmet, neljät,…*

Now, as it turns out, there are nouns that combine with collective numerals (and not with individual numerals). We will say that these nouns belong to a new family of grammatical numbers: the ***collectives***. This family comprises several grammatical numbers as members. To introduce them, let us begin by considering *pluralia tantum* like *scissors, pants*, and *glasses* – of which there are quite a few:

(28) a. *scissors, clippers, nippers, forceps, shears, tongs, tweezers, pliers, snuffers, bellows,…*
b. *pants, underpants, slacks, (blue)jeans, khakis, shorts, trunks, knicker(bocker)s, breeches, pantaloons, drawers, briefs, tights, panties, leggings,…*
c. *(eye)glasses, sunglasses, spec(tacle)s, shades, bifocals, contacts, clip-ons, binoculars,…*

They are all morphologically plural. And they are syntactically plural as well. Yet, they may combine, in one and the same form, with all collective numerals *one pair, two pairs* – and so on:

(29) *one pair of scissors, two pairs of scissors, three pairs of scissors,…*

We are therefore bound to assign them not to the plural but to the universal grammatical number – the ***collective universal*** grammatical number, in fact. This point was seen clearly in Jespersen (1924, 197), who wrote that

> when we say *my spectacles, his trousers, her scissors*, no one can tell whether one pair or more are meant […] the plural forms *spectacles, trousers, scissors*, in themselves thus, from a notional point of view, denote a 'common number' [i.e. a *universal* number].

13. See Ojeda (1997b, §§2, 5) and the references cited there.

So what should the collective universals in (28) denote? It might be claimed that they denote the same thing as individual universals, and that their "plurality" is nothing but a semantically void lexical idiosyncracy. But this does not seem plausible. First, the forms in (28) can all be enumerated by pairs. How could this be explained if their "plurality" were semantically void? Where would this duality come from? Also unexplained would be the fact that, as shown in (28), entire semantic classes would call for the same lexical idiosyncracy – the scissor class, the pants class, and the glasses class. Beyond this, notice that the "plurality" of these forms survives the morphological operations of clipping in English (30) and diminutive formation in Spanish (31). Why the resilience of an idiosyncracy?

(30) *spectacles / specs*
blue jeans / jeans
clip-on glasses / clip-ons

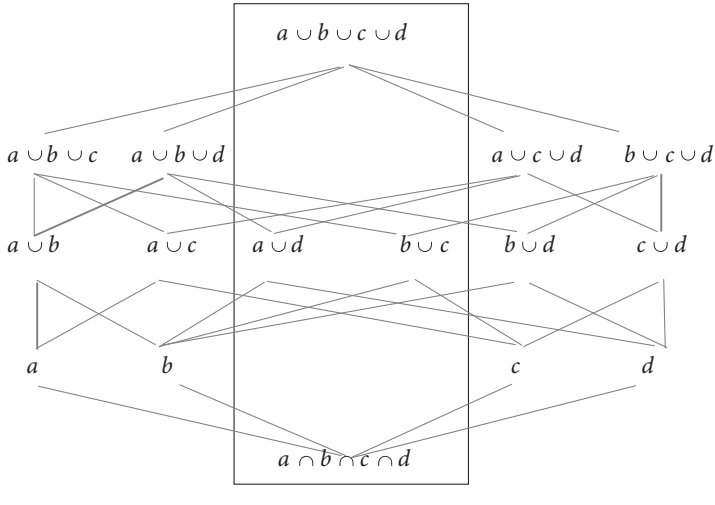
(31)

par(es) de tijeras / tijeritas	'pair(s) of scissors / small scissors'
par(es) de anteojos / anteojitos	'pair(s) of glasses / small glasses'
par(es) de pantalones / pantaloncitos	'pair(s) of trousers / small trousers'

And then there is the fact that these forms are *pluralia tantum* in language after language after language. How can they be lexically idiosyncratic in all of them?

So the nouns in (28) do not seem to be individual universals with semantically void lexical idiosyncracies. We therefore need special denotations for them. We propose to interpret each of these nouns as the closure, under joins and meets, of the individual pairs it contains. Thus, if there are but two pairs of scissors in a universe of discourse, and if one of these pairs is constituted by *a* and *d*, and if the other is constituted by *b* and *c*, then *scissors* would denote the set enclosed below.

(32)



Notice that this interpretation explains why a noun like *scissors* is counted by pairs (its denotation is generated by a set of pairs). It also explains why it is a *plurale tantum* in the first place. And why this plurality extends to entire semantic classes, survives morphological processes, and recurs crosslinguistically. The reason for all of these facts is that the plurality in question reflects a fundamental fact about the meaning of the word *scissors*: its denotation contains nothing but collections of individuals (in this case, these individuals are scissor blades, even if they are not necessarily referred to as such – or even if they are not commonly referred to at all).

We conclude that the collective number shows that we need to interpret nouns as closures of pairwise-disjoint sets. And this even if we did not have mass nouns to contend with.[14]

It should be pointed out that collective univerals do not have to name things taken two at a time; they can name things taken three at a time. Or more than three at a time, for that matter. To illustrate, let us turn to Finnish. It follows from the evidence in Corbett (2003) that this language has two universal numbers. One of these universal numbers is individual, is enumerated with individual numerals, and refers to individual entities; the other universal number is collective, is enumerated with collective numerals, and refers to collections of individual entities. Examples of these enumerations are given in (32)–(35). Following standard usage, we are describing individuals as *singular* (SG) and collectives as *plural* (PL). And this for numerals as well as for nouns.[15]

(33) a. *yksi* *hammas*
one.NOM.SG tooth.NOM.SG
'one tooth'

b. *yhdet* *hampaat*
one.NOM/ACC.SG tooth.NOM/ACC.PL
'one tooth-set; one denture'

(34) a. *kaksi* *kätä*
two.NOM/ACC.SG hand.PART.SG
'two hands'

b. *kahdet* *kadet*
two.NOM/ACC.PL hand.NOM/ACC.PL
'two pairs of hands'

14. It should be clear that $a \cup d$ and $b \cup c$ are correctly taken to be pairwise-disjoint, as two distinct pairs of scissors do not have common parts.

15. The singular numeral for *one* appears and governs a distinct nominative; the other numerals appear in the nominative/accusative and govern the partitive in the singular and the nominative/accusative in the plural.

(35) a. *kolme* *saapasta*
three.NOM/ACC.SG boot.PART.SG
'three boots'
b. *kolmet* *saappaat*
three.NOM/ACC.PL boot.NOM/ACC.PL
'three groups of boots'

(36) a. *neljä* *kuppia*
four.NOM/ACC.SG cup.PART.SG
'four cups'
b. *neljät* *kupit*
four.NOM/ACC.PL cups.NOM/ACC.PL
'four cup sets, typically four cup-and-saucer sets'

So collective universals can refer to pairs as easily as they can refer to collections other than pairs.[16]

Collective universals can also be found, albeit less systematically, in Japanese *huuhu* 'one or more married couples' (Martin 1975, p. 152; Ito 1999, pp. 8f), in Italian with the feminine plurals *ginocchia* 'pair(s) of knees', *ossa* 'one or more sets of skeletal remains', *mura* 'one or more sets of walls of a building or a city' (cf. Ojeda 1995), and in Uzbek *lablar* '(upper and lower) lips,' whose singular *lab* means one or more lips (Kononov 1960, §81).

But the universal is not the only collective number. There is also the ***collective plural***. This would be the class of nouns which can combine with collective numerals other than the numeral for *one* (but not with the collective numeral for *one*). An instance of such a number comes from Serbo-Croatian *teladi* 'two or more collections or kinds of calves' (Ojeda and Grivičić 2003). Other instances of this number come from nouns bearing what looks like a double plural marking – a peculiar phenomenon found from Scottish English (37) to Burushaski (38).[17]

(37) *shu-in-s*
shoe-PL-PL
'shoes of two or more people' (Jespersen 1954, II, §5.793)

(38) *tili-en-čin*
saddle-PL-PL
'two or more pairs of saddles' (Lorimer 1935, p. 46)

But it is perhaps in Arabic and in Breton where doubly marked plurals have received the most attention. According to a traditional grammar of Arabic,

16. See Ojeda (1997b) for more details.

17. I have documented the expression *two frieses*, pronounced [tʰu fɪajzɪz], for 'two sets of (French) fries' in the course of language acquisition (ROB, age 11).

> Necessity sometimes leads to pluralization, as to dualization of the plural. The broken plural is sometimes pluralized, when they mean to intensify the multiplication, and to notify different kinds of that sort, by assimilation of the [simple] plural expression to the singular. (Howell 1900, 1071)

Examples are as follows (see Fischer 1972, §106):

SINGULAR	SIMPLE PLURAL	DOUBLE PLURAL
rahṭun 'tribe'	*ʔarhuṭun* 'association of tribes'	*ʔaraahiṭu* 'associations of tribes'
yadun ' hand'	*ʔaydin* 'assistance'	*ʔayaadin* 'assistances'
baladun 'village'	*bilaadun* 'land'	*buldaanun* 'lands'

It is true that these plurals have been relexicalized. Yet, it is conceivable that they had a more general meaning at first (if they do not still retain the collective meaning in their full generality).[18] In any event, I assume that the SINGULAR is in fact an individual universal, that the SIMPLE PLURAL is in fact a collective universal, and that the DOUBLE PLURAL is our collective plural.

Along similar lines, the Breton singular *bugel* 'child' pluralizes once as *bugale* and twice as *bugaleou* – the latter with the meaning 'two or more bands of children'. But the collective plurals of Breton can be gleaned more clearly from its so-called "plurals of the dual". These are morphological duals that undergo pluralization as indicated below (see Pedersen 1913, §412 and Trépos 1957, p. 227).

(39)

DUAL	PLURAL OF A DUAL
daouarn 'pair of hands'	*daouarnou* 'pairs of hands'
divrec'h 'pair of arms'	*divrec'hiou* 'pairs of arms'
divorzed 'pair of thighs'	*divorzidi* 'pairs of thighs'
dichod 'pair of cheeks'	*dichotou* 'pairs of cheeks'
daoulagadou 'eyes of one person'	*daoulagadou* 'eyes of several persons'

Here I assume that the DUAL is a collective universal and that the PLURAL OF A DUAL is a plural collective. As might be expected, paired body parts like hands, arms, thighs, cheeks, and eyes tend to pluralize duals; when they pluralize singulars, however, they often have special nonphysiological senses. Thus, the plural of the singulars *dorn* 'hand' and *skouarn* 'ear' have developed the special senses of 'handles' – where the latter are actually ear-shaped (Trépos 1957, p. 227).

We conclude this section with a third collective number – the ***collective dual***. As might be expected, this is the class of nouns that may combine with the collective numeral for two (and with no other numeral). Examples can be provided from Arabic, where they are considered "duals of plurals" (Howell 1900, pp. 855f, 1085; Wright 1933, I, p. 191; Fischer 1972, §108b):

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18. See Ojeda (1992, 319f).

SINGULAR	PLURAL	DUAL OF A PLURAL
jamalun 'male-camel'	*jimaalun* 'male-camel herd'	*jimaalaani* 'two male-camel herds'
rumḥun 'spear'	*rimaaḥun* '[clump of] spears'	*rimaaḥaani* 'two clumps of spears'
aṣlun 'principle'	*uṣuulun* 'group of principles'	*uṣuulaani* 'two groups of pples.'

In short, we have collective numerals as well as individual ones. What collective numerals do for us here is show is that we need to recognize nominal roots that denote closures of pairwise-disjoint sets – not closures of atoms. Such closures are what the universals denote; closures minus the pairwise-disjoint set are what collective plurals denote; joins of exactly two pairwise-disjoint entities is what the collective duals denote.

8. The conceptional neuter

English displays an interesting contrast between *everything* and *every thing*; between *something* and *some thing*; and between *nothing* and *no thing*:

(40) *everything* / *every thing*
something / *some thing*
nothing / *no thing*

Intuitively, the one-word noun phrases seem to make stronger statements than the two-word noun phrases. Thus, to like everything seems to be more than to like every thing; to like nothing is to like even less than to like no thing. And liking some thing entails liking something – but not the other way around.

In some languages, these distinctions are marked inflectionally. Thus, in Modern Standard Spanish we have these contrasts in seven series of pronouns. Two of these series are personal (stressed or unstressed); three are demonstrative (proximal, medial, distal), and two are quantificational (existential and nonexistential).[19] Following received wisdom, these contrasts are presented below as contrasts of gender between masculines, feminines, and neuters:

19. Medieval Spanish marked this contrast in other series of pronouns. As did other Ibero-Romance dialects. Thus, Medieval Spanish had the emphatic demonstratives *aquéste/aquésta/aquesto* and *aquése/aquésa/aqueso*; Portuguese has the pronouns of universal quantification *todo/toda/tudo*; Judeo-Spanish has the relative series *cual/cuala/cualo*, and Asturian has the interrogative series *cuál/cuála/cualo* (see Ojeda 1993, p. 164ff).

	Masculine	Feminine	Neuter
Stressed	*él*	*ella*	*ello*
Unstressed	*el*	*la*	*lo*
Proximal	*éste*	*ésta*	*esto*
Medial	*ése*	*ése*	*eso*
Distal	*aquél*	*aquélla*	*aquello*
Existential	*alguno*	*alguna*	*algo*
Nonexistential	*ninguno*	*ninguna*	*nada*

It is the contrast between the neuters and the nonneuters that I would like to describe here. To fix intuitions, let us look at some clear examples.

(41) a. *El bueno me gusta.*
'The good one$_{MASC}$ pleases me.'
b. *La buena me gusta.*
'The good one$_{FEM}$ pleases me.'
c. *Lo bueno me gusta.*
'What is good pleases me.'

(42) a. *Éste es bueno.*
'This [thing$_{MASC}$ / stuff$_{MASC}$] is good.'
b. *Ésta es buena.*
'This [thing$_{FEM}$ / stuff$_{FEM}$] is good.'
c. *Esto es bueno.*
'This is good.'

(43) a. *Alguno es bueno.*
'Someone$_{MASC}$ / Some thing$_{MASC}$ is good.'
b. *Alguna es buena.*
'Someone$_{FEM}$ / Some thing$_{FEM}$ is good.'
c. *Algo es bueno.*
'Something is good.'

(44) a. *Ninguno es bueno.*
'None$_{MASC}$ / No-one$_{MASC}$ / No thing$_{MASC}$ / is good.'
b. *Ninguna es buena.*
'None$_{FEM}$ / No-none$_{FEM}$ / No thing$_{FEM}$ is good.'
c. *Nada es bueno.*
'Something is good.'

What is the neuter/nonneuter contrast about? For starters, it is not a contrast of gender. For, as the facts above suggest, the adjective root *buen-* 'good' has only two gender inflections: the masculine and the feminine. There is no third neuter ending. And this is no accident of the data in (41)–(43). There is no third ending for adjectives in all of Modern Standard Spanish.

The point could have been made from English, of course. For recall that the contrast in force here is akin to the contrasts in (40) above. But there was nothing about gender there; English does not even have grammatical genders.

So what is the *so-called* neuter/nonneuter contrast about? We get a lead to what this contrast is really about from Jespersen, who had the following to say about a series of pronouns he had described as *conceptionally neuter*.[20]

> *Something great* refers to a 'mass'; and has no plural, *some great thing* [on the other hand] has the plural *some great things*, referring to 'countables' […] the difference between *nothing new* and *no new thing* corresponds to the distinction between mass-words (non-countables) and thing-words (countables) […] This explains the distinction [made in] *I have not done anything good nor said any good thing* […] Like other mass words, *nothing* may be combined with *much* [though not with *many*; cf *nothing much* vs *nothing many*].
>
> (Jespersen 1954, II, §§5.213 & 17.323f)

As we see it, the association with mass reference is real, but it is derivative of the generality with which these conceptional neuters refer. It is derivative of this generality *and of the claim that the universe of discourse is a mass domain*.

To be more precise, let me claim that conceptional neuterality is, in essence, quantification over the entire universe of discourse. Conceptional nonneuterality, on the other hand, is quantification over a subset of the universe of discourse. The association with mass reference now follows from this – and from the claim that the universe of discourse as a whole is a mass domain.

In some cases, the restriction to a portion of the universe is induced by anaphora. Consider again (41a) and (41b). As it turns out, the NPs in them are anaphoric. They presuppose that some portion of the universe of discourse is antecedently given, by a noun that is referred back to. In Spanish this is done implicitly; in the English gloss it is done explicitly with the anaphor *one*. Interestingly, no such anaphora is required for the interpretation of (41c), which refers directly or deictically – just like its English gloss does. This is because there is no need for an anaphor to restrict the quantification of the neuter; the neuter quantifies over the entire domain of discourse.

In other cases, the restriction to a portion of the universe is not induced by anaphora but is still implicit. Consider again the nonneuters in (42) and (43). The pronouns therein can refer deictically to entities in the universe of discourse. Perhaps through some gestural means. No anaphora would be involved there. But these nonneuters can also refer anaphorically via an implicit noun. Thus, (42a) could be preceded by

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20. See Jespersen (1924, pp. 241ff).

(45) *Este libro es malo, pero …*
'This book is bad, but …'

Now the pronoun in (42a) will only quantify over books thanks to an anaphoric reference to the antecedent noun *libro* 'book'.

The association that the Spanish conceptional neuters have with mass reference is substantial. For, like Jespersen's forms, the Spanish neuters lack plurals, whereas their nonneuter counterparts do not. This follows from the claim that neuters quantify over the entire universe of discourse. And from the fact that the universe of discourse is atomless Or at least mass. For then there would be nothing to pluralize in it.

Notice that it follows from this that Spanish neuters will, like Jespersen's forms, reject the Spanish equivalent of *many*. For, since neuters are not consistent with plurality, they cannot tolerate *many*, which is a plural form; they can only tolerate the equivalent of *much*, which is not a plural form.

Beyond this, we may point to the fact that questions regarding the identities of the entities referred to by the neuters must involve *qué* 'what' rather than *cuál* 'which'; questions regarding the identity of entities referred to by the nonneuters, on the other hand, involve *cuál* 'which' rather than *qué* 'what':

(46) a. *¿Cuál es el que te gusta?* 'Which is the one you like'
b. ≠*¿Qué es el que te gusta?* ≠ 'What is the one you like?'

(47) a. **¿Cuál es lo que te gusta?* * ['Which is what you like?']
b. *¿Qué es lo que te gusta?* What is what you like?

This can be accounted for if we assume, as seems natural, that *cuál* 'which' presupposes an individuation which *qué* 'what' does not.

Also relevant in this regard is the pervasiveness of the morpheme *-un-* in the morphologies of the nonneuters. This morpheme of course means *one*, and is the prototypical morpheme of individuation. Particularly revealing in this regard is the role this morpheme plays in (43), where it is solely responsible for turning a neuter into a nonneuter. What the morphology seems to be telling us here is that the nonneuter *alguno* arises simply from the addition of individuation to the assertion of existence conveyed by *algo*.

But the association between neuters and mass reference is clearest in Nonstandard Spanish dialects, namely in the vernaculars of Asturias, Santander, and Valladolid. For, as it turns out, the neuters we have been talking about are not only "conceptional" in these varieties; they can also have nouns as antecedents. Crucially, however, these nouns must be mass.[21] Thus, in the Asturian city

21. I believe similar phenomena held widely in Standard Spanish as well – but not in modern times (see Ojeda 1992b, where parallelisms with Italian dialects are acknowledged as well).

of Sobrescobio the following examples have been documented by Conde (1978, pp. 141, 145, 151f, 160f, 184, 232ff).

(48) *apúrrime la mermelaa eso*
'pass me the jam – that (one)' (*eso* ⇒ the jam)

(49) *sácai a sustancia too*
'take all the substance from it' (*tóo* ⇒ the substance)

(50) *la carne ta cociéndose, nun toques dello*
'the meat is cooking; don't touch (of) it' (*ello* ⇒ the meat)

(51) *abía [un pan] lo más fino*
'there was a bread – the finest one' (*lo* ⇒ the bread)

It should be noted that this semantic agreement with the neuter is so strong in these vernaculars that it trumps the syntactic agreement with the masculine and the feminine. Thus, in Standard Spanish, the forms in (48)–(50) would be the feminines *esa, toda*, and *ella*. In (51) the Standard unstressed pronoun would not be with a feminine, but it would still be only the masculine *el*, not the neuter *lo*.

What seems to be going on here is that the neuter/nonneuter distinction found throughout Spanish in the pronominal system extends in these vernaculars to the nominal system, where it is used to mark the count/mass distinction. The reason that it can extend in this way is, presumably, that it was already marking that distinction in the pronominal system – at least if the universe of discourse is a mass domain as well. So the view that the universe of discourse is a mass domain is further supported by these facts.[22]

9. Challenges for the Aristotelian view

The proposals we have advanced face a number of serious challenges. The first of these questions whether mass terms in fact refer to atomless domains. After all, matter is not atomless, science assures us. Or energy, for that matter. The same can be said about footwear (when it individuates as shoes) or about luggage (when it individuates as bags). And perhaps of furniture as well. For, as has been often observed, while pieces of furniture seem to be furniture, the parts of these pieces do not. This is the challenge of *Atomlessnes*.

22. Some accounts in the literature claimed that the point of conceptional neuters was to allow quantification over entities which were neither fully atomistic nor fully atomless (something that nonneuters could not do; see Ojeda 1993). No such doubly negative entities exist in an Aristotelian setting, where all entities are fully atomless.

Another challenge for the Aristotelian deals with measure nouns – nouns like *meter, kilogram*, and *second*. On the one hand, measure nouns are like count nouns, as they may combine with numerals; on the other hand, measure nouns are unlike count nouns, as they cannot be regarded as the closure, under joins and meets, of a set of pairwise-disjoint entities (two meters, kilograms, or seconds may overlap). So measure nouns are count nouns that do not denote atomistic domains. In fact, they denote fully atomless domains. This is the challenge of *Measurement*.

A third challenge for the Aristotelian view deals with *Singularity*. For, we began by interpreting singularity as atomicity. Evidence drawn from collectives and other nouns prompted us to generalize and interpret singularity as pairwise-disjointness instead. And for the reasons mentioned in the preceding paragraph, measure nouns may well prompt us us to generalize, once again, and interpret singularity as pairwise-incomparability. Yet, there are singular nouns that seem to denote pairwise-comparable entities. The clearest examples are nouns for entities conceived in terms of sets – like *interval, space, series, set, collection, cluster, bundle*, and *group*. For one group can be part of another group, and one interval can be part of another interval. Also clear are nouns and nominals denoting quantities – like *amount, quantity, clump* (*of grass*), *body* (*of water*), *blob, hunk, wad* (perhaps less clear are more specific examples – say *twig*. For here one might want to claim that this noun always refers to a set of pairwise-disjoint entities, although what these entities are may vary from model to model. Thus, something that counts as a twig on one occasion of linguistic use may be but part of what counts as a twig on a different occasion of use).

The Aristotelian model for the interpretation of grammatical number is an atomless Boolean lattice. But atomless Boolean lattices are shocking in their number and variety. In fact, it can be shown that, if c is an infinite cardinality, then there will be 2^{2^c} atomless Boolean lattices of cardinality 2^c, where no two of these lattices are isomorphic.[23] In other words, for every nondenumerable cardinality there will be an incommensurably larger number of Aristotelian models of that cardinality. Do we need all of them to interpret grammatical number? If not, how do we begin to choose the ones we need? This is the challenge of *Proliferation* that the Aristotelian model raises.

Preliminary investigation into these challenges suggests that they can all be met, and that the Aristotelian view may prevail. Unfortunately, space limitations prevent us from reporting on these investigations here. We must therefore leave them for another opportunity.

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23. See Monk (1989, 482) for the corresponding proof for complete Boolean algebras.

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Comparatives in Brazilian Portuguese

Counting and measuring

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Comparatives in Brazilian Portuguese show that Bale and Barner's (2009) generalizations do not hold cross-linguistically; this leads to reconsidering the role of cardinality in mass and count syntax. The paper discusses contrasts in the use of naturally atomic, or object, mass nouns in Brazilian Portuguese and English. Brazilian Portuguese has a productive bare singular, which is analysed, following Pires de Oliveira and Rothstein (2011) as an object mass noun with a count counterpart. However, in comparative constructions it does not behave as Bale and Barner predict. We give an account of the relation between counting and measuring which explains the data and we show, using data from Hungarian, that the contrasts with English are not unique to Brazilian Portuguese.

Keywords: semantics, comparatives, bare singulars, measuring, counting, Brazilian Portuguese

Bale and Barner (2009) give a taxonomy of noun-types based on the behavior of nouns in comparative constructions. They make a number of generalizations about nominal behavior, and focusing on the properties of so-called 'fake mass nouns' like *furniture*, they propose a theory of the mass-count distinction. In this paper we argue that data from Brazilian Portuguese show that their generalizations cannot be correct. This leads us to reconsider the properties of fake mass nouns and, as a consequence, the basis of the mass-count distinction. In Section 1, we review their generalizations about comparative constructions. In the second section, we discuss data from Brazilian Portuguese which is a problem for their approach and which will lead us to reconsider how comparative constructions work. In Section 3 we will investigate naturally atomic (object) mass nouns in English. The fourth section is devoted to data from Hungarian which supports our general approach. In Section 5, we make a proposal about the semantics of comparison in counting and measuring contexts which we think throws some light on the data we discuss. Section 6 explains an outstanding difference between

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comparison with English flexible nouns and comparison in Brazilian Portuguese. In the conclusion, we stress the major result of this paper, namely that mass nouns are measurable predicates, while count nouns are countable predicates.

1. Bale and Barner (2009)

Bale and Barner argue that comparative constructions yield two crucial generalizations: (i) flexible nouns always denote individuals when used with count syntax as in (*three*) *stones* and never denote individuals when used with mass syntax as in *some stone*, and (ii) object mass nouns such as *furniture* always denote sets of individuals. The evidence for this comes from examining judgments about constructions such as *who has more X?* and *a has more X than b.* The authors claim that when a noun denotes a set of atoms or individuals, or a set of pluralities of individuals, comparison in these contexts always involves comparison of cardinalities. The count nouns in (1) involve comparisons of the number of individuals. For example (1a) is true if the number of boys in your class is greater than the number of boys in my class even if the overall volume of boys in my class is greater (e.g. the 10 boys in my class are all eighteen year old, while the 12 boys in your class are four year old)

(1) a. There are more boys in your class than in my class.
b. There are more girls in the class than boys.

With substance mass nouns such as *water* and *mud,* which denote sets of accumulations of non-individuated stuff, comparative operations compare overall quantities:

(2) a. John has more gold than Bill.
b. There is more mud on this floor than on that floor.

In (2a), the amount of gold that John has, its volume or weight, is compared to Bill's. The sentences in (2) do not allow comparison of the number of individual instances of the substance, since in the denotation of these nouns there are no individuals.

One of the main points that Bale and Barner make concerns object mass noun such as *furniture, jewelry, footwear*. Chierchia (1998, 2010) called these fake mass nouns, Rothstein (2010) called them naturally atomic mass nouns, and Schwarzschild (2011) refers to them as "stubbornly distributive predicates". As Rothstein and Schwarzschild both show, grammatical operations have access to the atoms in their denotation, for example, the predicate *big* distributes over the natural atoms. Consider, for instance, the sentence in (3), said to movers who are emptying the house (from Rothstein 2010):

(3) Please take the big furniture down first.

In (3), *big furniture* means big pieces of furniture. Barner and Snedeker (2005) show experimentally that comparisons of object mass nouns involve comparing numbers of individuals:

(4) a. John has more furniture/jewelry than Bill.
b. That baby has more footwear than her mother!

Bale and Barner argue that this indicates that object mass nouns denote individuated structures, and have the semantic properties of count nouns despite their mass syntactic properties. They suggest that all nouns, mass and count, are derived from root nouns, √N. Root nouns denote either individuated (i.e. atomic) or non-individuated (i.e. non-atomic) semi lattices.[1] Root nouns combine with a functional head which determines whether the lexical item used is mass or count: the mass head denotes the identity function and thus maps non-individuated lattices onto non- individuated lattices, and individuated lattices onto individuated lattices. The denotation of N_{mass} is thus the same as the root noun from which it is derived. The count head denotes *IND*, which maps a non-individuated lattice onto an individuated lattice, more precisely, *IND* applies to a non- individuated lattice W denoted by the root N to yield a structure W_{count} which contains all the individual objects in N and their joins. This is the denotation of $N_{count.}$ The denotation of the singular count noun is derived from N_{count}; it denotes the set of singular individuals in W_{count}. Both plural count nouns and object mass nouns thus denote individuated, or atomic, semi-lattices and this is reflected in the fact that comparison is comparison of cardinalities in both the examples in (1) and in (4). Assuming that *piece,* like the count functional head, denotes the function from non-individuated semi-lattices to individuated semi-lattices, (4a) will have the same interpretation as (5):

(5) John has more pieces of furniture/jewelry than Bill.

Barner and Bale identify a fourth type of nouns, namely flexible nouns like *stone* and *rope* which have both a mass and a count interpretation, depending on the context:

(6) a. This garden has more stone in it than that garden.
b. This garden has more stones in it than that garden.

Flexible nouns in English are governed by their syntactic properties: where there is no overt number morphology as in (6a), they cannot be compared by the cardinality; when they are marked syntactically as count, they can only be compared by

1. Non-individuated lattices may either have non-atomic minimal parts or be continuous.

cardinality. Thus (7b) is a question about comparing cardinalities, while (7a) asks for a comparison of overall volume:

(7) a. Which garden has more stone in it?
b. Which garden has more stones in it?

Bale and Barner claims that this is predicted by their theory: the root noun √stone denotes a non-individuated semi-lattice L, and the mass noun therefore has the same denotation. The count noun $stone_c$ IND(√stone), denotes an individuated semi-lattice which is a substructure of L. Since only individuated semi-lattices permit comparison via cardinality, they explain why (7a) does not allow comparison via cardinalities, while (7b) enforces it.

From this survey, Bale and Barner conclude that: (i) nouns denoting individuated lattices are compared via cardinalities, while nouns denoting non-individuated lattices are compared along continuous dimensions; (ii) comparative constructions can be used as a test to show whether a mass noun is substance or an object, since only object mass nouns are compared by cardinality; (iii) flexible nouns are always compared via cardinalities when used as count, but never when used as mass. Bale and Barner take this to indicate that flexible nouns are truly ambiguous in the sense that mass and count denotations denote different lattices. It follows from their analysis that object mass nouns have the semantics of count nouns (since, like count nouns they denote individuated lattices) but the morpho-syntax of mass nouns. Crucially, for Bale and Barner, the *IND* operation cannot apply vacuously. This means that, since $furniture_{root}$ already denotes an individuated lattice, it cannot be the input to an operation yielding a count noun. Thus, object mass nouns, unlike *stone/stones,* can never be part of a flexible pair.

The theory has some somewhat counter-intuitive consequences. In particular, while the root of *boy* does not denote an individuated semi- lattice, the root of *furniture* does. This is surprising since [+human] nouns like *boy* are intuitively naturally atomic, while object mass nouns, at least in English, are often super-ordinates which seem to have properties of kind terms.[2] Furthermore, Bale and Barner's theory predicts that non-atomic interpretations are not available for object mass nouns, and this seems too strong. (8a) should allow for furniture pieces, in the same way that (8b) allows for dog parts:

(8) a. After the hurricane, there was furniture strewn all over the village.
b. After the accident, there was dog all over the road.

2. Borer 2005 assumes that all nouns are derived from roots which are, in Bale and Barner's terms, unindividuated. For arguments against this, see Rothstein (2010, 2017).

However, as we will see, there is a much more basic problem with Bale and Barner's theory, namely that it is based on an empirical generalization which is not correct. We will explore this first by looking at noun denotations in Brazilian Portuguese, and then return to the English data.

2. Brazilian Portuguese bare singular

Data from Brazilian Portuguese raise doubts about the validity of the three generalizations of Bale and Barner both cross-linguistically and, ultimately, in English. In Brazilian Portuguese, as in English, comparison involving count nouns is comparison of cardinalities, and substance mass nouns are compared along continuous scales, but in addition to obviously count and mass nouns, Brazilian Portuguese also allows the so-called "bare singular". Pires de Oliveira and Rothstein (2011), contra Schmitt and Munn (1999) and others, argue that bare singulars are in fact mass nouns, patterning consistently in their grammatical properties with clearly mass nouns such as *ouro* 'gold' and *petróleo* 'oil'. They support this with two lines of argument, which we summarize here (for details see the original paper). First, they argue that the *prima facie* arguments against analyzing bare singulars as mass nouns are flawed. These arguments are based on the fact that, as (9) shows, representative mass nouns like *ouro* 'gold' cannot be antecedents for reciprocals and subjects of distributive predicates. However, bare singulars are acceptable in these contexts (10):

(9) a. *Ouro pes-a duas grama-s.
gold weigh-PRS.3SG two gram-PL
Intended meaning: 'Pieces of gold weigh two grams'.

b. *Ouro realç-a um ao outro.
gold enhance-PRS.3SG one to.the other.
Intended meaning: 'Pieces of gold enhance each other.'

(10) a. *Criança (nessa idade) pesa 20 kg.*
child (at.this age) weigh-PRS.3SG 20 kg.
'Children (at this age) weigh 20 kg.'

b. *Criança briga uma com a outra.*
Child fight one with the other
'Children fight with one another.'

Pires de Oliveira and Rothstein argue that comparing (9) and (10) is inappropriate. The appropriate comparison class for bare singulars is object mass nouns. As (11) shows, these nouns are acceptable with both reciprocals and distributive predicates.

(11) a. *Mobília (da Tok&Stok) pesa 20 k*
furniture (of Tok&Stok brand) weigh-PRS.3SG 20 k
'Pieces of furniture (from Tok&Stok) weigh 20 kilos.'

b. *Mobília (da Tok&Stok) encaixa uma com a outra*
furniture (of+Tok & Stok) fit-PRS.3SG one with the other
'Pieces of furniture (from Tok&Stok) fit into each other.'

(10a) and (11a) show that the predicate *pesa 20 kilos* 'weigh 20 kilos' can be distributed to individual pieces of furniture in the denotation of the mass noun *mobília* 'furniture' as well as to individual children in the denotation of *criança* 'child' (10b) and (11b) show both *criança* and *mobília* can be antecedents for reciprocals. (11b) is acceptable in European Portuguese as well, and thus the acceptability of these sentences is not connected to the fact that the Brazilian Portuguese allows bare singular nouns.[3]

The second line of argument presented in Pires de Oliveira and Rothstein (2011) concerns the interpretation and distribution of the bare singular and mass nouns in comparison with the bare plural. Bare singular nouns and mass nouns generally have the same distribution and interpretation, and together contrast with the bare plural. For instance, bare singular and mass nouns have only a generic interpretation in the subject position of stage level predicates, while bare plurals are ambiguous between a generic and an existential interpretation:

(12) a. *Bombeiro-s estão a disposição.*
fireman-PL be.PRS.3PL at available.
'Firemen are available' OR 'Some firemen are available'.

b. *Bombeiro está a disposição.*
fireman be.PRS.3SG at available.
'Firemen in general are available.'

c. *Petróleo está a disposição.*
oil be.PRS.3SG at available.
'Oil is available.'

(13) a. *João gosta de cachorro-s.*
João like-PRS.3SG of dog-PL.
'João likes dogs in general.' OR 'João likes some dogs.'

3. An open issue is that although object mass nouns in English allow distributive readings with stubbornly distributive predicates, as shown in (3), they cannot be antecedents for reciprocals. The English correlate of (11a) is ungrammatical:

(i) * Furniture (from Ikea) fits into each other

b. *João gosta de cachorro.*
João like-PRS.3SG of dog.
'João likes dogs in general.'

c. *João gosta de suco.*
João like-PRS.3SG of juice.
'João likes juice in general.'

If the bare singular in Brazilian Portuguese is a mass noun, as the evidence suggests, then all count nouns have a mass (i.e. bare singular) counterpart. A bare singular/count pair such as *criança/crianças* 'child/children' thus form a flexible noun pair, analogous to *stone/stones* in English. They should thus comply with Bale and Barner's third generalization stated above, namely that flexible nouns are always compared via cardinalities when used as count, but never when used as mass. However, this is in fact not the case. What we see is a different generalization: count nouns must be compared in terms of cardinalities, but the choice of dimension of comparison for the mass noun is context dependent. As we will show, this holds both for the mass (i.e. bare singular) counterpart of a count term, which Bale and Barner predict not to allow comparison via cardinalities, as well as for an object mass noun, such as *mobília* 'furniture' which they claim will only allow comparison via cardinalites. Look first at the examples in (14):

(14) a. *João tem mais livro-s que a Maria.*
João have.3SG.PRES.more book-PL that the Maria
'John has more books than the Maria.'

b. *João tem mais livro que a Maria.*
João have.3SG.PRES more book that the Maria.
'John has more book than the Maria.'

(14a) only compares cardinalities, and is true only if João has a greater number of individual books than Mary, while (14b) can be used either to assert that João has a greater number of individual books than Mary, or that he has a greater volume of book(s) than she has (though fewer books). If we are comparing, say the quantity of books that they each are carrying to school, (14a) is true if João has more books, even though his bag is much lighter, while (14b) can be true either if João has a greater number of books than Maria, but also, in the right context, if he has only two very heavy books (a dictionary and an atlas) while Maria has four light paperbacks in her backpack.

The context-dependence of the dimension of comparison for mass nouns holds not just in explicit comparative constructions, but also with *quanto/quantos* N 'how much vs. how many N', and quantifiers such as *muito/muitos* N 'much N' and *pouco/poucos* N 'little N', which involve comparison between the size of the intersection of N and a set P (denoted by the predicate) and the size of the

intersection of N and the complement of P. Look at the examples in (15), ((52.b) in Pires de Oliveira & Rothstein 2011):

(15) a. *Quanto-s livro-s ele comprou*?
how-many-PL book-PL he buy.PST.PRF.3SG
'How many books did he buy?'

b. *Quanto livro você comprou?*
How book you buy.PST.PRF.3SG
'What quantity of books did you buy?

(15a) allows only for computing answer in terms of cardinality, while the mass noun in (15b) allows either a cardinal or a volume reading, and can be answered by: *duas estantes cheias* 'two shelves-full' or *200*! This holds even if plural morphology is dropped from the count noun as happens in some dialects of BrP, and the count/mass contrast is marked only on the quantifier – as in *muitos livro* 'many books'. Thus, the count quantifier forces a cardinal interpretation in (16a), but the mass quantifier in (16b) allows interpretation by cardinality or volume, depending on the context:

(16) a. *João tem muita-s caneta(-s)/muito-s livro(-s).*
João have.3SG.PRES many-PL pen(-PL)/many-PLbook(-PL)
'John has many pens/many books.'

b. *João tem muita caneta/muito livro.*
João have.3SG.PRES much pen/much book.
'John has a lot of pens/books'

Thus, if count noun/bare singulars are flexible noun pairs, Bale and Barner's third generalization does not hold, since the mass noun allows comparison either between cardinalities or along a continuous dimension.

If mass nouns in these contexts allow a context-dependent choice of dimension of comparison, then we would expect object mass nouns such as *mobília* 'furniture' to behave the same way, and in fact they do. Out of the blue, (17a) compares numbers of pieces of furniture, but context allows a different choice of dimension, for example volume, as in (17b):

(17) a. *João tem mais mobília que a Maria.*
João have.3SG.PRS more furniture that the Maria.
'João has more furniture than Maria.'

b. *João tem mais mobília que a Maria então ele vai*
João have.PRS.3SG more furniture that the Maria then he goes
precisar de uma caminhonete maior.
to need of a truck bigger.
'John has more furniture than Maria, so he will need a larger moving truck'

Brazilian Portuguese thus shows that Bale and Barner's second generalization does not hold, since object mass nouns allow comparison along different scales, while count nouns do not. The choice of dimension of comparison for object mass nouns is context dependent, whether or not the mass noun has a count counterpart, while count nouns require cardinal comparisons. This leads to the conclusion that in Brazilian Portuguese, object mass nouns and count nouns have different types of denotations.

3. Naturally atomic (object) mass nouns in English

The data in Brazilian Portuguese require us to reexamine the data in English. And indeed we find that while out-of-the-blue, comparison of naturally atomic or object mass noun denotations is via cardinalities, contexts allows comparison by other dimensions too. (18a) is felicitous in exactly the same way that (17b) is, and (18b-c) gives a similar example.

(18) a. John has more furniture than Bill, so he will need the larger moving truck.
b. Who has more jewelry to insure?
c. John got sick because he ate more fruit than Mary. She ate two apples and three strawberries. He ate a whole watermelon.

Sentence (19), from Landman (2010), shows that the dimension of comparison when evaluating *most* N can be continuous when N is an object mass noun, but not when it is a count noun.

(19) a. In terms of volume, most livestock is cattle.
b. #In terms of volume, most farm animals are cattle.

Although *livestock* and *farm animals* are synonymous, only the mass noun allows for a comparison along the dimension of volume. The conclusion is then that also in English, naturally atomic object mass nouns do not force comparison via cardinalities, and thus cannot be assumed to have the same semantics as count nouns. These conclusions are supported experimentally by Grimm and Levin (2012).

These results contradict Bale and Barner's generalisations and are extremely problematic for their semantic theory of the mass-count distinction. Cardinal comparisons are obligatory with morpho-syntactically count nouns, and not the atomicity of the predicate or the kind of lattice denoted by the predicate. Cardinal comparisons are possible with object mass nouns, but not obligatory. Thus, it seems to be some property above and beyond the atomicity of the lattices which determines the obligatoriness of cardinality comparisons with count nouns. Before discussing the implications of this, we look briefly at another language in which comparisons show the same properties.

4. Hungarian

In this section we bring data which shows that in Hungarian too, mass nouns allow context to determine the dimension of quantity evaluation. As shown by Schvarcz and Rothstein (2017), Hungarian has two question words: *hány* 'how many', which goes with count nouns, and *mennyi* 'how much', which goes with mass nouns:

(20) a. *Mennyi rizs-et vettél?*
How much rice-ACC buy-Past-2ndSG
'How much rice did you buy?'

b. * *Három / Három kiló-t.*
Three / Three kilo-ACC
'Three kilos'

(21) a. *Hány könyv van a táská-d-ban?*
How many book be.PRES.3SG the bag-POSS.2SG-in
'How many books are there in your bag?'

b. *Csak három.*
'Only three'.

c. *#Három kiló.*
Three kilo.
'Three kilos.'

The measure answer in (21c) is pragmatically odd, since *hány* (how many) asks for a cardinal answer.

Note that count nouns in Hungarian are never marked plural when they occur with *hány* or with numbers (or with most other determiners). Although Hungarian has a productive plural marker as in *könyv* 'book' vs. *könyvek* 'books', the numeral occurs only with the singular noun as in *három könyv*, literally 'three book'.

Hungarian allows *mennyi* 'how much' to combine with a bare singular noun, similar to the Brazilian Portuguese data described above:

(22) *Mennyi könyv fér a táská-d-ba?*
how much book fit-2nd SG the bag-2nd poss-suff. into
'What quantity of book fit into your bag?'

However, in contrast to (21), an appropriate answer can be either a measure expression or a cardinal quantity judgment which makes use of a number. Given the question in (23a), either the measure answer in (23b); or the cardinal answers in (23c/23d) are acceptable. In (23c) the number is inflected for comparative marker and in (23d) it is marked ACC, since it is a direct object.

(23) a. *Mennyi könyv-et tudsz cipelni?*
How much book-ACC you are able to carry?
'What quantity of book can you carry?'

b. *Három kiló-t.*
Three kilo-ACC
'Three kilos.'

c. *Három-nál nem többet Mert különben elszakad*
Three-comparative not more because otherwise break
a táskám.
the bag+possesive my
'Not more than three, otherwise my bag would break.'

d. *Hárm-at*
three-ACC
'Three'

Assuming that *mennyi* 'how much' induces a mass usage of the bare noun, volume and cardinal answers are acceptable with the mass-counterpart of the count noun in Hungarian too. In contrast, *hány* 'how many' induces a count interpretation, and allows only for cardinal readings.

5. Theoretical analysis

We have seen that count syntax forces quantity evaluations in terms of cardinalities, while object mass nouns do not require it, but allow it subject to contextual constraints. Object mass nouns, however, also allow comparisons along a continuous dimension, while count nouns do not. This strongly supports the claim that they have different denotations, and that object mass nouns allow comparison along dimensions of measure, while count nouns only allow comparison in terms of cardinality, apparently counting values. This is strong support for the proposal in Rothstein (2010, 2011) that the difference between count nouns and mass nouns can be expressed perspectivally: count noun denotations are presented as sets of countable entities, while mass noun denotations are presented as measurable. Further support for this hypothesis, based on crosslinguistic data is discussed in Rothstein (2017). Among other pieces of evidence is data from Yudja, a Tupi language spoken in the Xingu region of the Amazon. In Yudja, as Lima (2014) shows, all nouns are countable and can be directly modified by numerals. Furthermore, Yujda does not appear to have measure expressions modifying nouns, (Lima 2014, this volume) suggesting that in a language in which measure is not available, a distinction between count and mass nouns is also superfluous.

We have then the following generalization: quantity evaluation in terms of cardinalities is necessary only in cases where counting is possible, and is possible (but not necessary) only where counting is impossible. What explains these facts? This issue reduces to two much more specific questions. First if we can compare

quantities of furniture (or livestock) in terms of cardinalities as in (24a), why can't we count them? Why are (24b-d) and (25) ungrammatical?

(24) a. John has more furniture than Bill.
b. * How many more?
c. How much more?
d. * John has one more furniture/two more furnitures.

(25) * João tem mais mobília-s que o Pedro
João have.3SG.PRES more furniture-PL that the Pedro

The second question is really the converse of the first. If mass nouns are not countable, how can we compare them in terms of cardinality? We stay agnostic (for the moment) about exactly how to represent the denotation of the mass noun. There are various different possibilities, - mass nouns denote kinds (Pires de Oliveira and Rothstein 2011), sets of instantiations of kinds (Chierchia 1998), sets of variants (Landman 2010), non-stable atomic sums (Chierchia 2010), sets of parts of atomic sums – and there may, in fact be crosslinguistic variation in what mass denotations are. However, the choice between these theories is beyond the scope of this paper.

Independent of the precise nature of the mass denotation, we suggest, following Rothstein (2010, 2011) that the fundamental contrast at the root of the mass-count contrast is the distinction between measuring and counting. Counting is putting entities in one-to-one correspondence with the natural numbers. It may be grammatically encoded in the plural morphology as in English and in Brazilian Portuguese or it may be lexically conveyed as in Hungarian, but it always involves individuating atomic entities. Singular count nouns denote sets of grammatically salient individuated atoms, and plurality closes this set under sum. Count nouns make the atomic elements in their denotation grammatically salient, and counting is possible. Measuring is assigning an overall quantity a value on a scale and does not involve individuation. Mass nouns denote lexical pluralities which can be measured.

Rothstein (2010) argues that atomicity is relative to context, and proposes encoding atomicity by indexing count nouns for the particular context relative to which their atomic structure is determined. Since counting presupposes a particular atomic structure, only count nouns, indexed for a particular context, have countable denotations. Mass nouns do not allow a set of atoms to be identified grammatically, and thus the linguistic operation of counting is impossible. This explains the contrast between *three pieces of furniture* / **three furnitures*: since *furniture* has no grammatically salient semantic atoms in its denotation and individuation is not linguistically encoded, items in the denotation of *furniture* cannot be grammatically counted. Classifiers allow a set of atoms to be grammatically

identified, and thus make counting possible. This answers the first of our two questions, why *furniture* is not a countable noun.

We now turn to the second question, namely how are comparisons in terms of cardinality possible with an object mass noun when counting is impossible? While mass nouns do not allow a set of atoms to be identified grammatically and counting is impossible, operations such as comparison may evaluate the relative sizes of sets in terms of their cardinality if context makes a set of natural atoms salient. This is shown in Barner and Snedeker's (2005) experimental results.

However, as Rothstein (2017, to appear) argues, comparison by cardinality does not involve counting, but measuring. Assume that measuring involves assigning a value to a quantity on a dimensionally salient scale, where a scale is a triple consisting of a dimension, a unit of measurement, and a set of values, for example, the weight scale is <Weight, Kilos, R>, and the width scale is <Width, Meters, R>. We assume that the numbers can form a cardinal scale also, <Cardinality, Natural Units, N>. When a mass predicate is naturally atomic as *furniture* and *mobília*, the cardinal scale is one option that can be made salient by context for comparisons and other measurements. Thus, the question in (26) can be translated as "which quantity of furniture has a higher value on the cardinal scale":

(26) Who has more furniture?

Answering this question may involve implicit counting, but may also involve estimation of cardinalities without counting. Thus, in the right context, (26) can be interpreted as asking for a non-cardinal scale, as exemplified in (18).[4]

6. Flexible nouns: English and Brazilian Portuguese

There remains a contrast between English and Brazilian Portuguese which needs to be explained. Both *mobília* and *furniture* allow comparison either in terms of cardinality or along another continuous dimension as shown in (17b) and (18a) above. However, with flexible nouns, including mass counterparts of count nouns, the two languages contrast. In (27), as Barner and Snedeker as well as Barner and Bale note, the English mass noun *stone* apparently allows comparison only on a continuous dimension. In (28), however, the bare singular *pedra* can be

4. Cardinal scales are discussed in more detail in Rothstein (2017). A formal theory of cardinal scales is presented in Rothstein (to appear). We refer the reader to these papers for details.

evaluated either with respect to cardinality or with respect to another continuous dimension.

(27) Which garden has more stone it in?

(28) Esse jardim tem mais pedra do que aquele.
This garden has more stone of+the that other.
"This garden has more stone than the other one."

In both languages it seems count syntax forces cardinal comparisons, while with object mass nouns, mass syntax allows either cardinal or a non- cardinal comparison. However, in Brazilian Portuguese, the mass noun in a flexible pair works like any other object mass noun, as in (28), while in English, in flexible pairs, mass syntax forces non-cardinal comparisons as in (27). Why should there be this contrast? We suggest the root of the contrast is pragmatic.

Following Pires de Oliveira and Rothstein (2011), count nouns in Brazilian Portuguese always have a mass counterpart. Assuming that mass nouns and count nouns are derived from operations on root nouns (it's irrelevant here whether these operations are lexical or syntactic), all root nouns have a mass realization, but only some have a count realization. The operation deriving count grammaticizes, and thus makes salient, the set of atoms generating the denotation. Count syntax is marked and forces comparisons in terms individuals of semantic atoms.[5] However, mass readings are grammatically the "default" case, and any aspect of their denotation can be made salient contextually, and used in comparisons. Predicates that denote naturally atomic individuals tend to be interpreted via cardinality if no other contextual clues are given, but allow for comparison along other dimensions, as we saw in examples (17) and (18). This holds for object mass nouns such as *mobília* 'furniture' as well as the mass noun partner in a flexible pair.

In contrast, English flexible nouns are comparatively rare, and mass syntax is not a default. English is an 'either-or' language: usually, either a mass noun or a count noun is derived from a root. As a consequence, in English, the choice between mass and count syntax determines the interpretation of flexible nouns: the choice of morphologically plural noun only allows for count interpretation, whereas the choice of mass privileges a non-cardinal interpretation – if the speaker wants to compare by cardinality, she should have chosen to use the count noun.

5. Pires de Oliveira and Mendes de Souza (2013) distinguish bare singulars from singular predicates which in comparisons coerce a partitive reading as in:

(i) João tem mais mesa que Pedro.
(ii) John has more table than Peter.

Thus, the mass counterpart of a flexible noun pair is specialized for a non-cardinal interpretation in English, but not in Brazilian Portuguese.

Object mass nouns, those that do not have a count counterpart, are not subject to the pragmatic constraint. Thus, *furniture* nouns allow both cardinal and continuous interpretations as we saw above, while plural count nouns only allow cardinal readings. In both languages, substance nouns only allow non-cardinal interpretations since salient natural atoms are necessary to make a cardinal evaluation possible.

Pires de Oliveira and Rothstein (2011) suggest that mass-as-default (as in Brazilian Portuguese) or 'either-mass-or-count' (as in English) may be a parameter at which languages differ, and that the contrasts in flexible noun interpretation follows from the variation at this point.

7. Summary

In this paper we distinguished counting from measuring in order to explain the pattern of behavior of bare noun phrases in comparative structures. We claimed that counting is putting atomic entities in one-to- one correspondence with the natural numbers, and that only count nouns denote sets of countable pluralities. Measuring, on the other hand, is assigning a value to a quantity on a scale without individuating its atomic parts.

Standard quantity judgments with count nouns involve counting (and not measuring), while quantity judgments with mass nouns involve measuring. But, as we have seen, quantity comparisons of mass noun denotations may apparently be comparing cardinalities. We have suggested that this is a form of measuring, which compares overall cardinality properties of quantities, but which does so without counting the atomic parts of the quantities. Measuring in terms of cardinalities assigns an overall cardinality to a quantity on a scale of natural numbers, and comparing quantities in this way involves seeing which cardinality value is higher on the scale. This kind of measuring is appropriate with a naturally atomic mass noun, in contexts when the individual entities in the denotation of the mass noun are salient, but naturally atomic mass nouns allow quantity judgments by measuring on both cardinality scales and other dimensional scales, and the context will determine which particular scale is salient. Mass nouns do not allow counting or plurality because atomicity is not grammatically encoded.

One issue that we have mentioned but not explored but which is closely connected to our proposal is the possibility of assigning cardinal properties to quantities in measuring contexts via estimation (rather than counting). This is proposed in Li and Rothstein (2012) for a construction in Mandarin where normally count

classifiers are used in syntactic contexts associated with measure classifiers. Space constraints prevent us from exploring the syntax and semantics of estimation any further here, and we leave this to future research.

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Lexical, syntactic, and pragmatic sources of countability

An experimental exploration of the mass-count distinction

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In this chapter, we suggest that the meanings of mass and count nouns result from the interaction of three components of language – lexical roots, syntax, and pragmatic inference. We begin by providing a brief history of early work on the mass-count distinction, and show how the experimental literature gradually converged on the idea that the mass-count distinction is rooted in quantification, rather than in the object/substance distinction. Next, we review experimental evidence suggesting that the mass-count distinction is asymmetric, such that although children and adults expect count nouns to denote individuals, they think that mass nouns can denote a wider range of phenomena including objects, substances, and actions (whether individuated or not). Based on these data, we propose a model in which count syntax takes unindividuated semantic representations as input, and specifies quantification over countable individuals, while mass syntax leaves the measuring dimension up to individual semantic representations, such that some nouns quantify according to mass/volume, while others are lexically specified for individuation and thus quantify according to number. Finally, we suggest that although syntax and lexical semantic representations help determine whether a noun denotes countable individuals, they do not specify which countable individuals they denote. Drawing on evidence from young children's surprising failures in countIng object pieces as whole objects, we propose that nouns themselves do not encode full conceptual criteria for individuation, but instead encode partial criteria that are filled out pragmatically, by contrasting alternative descriptions of objects and their parts.

Keywords: individuation, countability, language development, conceptual development, pragmatics

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1. Introduction

Language provides a system of mental representation that encodes meaning at multiple levels. When a speaker utters a sentence, inferences regarding its meaning can be derived from its grammatical structure, from the lexical meanings of the individual words that are used, and also via pragmatic inference – by considering how the chosen utterance contrasts with alternative utterances that the speaker might have uttered but chose not to.

Among the many case studies of meaning that linguists have investigated, the mass-count distinction may offer the clearest window into how lexical, syntactic, and pragmatic processes interact. The mass-count distinction is not only among the most studied semantic topics in linguistics, but is also heavily studied by philosophers, psycholinguistics, developmental psychologists, and neuroscientists. Researchers in these areas have made striking progress in understanding the cognitive underpinnings of the distinction, their origins in development, how conceptual representations get linked to grammar, and how pragmatic inferences are used to enrich semantic meanings in online processing.

In the present chapter, we provide an overview of this remarkable progress, and how the mass-count distinction provides a way forward for understanding other domains of linguistic meaning, and a model for interdisciplinary language research. In this chapter, we focus on the semantic notion of countability. We begin by sketching a history of how countability has been measured in philosophy, psychology, and linguistics, and what the sum of this evidence suggests about its representation both at the lexical and syntactic levels. Further, we argue that a complete model of the compositional semantics of the mass-count distinction ultimately depends on a theory of lexical concepts, and how lexical items encode criteria for individuation (or countability). We argue that this problem remains unsolved in the current literature in large part because theories of concepts attempt to explain too much, and that some of the most difficult phenomena are explained when lexical meanings are enriched via pragmatic contrast. To make this case, we present evidence from children's surprising failures to count whole objects until relatively late in development.

2. Lexical and syntactic sources of countability

Since at least the 1950s, the mass-count distinction has acted as a productive test case for understanding the relationship between language, semantic content, and perception. The topic has been studied by linguists, starting in the modern era with Jesperson (1924) and Bloomfield (1933), and picked up in the 1960s and 70s

by philosophers of language like Quine (1960, 1969), Parsons (1970), and Burge (1972), among others (see also Pelletier, 1979, 2010, and articles therein). Since then, the topic has been studied extensively across disciplines, including formal semantics (Bach, 1986; Bunt, 1979, 1985; Chierchia, 1998, 2010; Gillon, 1992; Higginbotham, 1994; Krifka, 1989, 1995; Link, 1983; Moltmann, 1997, 1998; Verkuyl, 1993; Rothstein, 2010) psycholinguistics (Barner, Wagner, & Snedeker, 2008; Gillon, Kehayia, & Taler, 1999; Iwasaki, Vinson, & Viglioooc, 2010; Markman, 1985; Wisniewski, Imai, & Casey, 1996), neuroscience (Grossman, Carvell, & Peltzer, 1994; Mondini, Angrilli, Bisiachhi, Spironelli, Marinelli, & Semenza, 2008; Vigliocco, Vinson, Martin, & Garret, 1999), language acquisition (Barner & Snedeker, 2005, 2006; Bloom, 1999; Brown, 1973; Gathercole, 1985; Gordon, 1985, 1988; Macnamara, 1982; Soja, 1992; Samuelson & Smith, 1999; Subramanyam, Landau, & Gelman, 1999), and by cross-linguistic researchers interested in variability in the expression of mass and count syntax (Cheng & Sybesma, 1998, 1999; Chien, Lust, & Chang, 2003; Krifka, 1995; Li, Barner, & Huang, 2008; Matsumoto, 1987; Senft, 2000; Yamamoto & Keil, 2000) and the effects such variability has on semantic content and non-linguistic thought (Barner, Inagaki, & Li, 2009; Barner, Li, & Snedeker, 2010; Gentner & Boroditsky, 2001; Imai & Gentner, 1997; Li, Dunham, & Carey, 2009; Li, Ogura, Barner, Yang, & Carey, 2009; Lucy, 1992; Mazuka & Friedman, 2000; Soja, Carey, & Spelke, 1991; Srinivasan, 2010).

The range of topics covered by this now vast literature is heterogeneous. However, this interdisciplinary approach has flourished – in a way almost completely foreign to other areas of semantics – because of a central assumption that count nouns denote kinds of countable atoms, and that these atoms correspond to psychological representations of objects and abstract individuals. Perhaps few other psychological phenomena are understood as well as object perception and individuation – a topic that has received experimental attention since the Gestalt psychologists, and which has subsequently been studied in work on visual attention, object tracking and permanence in infancy, and numerical cognition in adults, infants, and non-human animals, among others. Thus, unlike in many areas of semantics, the study of the mass-count distinction has benefitted from a well-articulated psychological theory of conceptual content, to which formal semantic representations might correspond. As a consequence, theories of the mass-count distinction generate predictions that can be readily tested using simple experimental methods. Since we know what an individual is – both semantically and psychologically – we can ask whether claims about the relationship between mass-count syntax and individuation are supported by experimental evidence – whether it be from psycholinguistics, neuroscience, or language acquisition.

Here, our purpose is to provide a non-exhaustive overview of the history of experimental efforts to understand the semantics of the mass-count distinction,

with a focus on how lexical concepts and syntactic structures interact to generate meaning. Our proposal is that the mass-count distinction cannot be properly understood if it is treated as a distinction between classes of words (i.e., lexical categories), though lexical meanings are critical to restricting the interpretation of nouns and their use as mass and count. Instead, we argue that some nouns (e.g., *shoe*) have semantic and conceptual content which, when used in grammatical contexts that license individuation – e.g., count syntax – generate specific individuated meanings (e.g., such that *a shoe* labels one whole shoe). Other nouns do not provide such criteria for individuation (e.g., *water*), and thus are either uninterpretable when used in count syntax, or result in coerced meanings (e.g., *a water* is a contextually specified unit of water). Critically, although objects and substances are prototypical instances of entities denoted by count and mass nouns respectively, we argue that a focus on these ontological classes is ultimately misleading in the case of the mass-count distinction, and that the formal semantic distinction must be captured at a more abstract level.

2.1 Early experimental studies of the mass-count distinction: Objects and substances

Experimental research on the semantic content of mass and count nouns has a relatively long history in psychology, dating back to at least Roger Brown, who conducted one of the first studies of word extension in children (Brown, 1957), spawning a wave of studies over the following five decades. Brown's experiment was important, both because it created a method for assessing how grammatical categories relate to meaning, but also because it created a precedent for how to understand the mass-count distinction, as rooted in the ontological distinction between objects and substances.

In his experiment, conducted with a small group of 3- to 5-year-old children, Brown presented subjects with a scene depicting "a pair of hands performing a kneading sort of motion, with a mass of red confetti like material … piled into a blue-and-white striped container." Thus, the scene depicted an action (kneading), a substance (confetti), and an object (the container). Brown next presented three words to describe the scene (*niss, sib*, and *latt*), which were presented in different grammatical frames, intended to indicate status as count noun, mass noun, or verb. For example, in one case the word *sib* was used to describe the action of kneading as follows: "Do you know what it means to *sib*? In this picture you can see *sibbing*. Now show me another picture of *sibbing*."[1] If the word was presented as

1. It is generally not noticed that Brown's verb condition presented the novel action word in *mass* syntax two out of the three times it was used (i.e., in the gerundive form *sibbing*). This

a count noun, children heard, "Do you know what *a sib* is? In this picture you can see *a sib*," etc. And for the mass presentations, children heard, "Do you know what *sib* is? In this picture you can see *some sib*." For the nouns, children were asked at test, "Now show me another picture of *a sib* / of *some sib*."

At test, children were asked to map the new word to one of three pictures, which held constant either the object, the substance, or the action. What Brown found is that children strongly preferred the object-match when the word was first presented as a count noun, that they preferred the substance-match when presented with the mass noun, and that they preferred the action-match when the word was presented in a verb context.

Subsequent studies, conducted in the several decades since, have replicated these findings and extended them in a variety of ways. Early among these efforts was a word extension experiment by Katz, Baker, and Macnamara (1974), which showed that still younger children (22- to 24-month-olds) differentiated count nouns from proper nouns (see also Gelman & Taylor, 1984). Later studies, which focused more directly on mass and count nouns, repeatedly found that children are more likely to associate count syntax with objects, and mass nouns with substances, when given a forced choice between the two (Dickinson, 1988; Imai, Gentner, & Uchida, 1994; Landau, Smith, & Jones, 1988; Samuelson & Smith, 1999; Soja, 1992). For example, in one such study, Soja, Carey, and Spelke (1991) presented 2-year-old English-speaking children with novel referents that were either solid or non-solid, and that varied in shape. Labels for these items were presented either with what they called "neutral" syntax (e.g., *the blicket*), in count syntax (e.g., *a blicket*), or in mass syntax (e.g., *some blicket*). At test, children were then shown two stimuli, one that matched the initial item only in shape (but not substance) and the other which matched the original item in substance (but not shape). Overall, when children initially saw a solid object during training, they extended the label to a shape-matched test stimulus, but when they saw a non-solid stimulus during training they extended its label to a substance-matched test item. This was true to the same degree whether or not children received supportive (unambiguous) mass-count syntax. In a later experiment, Soja (1992) crossed the object-substance distinction with the mass-count distinction, and found that children were relatively insensitive to syntax when learning object words, but not when learning substance words. Specifically, 2 ½ year old children overwhelmingly extended words according to shape whenever these labels referred to solid things; they extended by shape 90% of the time when the label was used in count

suggests that children are quite happy to map nouns to actions – somewhat contrary to the conclusion generally drawn from this work, that children map verbs to actions, and nouns to either objects or substances. We return to this issue when we discuss abstract mass nouns.

syntax and 76% of the time when it was used in mass syntax. For non-solids, however, children showed a much bigger effect of syntax: they extended by substance 91% of the time when they were labeled with mass nouns, but only 51% of the time when labeled with count nouns (suggesting that about 50% of the time, they extended according to shape when non-solid substances were labeled with count nouns).

Similar results have been found repeatedly in subsequent studies (Dickinson, 1988; Imai & Genter, 1997; Imai, Gentner, & Uchida, 1994; Landau, Smith, & Jones, 1988; Samuelson & Smith, 1999; etc.). Children strongly assume that count nouns label objects (or non-solid portions), but accept mass nouns more freely as labels for either substances or objects. For example, in one study Subrahmanyam, Landau, and Gelman (1999) found that 3-year-old children extended a novel noun labeling a solid entity by shape 90% of the time when it was introduced as a count noun, and 86% of the time when it was introduced as a mass noun. This shape bias for mass nouns declined somewhat with age, but nevertheless remained at 30% in adult subjects, suggesting that even mature speakers of English are willing to accept objects as referents of mass nouns. Also, critically, the tendency to accept mass nouns as labels for objects is even greater when the novel referents have complex shapes, suggestive of a function. In a word extension study by Barner and Snedeker (2006), both 3-year-olds and adults extended novel mass nouns by shape more than 50% of the time (62% and 53%, respectively) when the nouns labeled complex solid objects. Thus, for these stimuli, there was a slight preference to extend mass nouns according to shape, rather than substance.

These studies of how subjects relate the mass-count distinction to objects and substances suggest three conclusions. First, there is not a 1-to-1 mapping between mass-count syntax and the object-substance distinction. While count nouns are often used to label objects, subjects of all ages are also willing to accept objects as the referents of mass nouns, even when substance interpretations are readily available (e.g., in a two alternative forced-choice task). Second, because children are *less* likely to associate mass-count syntax with an object-substance distinction than adults, the object-substance distinction is almost certainly not the foundation of the mass-count distinction in language acquisition. Third, not only does the object-substance distinction fail to capture how children interpret mass and count nouns, but it also doesn't capture the subtleties of adult usage. In particular, adults often extend count nouns to label portions of non-solid stuff, which are not in any normal sense "objects" (e.g., "Two *waters*"). Thus, although objects and substances may be prototypical referents of count and mass nouns, the actual mass-count distinction appears to have a more abstract foundation, which may be appreciated from early in language acquisition.

Some early work on the mass-count distinction, conducted in the 1980s and 90s argued for this more abstract analysis, drawing upon intuitions from formal semantics and the philosophy of language. In one such study, conducted as a test of so-called semantic bootstrapping theories of language acquisition (Braine, 1992; Fodor; Grimshaw, 1981; Macnamara, 1982; Pinker, 1984; Schlesinger, 1971; see also Gentner, 1982), Gordon (1985) hypothesized that children were relatively unconcerned with the object-substance distinction when classifying nouns as mass or count, and that instead they cared more about the syntactic profiles of words, such that they would accept a substance noun as count or an object noun as mass. In his experiment, Gordon presented 3-, 4-, and 5-year-olds with either a solid object, a collection of solid objects, or a portion of non-solid stuff (e.g., in a test tube), and then presented one of two labels: "This is *a garn*" (singular count) or "This is *some garn*" (mass). Children were then shown either a collection of things like those shown during the object training (if the training stimulus was a solid object or collection) or a set of test tubes containing the non-solid substance used during training (if they were trained with the non-solid), and were told: "Over here we have more…". Children were then prompted to complete the phrase, as in the classic Wug test (Berko, 1958). What Gordon found was that most children pluralized the novel word – e.g., *garns* – when they were presented with a single solid object labeled with a singular count noun. However, when they were presented a collection of solid objects or a portion of non-solid stuff, and heard the stimuli labeled with mass syntax – "This is *some garn*" – they almost never used the plural, suggesting that their use of the plural was conditioned on the syntax of the training sentence, rather than on the ontological status of the training stimulus (i.e., its status as object or substance).

From this study, Gordon argued that the mass-count distinction is not learned from the object-substance distinction, and that in adults it is also more abstract, and related to the quantification of *individuals*, which include not only objects, but also more abstract things like events, ideas, and actions. While not necessarily a new idea among linguists, Gordon's proposal was controversial among developmental psychologists at the time, who had hoped to anchor syntactic learning in transparent categories that could be identified independently of language. To these psychologists, it seemed unlikely that young children could identify abstract individuals for the purposes of acquiring the semantics of the mass-count distinction, without already having acquired that distinction in the first place, scaffolded by an ontological object-substance distinction.

However, around the same time that Gordon was conducting his experiments, others were studying abstract mental representations in preverbal infants, using subtle looking time measures. In one early study, for example, Starkey, Spelke, and Gelman (1983) found that when 6- to 8-month-old infants were presented two

images – one depicting two objects and the other depicting three – they preferred to look at the image that matched a subsequent auditory sequence of either two or three sounds (see also Féron, Gentaz, Streri, 2006; Izard, Sann, Spelke & Streri, 2009; Kobayashi, Hiraki, Mugitani, & Hasegawa, 2004). Based on such results, Starkey et al. argued that infants must represent numerosity amodally, such that they can compare number across objects and sounds. Later studies supported this idea that infants and older children represent number amodally, and thus that they can represent and compare abstract individuals. Infants notice numerical differences between sequences of jumps (Sharon & Wynn, 1998; Wynn, 1996), and between numbers of collections (Wynn, Bloom, & Chiang, 2002), and can extract individual actions from continuous sequences of ongoing events (Hespos & Saylor, 2009). Older children, who are just learning to count objects, also happily count abstract individuals like jumps (Wagner & Carey, 2003; Wynn, 1990). Also, based on Gestalt cues like common motion, they can learn nouns that label collections of objects (Bloom & Keleman, 1995).

Later work, described in the following section, fortified this view that children's early grammatical mass-count distinction is rooted in individuation and quantification, rather than in the object-substance distinction. Also, using methods that test quantification, rather than reference to objects and substances, these later studies showed that the mass-count distinction is asymmetric, such that while count nouns denote individuals (or sets thereof), mass nouns can denote a wider range of phenomena including objects and substances, but also a host of other abstract phenomena, individuated or not.

2.2 Quantification over individuals and mass-count asymmetry: Evidence for lexical and syntactic sources of individuation

The main thesis of this chapter is that the meanings of mass and count nouns result from the interaction of three components of language – lexical roots, syntax, and pragmatic inference. The evidence for this idea, we believe, is provided most strongly by evidence from language acquisition. By testing how children's interpretation of mass and count nouns changes over time, we can pull apart the contributions of these three components, and show how each contributes to interpretationin a way not possible in adults.

The first step in this argument was to provide a brief history of early work on the mass-count distinction, and how in the experimental literature researchers gradually converged on the idea that the distinction is rooted in quantification, rather than in reference to objects and substances. Another important finding in this literature was that the mass-count distinction appears to be asymmetric. Although children and adults have a strong preference to link count nouns to countable

things (whether objects or portions of stuff), they do not have robust preferences for mass nouns, and can learn mass nouns that denote concrete objects.

In this section we present recent evidence in favor of both of these conclusions, based on studies of mass-count quantification. Also, we argue that the asymmetry between mass and count nouns provides strong evidence that there are both syntactic and lexical sources of individuation – i.e., that syntactic count functional heads specify individuation, whether for non-solid substances, actions, or novel phenomena, and that lexical semantic representations can also specify individuation and quantify over individuals when used in mass syntax.

In linguistics, the idea that the mass-count distinction is defined in terms of individuation (or atomic reference) emerged relatively early, and was expressed both informally (e.g., see Pelletier, 1979, and papers within), and in formal algebraic models (e.g., Link, 1983). Disagreement among these theories focused primarily on the semantic treatment of mass nouns, with relatively broad agreement with respect to count nouns, which by most accounts denote sets of atomic individuals. However,prior to recent empirical work, the distinct empirical predictions of these different approaches had not yet been tested.

According to one broad class of accounts, which we will call the Quinian Correspondence hypothesis, while count nouns divide their reference and denote countable individuals, mass nouns do not, and instead denote various types of non-individuals. A version of this idea is proposed by Link (1983, 1998) and also by many psychologists who study the mass-count distinction (e.g., Bloom, 1994, Bloom, 1999, Gordon, 1985, Macnamara, 1986; Soja, 1992; Wisniewski et al., 1996, and many more). According to Wisniewski et al. (1996), for example, language users "conceptualize the referents of count nouns as distinct, countable, individuated things and those of mass nouns as non-distinct, uncountable, unindividuated things" (Wisniewski et al., 1996, p. 271).

In favor of this idea, two linguistic tests have been proposed to show that only count nouns individuate. The first, described by Quine, is cumulative reference. According to Quine, only mass nouns refer cumulatively. For example, for a mass noun like *mud*, if A is *mud* and B is *mud*, then A and B taken together is also *mud*. In contrast, the same inference is not valid for a count noun like *shoe*. If A is *a shoe* and B is *a shoe*, it is not the case that A and B taken together are *a shoe*. However, as noted by Gillon (1996), cumulative reference, though relevant to understanding the semantics of singular and non-singular reference, does not characterize the difference between mass and count, since plural count nouns refer cumulatively: if the things in box A are *shoes* and the things in box B are *shoes*, then the things in the boxes A and B taken together are also *shoes* (see Gillon, 1996; Landman, 1991; Link, 1998; Pelletier, 1979; Schwarzschild, 1996). Thus, rather than carving out a difference between mass and count nouns,

cumulative referenceis a shared attribute of mass nouns and plural count nouns (see Chierchia 1998; Gillon, 1992, 1996).

A second and related semantic criterion for differentiating mass and count nouns was later proposed by Cheng (1973). Specifically, he argued that only mass nouns are subject to divisity of reference: a portion of *mud* divided in two arbitrary portions is still *mud*, but a *shoe* divided in two arbitrary pieces is no longer a *shoe*. However, this generalization fails to describe many count nouns, and a good number of mass nouns as well. First, many count nouns are subject to divisity: a *string*, *fence*, *rope*, *stone*, *curtain*, and *party* can each be divided into two arbitrary pieces, resulting in two individuals that can be labeled by the same count noun. Second, many mass nouns do not admit arbitrary divisity: *furniture*, *clothing*, *jewelry*, *luggage*, *underwear*, *mail*, and *ammunition* each have minimal parts, which if divided no longer count as *furniture*, *jewelry*, *luggage*, etc. Just as half a shirt is not *a shirt*, it is also not *clothing*.

In response to these problems, several linguists have argued against the Quinian view, and suggested that individuation is not restricted to count nouns. According to one such account, proposed by Gillon (1992, 1996), whereas count nouns specify reference to countable individuals, mass nouns are unspecified with respect to individuation. To determine whether a mass noun individuates, on Gillon's view, the language user must look out into the world: "World knowledge tells one that ammunition has minimal parts, or atoms, known as rounds" (p. 9). In other words, the semantics of mass and count nouns can be known by identifying what types of entities each class of word refers to in the world. Consequently, on this view, nouns that can be used flexibly as either mass or count (e.g., *a string*, *some string*) must always denote individuals both in their mass and their count forms, since to convert a noun from mass to count "requires that its denotation must be such that it has minimal parts, or atoms" (p. 28).

Chierchia (1998) proposed a similar, though stronger, idea. On his account, which he labeled the inherent plurality hypothesis, not only do mass nouns like *furniture* and *jewelry* denote sets of countable individuals, but so too do substance nouns like *mustard*, and even abstract nouns like *hope*. In these cases, atoms exist, but are either difficult to specify or vague in nature (for an alternative account of the mass-count distinction that is not based on the notion of atomicity, see Moltmann, 1997, 1998). Thus, on his view, "mass nouns come out of the lexicon with plurality already built in… this is the only way in which they differ from count nouns" (p. 53). And like Gillon, Chierchia predicted that flexible mass nouns like *hair*, *string*, and *stone* must denote the same things whether used in mass syntax or in count syntax. In reference to the Italian word for hair, *capelli*, which is a count noun unlike in English, Chierchia argued that, "Pavarotti's hair is Pavarotti's hair, whether we talk about it in Italian or in English, i.e. whether we get at it through

a mass noun or through a count noun… Yet, on most theories, Pavarotti's hair is some kind of atomless substance in English, but turns into an atomic one in Italian. If we don't want semantics to start looking like magic, we have to say that in the real world 'hair' and 'capello' obviously denote the same stuff." (p. 88)

Although the primary semantic tests for identifying nouns that individuate – e.g., cumulativity and divisity of reference – fail to differentiate mass and count nouns, proponents of the Quinian view nevertheless resist the idea that some, or perhaps even all mass nouns denote countable things. Instead, by Quinian accounts, what really matters is not how things appear in the world, but instead how these things are encoded linguistically. For example, proponents of the Quinian view propose that words like *furniture* and *jewelry* do not in fact pick out countable things like chairs, couches, necklaces, and rings, but instead cause language users to construe these entities as unindividuated masses. In the words of Wisniewski et al. (1996), "on a particular occasion, we may conceptualize a swan, several ducks, and a heron on a lake as an unindividuated group called waterfowl, and not think of them individually as birds" (p. 295). Likewise, on this view, the words *capello* and *hair* do not denote the same stuff. The first word – *capello* – denotes a kind of countable thing (i.e., an individual hair), whereas the second – *hair* – denotes a kind of substance from which individual hairs are made.

As can be seen, these two accounts of the mass-count distinction are impossible to differentiate without an empirical test of "construal" that not only captures our intuitions about uncontroversial cases, like *water* and *shoe*, but can also resolve differences about words like *string* and *jewelry*.

One such test, quantity judgment, meets these requirements, and provides two important insights into the mass-count distinction. First, as we describe below, this test shows that contrary to both Chierchia and Gillon, the presence of countable individuals in the world does not determine whether a noun individuates. Instead, as argued by the Quinian view, individuation depends on how an entity is construed, and thus depends upon which information about an entity is linguistically encoded by a word: *hair* and *capelli* do not name the same stuff in the world. Second, the quantity judgment test shows that, contrary to the Quinian view, although syntax affects construal, it does not do so for both count and mass nouns alike. In particular, although the use of a word in count syntax coerces an individuated meaning – e.g., such that *a water* must denote a countable entity – the use of a word in mass syntax does not force language users to construe its referents as unindividuated masses.

To show this, Barner and Snedeker (2005) presented 4-year-old children and adults with familiar count nouns that name solid objects (e.g., *shoe*, *candle*), substance-mass nouns that name non-solid substances (e.g., *mustard*, *ketchup*), and object-mass nouns like *furniture* and *jewelry*, which by some accounts should

not denote atomic individuals, but by other accounts should (Gillon, 1992, 1996; Chierchia, 1998). Also, they presented subjects with flexible words like *string*, *stone*, *paper*, and *chocolate*, and presented these words to some subjects using mass syntax, and to other subjects using count syntax. In these experiments, subjects saw two characters, Farmer Brown and Captain Blue, one of whom had one large object or portion (e.g., one giant shoe, or portion of mustard), and the other who had three tiny objects or portions (e.g., three tiny shoes or portions of mustard), and were asked who had more (e.g., Who has more shoes? Who has more mustard?).

As predicted by all previous accounts, subjects based their judgments on number for the count nouns (e.g., selecting three small shoes as *more shoes* than one big shoe), but on overall mass or volume for substance-mass nouns (e.g., selecting the large portion of mustard as *more mustard* than the three tiny portions). Critically, however, when tested with object-mass nouns, subjects based their judgments on number, and selected three tiny pieces of furniture as *more furniture* than one large piece, three pieces of jewelry as *more jewelry* than one large piece, and so on. Identical results were found when sets of 2 large things (or portions) were compared to 6 tiny things (or portions), and when the items came from heterogeneous kinds in the case of the object-mass nouns (e.g., when the furniture included both tables and chairs, or when mail included both packages and letters).

These results are not consistent with Quinian accounts like those of Bloom (1999), Gordon (1985), Link (1983, 1998) and others, which predict that all mass nouns denote non-individuals. For Gillon, on the other hand, judgments based on number for object-mass nouns but on mass or volume for substance-mass nouns is predicted if subjects look into the world to determine what mass nouns refer to, and formulate their judgments accordingly. And for Chierchia, these results are consistent with the idea that all mass nouns denote pluralities: atoms of furniture are chairs and tables, and thus 6 pieces of furniture contain more atoms than 3 pieces; atoms of mustard are not portions, but whatever minimal part satisfies the criteria for counting as mustard. Thus, a larger amount of mustard will contain more mustard atoms, regardless of how this portion is divided into smaller portions.

Results from flexible nouns, however, provided a key piece of additional data. On the Quinian view, the data from the quantity judgment task are only relevant if we know that the task taps into how language users construe referents, and how they are encoded linguistically – and not simply how things look in the world. Evidence that quantity judgments for flexible words shift according to their use in mass-count syntax would satisfy this requirement, and thus support the conclusion that even on a strong test of construal, object-mass nouns like furniture

individuate. On the views of Gillon and Chierchia, however, flexibility is not predicted to shift interpretation. For Chierchia, hair is hair, whether it is described as *hair* or *capello*. And for Gillon, the conversion of a noun from mass to count requires that the word pick out countable individuals when used in the mass form.

Interestingly, for words like *string*, *stone*, *chocolate* and *paper*, Barner and Snedeker found that subjects *did* shift their quantity judgments according to syntax. When words were presented in count syntax – e.g., Who has *more stones*? – subjects based their judgments on number, and selected three stones as *more stones* than one large one. When the same words were presented in mass syntax – e.g., Who has *more stone*? – subjects based their judgments on mass/volume, and now picked the large stone as *more stone* the three small ones. These results clearly show that hair is not hair by any name, and that individuation is not determined wholly by how things appear in the world. Instead, nouns can be used flexibly, and encode different semantic content when used in mass or count syntax. These results therefore are not compatible with the hypotheses of Gillon and Chierchia. Further, because they show that subjects shift their interpretation of words depending on how they are used syntactically,these results suggest that the quantity judgment task is indeed sensitive to construal. Consequently, when subjects based judgments on number for object-mass words like *furniture*, these judgments reflected how subjects construed the referents as they were encoded by mass nouns. These findings are thus difficult to explain for Quinian views, which hold that mass nouns should induce substance construals.

Instead, the data support an alternative, novel account of the mass-count distinction, with two basic generalizations:

> *Generalization 1:* All count nouns quantify by number (and thus denote countable individuals).
> *Generalization 2:* Mass nouns quantify by heterogeneous measuring dimensions, including mass, volume, and number.

By this account, the mass-count distinction is semantically asymmetric. Count syntax specifies a single measuring dimension, but mass syntax does not. Also, as noted by Bale and Barner (2009), two additional generalizations can be made regarding which mass nouns can denote individuals:

> *Generalization 3:* Nouns that denote individuals in mass syntax never denote the same individuals as count nouns.
> *Generalization 4:* Nouns that can be used flexibly as mass and count never denote individuals in their mass forms.

To explain these latter generalizations, Bale and Barner (2009) argued that count syntax takes unindividuated semantic representations as inputs, and returns individuated representations, whereas mass syntax applies an identity function to whatever semantic representation it takes as an input. Therefore, on this view, any noun that can occur in count syntax must have an unindividuated semantic representation in the lexicon, while nouns with individuated lexical representations *must* occur as mass nouns. Thus, in some sense, object-mass nouns like *furniture* are prespecified for individuation, and by virtue of this cannot also take the individuating function of count syntax, thereby explaining Generalization 3. Likewise, this model easily explains Generalization 4: only unindividuated nouns can appear in both count syntax (where they receive the individuating function) and in mass syntax (where they do not receive an individuating function, and thus take on the unindividuated interpretation).

Critically, on this model the semantic representation of the noun – whether individuated or unindividuated – is *not identical* to the concept that noun is associated with, which specifies whether the item is a kind of object, what it is made of, etc. Thus, by this account, while the word *shoe* may be associated with the concept SHOE – which may provide criteria indicating that shoes are discrete physical objects with specific properties – the semantic representation of the lexical item *shoe* is unspecified with respect to whether the noun should individuate or not, leaving this to the syntax (and thus the compositional semantics of English). However, concepts *do* determine whether an individuated meaning will be interpretable when derived grammatically. For the word *shoe* to be interpreted as a count noun, there must be some kind of countable thing that can be identified as its referent – e.g., a whole shoe – and this may be guided by conceptual criteria. Likewise for flexible words like *paper*, *chocolate*, *string*, and *stone*, and coerced meanings like "a water". Some kind of individual, whether conceptually specified or provided by context, must be available.

This idea of an asymmetry between count and mass syntax is supported not only by the data from the quantity judgment task just presented, but also by the word extension data described in the previous section. As already noted, when subjects are presented with a novel count noun that labels an unfamiliar object, they almost always assume that the noun denotes a kind of countable thing, and thus extend the word according to shape (e.g., when given a choice between an object that matches the original in shape, but not substance, vs. one that matches in substance but not shape). However, for novel mass nouns, subjects do not make such an assumption, and sometimes extend words by substance, and sometimes by shape (especially when the original object has a complex form).

Corroborating this connection between word extension and quantity judgment, Barner and Snedeker (2006) tested 3-year-olds and adults with both tasks,

using novel objects. Subjects were presented with either four "simple" novel objects or four "complex" novel objects, which were classified according to adult ratings of both complexity (in a 1–7 scale), and the appearance of having a function (also a 1–7 scale), such that complex objects were also more likely to be seen as having a function (for discussion, see Prasada, Ferenz & Haskell, 2002). Subjects were also tested with four kinds of non-solid substances, which were presented on plates in simple shapes. Each subject was presented all novel nouns either in mass syntax only, or in count syntax only. After learning a name for an unfamiliar object or portion of stuff (e.g., *tulver*) subjects were then given a word extension trial and a quantity judgment trial (with order varied across subjects). On the word extension trial, they saw a stimulus that matched the original only in shape, and another that matched only in substance, and were told, e.g., "Show me *a tulver*" (count condition) or "Show me *some tulver*" (mass condition). On the quantity judgment trial, they saw one large instance of the original stimulus (in the possession of one character) and three tiny versions (in the possession of a second character) and were asked, e.g., "Who has *more tulvers*?" (count condition) or "Who has *more tulver*?" (mass condition).

Using this method, Barner and Snedeker found that when nouns were presented in count syntax, adults extended the words by shape and based quantity judgments on number, regardless of whether the stimuli were simple or complex objects, or portions of non-solid stuff. However, when words were presented in mass syntax, judgments differed according to the nature of the stimuli. Subjects extended novel mass nouns overwhelmingly by shape and based quantity judgments on number if they were used to label complex, functional objects, and did so somewhat less so for simple objects, and less still for non-solid substances. Three-year-old children showed a similar pattern, though overall they were less sensitive to syntax than adults, and much more likely to accept objects as referents of mass nouns. Thus, as with the familiar stimuli studied by Barner and Snedeker (2005), word extensions and quantity judgments involving novel stimuli provide evidence for an asymmetry in the mass-count distinction: whereas count syntax specifies reference to countable individuals, mass syntax permits reference to countable things or to non-solid substances, and thus permits quantification by number in addition to mass/volume.

A further study using the quantity judgment method showed that this mass-count asymmetry is not specific to a small set of words like *furniture* and *jewelry*, but is instead a design feature that allows mass nouns to encode heterogeneous phenomena, and to quantify using diverse measuring dimensions. In this study, Barner, Wagner, and Snedeker (2008) presented adult subjects with written stories that described two characters, Jerry and Jake, who each performed some action described in either mass or count syntax. For example, in one scenario,

one character performed one very long dance, and the other performed three very short dances (described without mass or count syntax), and subjects were asked to judge either who did *more dances* (count condition), or who did *more dancing* (mass condition). Critically, subjects were asked these questions for a wide variety of action words, which differed according to their degree of iterativity. Prior to the study, a separate group of subjects were asked to rate a set of 45 verbs including *dance*, *cry*, *walk*, *run*, and also *jump*, *kick, step*, and *bite*, etc. according to whether they were durative or iterative. For example, for a word like *dance*, they were asked to consider sentences like "John jumped all day" or "John danced all day" and to judge whether the events described would require repeating an action over and over (iterative), or instead could be done continuously without stopping (durative). In the quantity judgment experiment, when subjects were presented with words rated as durative, such as *dance*, they based their quantity judgments exclusively on number when the words were presented in count syntax (e.g., Who did *more dances*?), but on non-numerical dimensions like time and distance when presented in mass syntax (e.g., Who did *more dancing*?). However, words that were rated as iterative, like *jump*, were interpreted differently. Now, judgments were based on number, regardless of syntax: if Jake did a greater number of jumps than Jerry (even very small ones that took much less time), subjects judged both that he did *more jumps*, and that he did *more jumping*.

These data from action words support the idea that whereas count syntax imposes number as a measuring dimension on words, mass syntax leaves this up to specific lexical items, allowing for a wide range of possible measuring dimensions. This is true of familiar words, novel object and substance words, and familiar action words too. These same intuitions can be readily obtained for more abstract words, too. To demonstrate that count syntax, but not mass syntax, imposes a uniform, commensurable measuring dimension on nouns, but that mass syntax does not, consider the nouns *hope* and *string*. Although we might know precisely how much hope we have, and precisely how much string we have, there is no single measuring dimension by which these two quantities can be compared, such that we can decide whether we have more hope than string, or vice versa. The question makes little sense. However, if we know precisely how many hopes we have, and how many strings, it is trivial to decide whether we have more hopes or strings, because both nouns are now measured according to number. Thus, count syntax can take as input two nouns that specify incommensurable measuring dimensions, and output nouns that specify number as a common measure.

As already noted, our proposal requires that a distinction be made between lexical semantic representations and lexical concepts. We have argued above that count syntax interacts with unindividuated lexical semantic representations to yield the interpretation that a noun denotes countable individuals. This implies

that lexical concepts do not yield the interpretation that a count noun denotes countable individuals. Concepts, however, may be necessary for determining *what* those countable individuals could be, and thus whether an individuated meaning will be interpretable when derived grammatically. This is evident by comparing how novel and familiar nouns are interpreted when embedded in count syntax. If we are told that a person has *a blicket*, we undertand that the person has an individual of some kind, due to the countability function of count syntax. But we do not know what kind of individual a *blicket* is, because we have not learned the concept BLICKET. In contrast, if we are told that a person has *a shoe*, we both understand that the person has an individual *and* what kind of individual it is. Because we have learned the concept SHOE, we can consult our knowledge of what counts as a shoe, which may include information about what shoes look like, what their function is, and so on. To sum up then, in mass-count languages, the interpretation that a noun denotes countable individuals may depend solely on lexical roots and syntax, but concepts may do the work of specifying what those countable individuals are.

In other languages, where no mass-count distinction exists, this separation between conceptual structure and lexical semantics may not exist in the same way. Evidence for this comes from studies of Japanese, which has no grammatical mass-count distinction. When Japanese adults are asked to make quantity judgments for novel or familiar nouns like those used in studies of English, subjects base their judgments on number if their translation-equivalents in English are used in count syntax (e.g., *shoe*, *candle*), but on mass/volume if their translation-equivalents in English are substance terms that are used in mass syntax (e.g., *mustard*, *toothpaste*; see Inagaki & Barner, 2009). Interestingly, for mass-count flexible words, like *string*, *stone*, *chocolate*, and *paper*, Japanese quantity judgments are on average directly between the mass and count judgments of English speakers for these same words. This result is important for two reasons. First, it again suggests that syntax has a strong effect on how items are construed, and that when there is no syntax, subjects face uncertainty, and sometimes choose by number, sometimes by substance. Contrary to Chierchia and Gillon, the world alone cannot determine whether or not words individuate. Second, the Japanese data suggest that words that are ambiguous in absence of mass-count syntax are precisely those words that are likely to be flexible in other languages. Not only were Japanese judgments mixed for words like *chocolate*, which are flexible within languages like English, but they were also mixed for words that vary in mass-count status across languages like *spinach*, *hair*, and *toast*, which are mass nouns in English (and lead to quantity judgments based on mass/volume) but are count nouns in French (and lead to quantity judgments based on number in speakers of Québécois; Inagaki & Barner, 2009). Thus, although the semantics of words differ across languages, as a function

of syntactic variation, it appears that the conceptual underpinnings of mass and count nouns are highly similar across languages, if not identical. Languages differ with respect to how different aspects of conceptual structure are selected by syntax, and not with respect to how concepts are represented (for additional evidence of this, see Li, Dunham, & Carey, 2009; Barner, Inagaki, & Li, 2009; Barner, Li, & Snedeker, 2010).

In this section, we have argued that quantity judgment provides a strong test of mass-count semantics that is sensitive both to psychological construal, and effects of syntax for uncontroversial words like *shoe* and *mustard*. This test reveals that flexible words like *chocolate* and *string* are interpreted differently depending on their use in mass or count syntax, and that in general whereas count syntax specifies quantification over countable individuals, mass syntax does not specify a single measuring dimension. Instead, mass syntax leaves the measuring dimension up to individual lexical items, such that in some cases (e.g., *furniture, jewelry*) nouns are lexically specified to individuate. Overall, these data suggest two sources of individuation: one syntactic (in the form of count syntax) and the other lexical (in the form of lexical specification for individuation on a subset of nouns). In languages that lack mass-count syntax, like Japanese, these measuring dimensions are mediated entirely by conceptual structure, without intervening grammatical functions to specify individuation.

In the final section, we expand on this general idea, and focus on non-grammatical sources of individuation, and in particular on the roles of conceptual and pragmatic information.

2.3 Conceptual and pragmatic sources of countability

Above, we described how syntax and lexical semantic representations help determine whether nouns denote countable individuals. Specifically, count syntax specifies the existence of countable individuals, such that when nouns are used in count syntax, they quantify according to number: If Farmer Brown has *more shoes* than Captain Blue, he has a larger number of shoes than Captain Blue. In contrast, mass syntax leaves the measuring dimension up to the semantic representations of individual lexical items, such that some nouns quantify according to mass/volume, while others are lexically specified for individuation and accordingly quantify according to number: if Farmer Brown has *more furniture* than Captain Blue, he has a larger number of pieces of furniture than Captain Blue.

Although these considerations clarify the role of syntax and lexical semantic representations in determining whether a noun denotes countable individuals, they do not specify which of the world's many countable individuals are actually in the noun's denotation. Thus, a question like "Does Farmer Brown

have more *books* than Captain Blue?" does not simply ask whether Farmer Brown has more countable individuals than Captain Blue. Instead, it provides a clear specification of what should be counted. The question directs the listener to count only the whole books that Farmer Brown and Captain Blue have, as opposed to their blood cells, gold chains, or even the pages of the books they own. But how might this work, if as we have argued, the semantic representations of nouns that can appear in count syntax are unindividuated? By most accounts, the *concepts* associated with nouns do this work, by providing criteria for individuation – i.e., for judging whether an entity is a countable individual of a particular kind (Carey, 2009; Macnamara, 1986; Xu, 2007). A full understanding of how a noun phrase denotes individuals, then, may depend not only on syntax and lexical semantic representations, but also on using the conceptual criteria for individuation associated with a noun (which as we have argued, are not part of the noun's semantic representation). In this section, we explore how such criteria may be encoded by concepts, drawing on evidence from how young children count objects.

On first glance, studies of language development suggest that children readily acquire nouns that encode full conceptual criteria for individuation. Many of the first words that children learn are count nouns that label concrete objects (Fenson et al., 1994) and children appear to use these early nouns to guide individuation appropriately. For example, when exposed to a new noun for a previously-unnamed object, three-year-olds expect the noun to label the whole object, rather than its parts (Markman & Wachtel, 1988), which suggests that children may correctly apply object nouns like *book*, *shoe*, or *fork*, to whole books, shoes, and forks, as opposed to their parts. Further, nouns appear to guidechildren's hypotheses about individuation, such that even infants expect to see two distinct objects when hearing two distinct count nouns, but to see two identical objects when hearing a single noun repeated twice, consistent with the idea that like adults, children expect individual nouns to label items of a single kind (Dewar & Xu, 2007, 2010; see also Waxman & Markow, 1995; Xu & Carey, 1996).

Recent studies, however, suggest that children actually struggle to use nouns to denote individuals in the ways that adult speakers do, suggesting that they may only gradually acquire complete lexical concepts – and full criteria of individuation –to guide their interpretation of nouns (e.g., Ameel, Malt & Storms, 2008; Wagner, Dobkins & Barner, 2013). For example, although children rapidly construct form-meaning mappings for color words, they initially use these words too broadly – e.g., labeling green, blue, and purple as "blue" – and only name colors like adults after several years (Wagner, et al., 2013; Carey & Bartlett, 1978). Similarly, children have difficulty mastering adult uses of artifact words like *bottle* and *jar*, which depend on a complex set of factors, including information about an

artifact's function, form, and process of creation (e.g., Bloom, 1996; Malt, 2010). Indeed, according to one recent report, children only converge on adult patterns of naming artifacts after a protracted period that extends into adolescence (Ameel et al., 2008).

Also consistent with the idea that young children may not possess a full set of conceptual knowledge to guide individuation, and most relevant to this chapter, is that children are surprisingly willing to use object nouns like *fork* to denote not only whole objects, but also their arbitrary parts. In a classic study, Shipley and Shepperson (1990) presented children with sets of objects, like forks, in which one of the objects had been broken into two or three arbitrary pieces. Whereas an adult will count two whole forks and a third that has been cut in half as either *two forks* or as *three forks*, children under age 7 often include broken pieces in their counts of whole objects– e.g., resulting in a count of *five forks* (Brooks, Pogue, & Barner, 2011; Shipley & Shepperson, 1990). Strikingly, children do this even though the broken pieces of the object are spaced close together, making it easy to recognize that they form a single whole object. This behavior also persists when children are asked to count only the "whole" objects (Shipley & Shepperson, 1990; Sophian & Kalhiwa, 1998), and even when the object has been broken in front of them and they had counted it as "one" just seconds before (Brooks et al., 2011). Critically, such behavior is also not limited to counting tasks, as children treat broken pieces as kind members when interpreting nouns more generally (Brooks et al., 2011). For example, when asked to "touch every *shoe*" or to "place a *shoe* in the circle", four-year-olds touch broken pieces of shoe, and are happy to place a broken shoe-piece in a circle. Together, then, these findings suggest that in contrast to adults, children do not restrict nouns like *shoe* to apply only to specific countable individuals like whole shoes.

So how might children begin to act like adults, and restrict their application of nouns like *shoe* only to whole objects? One possibility is that children's concepts initially encode only partial criteria for individuation, explaining their errors, but that these concepts are ultimately revised by age 7, when children stop making errors. For example, prior to age 7, children's concept SHOE could allow any object with shoe-like properties to be counted as *a shoe*, but such criteria could later be revised to allow only whole shoes to be counted as *shoes*. Thus, there may be a discontinuity between children's and adults' concepts, with only adult concepts providing full criteria for individuation. One reason to doubt that this is the case, however, is that children under age 7 do not treat all broken parts of objects as kind members. For example, when four-year-olds are presented with two whole bicycles and a third that has been broken into functional, nameable parts (e.g., into frames and wheels), children are less likely to count the broken bicycle-parts

as *bicycles*, and more likely to exclude them from their counts like adults (Brooks et al., 2011).

The fact that 4-year-olds exclude functional parts from their counts of whole objects butcontinue to include arbitrary parts in their counts until age 7 suggests an alternative hypothesis about how children begin to count like adults. In particular, children may begin to count like adults not because of conceptual change, but instead through a developing pragmatic ability to contrast what a speaker said with what they *could* have said (Clark, 1987, 1990; Grice, 1969). For example, when asked to "count the bicycles," children may infer that functional parts like wheels shouldn't be counted, because if the experimenter had wanted them to be counted, she would have said to "count the *wheels*". Thus, four-year-olds may not count wheels as *bicycles*, because they recognize that *wheel* is a better, more informative description of a wheel than is *bicycle*. In fact, children may not even need to know what functional parts like wheels are called to exclude them from their counts of whole objects: by non-linguistic criteria alone, parts like wheels may stand out as different kinds of objects than whole objects like bicycles, because they possess distinct, unique functions.[2] By contrast, children of this age may continue to count arbitrary parts of objects (e.g., pieces of fork) as kind members, both because these parts do not have unique functions, and because children may fail to access better descriptions for these parts than whole object labels: e.g., *fork* may be the best available description children have for pieces of fork.

Importantly, by this account, children do not ultimately achieve an insight through which lexical concepts like FORK or SHOE begin to specify full criteria for individuation. Instead, older children's and adults' concepts may be quite similar to those of young children, and may provide only partial criteria for individuation. However, older children and adults may behave differently from younger children because they may contrast their use of whole object labels against a wider set of alternative expressions, including not only nouns that label functional parts of objects (e.g., *wheel*), but also measure phrases that apply to arbitrary parts of objects (e.g., *piece of fork*, *half of shoe*, etc.). Thus, older children and adults may identify relevant countable individuals not because their lexical concepts provide full criteria of individuation, but instead via pragmatic inference, by contrasting whole object nouns with alternative expressions on-line. Critically, this approach lightens the explanatory burden traditionally placed upon concepts: concepts

2. Indeed, consistent with this, children exclude functional parts from their counts of whole objects (e.g., wheels from their counts of bicycles) more often than they are able to name them (e.g., to label them "wheels"; Brooks et al., 2011).

do not need to provide full criteria to restrict reference to whole objects, but can instead provide partial conditions that are enriched pragmatically. This may help make sense of why all theories of concepts to date have faced problems in explaining how concepts restrictreference to kind members (for discussion, see Laurence & Margolis, 1999): these theories may be attempting to explain too much.

The proposal outlined above predicts that children under age 7 should be capable of excluding parts from their counts of whole objects when these parts have unique functions, or when they have unique labels. To test these predictions, Srinivasan, Chestnut, Li & Barner (2013) presented children with sets of whole and broken novel objects, and manipulated whether these objects were broken into arbitrary or functional parts, and whether these parts were labeled or unlabeled. Thus, in one condition, children learned the name of a novel object (e.g., "This is a *zerken*"), and were then presented with a set containing two whole novel objects and a third broken into arbitrary pieces, and were asked to enumerate the set using the novel object label (e.g., "Can you count the *zerkens?*"). To assess whether labels are sufficient for the exclusion of arbitrary parts, in another condition children also learned a name for an arbitrary part of the novel object before being asked to count the set (e.g., "This is a *zerken*. And do you see this part? This is a *tamble*"). Finally, to probe the role of functional information, Srinivasan et al. (2013) also included two conditions in which children were taught the function of the novel object (e.g., "A *zerken* is for stirring juice"), and in which the novel object was broken into functional parts rather than arbitrary parts prior to the counting phase. To explore whether labels are necessary for excluding functional parts, these conditions also manipulated whether children learned a unique label for a functional part prior to counting.

Consistent with the predictions of the pragmatic account, children were more likely to exclude the broken parts of objects when these parts were functional or had been labeled. In particular, although children often counted arbitrary parts when they had not received unique labels, they were significantly less likely to do so when these parts had received labels, consistent with the idea that labels are sufficient for excluding parts. Further, children counted functional parts significantly less often than they counted arbitrary unlabeled parts, independent of whether the functional parts had been labeled or not, providing evidence that functional information is also sufficient for excluding parts.

The fact that the label manipulation affected whether arbitrary parts were excluded, but not whether functional parts were excluded, suggests that labels may be critical to how arbitrary parts are excluded. Thus, children under age 7 may include arbitrary parts, like pieces of shoe, in their counts of whole objects, like shoes, because they cannot access better descriptions for these parts than whole object labels. One possibility, then, is that young children have simply not learned measure phrases, like *piece of shoe* or *half of fork*, and do not understand that these

phrases are better descriptions of pieces of objects than whole object labels. This could preventchildren from inferring that a request to "count the forks" implies that only whole forks, and not arbitrary parts of forks, should be counted.

To explore when children begin tounderstand measure phrases and how they contrast with whole object labels, Srinivasan and colleagues probed three- and four-year-old children's comprehension using two tasks. In the verbal forced choice task, children were presented with a set – e.g., of two whole shoes, or of a single shoe cut in half – and then heard one character describe the set using a whole object label (e.g., "Farmer Brown says it's two shoes"), and a second character describe the set using a measure phrase (e.g., "Captain Blue says it's two pieces of shoe"), and were asked which character said it better. Meanwhile, in the semantic forced choice task, children were presented with a single description (e.g., "Can you point to two shoes") and chose between two referents of that description (e.g., between a set containing two whole shoes and a set containing two pieces of shoe). Interestingly, by age four, children were well above chance on each of these tasks, suggesting that by this age, children have learned measure phrases and understand how they contrast with whole object labels.

The fact that four-year-olds have acquired measure phrases but still fail to exclude arbitrary parts from their counts of whole objects suggests that children's difficulty stems not from an ignorance of measure phrases, but instead from an inability to spontaneously generate these phrases as alternative descriptions of arbitrary object-pieces. Consistent with this, in an earlier study, when measure phrases weren't explicitly presented to children as alternatives (as they were in the forced choice tasks described above), they often accepted whole object labels as descriptions of arbitrary parts, and this predicted whether they included arbitrary parts in their counts of whole objects (Srinivasan et al., 2013). Thus, children's counting of broken objects may indeed be explained by their ability to spontaneously consider measure phrases as contrasting alternatives to whole object labels.

Interestingly, a similar account has been proposed to explain why young children often fail to compute scalar implicatures until age six or seven: e.g., to judge that "some of the horses jumped over the fence" is an infelicitous description of an event in which all of the horses jumped over a fence. Just as in the case of measure phrases and whole object labels, when children are explicitly presented with more informative descriptions in these cases – e.g., "All of the horses jumped over the fence" – they readily recognize that they are better descriptions of the events (see Foppolo, Guasti, & Chierchia, 2011; see also Chierchia et al., 2001). These findings suggest that children may have difficulty with scalar implicatures because they have trouble activating more informative alternatives during on-line processing (for further evidence and discussion, see Barner & Bachrach, 2010; Barner, Brooks, & Bale, 2011; Stiller, Goodman, & Frank, 2011).

If children exclude arbitrary parts from their counts of whole objects by making a pragmatic inference over alternative descriptions of object parts, they should quantify more like adults when these alternatives have been primed, making them more available when counting. To test this hypothesis, Srinivasan et al. (2013) conducted another study in which children in the priming group were first shown a whole object and an arbitrary piece of that object – e.g., a shoe and a piece of a shoe – and were asked to point to the referents of a measure phrase ("Can you point to the piece of a shoe?") and whole object label ("Can you point to the shoe?"). Then, they were shown a set containing two whole objects and a third cut into two or three pieces, and were asked to count using the whole object label ("Can you count the shoes?"). Strikingly, this manipulation significantly improved children's ability to exclude arbitrary parts from their counts of whole objects, relative to a control group who did not receive the priming manipulation. Critically, children who received the priming manipulation did not receive any feedback about which of the objects were pieces and which were wholes, making it unlikely that children's concepts – and criteria for individuation – changed during the task. Instead, both children's and adults' concepts may encode only partial criteria for individuation – allowing arbitrary parts to be included as members of object kinds – and may only be filled out by contrasting them with alternative descriptions.

This conclusion, that adult-like criteria for individuation are not fully encoded by lexical concepts like FORK or BICYCLE, but instead depend on contrasting words like *fork* and *bicycle* with other nouns (e.g., in the case of nameable functional parts like *wheels*) and measure phrase descriptions (e.g., in the case of arbitrary parts), is also consistent with how children begin to useother kinds of words in adult-like ways. For instance, as children acquire more color words, and more words for artifacts, they also begin to converge on adult-like patterns of naming for existing words in their vocabularies (Ameel et al., 2008; Wagner et al., 2013). For example, by learning *green* and recognizing that it contrasts with other color words, children may narrow their overly-broad meanings for *blue* or *yellow* (Wagner et al., 2013). Thus, children may acquire conceptual criteria for individuation for a word not simply by learning that word, but also by learning other related words, recognizing that those words form a common class, and understanding how individual words in a class contrast with one another. This may be easier to do for some classes of words, compared to others. For instance, children readily form lexical classes for words for number, time, and color (Brooks, Audet, & Barner, 2012; Shatz, Tare, Nguyen & Young, 2010; Tare, Shatz, & Gilbertson, 2008; Wynn, 1992), and thus, can provide a color word in response to a question such as "What color is that?" long before they use that color word like adults. Children may quickly construct classes in these cases because multiple words in these classes are often introduced to children at once in routines and songs (e.g, the counting

routine "1–2–3–4…"), and are also encountered across different linguistic contexts (e.g., different color words are embedded in phrases such as "That color is ___", and "My favorite color is ___" and used in responses to questions like "What color is that?"; Tare et al., 2008). By contrast, children may receive comparatively sparse evidence that whole object labels and measure phrases are alternatives to one another, accounting for their prolonged trajectory of acquisition.

As noted above, a complete model of the compositional semantics of the mass-count distinction depends not just on attending to syntax and lexical semantic representations to determine whether a noun denotes countable individuals, but also on using conceptual criteria to figure out what those individuals might be. Based on evidence from young children, we have argued that nouns themselves do not encode full conceptual criteria for individuation. Instead, they may encode partial criteria that are filled out pragmatically, by contrasting alternative descriptions of objects and their parts.

3. Conclusions

In this chapter, we have described how the meanings of mass and count nouns result from the interaction of three components of language – lexical semantic representation, syntax, and pragmatic inference. We began by arguing that the mass-count distinction is best understood in terms of individuation and quantification, as opposed to in terms of an ontological distinction between objects and substances. Further, drawing on studies of word extension and quantity judgment, we suggested that the mass-count distinction is asymmetric, such that while count nouns denote individuals, mass nouns can denote a wider range of phenomena including objects, substances, and actions (whether individuated or not). These generalizations, we argued, are best understood in terms of a model in which count syntax takes unindividuated semantic representations as an input, and specifies quantification over countable individuals, while mass syntax leaves the measuring dimension up to individual semantic representations, such that some nouns quantify according to mass/volume, while others are lexically specified for individuation and accordingly quantify according to number (e.g., *furniture* and *jewelry*). Finally, we argued that while syntax and lexical semantic representations help determine whether a noun denotes countable individuals, they do not specify which countable individuals they denote, and that this depends on conceptual and pragmatic factors. Specifically, drawing on evidence from young children, we proposed that nouns themselves do not encode full conceptual criteria for individuation, but instead encode partial criteria that are filled out pragmatically, by contrasting alternative descriptions of objects and their parts.

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Countability shifts and abstract nouns

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The paper examines the mass-count distinction in abstract nouns, starting from the corpus-derived observation that most of the nouns that can be used in count or mass syntactic contexts ("elastic nouns") are (arguably) abstract. The paper evaluates various tests for mass-count status and different criteria for "abstractness", proposing seven semi-productive meaning shifts that can result in a transition from mass to count or vice-versa. Section 4.2 addresses the relation between abstract nouns and kinds (are bare abstract terms "names of kinds"? What are their instances? Are they always kinds, even as predicates? What types of meaning shifts are applicable to them?). The possibility of a degree argument is also discussed: some count quantifiers over abstract mass nouns range over degrees, but not all abstract nouns have this option. We use the Bochum Countability Lexicon to detect elastic nouns and classify them via morphological affixes, identifying some possible meaning alternations.

Keywords: semantics, mass-count distinction, countability, meaning-shifts, abstract nouns, corpus linguistics, BECL

1. Introduction

The literature on the grammatical distinction between "count" and "mass" nominals has long tried to identify semantic criteria that could give a rationale for the existence of these two classes. A simple approach, popular in descriptive grammars (see Jespersen, 1954 and Renzi, 1995 for Italian) has prototypical mass nouns like *water* or *gold* refer to "substances", and prototypical count nouns like *dog* or *gold ring* refer to discrete "objects". Link (1983) offered a formal translation of this idea; in this system, count and mass nouns denote in distinct domains, with different properties: the domain of count nouns has atomic elements, the domain of masses does not. This captures the intuition that masses, unlike the objects to which count nouns refer, are *non-quantized* (being non-quantized means that if p(x) holds and y is part of x, p(y) also holds; this is the *divisive reference* property in the terminology of C.-Y. Cheng, 1973); a mass noun like *space* has no parts which cannot also be described as *space*.

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This picture has long been known to be too simplistic. There are, for instance, near synonyms, both within language (*shoes/footware*) and across languages (English $hair_{mass}$ vs. Italian $capelli_{count,plur}$) where resorting to a completely distinct domain of reference seems undesirable (Chierchia, 1998a). Moreover, the existence of atoms appears to be neither sufficient nor necessary to distinguish the two classes. Not sufficient, because mass nouns like *furniture* or *luggage* (Doetjes' 1996 *count-mass* nouns) seem intuitively endowed with atomic parts (those we refer to with the expression *piece of furniture/luggage*); not necessary, because count nouns such as *object*, *splinter* or *part* do not seem to have subparts which cannot also be described as *objects*, *splinters* or *parts* (see Moltmann, 1997, 1998 and Rothstein, 2010 for discussion). Given these facts, it is significant that in recent years, the focus has shifted from the *existence* of minimal subparts to their *accessibility* for counting (atoms in masses are said to be "foregrounded", in Chierchia's 1998b, 2010 terminology; mass nouns refer to objects "in bulk", in Ojeda, 2005), or to whether the minimal elements can or cannot overlap (Landman, 2010).

Despite the existence of a lively discussion on these topics, it is interesting to note that most of the nouns used as examples of mass or count are *concrete*. One aim of this paper is to carry out a preliminary exploration of the countability status of *abstract* nouns, an extremely diverse (meta)class which – setting aside the case of eventive nominals – has received comparatively little attention in the semantic literature, despite notable book-size exceptions such as Asher (1993) and Moltmann (2013).

Some special properties of abstract nouns with respect to countability were already discussed in Tovena (2001) and Nicolas (2002, 2004), but abstract nouns are interesting in many ways and for different reasons. One is their sheer number: in some *genre* (e.g. much of scientific writing) nearly all nouns are arguably abstract. A second one is that abstract nouns ("abstracts" in what follows) frequently seem to alternate between a mass reading (e.g. *hope gave him joy*) and a count reading (*his three hopes, one great joy*). The goal of this paper is thus to look at abstract terms from the standpoint of the count/mass distinction, asking which meaning shifts might be most common with them, and if and how they differ from more familiar mass nouns like, as a matter of fact, *concrete*.

Some preliminary steps will be needed, and indeed the first three sections of this paper mostly deal with general issues, i.e. the choice of the most distinctive morphosyntactic markers for the count/mass distinction (Section 1.1), and the question whether countability is a lexical or cognitive property of nouns (Section 2). Section 3 will review the types of mass-count conversion operations that have been proposed for nouns in general, and discuss a few additional possibilities.

From Section 4 we turn to issues specific to the class of nouns under study, starting from the choice of a suitable definition of "abstractness" (Section 4.1) and

continuing with the problem of how abstract nouns in determinerless argument position relate to kinds and their instances (Section 4.2) and what kind of property we are modifying when we talk about *much courage*, or *a great courage*, as opposed to *much water* (vs. **a great water*) (Section 4.3).

Finally, Section 5 examines the countability status assigned in the Bochum Countability Lexicon to various classes of mass nouns, specified on the bases of their morphological and semantic features.

1.1 The grammar of countability

Obviously, a discussion of the semantic dimensions of the countability shift presupposes a criterion for when a noun is *grammatically* count or mass. The main criteria found in the literature are:

(1) "Mass nouns" (mud, wine, courage,…)
   a. appear in the singular with the determiners *much, less, a little, a bit of, more*
   b. appear without any determiner in the singular in at least some argument positions ("bare singulars"), in Germanic and most Romance languages;
   c. can be accompanied in the singular by adjectives such as *abundant, boundless, considerable* (Baldwin & Bond, 2003).

(2) "Count nouns" (*dog, table, project*,…)
   a. appear in the singular with the (complex) determiners *every, each, a (single), one*
   b. appear in the plural with (complex) determiners such as *many, few, a dozen, two, forty-four, a bunch of, a number of*, etc.
   c. appear in argument position without a determiner only in the plural ("bare plurals"), in Germanic and most Romance languages;
   d. can be accompanied by adjectives such as *numerous, innumerable*.

Mass nouns are typically syntactically singular,[1] but have properties characteristic of plural count nouns. Like masses, plurals are non-quantized, down to the singular (a sufficiently large subpart of a group of *horses* is still *horses*). Masses and plurals also share the *cumulative reference* property (Quine, 1960): if p(x) and p(y) then p(x + y): *water plus water* can still be described as *water, horses plus horses* is *horses*. In contrast, a part of a horse (a countable singular) is not a horse, a horse plus a horse is not a horse. From a distributional standpoint, a striking fact is that singular mass and plural count nouns can be bare (i.e. determinerless) arguments

1. Here I set aside plural mass nouns, defined as nouns which are syntactically plural but cannot be counted, like *brains, police* in British English, *viveri, vettovaglie* 'staples' in Italian.

in most Romance and Germanic languages ((1b) vs. (2c)), while singular count nouns cannot (cf. *I sell *computer/computers/food*).

This similarity between plurals and masses has prompted Chierchia (1998a) to propose that masses have a denotation which is the union of the denotations of a singular and plural count noun (*footware* = *shoe*∪*shoes*), This explains, among other things, the observation that mass nouns are not found in the plural (**oxygens, *footwares, *courages, *stuffs*, etc.), or when they are, their meaning seems to have shifted away from the singular meaning. This fact leads to another possible criterion to distinguish mass from count:

(3) a. If a mass noun pluralizes, its meaning shifts in ways which are not solely related to number (e.g. *much wine*: amount; *many wines*: variety)
b. Count nouns can generally pluralize without any meaning shift unrelated to number (the difference between *dog* and *dogs* is simply in the number of animals)

Understanding the nature of the shift associated with plurality (but also applicable to singular nouns in some cases) will be one of the main goals of this paper.

2. Countability: lexicon or cognition?

A preliminary question, as one ventures in the domain of countability, is whether "being mass" or "count" is a *grammatical* feature specified in the lexicon on nominal roots,[2] (see Chomsky, 1967: 82, Quirk et al., 1972: 127, and McCawley, 1979 for a discussion from a lexicographic perspective), or rather a context-driven meaning aspect which can in principle be present in any noun, more or less easily depending on encyclopedic features of the noun's denotation. The latter position was originally put forth in Allan (1980) and Pelletier and Schubert (1989), and has been recast in syntactic terms in Borer (2005). I will limit the discussion to Borer's work, given the resonance her proposal has had in the literature on the syntax/semantics interface.

According to Borer, being mass or count can only be a property of Determiner Phrases (DPs) as a whole; lexically, all nouns are mass; the ability for a noun to be counted comes from a functional projection, ClP, which selects the NP proper and returns discrete predicates. The Cl projection is overtly realized as a classifier, in Chinese or other classifier languages, or as the plural morpheme in English and other languages that mark singular/plural morphology (see Borer,

2. And derivational affixes, since some, e.g. the *-ware* of *kitchen-ware* can trigger a countability shift.

2005: Chapter 4). Mass DPs are nominals where the ClP layer is missing, allowing the non-quantized meaning of N to percolate up to the DP level (4).

(4) a. $[_{DP}$ D $[_{\#P}$ three $[_{ClP}$ cat_i+s $[_{NP}$ t_i]]]] *count, N moves to Cl^0*

b. $[_{DP}$ D $[_{\#P}$ much $[_{NP}$ salt]]]] *mass*

In defense of the idea that the countability of a noun is not marked in the lexicon, Borer offers examples of mass nouns which can be used as count (*a wine, a thread, a salt, a stone*) and of count nouns used as masses (*that's quite a bit of table/carpet for that money*), pointing out that to the extent nouns can be shifted to a count or mass meaning the presence of a formal feature which can be overridden is theoretically undesirable (as it would be a grammar in which nouns are lexically marked "masculine" or "feminine", if it turned out that masculine nouns can nearly always appear as feminine and vice-versa).

Evidently, the force of Borer's argument rests on the number of nouns which can be added to the list of examples above (masses which can be count and vice-versa), and to the extent to which this change is accompanied by a *regular* meaning shift. The presence of a meaning shift which has nothing to do with atomicity or granularity and which is, in addition, unpredictable, would mean that the nouns at issue must be listed in the mental lexicon. At that point, the lexicalist can just argue that there are two words, one count and one mass, connected in most cases by polysemy; what looks like a shift is merely the selection of one of the two forms.

The first part of the issue – how many nouns shift – is relatively easy to answer. The syntactic patterns in (1) and (2) can be turned into regular expression searches over a corpus of naturally occurring language. Using a subset of the indicators in (1) and (2), Katz and Zamparelli (2012) studied the frequency with which thousands of nouns appeared in unambiguously mass or count contexts in a 2.7 billion word corpus of English (UKWAC, Ferraresi et al., 2008).[3] The results showed a large overlap between the two classes, which is not predicted by a clear-cut lexical system in which countability is like gender or declension class.

> It is […] not the case that the rate with which a noun is used as a mass expression is inversely proportional with the rate at which that noun is used as a count expression. Specifically, the rate of use with mass determiners is essentially uncorrelated (−0.028) with the rate of use with count determiners, on a per-noun basis. Katz & Zamparelli 2012: 373

3. The possibility of being bare argument turns out to be very unreliable in a Web-derived corpus, due to the presence of section headings which use a special syntax, which often lacks determiners; see Baroni et al. (2009).

These findings undermine the simplest lexicalist position, but do not clearly point to a single alternative. What the study shows is that there are nouns which are rarely used as mass, others which are rarely used as count, and many which are used both ways (the ones we will call "elastic nouns"). Unfortunately, this still cannot tell us how the meaning of a word changes depending on its countability. A better tool to address this question is the Bochum English Countability Lexicon (BECL) Kiss, Pelletier, et al. (2014a), which specializes in the attempt to specify the meaning shifts that elastic nouns undergo. We will return to this tool in the last section of the paper.

Before getting there, let's consider the problem of the non elastic (henceforth "rigid") part of the lexicon. What shall we do with it? In Borer's approach, a mass-only noun is simply one that refers to an object that is difficult to conceptualize in discrete units. This means that the meanings of minimal pairs such as *footware* and *shoe* (*change/coin, curtain/drapery, knife/cutlery*, etc.) hide a fundamental difference which blocks the insertion of a ClP layer in the first, making it a mass, and allows it in the second.[4] What would this difference amount to? One may call this property "non-quantizability", or the "bulk-reference" property, possessed by *footware* but not by *shoe* – but for all intents and purposes, this property cannot be called anything else than 'being mass'. Unless one can make a case for a semantic difference *independent* from countability, which triggers mass or count as a side effect, near-synonym pairs with different countability status are very difficult to explain in Borer's terms. The problem is reminiscent of one attributed by Chierchia to Link's approach: if *shoe* and *footware* are drawn from different ontologies, how to spell out what they have in common?

Lexicalist countability theories are not unequipped to deal with nouns that shift between count and mass: they must postulate that there is a (smallish) set of ways to turn a mass noun into a count one and vice-versa, at the cost of a meaning shift. Borer acknowledges the possibility that a clash between the presence of Cl (count) and the noun meaning could result in meaning coercion,[5] but she does not seem to think of these phenomena as something that grammatical theory should strive to explain (see her discussion on pg. 106). This paper takes the opposite view: exploring the range of meaning shifts which coercion allows and the kinds

4. One could of course suggest that **footwares* does not exist because it is blocked by the existence of *shoes*, but this begs the question of why *footware/shoe* pairs should develop in the first place. Moreover, in Borer's account the count version is the complex, derived case, so if anything, we would expect *footware* to block *shoe(s)*.

5. "Coercion, then, is but the conflict that emerges when the grammar returns a computation which is not fully compatible with the conceptual properties of listemes embedded within these structures" (Borer, 2005: 106)

of nouns to which it is applicable is a pressing topic for research, particularly when these shifts apply productively, as one could expect from real semantic operators.[6]

Borer raises objections against a countability-shifting operator. If it existed – she argues – it should be able to apply also to constituents larger than NPs. On the opposite, once a noun has been modified by plurality (5a), amount nouns (5b) or amount modifiers (5c) (adding a ClP layer, in her approach) it cannot switch status:

(5) a. *There is rabbits in my stew. Borer, 2005: 104
b. *There is a portion of rabbits in my stew.
c. *Much rabbit are hopping about.

This argument, however, only applies to a completely unconstrained and essentially pragmatic notion of semantic operator. If meaning-shift operators are seen as part of the semantic computation, hence part of the grammar, there is no reason why they could not be restricted to apply to NPs only. Even in a totally unconstrained view of semantic operators, Borer's argument has flaws. (5a and c), for instance, contain agreement mismatches, and it is dubious that a semantic shift should be able to override a syntactic agreement clash.[7] Once agreement is controlled for, it is not so obvious that plurality is incompatible with mass meaning. *There are apples in the soup* can have a meaning almost identical to *there is apple in the soup:* "apple pulp in an amount greater than what a single apple can provide" (in the terminology of Moltmann, 1998 *apples* in this case are not an "integrated whole"). This can also be seen with measure phrases:

(6) a. There is one kilo of apple?(s) in the soup. *individual apples weigh <1 kg*
b. *There is (one kilo of) pea in the soup.
c. There are peas in the soup.
not necessarily the individual items, but pea pulp

To be sure, when a numeral is inserted the mass reading is blocked:

(7) a. There is one kilo of (*two) apples in the soup.
b. There are 20 peas in the soup. (Go find them!)

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6. Again, contrast the situation with that of the grammatical feature GENDER in a language such as Italian. Nouns come from the lexicon as either masculine or feminine; those which appear to go both ways are cases of homonymy ($parto_{masc}$ 'delivery' vs. $parte_{fem}$ 'part') or polysemy (e.g. $mela_{fem}$ 'apple' vs. $melo_{masc}$ 'apple tree'). But unlike with countability, there is no productive process which can change the gender of a noun.

7. In some languages, an externally singular subject can be compatible with a semantically-induced plurality in the verb (as in *this matching plate and wine glass are always sold together*), but the opposite is normally not true: *the cat and the dog *is/are a problem*, see Zamparelli (2008) for discussion.

But this could be due to the fact that the measure phrase *one kilo* must apply to a position lower than the cardinal (a general fact with pseudopartitives), or that the number *20* in (7b) is redundant (why counting them if you are not using this information?). I conclude, *contra* Borer, that the possibility of semantic countability-shifting operators remains open.

Let's now consider some of the more general shifts that have been proposed in the literature.

3. Countability shifts

Four main countability shifts can be distilled from the literature (see e.g. Pelletier & Schubert, 1989, Chierchia 1998a, Cheng & Sybesma, 1999):

(8) From mass to count
   a. **Kind-formation:** reference to the individual types or varieties of a certain noun
   (*three wines* ⇒ *three types of wine*)
   b. **Container reading:** reference to canonical doses or measures of a certain, substance denoting noun
   (*I drank three beers* ⇒ *three pints/glass/standard doses of beer*)

(9) From count to mass
   a. **Food-stuff reading:** reference to the food stuff derived from an animal/plant-denoting noun
   (*In Australia I tasted kangaroo* ⇒ *kangaroo meat*)
   b. **Lewis/Pelletier Grinding:** reference to the undifferentiated material substance of an object that has been ground
   (*After the explosion, there was computer all over the floor* ⇒ … *computer-derived material*)

Some authors do not distinguish (9a) from (b), but I think that the food interpretation is far more natural, and selective, than the rather far-fetched (9b). *Frenchmen eat snails* does not imply that they also eat the shells; grinding cases involve any part.

The shifts above are expressed as functions: given an input – a noun with a certain countability status – they return one with a different status and a partly different meaning. This presupposes that one can identify an initial and a derived state, which might not always be easy in some cases (see below). For concrete objects I will assume that taking the living animal or the structurally organized object as primitive and the derived food or pulp as secondary (with the result that the shifts in (9) increases entropy) is more natural than the opposite. If this is correct (10) shows that in some cases two of the shifts above must have happened

in sequence, but their order must be free (*animal* ⇒ *food* ⇒ *type of food* in (10a); *bird*⇒*type of bird*⇒*type of food* in (10b)):

(10) a. Cook apprentices at this school must be able to prepare at least two **lambs**, e.g. kofta and biryani, without looking at the recipes.
b. In the Hunting Season Celebration Party two distinct **birds**, often a grouse and a pheasant, are served as second course.

This discourages a "cartographic" analysis which would be the mirror image of Borer's: assigning these meaning shifts to some NP-internal functional projections. These projections are normally assumed to be ordered (see Cinque, 2002, a.o.), so a switch in their application would be unexpected.

The examples so far were all verbal arguments. If we look at comparatives, other types of meaning shifts emerge. One is illustrated by (corpus derived) examples such as:

(11) a. Surface RT is more tablet than PC.
b. Fitness centers that are more spa than gymnasium
c. That apple tree is more apple than tree.

This shift turns a noun into a graded predicate expressing similarity to that noun: (11a) is akin to *RT is more tablet-like than PC-like*.

(12) Similarity-to-N:
degree to which an individual has properties characteristic of N (*more PC* ⇒ *more with the properties of a PC*)

This shift differs from those seen so far in two respects. First, it can apparently apply to any noun, and the probability of finding a noun in this construction seems essentially uncorrelated with the probability of finding it in the other mass-only environment listed in (9) (*tablet* is after all a fairly prototypical count noun). Second, it is restricted to a comparative frame (*more/less N than N, as much N as N*), where two properties are compared; it follows that the result of the shift does not behave like a nominal, but as a predicative category (indeed, *N-like* is an adjective, *with the properties of N*, a PP): the construction gets much worse if used directly in argumental position, particularly as a subject (13), and even as an apposition (14).

(13) a. ??With Surface RT, I bought more computer than tablet.
b. *With Surface RT, more tablet (than PC) entered my house (than PC).
c. *More songwriter wrote these songs than singer (performed)

(14) a. With Chomsky, a greater linguist visited this university than political scientist.
b. *With Chomsky, more linguist visited this university than political scientist.

Despite being predicative like a common noun, *more N than N* cannot be used as a nominal D restrictor (15), again behaving as an adjective.

(15) *A/Some [more tablet (than PC)] is expensive (than PC).
Intended meaning: 'An object/Something which is more tablet-like (than PC-like) is expensive.'

If the second argument of the comparative is an individual, rather than a property, as in (16a), the meaning of the first N changes slightly; it can be found with scare quotes (16a), and in English the form *of a(n) N* is preferred (16b).

(16) a. Bill is more "songwriter" than Marc.
b. Bill is more of a songwriter than {*of a singer / ??singer / Marc}

(17) a. This piece of furniture is more "chair" than that one.
b. This piece of furniture is more of a chair than {??of a sofa / *sofa / that one}

I propose that (16a)/(17a) are prime examples of a shift different from (12), whose effect is essentially metalinguistic (18).

(18) **Metalinguistic shift:** degree to which something can be appropriately called "N" (*N* ⇒ *appropriately called "N")*

Judging from the possibility of scare quotes, it is likely that the shift in (18) can also apply to the frame in (11), though it feels perhaps more natural in (16) and (17). Note, moreover, than both shifts are indifferent to the plural (i.e. count) or singular status of their nouns, as (19) shows, and also orthogonal to whether the subject denotes a kind (20) or not.

(19) a. Those boxes are definitely more chairs then beds.
b. Those boxes are definitely more "chairs" then those dirty bags.

(20) a. Autogyros were designed to be more helicopters than airplanes. *Kind*
b. By now my old car was more artwork than wreckage. *Object*

In her PhD thesis, Sassoon (2008) proposes that nouns have a full set of graded dimension which are used to compare them to prototypical member of their class. Robins, for instance, are "better"/more prototypical birds because the values for various properties they have (movement, size, color, etc.) are closer to the average values of other members of the bird class than those of, say, penguins.[8] Adjectives,

8. Interestingly, a similar idea is used in modern computational semantics (see e.g. McDonald & Ramscar, 2001) to measure the semantic distance between words using distributional property vectors.

on the other hand, would differ from nouns in being graded only along one dimension – the one which gets measured in comparatives (*Jack is taller than Bill*).

Now, consider an abstract schema for (11) and (16):

(21) a. DP_1 is more N_1 than N_2
DP_1 is more N_1 than DP_2

An interesting possibility is that the shift in (12) is due to the presence of an operator over N_1/N_2 which converts the multidimensionality of nouns into an adjective-style single measure: the number of dimensions of DP_1 which are compatible in value with the corresponding dimensions of N_1 (i.e. $OP_{sim}(DP_1,N_1)$). Thus, an object which is a prototypical tablet will have a high score in a large number of properties that are characteristic of tablets (e.g. size, portability, low thickness, battery). This number is then compared to the analogous number for DP_1 and N2 (OP_{sim}(DP1,N2)).

(22) DP_1 is more N_1 than $N_2 = OP_{sim}(DP_1, N_1) > OP_{sim}(DP_1, N_2)$

The metalinguistic shift, on the other hand, achieves the same linearization by measuring the extent to which a DP has enough N-properties to be properly classified as "N", and compares that against the possibility for DP_2 to be classified in the same way.

(23) DP_1 is more N_1 than $DP_2 = OP_{meta}(DP_1, N_1) > OP_{meta}(DP_2, N_1)$

A syntactic effect of this process is that the nouns under comparison are reclassified as non-nominal predicates, hence the ungrammatically of (13). To summarize, I am proposing that the dominant meaning of e.g. (24a) claims that Chiron had more human features than equine features, whereas (24b) claims that, compared to Naxos, Chiron possessed a larger number of the stereotypical human feature needed to have him classified as "man".

(24) a. Chiron the centaur was more man than horse.
Chiron has more men-like features than horse-like features (though properly speaking, he is neither)

b. Chiron the centaur was more man than Naxos.
Given the properties they have, you would more correct at classifying Chiron as "man" than Naxos.

Where does this leave us? Though interesting, the similarity and metalinguistic shifts seems to apply to so many classes of nouns and noun forms (and possibly, not to nouns alone) that they contribute little to a study of how countability relates to semantic shifts. The study in Katz & Zamparelli (2012) included *more* in the patterns used to extract mass nouns, but this choice might have artificially increased

the set of elastic nouns.[9] Future studies should strive to control for cases like (11) (… *more tablet than PC*), excluding the singular comparative from the list of constructions used to extract mass nouns.

4. Going abstract

One important observation that emerges from Katz and Zamparelli's (2012) corpus-based approach is that the vast majority of nouns that are grammatically mass according to the criteria in (1) do not seem to refer to concrete objects. The proportion grows if we consider the subset of mass nouns which are also found with typical count determiners such as *every* and appear in the plural with cardinal numbers, thus qualifying as "elastic". Here is a representative sample of the most frequent such nouns, extracted from UKWAC:

(25) action activity agreement authority business challenge chance change character charge choice colour competition concern contact content control cost cover credit crime detail development effect error exercise fire force form glass government grain ground lead length life light matter movement need opportunity pace paper performance possibility practice priority production property range reading reason regulation repetition response return room sense service shade skill sound space sport structure style talk text treatment use value variation variety volume wine work

While it is obvious that these nouns (with the exception of *glass, paper* and *wine*) do not refer to the canonical substances we find in the literature, saying how many of them are "abstract" requires some criteria for abstractness. Defining what these might be turns out not to be an easy task.

4.1 Ways to be abstract

What should a noun be to be abstract? The most common answer is often given in the negative: a noun is abstract when it does *not* refer to something which can impinge on the senses. This criterion immediately suggests that there should be degrees of abstractness: psychological states, like *joy, pain* or *fear* are "felt" by their experiencers (though not by others), and should thus count as less abstract than say, *chance*, or *priority*. An even stricter criterion, popular in psychological research, is *imageability* (the extent to which a pool of people judge that a concept

9. "More" features prominently in the battery of tests used to compile the BECL, Section 5, but there it was filtered by human judgment, plus discussion.

can be represented by an image, see e.g. Della Rosa et al., 2010). However, these indexes are based on the average judgment of naive informants, who might have very different criteria, or none at all. Moreover, there are concrete objects, like spleens or oil fields, which are hard to visualize, and abstract ones which are not (most would argue that *absence* is abstract, but the absence of light, i.e. *shadow*, is plain to see.)

A completely different criterion for abstraction uses morphology as a guideline. In English, one could regard as abstract all the nouns derived from the suffixes *-ness, -ity, -tion* or *-hood, -itude, -cy, -ment, -ship* (cf. German *-heit,* Italian *-ezza, -ità*, etc.), or more generally, all the nouns derived from gradable adjectives (this is the class Nicolas, 2004 focuses on). This approach extracts a reliable but small subset of the abstract lexicon: in the list of the 76 most common elastic nouns in (25), only 5 end in *-tion*, 5 in *-ity*, none in *-hood, -ship, -cy* or *-ness* (except the non-compositional *business*). 5 more end in *-ment*, and at most 4 are de-adjectival (*active/activity, possible/possibility, long/length, prior/priority*). On the other end, about 44 nouns have highly semantically related verbal forms. This suggests the possibility that looking at nouns derived from verbs via zero-affixation might be a better way to find abstract mass nouns, though we still find pairs such as *to win/a win, to vote/a vote*, which are not mass, and some non corresponding cases (*to book/a book*).[10]

Despite their limited recall, it is important to keep in mind that morphological criteria can be extremely valuable when the goal is to try to pair derivational affixes with specific types of meaning (e.g. "modes of being abstract"), working with large numbers of lexical items (see a computational attempt in Marelli & Baroni, 2015, and Section 5).

Yet another criterion for abstractness, adopted by Guarino and Welty (2000) in their work on formal ontologies, rests on the possibility of a spatiotemporal collocation: abstract nouns are those that denote objects which do not have a location in space or time (though it is not clear what to make of the words *time* or *space* themselves). In some accounts (possibly dating back to Plato), these objects are the *attributes* of things (see e.g. Mill, 2002, Chapter 2.4). Events would not count as abstract in this classification (they can, moreover, impinge on the senses: think of *explosion, delivery* etc.), though the fact that their spacial location may be vague might make them less concrete than material objects.

10. However, a check with the noun classes in the BECL (see Section 5) shows that of the 332 verb-identical nouns which are present in the BECL noun list, 86% are rigidly count and 16% rigidly mass. So, while verbs might be a good way to find abstract (mass) nouns, they are not a good way to find elastic nouns.

Interestingly, according to this criterion many of the elastic nouns in (25) would end up being abstract in their mass use, concrete in the count one. Excluding from consideration words where the mass and count uses the corpus picks on might unrelated (e.g. *change* 'coins' and *changes* "differences"), we can easily find pairs such as (26).

(26) a. *Activity* (being active) vs. yesterday's *activities* (cf. actions)
b. *Agreement* (a state of concord) vs. the recently signed *agreements*
c. *Authority* (a social status) vs. the local *authorities* (people)
d. *Control* (an ability) vs. the airplane's *controls*
e. *Property* (ownership) vs. lost *properties*

On the opposite, it is difficult to find examples of elastic nouns in which the count version has no spatiotemporal collocation, but the mass version does.[11]

Some approaches to the abstraction problem are based on a methodology which is quite well-established in semantics: to tell whether something is abstract or concrete, look at the range of predicates that naturally apply to it (the same principle used, for instance, to distinguish *particular instances* from *kinds* in Lawler, 1973, Carlson, 1977 and many others). For instance, Guarino and Welty's criterion would mean that predicates such as *has a mass of X* and *will happen at T* should not apply to true abstracts. If we want to exclude psychological states, we would add *was perceived by Y*, and so forth. One important consequence of this predicate-based view is that the notion of "abstractness" turns out to be clearly orthogonal to two apparently similar notions: "generality" and "reality". Let's consider them in turn.

Lexical properties are arranged in hierarchies of increasing generality: poodles are dogs, dogs are mammals and mammals are animals. However,it would be wrong to say that *animal* is more abstract than *poodle*; it is only more general. This is because *animal* can support any predicate that can be applied to *dog*: it can bite, eat or drink. It follows that supercategories of concrete objects are in turn concrete objects, which implies that there should be no supercategory that spans abstract and concrete objects (indeed, ontologies such as Wordnet or DOLCE do not have a single root, a "general entity"-type object).

The next question is whether *kinds* of concrete objects (bare plurals like *dogs*, definites like *this kind of animal*) are more abstract then their instances, or just more general. The answer depends on one's theory of the way predicates apply to kinds. Examples like (27a) suggest that they might be abstract (though possibly not Guarino-Welty abstract), since no specific concrete object is widespread or comes

11. A near miss is cases like *water* vs. *the waters of the Atlantic; sand vs. the sands of the Sahara*, where the count version seems to refer to an expanse of space (see Acquaviva, 2008). This would still not qualify as abstract in Guarino and Welty's formulation, but it comes closer.

in multiple varieties (after all, kind terms like *order, species, genera* and *variety* belong to the scientific lexicon of taxonomic biology). But the predicates in (27b) speak in favor of concreteness: they are the same that could apply to any individual.

(27) a. Dogs {are widespread / come in many varieties}
b. Dogs {bark / have fur / scratch themselves}

Of course, if (27b) are actually generic quantifications over individuals, as many have proposed since Diesing (1992), Gerstner and Krifka (1987), such predicates would simply not count for establishing the concreteness of "real" kinds. Since the matter hinges on the broader problem of genericity we will leave it unresolved here, pointing out that there is at least partial evidence that kinds of concrete objects are (more) abstract than their instances. The inverse issue – whether bare abstracts denote kinds – will be taken up in the next section.

Much of the same reasoning applies to the predicate "exists in the real world" (the test for reality). Dragons do not exist, but in those stories where they do, they (mostly) have properties typical of concrete objects, while the similarly non-existent "wizardry" passes any test for being abstract. There may be unclear cases in between, but in general one wants to be able to distinguish abstract and concrete objects regardless of whether they belong to the world of evaluation or to some other (possible) world.[12]

4.2 Abstract nouns and kinds

Though kinds of concrete objects might or might not be abstract, there can be kinds of abstract objects, like the bare plural subject of (28a). And there are, indisputably, kinds of mass nouns, as in (28b).

(28) a. [Social needs] {are common / come in many varieties}
b. [Steel] {is common / comes in many varieties}

Putting the two observations together, we expect that bare singular noun arguments referring to abstract objects, like those in (29) should also be kinds, in agreement with the principle that all argumental bare nouns denote kinds in English (see Carlson, 1977 and later Neocarlsonian analyses).

(29) a. [Wisdom] is a property few people have. from Moltmann (2004)
b. [Humility] is a virtue.
c. [Ordinariness] is boring.

12. The reader interested in this discussion from a philosophical viewpoint is referred to the entry *Abstract Objects* in the Stanford Encyclopedia or Philosophy, http://plato.stanford.edu/entries/abstract-objects/. From the standpoint of linguistics, finer categories are useful only insofar they trigger linguistic effects.

Carlson (1977) already supported this position, pointing out that, like other bare nouns, singular abstracts have a (quasi-)universal reading with individual-level predicates (30a) and an existential one with episodic ('stage-level') predicates (30b) (Carlson 1977: 467). Overall, they pattern very much like *blood*, a concrete bare singular, in (31).

(30) a. Democracy is a form of government. *Universal*
b. The Greek practiced democracy. *Existential*

(31) a. {Justice / Blood } is scarce. *Universal*
b. Here there is {justice / blood} *Existential*

Both take narrow scope under intensional verbs ((32) cannot mean: there was some specific instance of justice/amount of blood which was looked for by someone), and accept some characteristic kind-level predicates (33).

(32) The {doctor / crowd} was looking for {blood / justice}

(33) a. {Democracy / Grappa} becomes more and more diluted as one travels South.
b. {Democracy / Grappa} comes in many different flavors.

This approach also predicts, correctly, that languages that use definite determiners to build nominal generics must also use them with universally-interpreted abstract nouns. In Italian this is true even in object position, where bare nouns are normally syntactically acceptable:

(34) Gianni odia *(la) banalità.
Gianni hates (the) ordinariness.

But if bare abstracts are kinds, three questions arise.

– What are the instances of abstract kinds?
– In elastic nouns, what is the relation between the kind formed from the mass reading and that formed from the count one?
– Are bare abstract nouns *always* kinds?

The theory that bare singular abstract nouns are kinds has been especially defended and elaborated in Moltmann 2004, 2013.[13] Moltmann points out that, contrary to a naive view which sees *ordinariness* as a nominalization of the corresponding

13. Moltmann (2004) discusses abstract noun which are the nominalization of adjectives, like *wisdom, ordinariness* or *originality* (see her Footnote 1). Moltmann (2013) extends the theory to cover many other types of nominalizations. In addition, this later work relies on the theory of *plural reference* (see Nicolas, 2008, a.o.), which transfers plurality from the domain of reference (sets, pluralities in the sense of Link, 1983, Schwarzschild, 1996) to the manner of reference.

adjective, meaning *the property of being ordinary*, the sentences in (35) are not synonymous with those in (36): the latter can be false when the former is true (e.g. being ordinary might be boring, but the abstract property of being ordinary might have an interesting formal semantic structure which makes it interesting *qua* property). Saying that these nouns are kinds avoids this problem and simultaneously accounts for the data in (30), (33).

(35) a. Ordinariness is boring
b. Friendliness is interesting.

(36) a. The property of being ordinary is boring
b. The property of being friendly is interesting.

Turning to the nature of their instances, Moltmann (2004, 2013) proposes that abstract terms denotes *kinds of tropes*, where "tropes" are specific instances of property attribution (*John's ordinariness, Sue's friendliness*, etc.). Tropes are taken as primitives, and rendered as relations between an individual (*Sue* in *Sue's friendliness*) and a set of properties (instances of friendliness. See Moltmann, 2004, Section 3.3).[14] Moltmann (2013) also proposes that bare abstract terms *plurally refer* to the individual tropes across all possible worlds – an aspect which we set aside here for reasons of space.

With episodic predicates like (37), the relation which is established is not between the agent and the kind itself *(generosity$_k$)*, but between the agent and specific manifestations of that kind, i.e. the individual tropes. In other terms, (37a) means something like *I have experienced acts* or *manifestations of generosity*.

(37) a. I have experienced [generosity].
b. I often encounter [hostility]

One potential problem is that one could then expect that the bare plural *acts of generosity* (or *instances, examples, tokens,* etc.), should always be synonymous with *generosity,* which it isn't.

(38) a. [Generosity / ??Acts of generosity]$_k$ are/is a virtue.
b. John puts [generosity / ??acts of generosity]$_k$ above all other virtues.

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14. Linguistically, tropes would be what is perceived in (ia), as opposed to (ib–d).

(i) a. John saw Mary's beauty
b. John saw Mary
c. ?John saw Mary's being beautiful
d. John saw that Mary was beautiful

Perception verbs have been used to motivate the ontological reality of events (*I saw Callas sing* = I witnessed a Callas singing event, Parsons, 1990) or situations (Barwise & Perry, 1983). Moltmann (2013, Chapter 7.2) argues that events could indeed be seen as a kind of tropes.

A similar problem is discussed in Yi (2015), who reports different truth conditions in (39a) and (b). In this case, the use of the definite in (b) blocks the existential reading, resulting in a reading which might be too strong (John might have just been looking for *some* wisdom). However, in (40), which only uses bare nouns, the (b) meaning ends up being too weak.

(39) a. John is looking for *wisdom*
b. John is looking for *the possible wisdom tropes*

(40) a. At the end of his life, John finally found *wisdom*
b. At the end of his life, John finally found *possible wisdom tropes/ manifestations*

It is important to note that the problem holds with concrete mass nouns as well: if we assume that the instances of the kind *water* are something like *amounts* or *portions of water*, we do not get full equivalence between the two in e.g. (41) (except in the existential reading *there are portions of water which are H^2O*).

(41) {Water / Portions of water} is/are H^2O.

Perhaps the contrasts in (38) and (41) could be attributed to pragmatics (why using *portions of water* if one is trying to get at the meaning of the much simpler *water*?). This is not implausible, but it is a dangerous path to follow. Recall the contrast in (35)/(36), where Moltmann replaces a simple description (*ordinariness*) with a more complex one (*the property of being ordinary*), to test if they are truly synonymous. If a complexity-based pragmatic theory could account the difference in judgment in the two cases, Moltmann's methodology risks to be undermined.

Leaving the matter unresolved, we return to the specific issue of elastic nouns. If N is elastic (e.g. *action/actions, hope/hopes*), can we identify a relations between the meanings of its bare singular and bare plural versions? Consider (42):

(42) a. I love [action/actions] in movies.
b. [Change/Changes] is/are part of life's essence.
c. [Activity/Activities] keep(s) sleep at bay.
d. [Contact/Contacts] is/are essential in life.

Given what we have said so far, the bracketed bare nominals are all kind-denoting, so, if the singular and plural versions are different in meaning (or, as it happens, felicity), this difference must be located solely in the meanings shift between the count and mass version. Moreover, the count versions cannot be obtained from the Kind-shift seen in (8)a: this shift would make the bare plurals in (42a,b) synonymous with their overt "bare kind" versions shown in (43), which are hardly possible.[15]

15. The problem does not come from a ban on bare overt kind constructions, which do exist. (ia) is an example from Section 4.1 of this paper; (ib) has a fine existential interpretation.

(43) a. ??I love [kinds of action(s)] in movies.
b. ??[Kinds of change(s)] are part of life's essence.

Clearly, we need some alternative types of meaning correspondences, keeping in mind that it could sometimes be difficult to decide if they are directional shifts (and if so, in which direction), or a matter of lexical polysemy. An analysis of the list of frequent elastic nouns given above and repeated here for convenience, reveals a few relevant patterns (with overlaps).

(25) action activity agreement authority business challenge chance change character charge choice colour competition concern contact content control cost cover credit crime detail development effect error exercise fire force form glass government grain ground lead length life light matter movement need opportunity pace paper performance possibility practice priority production property range reading reason regulation repetition response return room sense service shade skill sound space sport structure style talk text treatment use value variation variety volume wine work

A. Count nouns that refer to events, which can last, or happen at specific times (*yesterday's* N). At least:

(44) action activity challenge change choice competition crime development error movement performance production reading repetition response service variation work

In several cases, the mass meaning seems to be directly related (quite possibly via the kind-instance relation) to the individual tropes in the way Moltmann suggests (e.g. *activity* is related to the totality of someone's individual activities, *change*, to the *changes*, etc.). In others, however, the relation is more idiosyncratic (*reading /readings* (poetry)), or the count version is more concrete (*work/works* (of art)).

B. Count nouns which are (more or less concrete) *result nominals* derived from the verbal root:

(45) agreement charge choice contact content credit detail development effect error property regulation response service work.

possibly also *life* (result of *living*), *cost (money payed), opportunity (missed, taken), possibility, production*, etc.

(i) a. Kinds of concrete objects might or might not be abstract
b. Our zoo had common types of animals, plus some guest star.

C. Count nouns which seem to be derived via the Container-shift in (8b) (i.e. portions of the mass).

(46) fire shade sound space text (time)

These cases are very close to concrete mass nouns like *water*, down to the possibility of an "expanse" reading (see Footnote 11: *the fires of hell, the sounds of New Orleans, the shades of the jungle, the times of Camelot*).

D. Count nouns which seem to be derived by the Kind-shift: *need, sport, style* (also: *dislike, disadvantage*, etc.). So, *I practice three sports every week* cannot mean that I practice three sessions (i.e. "doses") of the same sport every week, but rather, three kinds of sport.

E. Yet other cases seem to refer to the agents of the verb (people or organizations: *government(s), authority(+ies)*, but also the mass *crime* in *organized crime*), or have idiosyncratic polysemic relations (e.g. in *ground, paper, room (chamber), volume (sound), matter (gray)*; these are the nouns which the BECL calls *multiples*.).

We conclude that if we treat bare elastic abstract mass nouns as kinds, the instances of these kinds might in some cases be strictly related to the entities denoted by their count noun counterpart (as in (A) above). In other cases the relation between count and mass version will be much more complex and unpredictable, often mediated by the verb underlying the nominal.

The third question to address in this section is what happens when bare abstract nominals are *not* treated as kinds. A case in point is predicate nominals.

(47) a. Fido and Lara are [dogs].
b. The content of this glass is [water].
c. This is [vodka]. *pointing to some vodka*

To make (47b) work, *water* should denote a set of amounts/portions of water (a semantic type which is independently needed for quantificational cases like *some/much/a lot of water*$_{<et>}$).

What happens with abstract mass nouns? (48), uttered upon witnessing a particularly telling act or event, seem perfectly possible. The acceptability of these cases suggest that these predicative abstract cases can be property-denoting, much like *water*.

(48) a. THAT was courage / character!
b. THIS is {real justice / pure chance / perfect control / just practice / real content / total chaos …}

But now, the nouns in (48) contrast with those in (49), which are frequently found as bare mass singular arguments in a UKWAC search, but never as bare mass predicate nominals.

(49) ??THAT was {absurdity / allegiance (to …) / blockage (of…) / characterization (of…) / deletion (of…) / opinion (about…) / possibility (of…) / priority (to …) …}.

The difference between the two sets is that the nouns in (48) are either rigid (*courage, justice*), or have very different meanings as count and mass, while those in (49) are elastic and with the option of a semantically transparent indefinite singular (contrast with **a courage/justice*), which is put to use in:

(50) THIS is {an absurdity / ?an allegiance (to…) / a blockage / a characterization (of…) / a deletion / an opinion / a possibility / a priority / …} …

This shows that English (and probably other languages: the pattern is identical in Italian) prefers to use the count version of (transparent) elastic nouns, rather than deriving a property reading from the mass version. This preference could point to the presence of a marked semantic operator, which derived the property denotation needed in (48) from the bare mass noun predicate, interpreted as a kind exactly as in (35). Using the count version (either as a lexical option in a polysemy relation with the count version, or as the result of one of the semiproductive derivations listed in A–E above) avoids this operator, and is thus preferred whenever possible. The two options are shown in (51).

(51) a. This was [$OP_{<e^k,<e^o,t>>}$ $courage^{mass}_{k}$]
This was an [$absurdity^{count}_{<et>}$]

4.3 Gradedness in abstract nouns

We have so far mostly considered the role of *determinerless* abstract mass nouns. However, these nouns can also appear under regular mass determiners, just like concrete ones:

(52) a. There was(n't) more / much / some / a bit of / a lot of {water / wine / furniture} left.
b. There was(n't) more / much / some / a bit of / a lot of {patience / beauty / authority / courage / chaos} left in her.

It is well-established since Link (1983), Gillon (1992) a.o. that with concrete mass nouns these determiner measure *amounts*, and that these amounts are (for all

practical purposes) continuous.[16] This fits with the fact that, as we have seen in Section 1, concrete mass nouns have the divisive and the cumulative property:

(53) a. Together, this water and that water are still water.
b. Half of this water is still water

These properties extends to abstract mass nouns, though non-far-fetched examples are somewhat harder to construct, partly due to the resistance of bare abstracts to be used as predicates (see (49)). Still, Nicolas (2002) constructs convincing examples using the noun *part*, as in (54).

(54) a. I could only admire part of the *disorder* that you left behind.
b. During the day I can only see part of the *beauty* of Paris.

Distributivity succeeds for e.g. *chaos* (55a), but – Nicolas claims – fails for *idea*, a rigid abstract count noun (56).

(55) This chaos is only part of the chaos that the children created in the apartment.

(56) a. What you are hearing is only [part of the idea that I have]$_i$.
Nicolas (2002: 3)
b. ??[This idea]$_i$ is more than enough for me.

Cumulativity is probably easier to test, and seems well-established for abstract and concrete mass nouns alike.

(57) a. John and Lucy's love/beauty (together) was more love/beauty than Ted could handle. Nicolas (2002)
b. John and Lucy's beauty was more than Marc could handle.

However, abstract+abstract like *chaos+chaos* is not quite parallel to concrete+concrete (*water+water*): the latter refers to bigger *amounts*, the former to higher *degrees*. As Van de Velde (1995) initially observed, abstract nouns often express *graded properties*, and quantification over such nouns modifies the degree to which the property holds. Surprisingly, this can sometimes give the illusion of a countable meaning even in rigid mass terms. Tovena (2001) points out that in Italian abstracts such as *coraggio* 'courage' or *talento* 'talent' can be quantified over by the normally count determiner *nessuno* 'no' (lit. 'not-one'). In (58), *courage/talento* pattern with the count noun *amico* 'friend', not with *cotone* 'cotton'. Still, singular universal quantification (**ogni/ciascun coraggio* 'every/each courage') remains unavailable.

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16. The well-known exception is *furniture*-type mass nouns, which seems to have natural discrete atomic elements (see also *luggage, mail*). Even here, context can trigger a continuous measure, witness (i)

(i) By weight, family A has more {furniture / *members} than family B.

Genuine concrete count nouns do not have this option, regardless of contexts.

(58) Carlo non ha nessun {coraggio / talento / amico / *cotone}.
Carlo not has no {courage / talent / friend / cotton}

Nicolas (2002) and Jayez and Tovena (2002: Section 4) observe that in English the singular indefinite determiner can appear with many abstract mass nouns, as long as they are modified by adjectives, especially the word *certain* (59) (see also Hinterwimmer & Umbach, 2015 for German). The effect is visible with corpus analyses: while modified singular count indefinites like *a large dog* are about half as frequent as unmodified ones, with mass nouns the ratio becomes 0.69.[17] The effect can be replicated in Italian, with a broader range of adjectives (60).

(59) He needed a ??(certain) {courage / intelligence / dedication }

(60) Hai mostrato {un tale / un qualche / un bel} coraggio
you_have shown {a such / a some / a great} courage
"You showed {such a / quite some / a great deal of} courage"

(59) is understood as "a certain *degree* of courage/intelligence/dedication", certainly not as a synonym of "a certain kind of courage", etc., which would be the expected meaning if *courage* underwent the Kind-shift. Indeed, mass nouns like *tempo* 'time' or *spazio* 'room/space' which – as noted above for English – seem to fall between concrete and abstract, do not accept a paraphrase with *degree* (61), and do not allow *nessuno* either (62).

(61) Un (certo / alto) grado di {pazienza / intelligenza / dedizione
A (certain / high) degree of {patience / intelligence / dedication
/ *tempo / *spazio}
/ time / space}

(62) *Carlo non ha nessun(o) {spazio / tempo} per questo.
Carlo not has no {space / time} for this

As expected, the adjectives *massimo* 'maximal' and *minimo* 'minimal', which apply to scales, are not compatible with concrete mass nouns:

(63) a. Non ho la minima {paura / preoccupazione / *acqua}
Not I_have the minimal {fear / worry / *water}
"I don't have any fear/worry/water at all"

b. Qui serve la massima {attenzione / cura / *acqua in
here one_needs the maximal {attention / care / water in
questa vasca}
this tank}

17. This count was carried out on the British National Corpus, using syntactic criteria to identify mass nouns. [A-ADJ-Ns] had 340030 non-mass and 29158 mass cases, [A-N] had 680408 non-mass and 425461 mass cases, respectively.

Citing Van de Velde (1995), Tovena calls the class of mass nouns that can be quantified over degrees *Intensive Nouns*. Their characteristic is the "possibility of undergoing continuous increase or contraction without a corresponding extension in space or time." (Tovena, 2002: 570). Her proposal is that the degrees of intensity of these nouns provide a "weakly discretized" domain, which is sufficiently atomic to be referred to with specific indefinites, but not enough to be quantified with *every* or counted. The remaining question is why a modifier is needed.

As Tovena and other observed, the modifiers appended to abstract mass nouns often make their degree more specific. Their effect seems in fact similar to the one we obtain with the words *kind* or *amount*, in (64). All objects belong to some kind or other, and all concrete mass nouns come in some quantity, so unmodified *kind* or *amount* are simply too nondescriptive to be used; only the addition of a modifier makes them informative. By the same token, I propose that since all graded adjectives have some degree or other, without a modifier the plain specification that "there is a degree" carries no information.

(64) a. A ??(strange / certain) kind of thing was on my desk.
b. Between the two buildings there was a(n) ?(surprising / large / small) amount of space.

The last question to address in this section is whether quantification over abstract mass nouns is *always* over degrees. The problem is that an overt *degree* modifier is not fully acceptable in cases such as (65), except perhaps in highly metaphorical meanings.

(65) a. ??She knows/studied a certain degree of {chemistry / journalism / research / theater}
b. ??He has a certain degree of {life / ill-health / advertising / creation} to his credit.

Yet, one can say: *she had studied a lot of chemistry/journalism/ research / advertising*, etc. Replacing *degree* with *amount* (which applies to all non-intensive noun: *he spilled a small amount of wine*) notably improves the situation. This suggests that there are abstract mass nouns which are not intensive.

Consider now the quantifier *most*. When used with nouns, it means something like "somewhat more than half" (66).

(66) a. Most people left.
b. Most wine is white.
c. Most criticism is not constructive.
d. Most research pretends to be applied.

Most can be found with a motley mix of (singular) mass nouns, but in this combination it is quite rare (1884 cases in the *whole* UKWAC corpus, out of

230944 tokens of *most*+N), and the N distribution profile one gets is quite different from what we saw in (25): there are more concrete mass cases, and more eventive nouns.[18] Interestingly, the corresponding adverb *mostly* cannot apply to graded adjectives (67), unlike the adverbs *very* and *extremely*.[19] Specifically, (67) cannot mean anything like "John's height is more than half the (mean) height of people judged tall" (compare with *John is somewhat tall*), or "the door is more than halfway closed" (compare with *the door is half closed*).

(67) a. John is {very / extremely / *mostly} tall.
b. The door is mostly closed. *only temporal meaning*

This strongly suggests that *most* cannot quantify over degrees. As expected, pairing it with rigid abstract mass nouns which have a strong 'degree' component, such as those in (68), leads to ungrammatically (and to unattestedness in UKWAC).

(68) ??Most {courage / intelligence / dedication / worry / talent / …}

Should we now conclude that the abstract nouns which do combine with *most* (e.g. *criticism* or *research* in (66)) belong to the same class as *water* and other concrete mass nouns? This position was originally put forth in Levinson (1978), but conceptually, it is rather counterintuitive: canonical concrete mass nouns are well-known for their *undifferentiated* parts, but this does not apply to many abstracts. Water or mud are uniform, research, chemistry and drama are most definitely not. Is there a way to bring out this intuition at a linguistically testable level?

Let's consider the *proportional partitive* construction (69) (Falco & Zamparelli, 2019) exemplified in (69).

(69) Half/Part/Two thirds/20%/Most of DP is P

(70) a. Half of the boys were underwater.
b. Most of John was already underwater.
c. Two thirds of the house were painted green.

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18. The list of *Most*+N_{sing} cases with more then 9 tokens in UKWAC comprehends (frequency given before): 10 folk, 10 funding, 10 material, 11 damage, 11 PC, 11 traffic, 11 use, 11 waste, 12 crime, 12 training, 12 value, 13 communication, 13 learning, 13 significance, 14 business, 15 emphasis, 15 support, 17 energy, 18 activity, 18 steam, 19. importance, 19 money, 20 fish, 20 time, 22 food, 24 percent, 31 information, 33 research, 46 software, 48 staff, 49 work, 53 interest, 57 attention, 66 concern.

19. We set aside the meanings *John is tall most of the time*, and the far-fetched *for most of the people you ask, John is tall*. Note that *most* is a maximality operator in *the most intelligent person*, and akin to *very* in *a most intelligent person*. Still, one cannot say: *a most closed door* in the sense "more than half closed".

When applied to bare mass nouns, this construction tends to select *abstract* cases (Graham Katz, p.c.), yielding a quantification over "aspects" or "constituents" (or, when possible, time subperiods), which is not suitable for concrete masses (72).[20]

(71) a. Most/Much of theater is improvisation
b. Much/Half of wisdom is experience.
c. Most/Too much of courage is bad risk assessment.

(72) a. ?Most of mud is water.
b. ?Much of furniture is wood/chairs

This shows that the behavior of abstract mass terms must really be investigated at all levels. As restrictors, some admit degree quantification (and with it, the modified indefinite article over that degree) much more readily than others. Those that do not begin to look closer to concrete count nouns. But as full DPs (probably kind denoting, as we saw in the previous section), abstracts seem to diverge again from concretes – a remind that we have just scratched the surface of this complex phenomenon.

5. A BECL-based review of mass-count shifts with abstract nouns

In this final section, I will look at the set of elastic mass nouns on a larger scale, using data drawn from BECL 2.0, a recent, large-scale annotation project which lists the countability status and the presence of the Kind or Container shift for 10667 English noun *senses*, extracted from Wordnet and manually annotated by between two and four native speakers (see Kiss, Pelletier, et al., 2014b, Kiss, Husic, et al., 2014 for details). In version 2.0, the data are reported only when all the annotators reached agreement. Lemma frequencies from the Open American National Corpus are provided.

In BECL, the decision on how to classify a noun sense in one class or another in the lexicon depends on the outcome of 3 tests. For each of the noun senses of the lemma under investigation, the annotators had to answers the following choices.[21]

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20. The list of *Most*+N_{sing} cases with more then 3 tokens in UKWAC comprehends (frequency given before; not cleaned): 312 today, 55 humanity, 50 yesterday, 42 time, 41 history, 39 life, 31 mankind, 30 mine, 29 day, 25 society, 16 em, 15 use, 13 year, 13 wall, 13 interest, 12 Merseyside, 11 industry, 11 everything, 9 way, 7 respect, 7 morning, 7 money, 7 chapter, 6 work, 6 tonight, 6 tomorrow, 6 night, 6 hisstandard, 6 europe, 5 week, 5 science, 5 course, 5 agriculture, 4 return, 4 pre-season, 4 population, 4 page, 4 lunchtime, 4 government, 4 fish, 4 Christianity, 4 art, 4 area.

21. I ignore other data from the spreadsheet when not relevant for our study. See Kiss, Pelletier, et al., 2014b for a full discussion.

– The first test checks whether singulars under the mass determiner *more* are possible.

  TI.1 Is it possible to say: NP$_1$ VERB MORE NOUN[SG] THAN NP$_2$?
  (e.g. *The boy ate more **fruitcake** than the girl)*

If the answer is positive, the annotator is asked to say whether the comparison is based on the amount of matter or the number of items (relevant for *John has more **furniture** than Bill*, as shown in a study by Bale & Barner, 2009). VERB could not be *be*.

– The second test aims to detect if a noun can be pluralized, and if this triggers a Kind or Container meaning (the two were lumped together).

  TII.1 Is it possible to say: NP$_1$ VERB MORE NOUN[PL] THAN NP$_2$?
  (e.g. *The boy ate more **fruitcakes** than the girl)*

If the answer is positive, the annotator checks for the presence of Kind/Container shift by answering TII.2.

  TII.2 Is the meaning above equivalent to the meaning NP$_1$ VERB MORE CLASSIFIER OF NOUN [SG] THAN NP$_2$? Where CLASSIFIER was "kind" or an appropriate container.

For instance, the annotator answered Yes to TII and TII.2 on the basis of *the man drank more whiskies than the child* and its equivalence with *the man drank more kinds/glasses of whiskey than the child*.

– The third test checks for the availability of the singular indefinite article in copular subject position.

  TIII.1 Is is possible to say: [INDEF-DET + NOUN-[SG]] IS { SOME PROPERTY OF NOUN }?
  (e.g. *a **whiskey** is a glass full of whiskey)*

Note that the indefinite must apply to the *unmodified* noun.

  TIII.2 Is is possible to say: NOUN-[SG] IS { SOME PROPERTY OF NOUN }?
  (e.g. ***Whiskey** is a drinkable liquid*)

Depending on how they reacted to the various tests, noun senses were assigned to 18 (arbitrarily tagged) classes. For instance, class 235 contains rigid count-nouns (no *more*+sing., plural ok, no bare singular), Class 528 rigid mass nouns (bare singular, no plurals at all, unmodified indefinite *a* impossible), etc. Nouns which received negative answers for both TI.1 and TII.1 were identified as 'unmarked' for countability in Kiss, Husic, et al. (2014) (i.e. neither count or mass; examples were certain senses of *bias, fate* and *tail*).

Given our interest in elasticity, the cases that most concern us here are those nouns which pass TI.1 and TII.1 (i.e can appear with both singular and plural *more; dual-life* nouns, in BECL terminology). If the plural is judged to be due to a Kind/Container shift we have Class 510, with 315 nouns. If not, Classes 726 and 729 (the latter contains only 3 eventive nouns *slaying, kidnapping* and *theft* which pass TI.2, i.e. where *more* N is judged to depend on the number of events), for a total of 165 nouns. We can now use as a criterion for abstractness the use of certain abstraction-triggering suffixes, specifically *-tion* (*activation*) *-ity* (*scarcity*) and *-ness* (*happiness*), see Plag (1999).[22] The outcome for the various classes is given in Table 1.

The first thing to observe is that the abstract suffixes in our survey are much more frequent in mass senses. In particular, the *-tion* suffix makes up for almost half of Class 726, the elastic nouns whose alternation is *not* due to the Kind or Container shifts. Individual inspection shows that this Class is dominated by nouns (often in *-ation*) which refer to events in the count sense and to generalizations over these events in the mass sense. Examples are:

Table 1. Distribution of abstracts with different morphological profiles across BECL classes

		All nouns			Morphological abstracts			
BECL Class		Lemmas#	Senses #	Sense/-lemma ratio	*-ity*	*-ness*	*-tion*	Abstract/ senses ratio (%)
Rigid	235 (count only)	4968	8025	3,63	63	9	438	6%
	528 (mass only)	1437	1866	1.3	194	135	224	30%
Elastic	510 (Kind/ Container shift)	290	314	1.08	8	6	10	8%
	726 (non K/C shift)	155	165	1.06	5	0	66	43%

(73) absence acclimation accumulation burglary capitalization condemnation confirmation contamination contradiction crystallization decapitation deception decline degeneration detoxification devaluation difficulty diffraction dilation disclosure …

22. While these are by no means the only affixes producing abstract nouns (cf. *archer-y, betray-al, annoy-ance, orphan-age, nation-hood, despot-ism*, etc.), the others were either highly ambiguous, or too rare to be attested in the elastic group (*-ism* gave 76 hits in the mass-only group, cf. *more Communism*, but 0 in the elastic categories).

In some cases the mass sense can in turn take a process reading (words like *capitalization, contamination, crystallization, decline* can be prefixes with *the process of* and can supports predicates such as *can last a long time*). Others (e.g. *difficulty, contradiction*) seem to be statives, closer to "notions" (though note that we can replicate Moltmann's argument apropos the contrast between (35) and (36): *contradiction is common in political speeches* isn't quite equivalent to *the notion of contradiction is common)*. In both cases, the kind analysis discussed in Section 4.2 might be a viable option.

Turning to Class 510 (elastic, with K/C shift), it contains the same rate of abstract nouns as the purely countable Class 235, but a high proportion of names of substances (around 160). Individual examination of their plurals reveals just a few Container shifts (for *ale, champagne, coffee*), plus something which we might term "Sortal Classifier Shifts" (e.g. *bread/breads* 'loafs of bread', *popcorn/popcorns* 'pieces of popcorn', etc.). The Kind shift is plausible in about 80 cases, mostly chemicals e.g. *alcohol carbohydrate clay condensate corn cotton cyanide detergent dye electrolyte emulsion ester estrogen ether extract*.[23]

Other cases do not properly belong to Class 510. In particular, many substances in the plural seem to refer to idiosyncratic objects which are partially made up of them: *bronze/bronzes* (statues in bronze) *canvas/canvases* (paintings), *copper/coppers* (small coins in British English), *iron/irons* (e.g. for prisoners), *tissue/tissues* (napkins), *timber/timbers* (beams), *tin/tins* (cans), see also *wood/woods, speech/speeches*, etc. We do not want to think of this as a productive semantic shift from mass to count, since it is essentially unpredictable which object one ends up with. Neither is the other direction more viable, since this process seems far more lexicalized than Grinding (grinding coppers does not get you the element copper; grinding woods, not only wood). Rather, it seems to be a lexical correspondence which can become an analogical model for other nominal pairs.

As Table 1 shows, mass nouns of all classes have a much lower sense/lemma ratio than count nouns. This might be an artifact of frequency (frequent terms are more polysemous), but it could also be the result of working with the (very fine-grained) set of Wordnet senses. If a lemma is elastic, it might be that its count and mass meanings might be attributed to different senses, one of which would end up in the unambiguously count class (235), the other in the mass-only class

23. Yet another class of cases is the systematic relation between a type of tree (e.g. *chestnuts, birches, hardwoods, redwoods*) and their wood (mass). This is a specialized form of the Lewis/Pelletier Grinding-shift (9).

(528).[24] To check this possibility, I looked at lemmas with multiple senses, 460 of which have senses in multiple classes. From this group, 253 have senses both in the "count only" Class 235 and in the 'mass only' Class 528 – thus confirming the "split-countability" hypothesis. This group contains many true homonyms (*cricket* the animal, count vs. the game, mass), but also a large number of abstracts (again, the main class in *-tion*, with 48 cases). Conversely, lemmas in multiple classes but with no count meanings (49 cases) are mostly substance-referring.

A final interesting class is that of nouns which refer to human psychological states, like those in (74).

(74) ambition belief concern desire dislike doubt fear hope love suspect thought…

In their count senses, these words can refer to the propositional contents of the mental states (i.e. to what I believe, think, fear, hope, suspect, am ambitious about, etc.). They contrast, on the one hand, with personal properties which are not mental states (*ability disabilities skill vulnerability*) and which have count versions that seem to exemplify the general property ('my disabilities' are not the things I am not able to do, e.g. fencing, etc.); on the other, with properties such as *courage, alertness, blandness, shyness* which have no count counterpart at all. This suggests the existence of one further semantic shift – from the propositional content to the attitude.

(75) **Attitude-formation:** reference to the mental attitude held with respect to a cognitive or emotional content.
(*object of a mental attitude* ⇒ *mental attitude*)

Still, the *direction* of the shift seems to be quite arbitrary in this case.

6. Conclusions

We navigate a complex world, largely made of cultural object, and we encounter a very big number of terms whose connections with the senses are very indirect, embodied cognition notwithstanding (Borghi and Binkofski, 2014; Louwerse, 2011). Abstract terms arise from this situation, and challenge the strengths of current lexical semantics. While the field has a long way to go before it can start to

24. In some cases, but not in others, the Wordnet annotators separated the event and the underlying process in two senses (for instance *fire* as an event is separated from *fire* as "combustion process", mass). In general, the sum of the unavoidable idiosyncrasies of the Wordnet and the BECL annotators decreases the consistency of the data.

give a formal account of this largely overlooked area of the content lexicon, it is important to clarify what semantics (as opposed to psychology or philosophy) could be reasonably expected to do on the matter.

In my view, the questions one can raise about the abstract lexicon should be, at this stage, very much linguist's questions: in what kinds of constructions these terms participate, with which modifiers, with which predicates. Many questions are typological in nature: linguists have been keen to point out the difference in countability across languages for terms such as *pasta* or *hair*, but of course, if countability was a lexical feature like gender, we would expect a much larger variation. Nobody denies the existence, in the countability feature, of a broad semantic component which just isn't present in gender beyond relatively few biological cases (see Zamparelli, 2008 for discussion). If the analysis stopped at concrete nouns, the fact that *water* is uncountable in all the languages where the distinction is expressed would hardly be surprising. But if we expand it to abstract terms, the comparison becomes a lot more interesting. How come *John has more difficulties* alternates with *more difficulty*, but *more problems* does not alternate with **more problem?* Is it because *problem* does not have the degree argument that singular *more* could modify? If this is so, is there a language which distinguishes "problem" and "difficulty", but where both have a degree argument? Or where the plural of "courage" expresses the things one is brave in the face of – be they lions or tax inspectors?

This paper attempted a first step in this direction, contrasting abstract terms with other properties and kinds, and mapping the range of productive shifts that languages can employ to move from one meaning to the other. The next step should be, in my opinion, a methodological one: combining intuitions drawn from theoretical linguistic, philosophy, lexicography and corpus linguistics (including distributional semantics), but with a crucial focus on language variation.

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Name Index

Subject Index

The mass-count distinction is a morpho-syntactic distinction among nouns that is generally taken to have semantic content. This content is generally taken to reflect a conceptual, cognitive, or ontological distinction and relates to philosophical and cognitive notions of unity, identity, and counting. The mass-count distinction is certainly one of the most interesting and puzzling topics in syntax and semantics that bears on ontology and cognitive science. In many ways, the topic remains under-researched, though, across languages and with respect to particular phenomena within a given language, with respect to its connection to cognition, and with respect to the way it may be understood ontologically. This volume aims to contribute to some of the gaps in the research on the topic, in particular the relation between the syntactic mass-count distinction and semantic and cognitive distinctions, diagnostics for mass and count, the distribution and role of numeral classifiers, abstract mass nouns, and object mass nouns *(furniture, police force, clothing)*.

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